IV.B. Air Quality

IV.B.1 Introduction

This section evaluates the potential air quality impacts of the proposed 2006 LRDP. This section discusses the regulatory framework for air quality management and the existing air quality conditions in the project area, and it analyzes the potential for the project to affect existing air quality conditions, both regionally and locally, from activities that emit radioactive and non-radioactive materials. It also analyzes the types and quantities of emissions that would be generated on a temporary basis due to project construction and over the long term due to project operation.

The analysis in this section is based on a review of existing air quality conditions in the region and air quality regulations administered by the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the Bay Area Air Quality Management District (BAAQMD). This includes *CEQA Guidelines* established by the BAAQMD, December 1999; and the *Bay Area 2005 Ozone Strategy*, also prepared by the BAAQMD, January 2006. Other sources of information used in this chapter include various LBNL documents, the general plans for the cities of Berkeley and Oakland, the EIR for the Berkeley General Plan, and the *University of California CEQA Handbook* prepared by the UC Office of the President.

Where relevant, this section presents estimates of future emissions based on standard air quality modeling techniques. This section also presents the results of a health risk assessment undertaken to evaluate potential effects that could result from human exposure to emissions of toxic air contaminants generated by expected growth and development of LBNL.

IV.B.2 Setting

Air quality is affected by the rate, amount, and location of pollutant emissions and the associated meteorological conditions that influence pollutant movement and dispersal. Atmospheric conditions, including wind speed, wind direction, and air temperature, in combination with local surface topography (i.e., geographic features such as mountains, valleys, and San Francisco Bay), determine the effect of air pollutant emissions on local air quality.

IV.B.2.1 Climate and Meteorology

The project site is located in the cities of Berkeley and Oakland within the boundaries of the San Francisco Bay Area Air Basin (Bay Area). The Bay Area's moderate climate steers storm tracks away from the region for much of the year, although storms generally affect the region from November through April. Berkeley's proximity to the refreshing onshore breezes stimulated by the Pacific Ocean provide for generally very good air quality at LBNL. However, during the ozone smog season (typically, May through October), transport studies have shown that ozone precursor emissions generated in Oakland and Berkeley are often transported to other regions of the Bay Area and beyond (e.g., Central Valley) that are more conducive to the formation of ozone

smog. In the winter, reduced solar energy and cooler temperatures diminish ozone smog formation, but increase the likelihood of carbon monoxide formation.

Temperatures in the LBNL area average in the mid-fifties annually, generally ranging from the low-forties on winter mornings to mid-seventies during summer afternoons. Daily and seasonal oscillations of temperature are small because of the moderating effects of the nearby ocean. In contrast to the steady temperature regime, rainfall is highly variable and confined almost exclusively to the "rainy" period from November through April. About 95 percent of the average annual rainfall of approximately 30 inches at the LBNL site occurs during this period. Precipitation may vary widely from year to year as a shift in the annual storm track of a few hundred miles can mean the difference between a very wet year and drought conditions. Winds in the project area display several characteristic regimes. During the day, especially under fair weather conditions, winds are from the west and northwest as air is funneled through the Golden Gate toward the Laboratory. At night, cooling of the land generates winds from the east and southeast. Summer afternoon sea breezes typically range from 20 to 30 miles per hour. Peak annual winds occur during winter storms. South and southeast winds typically also precede weather systems passing through the region.

IV.B.2.2 Criteria Air Pollutants

As required by the federal Clean Air Act passed in 1970, the United States Environmental Protection Agency has identified six criteria air pollutants that are pervasive in urban environments and for which state and federal health-based ambient air quality standards have been established. EPA calls these pollutants criteria air pollutants because the agency has regulated them by developing specific public health- and welfare-based criteria as the basis for setting permissible levels. Ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter (PM), and lead are the six criteria air pollutants.

Ozone

Ozone is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections and that can cause substantial damage to vegetation and other materials. Ozone is not emitted directly into the atmosphere, but is a secondary air pollutant produced through a complex series of photochemical reactions involving reactive organic gases (ROG) and nitrogen oxides (NOx). ROG and NOx are known as precursor compounds for ozone. Significant ozone production generally requires ozone precursors to be present in a stable atmosphere with strong sunlight for approximately three hours. Ozone is a regional air pollutant because it is not emitted directly by sources, but is formed downwind of sources of ROG and NOx under the influence of wind and sunlight. Ozone concentrations tend to be higher in the late spring, summer, and fall, when the long sunny days combine with regional subsidence inversions to create conditions conducive to its formation and accumulation. Ground level ozone in conjunction with suspended particulate matter in the atmosphere leads to hazy conditions generally termed as "smog."

Carbon Monoxide

Carbon monoxide, a colorless and odorless gas, is a non-reactive pollutant that is a product of incomplete combustion and is mostly associated with motor vehicles. High carbon monoxide concentrations develop primarily during winter when periods of light wind combine with the formation of ground level temperature inversions (typically from the evening through early morning). These conditions result in reduced dispersion of vehicle emissions. Motor vehicles also exhibit increased carbon monoxide emission rates at low air temperatures. When inhaled at high concentrations, carbon monoxide combines with hemoglobin in the blood and reduces the oxygen-carrying capacity of the blood. This results in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease, or anemia.

Nitrogen Dioxide

Nitrogen dioxide is an air quality concern because it acts as a respiratory irritant and is a precursor of ozone. Nitrogen dioxide is produced by fuel combustion in motor vehicles, industrial stationary sources, ships, aircraft, and rail transit.

Sulfur Dioxide

Sulfur dioxide is a combustion product of sulfur or sulfur-containing fuels such as coal and oil, which are restricted in the Bay Area. Its health effects include breathing problems and may cause permanent damage to lungs. Sulfur dioxide is an ingredient in acid rain (acid aerosols), which can damage trees, lakes, and property. Acid aerosols can also reduce visibility.

Particulate Matter

PM-10 and PM-2.5 consist of particulate matter that is 10 microns or less in diameter and 2.5 microns or less in diameter, respectively. A micron is one-millionth of a meter, or less than one-25,000th of an inch. For comparison, human hair is 50 microns or larger in diameter. PM-10 and PM-2.5 represent particulate matter of sizes that can be inhaled into the air passages and deep into the lungs and can cause adverse health effects. Particulate matter in the atmosphere results from many kinds of aerosol-producing industrial and agricultural operations, fuel combustion, and atmospheric photochemical reactions. Some sources of particulate matter, such as demolition and construction activities, are more local in nature, while others, such as vehicular traffic, have a more regional effect. Very small particles (PM-2.5) of certain substances (e.g., sulfates and nitrates) can cause lung damage directly, or can contain adsorbed gases (e.g., chlorides or ammonium) that may be injurious to health. Particulates also can damage materials and reduce visibility.

Particulate matter emissions in a setting like Berkeley Lab are mainly from urban sources, dust suspended by vehicle traffic and secondary aerosols formed by reactions in the atmosphere. Particulate concentrations near residential sources generally are higher during the winter, when more fireplaces are in use and meteorological conditions prevent the dispersion of directly emitted contaminants.

Lead

Leaded gasoline (phased out in the United States beginning in 1973), paint (on houses, cars), smelters (metal refineries), and manufacture of lead storage batteries have been the primary sources of lead released into the atmosphere. Lead has a range of adverse neurotoxic health effects; children are at special risk. Some lead-containing chemicals cause cancer in animals.

IV.B.2.3 Toxic Air Contaminants

The California Health and Safety Code defines toxic air contaminants (TACs) as air pollutants "which may cause or contribute to an increase in mortality or in serious illness, or which may pose a present or potential hazard to human health" (Health and Safety Code Section 39655(a)). By definition, TACs include substances listed in the federal Clean Air Act as "hazardous air pollutants." TACs are less pervasive in the urban atmosphere than criteria air pollutants, but are linked to short-term (acute) or long-term (chronic and/or carcinogenic) adverse human health effects. There are hundreds of different types of TACs, with varying degrees of toxicity. Sources of TACs include industrial processes, commercial operations (e.g., gasoline stations and dry cleaners), and motor vehicle exhaust. Unlike regulations concerning criteria air pollutants, there are no ambient air quality standards for evaluation of TACs based on the amount of emissions. Instead, emissions of TACs are evaluated based on the degree of health risk that could result from exposure to these pollutants.

As noted above, the federal Clean Air Act refers to the term "hazardous air pollutants" while California regulations use the term "toxic air contaminants." "Toxic air contaminants" will be the term used in this document.

IV.B.2.4 Regulatory Context

EPA is responsible for implementing the programs established under the federal Clean Air Act, such as establishing and reviewing the federal ambient air quality standards and judging the adequacy of State Implementation Plans (SIP). However, EPA has delegated the authority to implement many of the federal programs to the states while retaining an oversight role to ensure that the programs continue to be implemented. In California, CARB is responsible for establishing and reviewing the state ambient air quality standards, developing and managing the California SIP, securing approval of this plan from EPA, and identifying TACs. A notable exception, which affects Berkeley Lab, exists for radioactive air contaminants as the EPA has retained its authority to enforce its National Emissions Standards for Hazardous Air Pollutants (NESHAP) requirements for radioactive air emissions. CARB also regulates mobile emissions sources in California, such as construction equipment, trucks, and automobiles, and oversees the activities of air quality management districts, which are organized at the county or regional level. An air quality management district is primarily responsible for regulating stationary emissions sources at facilities within its geographic areas and for preparing the air quality plans that are required under the federal Clean Air Act and California Clean Air Act. The BAAQMD is the regional agency with regulatory authority over emission sources in the Bay Area, which includes all of San Francisco, San Mateo, Santa Clara, Alameda, Contra Costa, Marin, and Napa counties and the southern half of Sonoma and southwestern half of Solano counties.

Criteria Air Pollutants

Ambient Air Quality Standards

Regulation of criteria air pollutants is achieved through both national and state ambient air quality standards and emissions limits for individual sources. Regulations implementing the federal Clean Air Act and its subsequent amendments established national ambient air quality standards for the six criteria pollutants. California has adopted more stringent state ambient air quality standards for most of the criteria air pollutants. In addition, California has established state ambient air quality standards for sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. Because of the unique meteorological conditions in the state, there is considerable diversity between state and national standards currently in effect in California, as shown in Table IV.B-1. The table also summarizes the principal sources for each pollutant.

The ambient air quality standards are intended to protect the public health and welfare, and they incorporate a margin of safety. They are designed to protect those segments of the public most susceptible to respiratory distress, known as sensitive receptors, including asthmatics, the very young, the elderly, people weak from other illness or disease, or persons engaged in strenuous work or exercise. Healthy adults can tolerate occasional exposure to air pollution levels somewhat above the ambient air quality standards before adverse health effects are observed.

Attainment Status

Under amendments to the federal Clean Air Act, EPA has classified air basins or portions thereof, as either "attainment" or "nonattainment" for each criteria air pollutant, based on whether or not the national standards have been achieved. The California Clean Air Act, which is patterned after the federal Clean Air Act, also requires areas to be designated as "attainment" or "nonattainment" for the state standards. Thus, areas in California have two sets of attainment/nonattainment designations. In addition, an area may be designated "unclassified" for a particular pollutant if there is insufficient information to indicate whether or not the ambient air quality standard for that pollutant is being met. The unclassified status can change if additional monitoring information becomes available to allow a designation to be made.

The Bay Area is currently designated "nonattainment" for state and federal ozone standards (1-hour and 8-hour standards, respectively) and for the state PM-10 and PM-2.5 standards. The Bay Area is "attainment" or "unclassified" with respect to the other ambient air quality standards. Table IV.B-1 also shows the attainment status of the Bay Area with respect to the federal and state ambient air quality standards for different criteria pollutants.

Air Quality Plans

The 1977 Clean Air Act Amendments require that regional planning and air pollution control agencies prepare a regional Air Quality Plan to outline the measures by which both stationary and mobile sources of pollutants can be controlled in order to achieve all standards specified in the Clean Air Act. The 1988 California Clean Air Act also requires development of air quality plans and strategies to meet state air quality standards in areas designated as nonattainment (with the exception of areas designated as nonattainment for the state PM standards). Maintenance plans

TABLE IV.B-1
AMBIENT AIR QUALITY STANDARDS AND BAY AREA ATTAINMENT STATUS

Pollutant	Averaging Time	State Standard	Bay Area Attainment Status for California Standard	Federal Primary Standard	Bay Area Attainment Status for Federal Standard	Major Pollutant Sources
Ozone	8 Hour	0.07 ppm	Unclassified	0.08 ppm	Nonattainment	Motor vehicles,
	1 Hour	0.09 ppm	Nonattainment	---	---	Other mobile sources, combustion, industrial and commercial processes
Carbon Monoxide	8 Hour	9.0 ppm	Attainment	9 ppm	Attainment	Internal combustion engines, primarily gasoline-powered motor vehicles
	1 Hour	20 ppm	Attainment	35 ppm	Attainment	
Nitrogen Dioxide	Annual Average	---	---	0.053 ppm	Attainment	Motor vehicles, petroleum refining operations, industrial sources, aircraft, ships, and railroads
	1 Hour	0.25 ppm	Attainment	---	---	
Sulfur Dioxide	Annual Average	---	---	0.03 ppm	Attainment	Fuel combustion, chemical plants, sulfur recovery plants and metal processing
	24 Hour	0.04 ppm	Attainment	0.14 ppm	Attainment	
	1 Hour	0.25 ppm	Attainment	---	---	
Particulate Matter (PM-10)	Annual Arithmetic Mean	20 μg/m3	Nonattainment	50 μg/m3	Attainment	Dust- and fume-producing industrial and agricultural operations, combustion, atmospheric photochemical reactions, and natural activities (e.g., wind-raised dust and ocean sprays)
	24 Hour	50 μg/m3	Nonattainment	150 μg/m3	Unclassified	
Particulate Matter (PM2.5)	Annual Arithmetic Mean	12 μg/m3	Nonattainment	15 μg/m3	Attainment	Same as above
	24 Hour	---	---	65 μg/m3	Attainment	
Lead	Calendar Quarter	---	---	1.5 μg/m3	Attainment	Lead smelters, battery manufacturing & recycling facilities
	30-Day Average	1.5 μg/m3	Attainment	---	---	

Note: ppm – parts per million; μg/m3 – micrograms per cubic meter

SOURCE: Bay Area Air Quality Management District, 2005, available at http://www.baaqmd.gov/pln/air_quality/ambient_air_quality.htm

are required for attainment areas that had previously been designated nonattainment in order to ensure continued attainment of the standards. Air quality plans developed to meet federal requirements are referred to as State Implementation Plans.

Bay Area plans are prepared with the cooperation of the Metropolitan Transportation Commission, and the Association of Bay Area Governments (ABAG). Currently, there are three plans for the Bay Area. These are:

- The *Bay Area Ozone Attainment Plan for the 1-Hour National Ozone Standard* (BAAQMD, 2001) developed to meet federal ozone air quality planning requirements;
- The *Bay Area 2005 Ozone Strategy* (BAAQMD, 2006) developed to meet planning requirements related to the state ozone standard; and
- The *1996 Carbon Monoxide Redesignation Request and Maintenance Plan for Ten Federal Planning Areas*, developed by the air districts with jurisdiction over the ten planning areas including the BAAQMD to ensure continued attainment of the federal carbon monoxide standard. In June 1998, the EPA approved this plan and designated the ten areas as attainment. The maintenance plan was revised in October 1998.

The Bay Area 2001 Ozone Attainment Plan was prepared as a proposed revision to the Bay Area part of California's plan to achieve the federal 1-hour ozone standard. The plan was prepared in response to EPA's partial approval and partial disapproval of the Bay Area's 1999 Ozone Attainment Plan and finding of failure to attain the federal ambient air quality standard for ozone. The revised Ozone Attainment Plan was approved by CARB in 2001 and by EPA in 2003. EPA also made an interim final determination that the plan corrects deficiencies identified in the 1999 plan. However, in April 2004, EPA made a final finding that the Bay Area has attained the federal 1-hour ozone standard. Because of this finding, the previous planning commitments in the 2001 Ozone Attainment Plan for the federal 1-hour ozone standard are no longer required. The region must submit to EPA a redesignation request and a maintenance plan to show that the region will continue to meet the 1-hour ozone standard.

EPA recently transitioned from the federal 1-hour standard to a more health-protective 8-hour standard. In April 2004, EPA designated regions for the new federal 8-hour standard. Defined as "concentration-based," the new federal ozone standard is set at 0.08 parts per million (ppm) averaged over eight hours. The new national 8-hour standard is considered to be more health-protective because it protects against health effects that occur with longer exposure to lower ozone concentrations.

At the same time, EPA designated regions as attainment and nonattainment areas for the 8-hour standard. These designations took effect on June 15, 2004. EPA formally designated the Bay Area as a nonattainment area for the national 8-hour ozone standard, and classified the region as "marginal" according to five classes of nonattainment areas for ozone, which range from marginal to extreme. Marginal nonattainment areas must attain the federal 8-hour ozone standard by June 15, 2007. While certain elements of Phase 1 of the 8-hour implementation rule are still undergoing legal challenge, EPA signed Phase 2 of the 8-hour implementation rule on

November 9, 2005. It is not currently anticipated that marginal areas will be required to prepare attainment demonstrations for the 8-hour standard. Other planning elements may be required. The Bay Area plans to address all requirements of the federal 8-hour standard in subsequent documents.

For state air quality planning purposes, the Bay Area is classified as a *serious* nonattainment area for ozone. The *serious* classification triggers various plan submittal requirements and transportation performance standards. One such requirement is that the Bay Area update the Clean Air Plan every three years to reflect progress in meeting the air quality standards and to incorporate new information regarding the feasibility of control measures and new emission inventory data. The Bay Area's record of progress in implementing previous measures must also be reviewed. On January 4, 2006, the BAAQMD adopted the most recent revision to the Clean Air Plan – the *Bay Area 2005 Ozone Strategy*. The control strategy for the *2005 Ozone Strategy* is to implement all feasible measures on an expeditious schedule in order to reduce emissions of ozone precursors and consequently reduce ozone levels in the Bay Area and reduce transport to downwind regions.

In April 2005, CARB established a new 8-hour average ozone standard of 0.070 parts per million (the same as 70 parts per billion). The new standard took effect in May 2006. CARB is currently working on designations and implementation guidance for the new standard. The one-hour state standard has been retained. The San Francisco Bay Area has not attained the state eight-hour standard, and will be taking action as necessary to address the new standard once the planning requirements have been established.

Toxic Air Contaminants

Non-Radioactive Pollutants

Toxic Air Contaminants (TACs) are regulated at the federal level pursuant to the Clean Air Act, which requires implementation of the National Emission Standards for Hazardous Air Pollutants. A total of 189 such air pollutants are included in the Clean Air Act Amendments of 1990, which revamped the NESHAP program to offer a technology-based approach for reducing the emissions of regulated TACs.

The toxic air contaminants program was implemented in California in 1983 with the passage of the Toxic Air Contaminant Identification and Control Act, better known as the Tanner Bill or AB 1807. The Tanner Bill was amended in 1992 (AB 2728) to include the 189 federal hazardous air pollutants as state TACs.

The California Air Resources Board amended the state TAC list in 1998 by identifying particulate matter emissions from diesel-fueled engines as a TAC. Because the vast majority of diesel exhaust particles are very small by weight (approximately 94 percent of their combined mass consists of particles less than 2.5 micrometers in diameter), both the particles and their coating of TACs can be inhaled into the lungs. EPA has conducted an extensive evaluation of the cancer and non-cancer health effects of diesel exhaust and issued final rules on January 18, 2001, to tighten emission standards for diesel heavy-duty truck engines. The new EPA standards will be fully

implemented in 2007. In 2000, the California Air Resources Board developed its comprehensive Diesel Risk Reduction Plan, which calls for a 75-percent reduction in diesel PM by 2010 and an 85-percent reduction by 2020 (from the base year 2000 level). The plan has three major components: first, to require low-sulfur diesel fuel (no more than 15 grams of sulfur per million grams of diesel fuel); second, to develop or implement emission standards for new diesel engines that will reduce PM by 90 percent; and third, to require that existing engines use pollution controls where technically feasible and cost-effective. Between 2001 and May 2004, CARB approved new regulations for five diesel fleets: transit buses, refuse haulers, transportation refrigeration units, stationary engines, and portable engines. Together, these fleets account for about 15 percent of California's diesel PM pollution.

Another major component of California's toxic air contaminants program is AB 2588, or the Air Toxics "Hot Spots" Information and Assessment Act of 1987. AB 2588 currently regulates over 600 air toxics, including all of the Tanner-designated TACs. Under AB 2588, specific facilities, including LBNL, must quantify emissions of regulated air toxic and report them to the local air pollution control districts. If an air pollution control district determines that a given facility poses a potentially significant public health risk, the facility is required to perform a health risk assessment. LBNL has not posed this level of risk. The BAAQMD manages regular updates to AB 2588 reporting requirements through its annual permit renewal program.

The BAAQMD's air permitting program includes a requirement to perform a toxics emission screening analysis on all permit applications. If the BAAQMD concludes that projected emissions of a specific toxic air contaminant from a proposed new or modified source suggest a potential public health risk, then the applicant is subject to a health risk assessment for the source in question. The project must demonstrate acceptable risk levels for the source or the permit may be denied. While the preparation of the 2006 LRDP does not fall under BAAQMD permitting requirements, all future new sources or modifications to existing sources at LBNL are subject to BAAQMD permit review and possible health risk assessment.

The foregoing notwithstanding, a health risk assessment considering activities and sources across the entire facility was prepared for the 2006 LRDP to evaluate potential health risks resulting from emissions of regulated TACs and radioactive pollutants. The health risk assessment results are discussed under Impact AQ-4.

Radioactive Pollutants

The NESHAP regulations promulgated by EPA under the 1990 Clean Air Act Amendments also included control of radionuclide emissions. Subpart H of 40 CFR Part 61 established facilities owned and operated by the Department of Energy (DOE), such as LBNL, as one of the source categories subject to NESHAP regulations. Some DOE facilities emit a wide variety of radionuclides in various physical and chemical states. The purpose of subpart H is to limit radionuclide emissions (not including radon) from the stacks and vents at DOE facilities so that no member of the public receives an effective dose equivalent of more than 10 millirem per year. Subpart H requires emissions sampling, monitoring, and dose calculations to determine compliance with the standard.

LBNL has been in full compliance with subpart H since 1995, when EPA sent DOE written confirmation that LBNL had satisfactorily completed all requirements of a federal facilities compliance agreement. As part of this agreement, LBNL formalized all phases of its NESHAP program and proposed a graded strategy for performing the periodic confirmatory measurements required by the NESHAP regulations. Emissions measurement categories are determined by the greatest potential effective dose equivalent from airborne radionuclide emissions that could be received by a member of the public at an off-site point where there is a residence, school, business, or office. This is called the maximally exposed individual.

Radiochemical and radiobiological studies performed at Berkeley Lab typically use small millicurie quantities of a variety of radionuclides. All use of radioactive material at Berkeley Lab must be in accordance with an LBNL authorization or permit process. A radiation work authorization is issued for long-term projects that operate under routine radiological conditions; a radiation work permit is issued for non-research projects or tasks that require special radiation protection measures. Each authorization or permit is reviewed at least every 18 months, depending on changes to the project. An authorization or permit establishes the location of radioactive material areas (work areas where unsealed radioactive material is handled) and radioactive material storage areas (controlled areas where radioactive material is stored only, with no direct manipulation of the material).

Nanomaterials

Nanoscience is an emerging area of research aimed at the development of structures and devices at the atomic, molecular, or macromolecular levels to produce materials with novel properties and perform functions at the molecular level. EPA has listed nanotechnology as an area for future study under its "Futures Analysis" program, and only recently has EPA begun funding research in this area. No regulatory standards have been developed. Consequently, this topic is not addressed further in this section. The US Department of Energy has issued a secretarial Policy Statement on Nanoscale Safety. This policy statement is included in Appendix G.

BAAQMD Rules and Regulations

The BAAQMD is the regional agency responsible for rulemaking, permitting, and enforcement activities affecting non-radioactive stationary sources. Specific rules and regulations adopted by the BAAQMD limit the emissions that can be generated by various uses and/or activities, and identify specific pollution reduction measures that must be implemented in association with various uses and activities. These rules regulate not only emissions of the six criteria air pollutants, but also emissions of toxic air contaminants and acutely hazardous non-radioactive materials.

Emissions sources subject to these rules are regulated through the BAAQMD's permitting process and standards of operation. Through this permitting process, including an annual permit review, the BAAQMD monitors generation of stationary emissions and uses this information in developing its air quality plans. Any stationary sources of emissions constructed as part of the LBNL 2006 LRDP would be subject to the BAAQMD *Rules and Regulations*. Both federal and

state ozone plans rely heavily upon stationary source control measures set forth in the BAAQMD's *Rules and Regulations*.

LBNL currently has 32 operating permits. These include:

- Epoxy mixing booth located in Building 53;
- Gasoline dispensing facility located near Building 76;
- E85 (85 percent ethanol, 15 percent unleaded gasoline) fuel dispensing facility located near Building 76;
- Soil vapor extraction systems located near Buildings 6 and 58;
- Paint spray booths in Buildings 76 and 77;
- Sandblast exhaust booth in Building 77;
- Sitewide solvent wipe cleaning activities occurring in various buildings; and
- Standby emergency generators (23) supporting various buildings.

The E85 fuel dispensing facility is the newest of the permitted sources, having received its Authority to Construct during the summer of 2003 and having become operational during the spring of 2004. The new E85 facility operates adjacent to the present gasoline dispensing facility. A significant and ever-increasing portion of LBNL's fleet is currently capable of using this alternative fuel.

Stationary source activities must comply with BAAQMD standards of operation regulations. These include shop activities such as sawing, drilling, and milling. Mobile sources of criteria air pollutant emissions (LBNL-related traffic) are exempt from BAAQMD regulations.

The BAAQMD's New Source Review regulations predominantly apply to non-radioactive nonattainment pollutants. The purpose of the New Source Review rule is to provide for the review of new and modified sources and provide mechanisms, including the use of best available control technology for both criteria and toxic air pollutants, and emissions "offsets" (effectively precluding other emissions from occurring) by which authorities to construct such sources could be granted. The New Source Review regulations also include Prevention of Significant Deterioration rules for attainment pollutants, which are designed to ensure that the emission sources will not exceed a specified increase in pollutant concentration or interfere with the attainment or maintenance of ambient air quality standards.

Best available control technologies are required for sources that require an authority to construct or a permit to operate if emissions from a new source or increase in emissions from a modified source would be 10 pounds or more per day of any of a number of organic compounds, nitrogen oxides, sulfur dioxide, particulate matter, or carbon monoxide, or possibly lesser amounts of toxic air contaminants. The BAAQMD's New Source Review regulations require the purchase of emission offsets for any new or modified source that produces a cumulative increase in emissions above a certain level of nitrogen oxides and precursor organic compounds.

Local Plans and Policies

LBNL is a federal facility operated by the University of California and conducting work within the University's mission on land that is owned or controlled by The Regents of the University of California. As such, LBNL is generally exempted by the federal and state constitutions from compliance with local land use regulations, including general plans and zoning. However, LBNL seeks to cooperate with local jurisdictions to reduce any physical consequences of potential land use conflicts to the extent feasible. The western part of the LBNL site is within the Berkeley city limits, and the eastern part is within the Oakland city limits. This section summarizes relevant polices contained in both the Berkeley and Oakland general plans.

City of Berkeley General Plan

The Environmental Management Element of the City of Berkeley General Plan adopted on April 23, 2002 contains the following objectives and policies related to air quality:

> Objective 3. Reduce emissions and improve air quality.
>
> Policy EM-18: Regional Air Quality Action. Continue working with the Bay Area Air Quality Management District and other regional agencies to:
>
> 1. Improve air quality through pollution prevention methods.
> 2. Ensure enforcement of air emission standards.
> 3. Reduce local and regional traffic (the single largest source of air pollution in the city) and promote public transit.
> 4. Promote regional air pollution prevention plans for business and industry.
> 5. Promote strategies to reduce particulate pollution from residential fireplaces and wood-burning stoves.
> 6. Locate parking appropriately and provide adequate signage to reduce unnecessary "circling" and searching for parking.
>
> Policy EM-19: 15% Emission Reduction: Global Warming Plan. Make efforts to reduce local [air quality] emissions by 15% by the year 2010.
>
> Policy EM-20: City of Berkeley Fleet. The City should exceed Federal and State [air quality] standards for all City fleet vehicles and use all means practical to reduce emissions of criteria pollutants and greenhouse gases.
>
> Policy EM-21: Alternative Fuels. Work with the University of California, the Berkeley Unified School District, and other agencies to establish natural gas fueling and electric vehicle recharging stations accessible to the public.
>
> Policy EM-22: Public Awareness. Increase public awareness of air quality problems, rules, and solutions through use of City publications and networks.

In addition, the following policies in the Berkeley General Plan Transportation Element are applicable to the 2006 LRDP:

Policy T-10 Trip Reduction. To reduce automobile traffic and congestion and increase transit use and alternative modes in Berkeley, support, and when appropriate require, programs to encourage Berkeley citizens and commuters to reduce automobile trips, such as:

2. Participation in the Commuter Check Program.
3. Carpooling and provision of carpool parking and other necessary facilities.
4. Telecommuting programs.
8. Programs to encourage neighborhood-level initiatives to reduce traffic by encouraging residents to combine trips, carpool, telecommute, reduce the number of cars owned, shop locally, and use alternative modes.
9. Programs to reward Berkeley citizens and neighborhoods that can document reduced car use.
10. Limitations on the supply of long-term commuter parking and elimination of subsidies for commuter parking.

Policy T-12 Education and Enforcement. Support, and when possible require, education and enforcement programs to encourage carpooling and alternatives to single-occupant automobile use, reduce speeding, and increase pedestrian, bicyclist, and automobile safety.

Policy T-13 Major Public Institutions. Work with other agencies and institutions, such as the University of California, the Berkeley Unified School District, Vista Community College, the Alameda County Court, and neighboring cities to promote Eco-Pass and to pursue other efforts to reduce automobile trips.

Policy T-19 Air Quality Impacts. Continue to encourage innovative technologies and programs such as clean-fuel, electric, and low-emission cars that reduce the air quality impacts of the automobile.

Policy T-20 Neighborhood Protection and Traffic Calming. Take actions to prevent traffic and parking generated by residential, commercial, industrial or institutional activities from being detrimental to residential areas.

City of Oakland General Plan

The Oakland General Plan Land Use and Transportation Element was approved in March 1998. Policy language is focused on economic development (Industry and Commerce policies), Transportation and Transit-Oriented Development, Downtown, the Waterfront, and the Neighborhoods, as well as Housing; there is limited discussion of institutional uses and employment. The following transportation-related policies are applicable to the 2006 LRDP:

Policy T2.1 Encouraging Transit-Oriented Development. Transit-oriented development should be encouraged at existing and proposed transit nodes, defined by the convergence of two or more modes of public transit such as BART, bus, shuttle service, light rail or electric trolley, ferry, and inter-city or commuter rail.

Policy T2.5 Linking Transportation and Activities. Link transportation facilities and infrastructure improvements to recreational uses, job centers, commercial nodes, and social services (i.e., hospitals, parks, or community centers).

Policy T3.2 Promoting Strategies to Address Congestion. The City should promote and participate in both local and regional strategies to manage traffic supply and demand where unacceptable levels of service exist or are forecast to exist.

Policy T3.5 Including Bikeways and Pedestrian Walks. The City should include bikeways and pedestrian walks in the planning of new, reconstructed, or realigned streets, wherever possible.

Policy T3.6 Encouraging Transit. The City should encourage and promote use of public transit in Oakland by expediting the movement of and access to transit vehicles on designated "transit streets" as shown on the Transportation Plan.

Policy T4.2 Creating Transportation Incentives. Through cooperation with other agencies, the City should create incentives to encourage travelers to use alternative transportation options.

Policy D3.2 Incorporating Parking Facilities. New parking facilities for cars and bicycles should be incorporated into the design of any project in a manner that encourages and promotes safe pedestrian activity.

Policy N1.2 Placing Public Transit Stops. The majority of commercial development should be accessible by public transit. Public transit stops should be placed at strategic locations in Neighborhood Activity Centers and Transit-Oriented Districts to promote browsing and shopping by transit users.

Policy N5.1. Residential areas should be buffered and reinforced from conflicting uses through the establishment of performance-based regulations, the removal of non-conforming uses, and other tools.

The Open Space, Conservation, and Recreation (OSCAR) Element of the City of Oakland General Plan was adopted in 1996. OSCAR Element policies that pertain to natural resources and are relevant to implementation of the LBNL LRDP include the following:

Policy CO-12.1. Promote land use patterns and densities which help improve regional air quality conditions by: (a) minimizing dependence on single passenger autos; (b) promoting projects which minimize quick auto starts and stops, such as live-work development, and office development with ground-floor retail space; (c) separating land uses which are sensitive to pollution from the sources of air pollution; and (d) supporting telecommuting, flexible work hours, and behavioral changes which reduce the percentage of people in Oakland who must drive to work on a daily basis.

Policy CO-12.3. Expand existing transportation systems management and transportation demand management strategies which reduce congestion, vehicle idling, and travel in single-passenger autos.

Policy CO-12.4. Require that development projects be designed in a manner which reduces potential adverse air quality impacts. This may include: (a) the use of vegetation and landscaping to absorb carbon monoxide and to buffer sensitive receptors; (b) the use of low-polluting energy sources and energy conservation measures; (c) designs which encourage transit use and facilitate bicycle pedestrian travel.

Policy CO-12.5. Require new industry to use best available control technology to remove pollutants, including filtering, washing, or electrostatic treatment of emissions.

Policy CO-12.6. Require construction, demolition and grading practices which minimize dust emissions. These practices are currently required by the City and include the following:

- Avoiding earth moving and other major dust-generating activities on windy days.
- Sprinkling unpaved construction areas within water during excavation, using reclaimed water where feasible. (Watering can reduce construction-related dust by 50 percent.)
- Covering stockpiled sand, soil, and other particulates with a tarp to avoid blowing dust.
- Covering trucks hauling dirt and debris to reduce spills. If spills do occur, they should be swept up promptly before materials become airborne.
- Preparing a comprehensive dust control program for major construction in populated areas or adjacent to sensitive uses like hospitals and schools.
- Operating construction and earth-moving equipment, including trucks, to minimize exhaust emissions.

Policy CO-12.7. Coordinate local air quality planning efforts with other agencies, including adjoining cities and counties, and the public agencies responsible for monitoring and improving air quality. Cooperate with regional agencies such as the Bay Area Air Quality Management District (BAAQMD), the Metropolitan Transportation Commission (MTC), the Association of Bay Area Governments (ABAG), and the Alameda County Congestion Management Agency in developing and implementing regional air quality strategies. Continue to work with BAAQMD and the California Air Resources Board in enforcing the provisions of the State and Federal Clean Air Acts, including the monitoring of air pollutants on a regular and on-going basis.

IV.B.2.5 Existing Air Quality

Criteria Air Pollutants

The BAAQMD operates a regional monitoring network that measures the ambient concentrations of the six criteria air pollutants. Existing and probable future levels of air quality in Berkeley and Oakland can generally be inferred from ambient air quality measurements conducted by the BAAQMD at its nearby monitoring stations. There are no BAAQMD monitoring stations in Berkeley. The Alice Street station in Oakland is nearest to the project site (located approximately 4 miles to the south). This station monitors ozone and carbon monoxide. The nearest station that monitors PM-10 is located at Chapel Way in Fremont, approximately 30 miles southeast of the LBNL site. Since particulate matter is a local pollutant, data from the Chapel Way station cannot be considered to be representative of particulate matter concentrations in the project area. Table IV.B-2 shows a five-year summary of monitoring data for ozone and carbon monoxide from the Alice Street station. The table also compares these measured concentrations with state and federal ambient air quality standards. Table IV.B-3 shows trends in regional exceedances of the federal and state ozone standards. Because of the number of exceedances, ozone is the criteria pollutant of greatest concern in the Bay Area. Bay Area counties experience most ozone exceedances during the period from April through October.

TABLE IV.B-2
AIR QUALITY DATA SUMMARY (2001-2005) FOR THE PROJECT AREA

Pollutant	Standard[b]	Monitoring Data by Year				
		2001	2002	2003	2004	2005
Ozone[a]:						
Highest 1-Hour Average (ppm)[c]		0.07	0.05	0.08	0.08	0.07
Days over State Standard[d]	0.09	0	0	0	0	0
Days over Federal Standard	0.12	0	0	0	0	0
Highest 8-Hour Average (ppm)[c]		0.04	0.04	0.05	0.06	0.05
Days over Federal Standard	0.08	0	0	0	0	0
Carbon Monoxide[a]:						
Highest 1-Hour Average (ppm)[c]		5.0	4.4	3.9	NA	NA
Days over State Standard	20	0	0	0	0	
Days over Federal Standard	35	0	0	0	0	
Highest 8-Hour Average (ppm)[c]		4.0	3.3	2.8	2.6	2.4
Days over State/Federal Standard	9.0	0	0	0	0	0

NA – Not Available

[a] Data are from BAAQMD's Alice Street station in Oakland.
[b] Generally, state standards are not to be exceeded and federal standards are not to be exceeded more than once per year.
[c] ppm – parts per million.

SOURCE: California Air Resources Board, *Summaries of Air Quality Data*, 2001, 2002, 2003, 2004, 2005; http://www.arb.ca.gov/adam.

TABLE IV.B-3
SUMMARY OF OZONE DATA FOR THE SAN FRANCISCO BAY AREA AIR BASIN, 1996–2005

Year	Number of Days Standard Exceeded[a]			Ozone Concentrations in ppm[b]	
	State 1 hr	Federal 1 hr	Federal 8 hr	Maximum 1 hr	Maximum 8 hr
2005	9	0	1	0.12	0090
2004	7	0	0	0.11	0.084
2003	19	1	7	0.13	0.101
2002	16	2	7	0.16	0.106
2001	15	1	7	0.13	0.100
2000	12	3	9	0.15	0.144
1999	20	3	4	0.16	0.122
1998	29	8	16	0.15	0.111
1997	8	0	0	0.11	0.084
1996	34	8	14	0.14	0.112

[a] This table summarizes the data from all of the monitoring stations within the Bay Area.
[b] ppm – parts per million.

SOURCE: California Air Resources Board web site at http://www.arb.ca.gov/adam/cgi-bin/db2www/polltrendsb.d2w/Branch, 2005.

In contrast to some areas of the Bay Area Air Basin, air quality in Berkeley meets clean air standards on most days. While the meteorology is generally favorable for maintaining good air quality, the Berkeley area, along with other portions of the Bay Area that make up the central urban area (i.e., Berkeley-Oakland-San Francisco), is often considered a source region for some pollutants that contribute to elevated concentration levels in downwind communities, such as the Livermore Valley. This is especially the case with mobile or transportation sources.

Motor vehicle transportation, including automobiles, trucks, transit buses, and other modes of transportation, is the major contributor to regional air pollution. Stationary sources were once important contributors to both regional and local pollution. Their role has been substantially reduced in recent decades by pollution control programs. Any further progress in air quality improvement now focuses heavily on transportation sources.

The principal sources of ozone precursors ROG and NOx in the Bay Area include on-road motor vehicles (approximately 39 percent for ROG and 53 percent for NOx), other mobile sources (approximately 17 percent for ROG and 31 percent for NOx), solvent evaporation (approximately 18 percent for ROG), fuel combustion (approximately 11 percent for NOx) and oil and gas production (approximately 8 percent for ROG). Bay Area emissions of the ozone precursors ROG and NOx are expected to decrease by approximately 30 and 44 percent, respectively, between 2004 and 2020 (California Air Resources Board, 2005a) largely as a result of the State's on-road motor vehicle emission control program. The Bay Area has a significant motor vehicle population, and these reductions are projected as vehicles meeting more stringent emission standards enter the fleet and all vehicles use cleaner burning gasoline and diesel fuel or alternative fuels. This includes the use of improved evaporative emission control systems, computerized fuel injection, engine management systems to meet increasingly stringent California emission standards, cleaner gasoline, and the Smog Check program. ROG and NOx emissions from other mobile sources and stationary sources are also projected to decline as more stringent emission standards and control technologies are adopted and implemented.

Table IV.B-2 shows that there have been no exceedances of state and federal ambient carbon monoxide standards at the Alice Street station in Oakland in the last five years. Based on BAAQMD carbon monoxide isopleth maps, projected 2004 background carbon monoxide concentrations in the project vicinity are approximately 5 parts per million, 1-hour average, and 3 parts per million, 8-hour average (BAAQMD, 1999). Currently, on-road motor vehicles are responsible for approximately 70 percent of the carbon monoxide emitted within the San Francisco Bay Area, including Alameda County. Carbon monoxide emissions are expected to decrease within the county by approximately 48 percent between 2004 and 2020 due to attrition of older, high-polluting vehicles, improvements in the overall automobile fleet, and improved fuel mixtures (California Air Resources Board, 2005a).

As explained above, there are no data from a monitoring site that can be considered representative of PM concentration in the project area. Generally, contributors to PM concentrations in the project area are primarily urban sources, dust suspended by vehicle traffic, and secondary aerosols formed by reactions in the atmosphere. Particulate concentrations near residential

sources generally are higher during the winter, when more fireplaces are in use and meteorological conditions prevent the dispersion of directly emitted contaminants. Direct PM-10 emissions in Alameda County are expected to increase by approximately 6 percent between 2004 and 2020 (California Air Resources Board, 2005a), primarily from fugitive dust from a projected rise in the vehicle miles traveled as well as stationary sources (such as industrial activities) and area sources (such as construction and demolition, road dust, and other miscellaneous processes). Fugitive dust refers to particulate matter not emitted from a duct, tailpipe, or stack, which becomes airborne due to the forces of wind, man's activity, or both. Activities that generate fugitive dust include vehicle travel over paved and unpaved roads, brake wear, tire wear, soil cultivation, off-road vehicles or any vehicles operating on open fields or dirt roadways, wind erosion of exposed surfaces, and storage piles at construction sites. PM-2.5 emissions in Alameda County are projected to remain steady over the same period (California Air Resources Board, 2005a) as the reduction in emissions from on-road and off-road engines would be offset by an increase in their activity and also an increase in industrial growth.

The standards for nitrogen dioxide, sulfur dioxide, and lead are being met in the Bay Area, and the latest pollutant trends suggest that these standards will not be exceeded in the foreseeable future (BAAQMD, 2001).

Toxic Air Contaminants

San Francisco Bay Area

Both the BAAQMD and CARB have monitoring networks in the Bay Area that measure ambient concentrations of certain non-radioactive toxic air contaminants that are associated with strong health-related effects and are present in appreciable concentrations in the Bay Area. The BAAQMD uses this information to determine risks for a particular area. Generally, ambient concentrations of toxic air contaminants are similar through the urbanized areas of the Bay Area. Of the pollutants for which monitoring data are available, benzene and 1,3- butadiene (which are emitted primarily from motor vehicles) account for over one half of the average calculated cancer risk (BAAQMD, 2004). Benzene levels have declined dramatically since 1996 with the advent of Phase 2 reformulated gasoline. The use of reformulated gasoline also appears to have led to significant decreases in 1,3-butadiene. Due largely to these observed reductions in ambient benzene and 1,3-butadiene levels, the calculated network average cancer risk has dropped significantly in recent years. Based on 2002 ambient monitoring data, the BAAQMD reported a calculated lifetime risk of contracting cancer from measured concentrations of TACs, *excluding* diesel particulate matter, to be 162 in one million averaged over all Bay Area locations (BAAQMD, 2004; p. 3). This is 46 percent less than what was observed in 1995 (BAAQMD, 2004; p. 3). Subsequently released data from the state indicates that the Bay Area lifetime cancer risk from TACs, again excluding diesel particulate, was 111 in one million in 2004 (California Air Resources Board, 2006; p. 237).

Because diesel particulate matter cannot be directly monitored in the ambient air, the BAAQMD uses CARB's estimates of the population-weighted average ambient diesel particulate concentration for the Bay Area to derive an average cancer risk from diesel particulate matter

exposure at about 480 in one million, as of 2000 (California Air Resources Board, 2005b). The risk from diesel particulate matter has declined from 750 in one million in 1990 and 570 in one million in 1995 (California Air Resources Board, 2005b).

These calculated average cancer risk values from ambient air exposure in the Bay Area can be compared against the lifetime probability of being diagnosed with cancer in the United States, from all causes, which is more than 40 percent, or greater than 400,000 in one million (National Cancer Institute, 2004).

The TAC monitoring stations closest to the LBNL are the Richmond–7th Street Station (1065 7th Street), approximately 7 miles northwest of LBNL, and the Oakland–Davie station (Davie Tennis Stadium, 198 Oak Street), approximately 5 miles south. Table IV.B-4 provides a summary of TAC data for the San Francisco Bay Area Air Basin.

Non-Radioactive Toxic Air Contaminants at LBNL

Many facilities at LBNL are minor sources of regulated air emissions of criteria pollutants or toxic air contaminants. Activities or operations at LBNL that result in TAC emissions include laboratory hood and fume vent emissions, individual boilers for heating and energy operations, standby generators, paint spray booths, and mobile sources that include facility motor pool vehicles and employee shuttle buses.

Radioactive Toxic Air Contaminants

Radiochemical and radiobiological studies performed at LBNL typically use very small (millicurie) quantities of a variety of radionuclides, including carbon-14, hydrogen-3 (tritium),[1] and iodine-125. In addition, radioactive gases are a by-product of charged-particle accelerator operations. Radioactive gases produced by accelerator operations in Buildings 6, 56, and 88 include carbon-11, nitrogen-13, oxygen-15, and fluorine-18. These radioactive gases are considered short-lived radionuclides; flourine-18 has the longest half life, which is less than 2 hours.

Airborne radionuclides could be emitted from any of several locations at LBNL, such as stacks atop buildings. Stack release points vent one or more radioactive material areas where emissions can be measured by sampling or monitoring. Emissions from other release points are controlled by radiation work authorizations or permits and by periodic evaluation; no sampling or monitoring is required.

All radionuclides that are authorized for use or storage at LBNL are considered when determining if emissions from a stack must be measured. As required by 40 CFR Part 61, when making this determination, no credit is taken for emission controls, such as filters and other devices that prevent radionuclides from being emitted into the air. Based on the potential to emit airborne

[1] The Lab has ceased operating the National Tritium Labeling Facility that was formerly operated at the Lab, which resulted in substantial reductions in the already small quantities of tritium used at the Lab. The Lab currently samples for tritium at Buildings 75 and 85, and tritium is authorized for use at various locations around the site.

TABLE IV.B-4
SAN FRANCISCO BAY AREA AIR BASIN TOXIC AIR CONTAMINANTS – ANNUAL AVERAGE CONCENTRATIONS AND HEALTH RISKS

TAC	Annual Average Concentration[a] and Health Risk[b]	2000	2001	2002	2003	2004
Acetaldehyde	Annual Average	0.68	0.73	0.63	0.74	0.74
	Health Risk	3	4	3	4	4
Benzene	Annual Average	0.56	0.43	0.45	0.44	0.37
	Health Risk	52	39	42	41	34
1,3-Butadiene	Annual Average	0.15	0.13	0.14	0.1	0.09
	Health Risk	56	50	51	37	34
Carbon Tetrachloride	Annual Average	0.09	0.09	0.09	0.1	NA
	Health Risk	25	23	24	25	NA
Chromium (Hexavalent)	Annual Average	0.12	--	0.07	0.1	0.09
	Health Risk	18	--	11	14	14
Para-Dichlorobenzene	Annual Average	0.11	0.14	0.15	0.15	0.17
	Health Risk	7	9	10	10	11
Formaldehyde	Annual Average	1.77	2.32	2.57	2.22	1.71
	Health Risk	13	17	19	16	13
Methylene Chloride	Annual Average	0.53	0.27	0.22	0.22	0.14
	Health Risk	2	<1	<1	<1	<1
Perchloroethylene	Annual Average	0.08	0.06	0.05	0.04	0.04
	Health Risk	3	2	2	2	1
Diesel Particulate Matter [c]	Annual Average	1.6	NA	NA	NA	NA
	Health Risk	480	NA	NA	NA	NA
Total Health Risk (without diesel particulate)		179	144	162	149	111
Total Health Risk (with diesel particulate)		649	NA	NA	NA	NA

NA – Not Available

[a] Concentrations for Chromium (Hexavalent) are expressed as nanograms per cubic meter and concentrations for diesel particulate matter are expressed as micrograms per cubic meter. Concentrations for all other TACs are expressed as parts per billion.

[b] Health Risk represents the number of "excess" cancer cases per million people based on a lifetime (70-year) exposure to the annual average concentration; the number of "excess" cases attributed to a particular contaminant is the incremental lifetime increase in cancer cases (or in an individual's risk of contracting cancer) beyond that resulting from other factors. There may be other significant contaminants other than the ones presented here for which monitoring and/or health risk information are not available.

[c] Diesel particulate matter concentration estimates are based on receptor modeling techniques, and estimates are available only for selected years. Most recent data available are for the year 2000 and have been used for all other years presented.

SOURCE: California Air Resources Board, 2005.

radionuclides, the number and location of monitored and sampled stacks is determined using a EPA-approved NESHAP compliance approach. Table IV.B-5 summarizes the current compliance approach, revised by LBNL and approved by EPA in 2005.

Since November 2002, all Berkeley Lab release points were considered minor sources of radionuclides. That is, the effective dose equivalent from each release point was less than 0.1 millirem per year, which is the threshold limit for minor sources. In June 2005, 13 minor release points that could result in an effective dose equivalent greater than 0.01 millirem per year were sampled or monitored; more than 100 minor release points did not require sampling or monitoring.

TABLE IV.B-5
SUMMARY OF NESHAP COMPLIANCE STRATEGY FOR MEASURING EMISSIONS IN 2005

Annual Effective Dose Equivalent (EDE) millirem/year	Category	Requirements
EDE > 10.0	Non-compliant	Reduction or relocation of source and reevaluation prior to authorization
10 > EDE > 1.0	1	• Continuous sampling with weekly collection and analysis AND • Real-time monitoring with alarming telemetry for short-lived ($t_{1/2}$ < 100 h) radionuclides resulting in > 10% of potential dose to maximally exposed individual
1.0 > EDE > 1.0×10^{-1}	2	• Continuous sampling with monthly collection and analysis OR • Real-time monitoring for short-lived ($t_{1/2}$ < 100 h) radionuclides resulting in > 10% of potential dose to maximally exposed individual
1.0×10^{-1} > EDE > 1.0×10^{-2}	3	Periodic sampling 25% of the year
EDE < 1.0×10^{-2}	4	Potential dose evaluation before project starts and when annual radionuclide use limits (as authorized by internal LBL documents) are revised; no sampling or monitoring required

NESHAP – National Emissions Standards for Hazardous Air Pollutants

SOURCE: Radionuclide Air Emission Report for 2005, Lawrence Berkeley National Laboratory, June 2006.

Toxic Air Contaminants and Existing Air Quality

Unlike criteria air pollutants, for which existing air quality is predominantly determined by standardized methods of measuring pollutant concentrations in the ambient environment, air quality related to toxic air contaminants requires an assessment of health risk that is based on either the measured or predicted ambient concentrations of the toxics. The predictive approach is the one most often used because modern computer dispersion models approved by regulatory agencies like EPA are capable of providing representative concentrations for a wide range of toxic substances in the air under various meteorological conditions in a fraction of the time and cost of specialized ambient monitoring of air toxics, if such monitoring methods even exist. The predictive approach can also provide estimated concentrations across a broad region surrounding the source of these emissions rather then the single result represented by monitoring at a specific location. Generally, a health risk assessment reports results that represent the location of maximum risk level.

One outcome of LBNL's comprehensive human health risk assessment was an upper bound estimate of the risk posed by air emissions from existing sources at LBNL. Designed with assumptions that often erred on highly improbable values, the health risks were estimated for stationary sources such as research laboratories and support operations (e.g., standby generators, paint spray booths), as well as mobile sources such as LBNL's fleet of on- and off-site shuttle buses. The following paragraphs discuss the maximum health risk modeled for existing conditions.

The maximum off-site (residential and other locations) lifetime risk of developing cancer from existing LBNL air emission sources of non-radionuclide compounds for a hypothetical maximally exposed individual (MEI) who resides 70 uninterrupted years at the same location was estimated at 80 in one million. The location of the MEI was just outside the western LBNL boundary, near where Hearst Avenue becomes Cyclotron Road. Diesel particulate matter contributed 94.5 percent of this risk. Mobile sources accounted for 95 percent of this diesel particulate matter risk, or 90 percent of the total cancer risk. Operation of support equipment such as diesel generators and forklifts contributed 4.5 percent of the risk. Emissions of chemicals from all research laboratories were estimated to contribute less than one percent of the lifetime risk at this location. The maximum on-site lifetime cancer risk for a LBNL employee was calculated at 40 in one million. Both the 80-in-one-million and 40-in-one-million figures may be compared with the California Air Resources Board's estimate of total cancer risk from toxic air contaminants, including diesel particulate matter, of 659 in one million for the Bay Area as a whole (California Air Resources Board, 2006; Table 5-43).[2]

For lifetime cancer risk due to airborne radionuclide emissions, the maximum off-site lifetime risk from existing LBNL sources for the MEI was estimated at 0.3 in one million for a typical resident. For on-site workers, the maximum lifetime cancer risk was also 0.3 in one million.

Another indication of the low risk of LBNL's activities is the calculated effective dose equivalent from airborne radionuclides as required by the NESHAP regulations. In 2005, the calculated dose to the maximally exposed individual (a hypothetical person residing continuously at the Lawrence Hall of Science) from airborne radionuclides was 0.02 millirem. This is 0.2 percent of the annual NESHAP limit of 10 millirem per year from airborne radionuclide emissions.

The NESHAP limit ensures that the maximum estimated risk of cancer incidence for a person living near a facility who is exposed to the emitted pollutant for 70 years is less than 100 in one million. At LBNL, the maximum dose from airborne radionuclide emissions is therefore equivalent to 0.2 in one million.

Evidence that the calculated dose is overestimated is provided by the results of ambient air sampling, which show no increase in airborne radionuclides over those normally found in the ambient air. Results of air emissions measurements at LBNL are published annually in the LBNL site environmental report.[3]

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2 The LBNL-specific cancer risk figures of 80 in one million and 40 in one million would not be additive with the Bay Area-wide risk of 659 in one million (or the areawide risk of 480 in one million from diesel particulate), but would be considered contributing elements to the overall area-wide risk. However, the 659-in-one-million risk represents a population-weighted average for the entire Bay Area; some locations have greater risk and some, lesser.

3 Reports from recent years are available at http://www.lbl.gov/ehs/esg/tableforreports/tableforreports.htm.

The highest Hazard Index for non-cancer health effects for off-site receptors under baseline (existing) conditions from both radionuclide and non-radionuclide compounds was 0.2, well below the 1.0 Hazard Index that is considered an acceptable non-cancer health effects.[4] For on-site (worker) receptors, the highest Hazard Index was also 0.2.

IV.B.2.6 Sensitive Receptors

Some receptors are considered more sensitive than others to air pollutants. The reasons for greater than average sensitivity include pre-existing health problems, proximity to emissions source, or duration of exposure to air pollutants. Certain people associated with schools, hospitals and convalescent homes are considered to be relatively sensitive to poor air quality because children, elderly people, and the infirm are more susceptible to respiratory distress and other air quality-related health problems than the general public. People in residential areas are also sensitive to poor air quality because they usually stay home for extended periods of time, with associated greater exposure to ambient air quality. Recreational areas are also considered sensitive locations. Vigorous exercise associated with recreation places a high demand on the human respiratory system and thus leads to greater exposure to ambient air quality conditions.

Sensitive land uses surrounding the project site include residences, open space areas, student dormitories, and day care centers. Because the LBNL site is located within property that is owned by the University of California, it does not generally share unbuffered borders with residential areas, except along its western and northern boundary near Cyclotron Road. North of the central portion of LBNL, located on the slopes above LBNL, are University of California facilities: the Lawrence Hall of Science, the Space Sciences Laboratory, and the Mathematical Sciences Research Institute. Also to the north and northwest of LBNL are residential neighborhoods and a neighborhood commercial area within the City of Berkeley.

Southwest of LBNL is the 180-acre UC Berkeley campus, a public institution operated and maintained by the University of California. Within the campus and in close proximity to LBNL are a dormitory, Foothill Student Housing facility, and a day care facility, which is located in Girton Hall. The area southeast of LBNL, including the open space areas of Strawberry Canyon, is also owned by the University of California.

The land to the east, southeast, and northeast of LBNL receives the primary downwind air patterns; this area consists primarily of open space including the University of California's Ecological Study Area and the Botanical Garden. Northeast of LBNL is the 2,000-acre Tilden Regional Park and to the east is the 205-acre Claremont Canyon Regional Preserve. Along the western boundary of LBNL, the land use in Berkeley is predominantly residential, consisting of

[4] The hazard index (for multiple substances) combines the hazard quotient (for single substances). Each hazard quotient is the "ratio of the potential exposure to the substance and the level at which no adverse effects are expected." A hazard quotient of less than 1 indicates no adverse health effects are expected from exposure to a particular substance, while a hazard quotient greater than 1 indicates adverse health effects are possible. Likewise, an aggregated hazard index of less than 1 indicates no likely adverse health effects from exposure to all contaminants analyzed, while a hazard index greater than 1 means that adverse health effects are possible (US EPA, 2006). A hazard index of 1.0 is also considered the threshold of significance in CEQA analysis by the University of California Office of the President, as set forth in the *UC CEQA Handbook.*

single- and multiple-family residential units; the nearest residences there are within about 150 feet of the Laboratory boundary, and within about 400 feet of the nearest Laboratory buildings (Buildings 88 and 90). Other residences, also in Berkeley, are even closer to the Laboratory's northernmost boundary, but somewhat farther from Laboratory buildings. There are single-family residences in the Panoramic Hill neighborhood along the Berkeley-Oakland border, south of the Laboratory. However, these homes are separated from the Laboratory by Strawberry Canyon, and the nearest residences are greater than approximately 1,000 feet distant.

IV.B.3 Impacts and Mitigation Measures

IV.B.3.1 Significance Criteria

For purposes of this EIR, air quality impacts would be considered significant if they would exceed the following Standards of Significance, which are based on Appendix G of the state CEQA Guidelines and the UC CEQA Handbook:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors);
- Expose sensitive receptors to substantial pollution concentrations;
- Create objectionable odors affecting a substantial number of people;
- Exceed the probability of 10 in one million of a maximally exposed individual contracting cancer;
- Have ground level concentrations of non-carcinogenic toxic air contaminants that would result in a Hazard Index greater than 1.0 for the maximally exposed individual; or
- Exceed an applicable LRDP EIR or program EIR standard of significance. This criterion is used in situations where the campus may have identified an air quality standard that is different from or exceeds the state standards.

The UC CEQA Handbook states that, where applicable, the significance criteria established by the applicable air district may be used to make these determinations. The handbook recommends that, for an LRDP EIR (as opposed to a project-specific EIR), the analysis of potential air quality impacts should focus on the potential for development pursuant to the LRDP to conflict with or obstruct applicable air quality planning efforts, cause or contribute to a violation of any air quality standard, or expose receptors to substantial air pollutant concentrations of toxic air contaminants or odors.

Thresholds for Criteria Air Pollutants

The *BAAQMD CEQA Guidelines* (BAAQMD, 1999) distinguish between individual development projects and planning documents, such as city and county general plans, specific area plans, and redevelopment plans. The BAAQMD states that the "evaluation of a plan's air quality impacts should focus on the analysis of the plan's consistency with the most recently adopted regional air quality plan" (BAAQMD, 1999; p. 51). For evaluation of operational impacts from individual projects, the BAAQMD recommends a quantitative threshold of 80 pounds per day or 15 tons per year for ROG, NOx, and PM-10. For carbon monoxide, an increase of 550 pounds per day would be considered significant if it led to a possible local violation of the ambient air quality standards.

In accordance with the *BAAQMD CEQA Guidelines* and the UC CEQA Handbook, this EIR judges the significance of the overall impact of the LRDP's operational emissions of criteria air pollutants based on the consistency of the LRDP with the *Bay Area 2005 Ozone Strategy* (BAAQMD, 2006), which is the most recently adopted regional air quality plan. The analysis also estimates total emissions generated by the full implementation of the LRDP, but does not use the comparison of these emissions with the BAAQMD's quantitative significance thresholds as the criterion for determining the significance of the overall impact of the LRDP. (Individual development projects undertaken in the future pursuant to the LRDP would be subject to a significance determination based on the BAAQMD's quantitative thresholds.)

According to the BAAQMD (1999; p. 51), a planning document's consistency with the *2005 Ozone Strategy* is established through a comparison of the plan's projections of population and vehicle use (vehicle miles traveled) with those upon which the *2005 Ozone Strategy* is based; the extent to which the plan implements transportation control measures identified in the *2005 Ozone Strategy*; and whether the plan provides buffer zones around sources of odors and toxics.

This analysis does not address odor impacts, as there is no history of reported odor complaints from LBNL, and the buffer zone around most of the Laboratory's perimeter – between Laboratory buildings and facilities and potential receptors – generally would preclude any exposure of off-site receptors (especially residents) to any odors that could be generated at the Laboratory. Also the proposed uses at the Laboratory pursuant to the LRDP would be similar in overall nature to the existing uses at the Laboratory. Therefore activities pursuant to the LRDP are not expected to generate any odor complaints in the future.

Thresholds for Toxic Air Contaminants

For the analysis of toxic air contaminant impacts, the *BAAQMD CEQA Guidelines* consider a project to have a significant impact if it has the potential to expose sensitive receptors or the general public to toxic air contaminants in excess of the following thresholds:

- Increased probability of developing cancer ("excess cancer risk") for the Maximally Exposed Individual exceeds 10 in a million; or
- Ground level concentrations of non-carcinogenic toxic air contaminants would result in a Hazard Index greater than 1 for the Maximally Exposed Individual.

IV.B.3.2 Impact Assessment Methodology

Air quality impacts resulting from the implementation of the LRDP fall into two categories: short-term impacts due to construction and long-term impacts due to project operation. Construction activities would affect local particulate concentrations primarily due to fugitive dust sources and increase other criteria pollutant emissions from equipment exhaust. Operation of construction equipment would increase emissions of diesel particulate matter, a TAC, which could affect nearby receptors.

Over the long term, the project would result in an increase in criteria pollutant emissions primarily due to related motor vehicle trips. On-site stationary sources and area sources would result in lesser quantities of criteria pollutant emissions. Stationary sources, such as emergency generators, and diesel-fueled mobile sources would generate emissions of toxic air contaminants that could pose a health risk.

The Lab will evaluate whether the air quality impacts of any later activity implemented pursuant to the LRDP were examined in this program EIR before approving the activity as being within the scope of the project covered by the program EIR. If specific project differences from the presentation of the Illustrative Development Scenario and the 2006 LRDP EIR are such that the project is not within the scope of the LRDP EIR or the specific impact statements and mitigation measures do not cover the individual project pursuant to CEQA Guidelines Sections 15168(c)(2) and 15168(c)(5), then appropriate, project-specific CEQA analysis will be tiered from this 2006 LRDP EIR in accordance with CEQA Guidelines Section 15168(d)(1-3).

Criteria Air Pollutants Assessment Methodology

For construction-phase impacts, BAAQMD normally does not require quantification of construction emissions, but recommends that the assessment be based on a consideration of the control measures to be implemented (BAAQMD, 1999).

The EIR evaluates the significance of the LRDP's operational emissions of criteria air pollutants at a plan level by determining the consistency of the LRDP with the *Bay Area 2005 Ozone Strategy*. However, operational-phase emissions of criteria pollutants were also quantified using the URBEMIS2002 model and average daily trip estimates from the traffic study for the project.

Toxic Air Contaminants Assessment Methodology

A comprehensive human health risk assessment was completed to evaluate impacts from emissions of toxic air contaminants. It determined the potential impacts of these emissions resulting from expected growth and development of LBNL through 2025 (Golder, 2007). The objective of the health risk assessment was to assess the incremental change in potential health risk to the community from proposed development relative to current baseline conditions. The health risk assessment evaluated emission impacts of toxic air contaminants from both periodic construction activities and ongoing research and associated operations activities**.** The analysis used a detailed emissions inventory strategy and modeled atmospheric dispersion of radioactive and non-radioactive pollutants to characterize potential exposure risk and hazards to the

surrounding residential and worker populations. The quantification of LBNL air emissions included all laboratory and support equipment point-source emissions, including both research-related sources such as laboratory fume hoods and support sources such as standby diesel generators, building boilers, and paint spray booths. Also included were emissions from mobile sources associated with LBNL, notably the Laboratory's fleet of diesel buses and other support vehicles. Modeling was conducted using the EPA-approved AERMOD air quality dispersion model (for estimating air inhalation exposure) and CalTOX risk model (for estimating non-inhalation exposures for certain chemicals).

In summary, the process consisted of the following:

1) Identify radionuclide and non-radionuclide chemicals of interest emitted to the air from sources associated with LBNL.

2) Determine appropriate toxicological factors for use in assessing the potential human health risk and hazard for the chemicals of interest.

3) Estimate air emissions of chemicals of interest for emission sources associated with LBNL.

4) Select the radionuclide and non-radionuclide chemicals emitted that account for nearly all of the potential human health risk and hazard based on facility-wide emissions (i.e., identify chemicals of potential concern for the project).

5) Perform dispersion modeling to determine maximum potential ambient concentrations of the chemicals of potential concern.

6) Calculate maximum potential human health risk and hazard due to exposure to chemicals of potential concern emitted from sources associated with LBNL (based on the location-specific dispersion modeling results). A total of more than 800 receptor locations were evaluated, both on- and off-site, based on a grid pattern overlaid on the study area.

The methodology for selecting the chemicals of interest for the risk assessment considered all laboratory and support activities at LBNL. Estimated emissions from these activities were compared against regulatory lists that contained approximately 1,300 chemicals. A systematic screening procedure that considered quantity of emissions and the chemical's toxicity parameters reduced the number of non-radioactive chemicals to 23 and radionuclides to 4 that were then evaluated through the modeling portion of the health risk assessment. These chemicals of potential concern are those that were determined to generate greater than 90 percent of both carcinogenic and non-carcinogenic risk; that is, those chemicals that, based on their toxicity and the volume used at LBNL, account for the overwhelming share of both cancer risk and non-cancer health effects.[5] Table IV.B-6 lists the chemicals of potential concern that were included in the health risk assessment and their estimated baseline annual emission rates.

[5] In the preliminary screening study for the health risk assessment, diesel particulate matter was found to generate more than 95 percent of the overall cancer toxicity of all contaminants evaluated and nearly 30 percent of the overall non-cancer toxicity. In order not to exclude other contaminants (that otherwise would be excluded from the 90-percent threshold), diesel particulate was retained in the study as a chemical of potential concern, but was removed from the screening process to allow a representative mix of other chemicals to compose the 90-percent risk threshold.

TABLE IV.B-6
SELECTED CHEMICALS OF POTENTIAL CONCERN AND BASELINE EMISSION RATE – LBNL HEALTH RISK ASSESSMENT

Non-Radionuclide Chemicals

Chemical	Pounds/Year	Chemical	Pounds/Year
Formaldehyde	175.86	Crotonaldehyde	.7
Carbon Tetrachloride	31.07	Cadmuim	.11
Chloroform	233.9	Boron Trifluoride	3.42
Benzene	109.38	Hydrochloric Acid	260.07
Vinyl Chloride	19.29	Chlorine	28.41
Acetaldehyde	67.70	Diesel Particulate Matter	602.9
Vinylidene Chloride	1.52	7,12 – Dimethylybenz(a)antracene	163E-03
1,3-Butadiene	10.10	Naphthalene	1.95
Acrolein	3.81	Fluoranthene	.27
Ethylene Dichloride	27.26	Benzo(a)pyrene	1.18E-02
Acroylonitrile	1.55	Dibenzo(a,h)anthracene	8.85E-04
Hydrazine	.44		

Radionuclide Chemicals

Chemical	Curies/Year	Chemical	Curies/Year
C-11	4.80E-01	I-125	2.10E-03
F-18	3.40E-01	TH-232	8.65E-07

SOURCE: Golder, 2007.

Both cancer risk and non-cancer health effects from emissions of toxic substances were assessed in the health risk assessment. Consistent with accepted practice, the acceptable maximum lifetime cancer risk from chronic exposure has a probability threshold value of 10 in one million. Accordingly, a project is considered to have a less-than-significant impact in terms of lifetime cancer risk, if the project would result in a maximum increase at any one location of no more than 10 in one million in the risk of contracting cancer during a lifetime of exposure to emissions from the project.[6] For example, if the existing maximum risk of contracting cancer were 50 in one million, and a project were to increase that risk to 57 in one million (i.e., an increase of less than 10 in one million), the project would be considered to result in a less-than-significant impact, whereas if the project were to increase the maximum risk of contracting cancer to 62 in one million (i.e., an increase of more than 10 in one million), the impact would be considered significant.

For cancer risk due to the proposed 2006 LRDP, two comparisons based on the health risk assessment examined projected lifetime risks of contracting cancer, estimated at more than 1,700 on-site and off-site receptor locations. One comparison involved the lifetime risk of contracting cancer due to existing operations of Berkeley Lab versus both the future lifetime risk without implementation of the proposed 2006 LRDP (using assumptions about emissions anticipated to be generated in 2025). The other comparison involved the lifetime risk of contracting cancer due

6 As stated in the Setting, the National Cancer Institute reports that the lifetime probability of being diagnosed with cancer in the United States, from all causes, is more than 40 percent, or greater than 400,000 in one million.

to existing operations of Berkeley Lab versus the future lifetime risk with full implementation of the LRDP. In this way, for each receptor it is possible to determine the "background" change (due to reduced emissions, largely from motor vehicles and stationary engines, that will result from future implementation of existing regulations). It is also possible to determine the separate incremental change due to implementation of the proposed 2006 LRDP. Any increase in lifetime cancer risk of more than 10 in one million at any of the receptors, then, would result in a potentially significant impact.

Potential non-cancer health effects for a series of locations[7] on and off the Laboratory hill site was assessed by use of a "Hazard Index," which is the sum of the ratios of each chemical's hazard quotient. (The hazard quotient is determined for each chemical by comparing the modeled exposure level at a particular receptor location to the acceptable exposure level for that chemical. In other words, a hazard quotient is the fraction of a non-cancer health effects threshold, for a particular contaminant, experienced by a person at a particular location.) Hazard indices are calculated for both long-term (chronic) and short-term (acute) health effects. Consistent with accepted practice, hazard indices less than 1.0 indicate acceptable non-cancer health effects. The UC CEQA Guidelines incorporate both of the above standards (increase of 10 in one million for lifetime cancer risk and 1.0 for hazard index).

Potential chronic exposure to LBNL chemicals of potential concern was assessed based on hypothetical on-site worker and off-site resident receptor types. The on-site worker was assumed to represent an LBNL employee working within the Laboratory boundaries and exposed for 8 hours per day, 245 days per year for 40 years. The off-site resident was assumed to be representative of residents living near LBNL. The assumption for this resident was an exposure for 24 hours per day for 350 days per year for a total of 70 years, which is the extremely conservative standard approach used in human health risk assessments. Alls receptors were assumed to be exposed by the inhalation pathway, as well as by certain non-inhalation pathways due to deposition of air emissions and subsequent exposure via ingestion of the chemicals.

In addition to performing a comprehensive human health risk assessment, LBNL annually assesses the effective dose equivalent from airborne radionuclides, as required by EPA's NESHAP regulations as mentioned earlier.

Like the assumptions used in the comprehensive human health risk assessment, the calculated dose for NESHAP compliance reporting overestimates the actual dose because many conservative factors are used in the calculation. These factors include assumptions about the amounts, types, and forms of radionuclides emitted during the year; the health effects of the emitted radionuclides; the extent to which emissions disperse in the air; the ingestion of vegetables, milk, and beef produced within 50 miles of LBNL; and the maximally exposed individual residing full-time at the Lawrence Hall of Science.

7 The results of the health risk assessment are location-specific; that is, the potential risk and hazard for each contaminant varies from location to location. In general, the reported results are for the particular locations of maximum risk level for each contaminant or series of contaminants.

Cumulative Impact Assessment Methodology

This EIR section also evaluates whether the implementation of the LBNL 2006 LRDP in conjunction with other reasonably foreseeable projects would result in cumulative significant impacts on air quality, based on traffic forecasts developed from the Alameda County Countywide Travel Demand Model along with trip generation and distribution data developed for the LRDP, as well as the UC Berkeley LRDP, thereby incorporating both regional and LRDP-specific characteristics into the analysis. Cumulative impacts could be significant even if the project's individual impacts are less than significant, as the project impacts could combine with air quality impacts from other projects in the area to cause conflicts with or obstruct implementation of the applicable air quality plan, violate or contribute substantially to an air quality violation, or expose sensitive receptors to substantial pollutant concentrations.

For the assessment of cumulative impacts from increase in criteria air pollutant emissions, this EIR determines the consistency of the 2006 LRDP with the current regional air quality plan.

IV.B.3.3 2006 LRDP Principles, Strategies and LBNL Design Guidelines

2006 LRDP Principles and Strategies

The 2006 LRDP proposes four fundamental principles that form the basis for the development strategies provided for each element of the LRDP. The one principle most applicable to air quality is to "Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship."

The 2006 LRDP provides strategies intended to minimize potential environmental impacts that could result from implementation of the 2006 LRDP (see Chapter III, Project Description for further discussion, and see Appendix B for a full listing of principles, strategies and design guidelines). The strategies set forth in the 2006 LRDP applicable to air quality include the following:

- Protect and enhance the site's natural and visual resources, including native habitats, riparian areas, and mature tree stands by focusing future development primarily within the already developed areas of the site;
- Increase development densities within areas corresponding to existing clusters of development to preserve open space, enhance operational efficiencies and access;
- Site and design new facilities in accordance with University of California Presidential Policy for Green Building Design to reduce energy, water and material consumption and provide improved occupant health, comfort and productivity;
- Increase use of alternate modes of transit through improvements to the Laboratory's shuttle bus service;
- Promote transportation demand management strategies such as vanpools and employee ride share programs;

- Maintain or reduce the percentage of parking spaces relative to the adjusted daily population; and
- Consolidate parking into larger lots and/or parking structures, locate these facilities near Laboratory entrances to reduce traffic within the main site.

LBNL Design Guidelines

The LBNL Design Guidelines were developed in parallel with the LRDP and are proposed to be adopted by the Lab following The Regents' consideration of the 2006 LRDP. The LBNL Design Guidelines provide specific guidelines for site planning, landscape and building design as a means to implement the LRDP's development principles as each new project is developed. Specific design guidelines are organized by a set of design objectives that essentially correspond to the strategies provided in the LRDP. The LRDP Design Guidelines provide the following specific planning and design guidance relevant to air quality to achieve these design objectives (primarily by encouraging pedestrian travel on the main hill site, with the potential for commensurate reduction in vehicle travel):

- Create new Commons Spaces (central, campus-like collegial spaces creating a focal point and gathering space in each research cluster) in clusters that currently lack them;
- Stimulate pedestrian activity and interaction in the Commons Spaces;
- Create as high a density and critical mass around Commons Spaces as possible;
- Design pathway layouts that support pedestrian flow and encourage casual interaction; and
- Minimize visual and environmental impacts of new parking lots

These objectives can be found in the "B. Research Clusters" and "C. Linkages" sections of the LBNL Design Guidelines.

IV.B.3.4 Impacts and Mitigation Measures

Impact AQ-1: Construction[8] of new facilities proposed under the LBNL 2006 LRDP would generate short-term emissions of fugitive dust and criteria air pollutants that would affect local air quality in the vicinity of construction sites. (Significant; Less than Significant with Mitigation)

Construction activities including demolition would occur intermittently at different sites in the project area throughout the 20-year period over which the project would be implemented. Although the related impacts at any one location would be temporary, construction of individual projects under the proposed project has the potential to cause adverse effects on the local air quality in and around the LBNL area. Construction activities would generate substantial amounts of dust (including PM-10 and PM-2.5) primarily from fugitive sources and lesser amounts of particulate matter and other criteria air pollutants primarily from operation of heavy equipment

8 For the purposes of this EIR, the term "construction," unless specifically indicated otherwise, includes activities that involve construction of new facilities, major rehabilitation or modification of existing facilities, and demolition of existing facilities.

construction machinery (primarily diesel-operated) and construction worker automobiles (primarily gasoline-operated).

Fugitive dust emissions would vary from day to day, depending on the level and type of activity, silt content of the soil or other materials being handled, and the prevailing weather. Sources of fugitive dust during construction would include vehicle movement over paved and unpaved surfaces, demolition, excavation, earth movement, grading, and wind erosion from exposed surfaces. In the absence of mitigation, construction activities may result in significant quantities of dust, and as a result, local visibility and particulate matter concentrations may be adversely affected on a temporary and intermittent basis during the construction period. In addition, the fugitive dust generated by construction would include not only PM-10 and PM-2.5, but also larger particles, which would fall out of the atmosphere within several hundred feet of the site and could result in nuisance-type impacts. Demolition of buildings constructed prior to 1980 often involves hazardous materials such as asbestos used in insulation, fire retardants, or building materials (e.g., floor tile, roofing) and lead-based paint. Airborne asbestos fibers and lead dust pose a serious health threat. The demolition, renovation, and removal of lead- and asbestos-containing building materials would be subject to the requirements of BAAQMD Regulation 11, Rules 1 and 2.

The BAAQMD's approach to analyses of construction impacts is to emphasize implementation of effective and comprehensive control measures rather than detailed quantification of emissions. The BAAQMD considers any project's construction-related impacts to be less than significant if the required dust-control measures are implemented. With implementation of these measures (detailed in Mitigation Measures AQ-1a and AQ-1b), the impact would be considered less than significant.

Construction activities would also result in the emission of other criteria air pollutants from equipment exhaust, construction-related vehicular activity, and construction worker automobile trips. Emission levels for construction activities would vary depending on the number and type of equipment, duration of use, operation schedules, and the number of construction workers. Criteria pollutant emissions of ROG and NOx from these emission sources would incrementally add to the regional atmospheric loading of ozone precursors during project construction. The *BAAQMD CEQA Guidelines* recognize that construction equipment emits ozone precursors, but indicate that such emissions are included in the emission inventory that is the basis for regional air quality plans. Therefore construction emissions are not expected to impede attainment or maintenance of ozone standards in the Bay Area (BAAQMD, 1999). The impact would therefore be less than significant.

Emissions of toxic air contaminants associated with construction activity are addressed separately under Impact AQ-4.

> **Mitigation Measure AQ-1a:** The BAAQMD's approach to dust abatement calls for "basic" control measures that should be implemented at all construction sites, "enhanced" control measures that should be implemented at construction sites greater than four acres in area, and "optional" control measures that should be implemented on a case-by-case basis

at construction sites that are large in area or are located near sensitive receptors, or that, for any other reason, may warrant additional emissions reductions (BAAQMD, 1999).

During construction of individual projects proposed under the LRDP, LBNL shall require construction contractors to implement the appropriate level of mitigation (as detailed below), based on the size of the construction area, to maintain project construction-related impacts at acceptable levels; this would reduce the potential impact to a less-than-significant level.

Elements of the "basic" dust control program for project components that disturb less than one acre shall include the following at a minimum:

- Water all active construction areas at least twice daily. Watering should be sufficient to prevent airborne dust from leaving the site. Increased watering frequency may be necessary whenever wind speeds exceed 15 miles per hour. Reclaimed water should be used whenever possible.

- Cover all trucks hauling soil, sand, and other loose materials or require all trucks to maintain at least two feet of freeboard (i.e., the minimum required space between the top of the load and the top of the trailer).

- Pave, apply water three times daily (or as sufficient to prevent dust from leaving the site), or apply (non-toxic) soil stabilizers on all unpaved access roads, parking areas, and staging areas at construction sites.

- Sweep daily or as appropriate (with water sweepers using reclaimed water if possible) all paved access roads, parking areas and staging areas at construction sites.

- Sweep streets daily or as appropriate (with water sweepers using reclaimed water if possible) if visible soil material is carried onto adjacent public streets.

Elements of the "enhanced" dust abatement program for project components that disturb four or more acres shall include all of the "basic" measures in addition to the following measures:

- Hydroseed or apply (non-toxic) soil stabilizers to inactive construction areas (previously graded areas inactive for ten days or more).

- Enclose, cover, water twice daily (or as sufficient to prevent dust from leaving the site), or apply (non-toxic) soil stabilizers to exposed stockpiles (dirt, sand, etc.).

- Limit traffic speeds on unpaved roads to 15 miles per hour.

- Install sandbags or other erosion control measures to prevent silt runoff to public roadways.

- Replant vegetation in disturbed areas as quickly as possible.

Elements of the "optional" control measures are strongly encouraged at construction sites that are large in area or located near sensitive receptors, or that for any other reason may warrant additional emissions reductions:

- Install wheel washers for all exiting trucks, or wash off tires or tracks of all trucks and equipment leaving the site.

- Install wind breaks, or plant trees/vegetative wind breaks at windward side(s) of construction areas.

- Suspend excavation and grading activity when winds (instantaneous gusts) exceed 25 miles per hour.

- Limit the area subject to excavation, grading, and other construction activity at any one time.

- Pave all roadways, driveways, sidewalks, etc. as soon as possible. In addition, building pads should be laid as soon as possible after grading unless seeding or soil binders are used.

- Designate a person or persons to monitor the dust control program and to order increased watering, as necessary, to prevent transport of dust off-site. Their duties shall include holidays and weekend periods when work may not be in progress. The names and telephone numbers of such persons shall be provided to the BAAQMD prior to the start of construction.

Mitigation Measure AQ-1b: To mitigate equipment exhaust emissions, LBNL shall require its construction contractors to comply with the following measures:

- Construction equipment shall be properly tuned and maintained in accordance with manufacturers' specifications.

- Best management construction practices shall be used to avoid unnecessary emissions (e.g., trucks and vehicles in loading and unloading queues would turn their engines off when not in use).

- Any stationary motor sources such as generators and compressors located within 100 feet of a sensitive receptor shall be equipped with a supplementary exhaust pollution control system as required by the BAAQMD and the California Air Resources Board.

- Incorporate use of low-NOx emitting, low-particulate emitting, or alternatively fueled construction equipment into the construction equipment fleet where feasible, especially when operating near sensitive receptors.

- Reduce construction-worker trips with ride-sharing or alternative modes of transportation.

Significance after Mitigation: Less than significant.

Project Variant. The project variant would not result in any change in building or facility construction, compared to the proposed project, and therefore construction impacts would be as described above. With implementation of mitigation measures AQ-1a and AQ-1b, this impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP will be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts to land use and planning. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario would affect local air quality in the vicinity of such projects as a result of short-term emissions of fugitive dust and criteria air pollutants. For the reasons stated above with regard to full implementation of the LRDP, this impact would be less than significant with implementation of Mitigation Measures AQ-1a and AQ-1b.

Impact AQ-2: Proposed development under the LBNL 2006 LRDP would generate long-term emissions of criteria air pollutants from increases in traffic and stationary sources. (Less than Significant)

The LBNL 2006 LRDP is a planning document that includes several individual projects anticipated to be developed through 2025. Therefore, the significance of LRDP-generated impacts of criteria air pollutants has been analyzed at a plan level. In accordance with the *BAAQMD CEQA Guidelines*, the air quality impacts are evaluated based on the LRDP's consistency with the current regional air quality plan (i.e., the *Bay Area 2005 Ozone Strategy)*. Operational emissions from the implementation of all projects pursuant to the LRDP have also been quantified. This information is used to determine impacts for specific projects under the LRDP and not the impacts of the LRDP as a whole.

Plan-Level Analysis

The *BAAQMD CEQA Guidelines* direct that a planning document's consistency with the *Bay Area 2005 Ozone Strategy* is established through a comparison of the plan's projections of population and vehicle use with those in the *2005 Ozone Strategy*; the extent to which the plan implements transportation control measures identified in the *2005 Ozone Strategy*; and whether the plan provides buffer zones around sources of odors and toxics.

Consistency with 2005 Ozone Strategy Projections

Consistency with the *Bay Area 2005 Ozone Strategy's* projections is found if the plan's population growth projections would not exceed the comparable projections in ABAG's *Projections 2000*, which contains the population growth projections on which the *2005 Ozone Strategy* is based. Additionally, the rate of increase in vehicle miles traveled must be found to be equal to or less than the growth in population.

Because the 2006 LRDP is a physical land use plan for a research and academic institution (i.e., it has no residential component, unlike a city or county general plan or specific plan), on-site employment growth, rather than residential growth, is the best possible measurement that can be used to compare the LRDP to *Projections 2000*. Thus, employment projections for the City of Berkeley, where the majority of LBNL facilities are located, and, to a lesser extent, the City of Oakland, as provided to ABAG, must include LBNL jobs in order for LBNL employment growth to be included in the *Bay Area 2005 Ozone Strategy*.

Forecasts in *Projections 2000* contained more than enough jobs to accommodate the LRDP's projected increase in adjusted daily population (ADP) and resulting growth in employment; *Projections 2000* assumed an increase in employment in Berkeley of more than 8,000 between the years 2000 and 2020 (the horizon date of *Projections 2000*), with an additional 29,500 jobs forecast in Oakland. Therefore, while job growth at LBNL might result in some redistribution within Berkeley and/or Oakland of employment forecast in *Projections 2000*, the increased employment would be consistent with the job growth on which the *2005 Ozone Strategy* forecasts were based. The LBNL ADP would increase from the current 4,375 to 5,525, or approximately 26 percent.

As to vehicle miles traveled (VMT), almost 40 percent of LBNL employees currently use travel means other than driving alone to commute to work. Assuming no wholesale change in the location of employees in the future, the approximately 26-percent increase in ADP would result in about a 16-percent increase in VMT, which would be less than the rate of ADP growth. Even if some future Laboratory employees lived farther from the Laboratory than do current employees, LBNL's history of encouraging alternative travel modes is likely to keep the VMT increase below the increase in ADP and employment. This is supported by the 2006 LRDP, which allows for no relative increase in the ratio of parking spaces to ADP, meaning that on-site parking would continue to be a limiting factor in driving to work.

Consistency with Bay Area 2005 Ozone Strategy Transportation Control Measures

Consistency with the *Bay Area 2005 Ozone Strategy's* Transportation Control Measures (TCMs)[9] is found if the jurisdiction adopting the plan evidences "reasonable efforts" to implement applicable TCMs. The University's status as both approving jurisdiction and project proponent and employer results in some overlapping responsibility. TCMs identified in the *BAAQMD CEQA Guidelines* as applicable to cities and counties, the jurisdictions generally involved in adoption of planning documents, include the following:

TCM 1 – Support Voluntary Employer-Based Trip Reduction Programs

TCM 9 – Improve Bicycle Access and Facilities

TCM 12 – Improve Arterial Traffic Management

TCM 15 – Local Clean Air Plans, Policies and Programs (focus on site design to reduced single-occupant trips)

9 Transportation Control Measures are strategies and methods to reduce vehicular travel.

TCM 17 – Conduct Demonstration Projects (to reduce emissions, such as implementation of clean fuel vehicle fleets)

TCM 19 – Pedestrian Travel (promote development patterns to encourage walk trips; include pedestrian improvements in capital projects)

TCM 20 – Promote Traffic Calming Measures[10]

LBNL is in a position to implement some of the above TCMs more readily than others. For example, the Laboratory supports trip reduction and pedestrian trips by operating its own shuttle service, including both on- and off-site routes; encourages bike travel by providing bicycle racks on its shuttle buses; has switched its shuttle fleet to "biodiesel" fuel (an alternative to diesel that can be produced from any fat or vegetable oil, including waste cooking oil); and has installed a new fueling station for an alternative fuel (85 percent ethanol and 15 percent gasoline). In addition, one of the objectives of the 2006 LRDP is to "Clarify and strengthen existing pedestrian and vehicular circulation to enhance way-finding and promote safety." Inasmuch as the Laboratory controls only roadways within its fence line, it is not especially able to effect changes in arterial traffic management (TCM 12) or traffic calming (TCM 20).

Other TCMs are applicable to employers and include the following:

TCM 13 – Transit Use Incentives (such as provision of Commuter Checks to employees)

TCM 14 – Improve Rideshare/Vanpool Services and Incentives

TCM 16 – Intermittent Control Measure/Public Education (participation in the BAAQMD's "Spare the Air" campaign to reduce driving on smoggy days)

TCM 18 – Transportation Pricing Reform (including providing a cash payment in lieu of parking to employees who do not drive to work)

LBNL currently offers and would continue to offer, under the LRDP, financial incentives for alternatives to driving alone, both in the form of pre-tax payments, for either transit passes or for vanpool expenses. The Laboratory also participates in Alameda County's Guaranteed Ride Home program, under which employees who ride transit or carpool to work can obtain a ride home in the event of an emergency or if they miss their carpool. LBNL promotes the BAAQMD's Spare the Air program by annually notifying Laboratory employees of its program through the Laboratory's electronic newsletter. Finally, LBNL encourages carpooling by providing links on its website to the Metropolitan Transportation Commission carpool-matching program.

Under the 2006 LRDP, Berkeley Lab would continue to seek opportunities to implement new or expand existing TCMs. The Laboratory has developed a draft TDM Program that specifically addresses a number of the TCMs, with trip reduction strategies that would be promoted during the 2006 LRDP planning period. The draft TDM Program is included in Appendix F of this EIR.

[10] The BAAQMD 2004 Ozone Strategy table of draft control measures (viewed May 13, 2005, at http://www.baaqmd.gov/pln/plans/ozone/2003_workgroup/cmsummarytables.pdf) notes, however, that "Traffic calming is an important support program for other TCMs, particularly bike/ped programs, but it is uncertain how much additional emission reductions can be attributed specifically to traffic calming projects."

Impacts Associated with Odors and Toxics

To be consistent with the *2005 Ozone Strategy*, a plan should provide for buffer zones around potential sources of odors and/or toxic air contaminants. As noted under "Significance Criteria" above, LBNL has no history of odor complaints and does, in fact, provide an extensive buffer zone around most of the Laboratory's perimeter. In the northwest corner of LBNL, the only area of LBNL not separated by an extensive buffer zone from nearby residences, sensitive receptors are upwind from LBNL facilities during generally prevailing westerly and northwesterly winds, thereby further reducing any potential for odor impacts.

It is noted that this same buffer zone serves to separate potential receptors from toxic air contaminant emissions at LBNL. Potential impacts related to toxic air contaminants are discussed in detail below, under Impact AIR-4.

Conclusion

In summary, the 2006 LRDP would be consistent with the *Bay Area 2005 Ozone Strategy* because it would not result in employment in excess of the *2005 Ozone Strategy's* projections and would not result in a VMT increase greater than the increase in Laboratory employment; the LRDP would implement transportation control measures identified in the *2005 Ozone Strategy*; and the LRDP would provide appropriate buffer zones around sources of odors and toxics. Therefore, emissions of criteria air pollutants resulting from development pursuant to the LRDP would not be significant.

Project-Level Analysis

Table IV.B-7 presents estimated emissions of criteria pollutants due to implementation of the LRDP. The estimates include criteria pollutant emissions from all projects proposed under the LRDP. The table also provides BAAQMD's project-level thresholds of significance.

TABLE IV.B-7
OPERATIONAL EMISSIONS (pounds per day)

Pollutant	BAAQMD Thresholds	Vehicular Emissions[a]	Stationary-Source Emissions
Reactive Organic Gases (ROG)	80	37.2	0.5
Nitrogen Oxides (NOx)	80	39.7	5.3
Particulate Matter (PM-10)	80	32.2	<0.1
Carbon Monoxide (CO)	550	381.3	2.7

BAAQMD – Bay Area Air Quality Management District

[a] Emission factors were generated by the Air Board's URBEMIS2002 model for San Francisco Bay Air Basin, and assume a default vehicle mix. Input assumptions include an ambient summer temperature of 75 degrees, winter temperature of 50 degrees and year 2005 EMFAC2002 composite emissions factors (which overstate emissions, because development under the LRDP would continue through 2025). Emissions are based on 1,600 new vehicle trips per day, using 1,200 employees at 1.33 daily vehicle trips per employee and the "Industrial Park" land use designation in URBEMIS2002. All daily estimates are for summertime conditions except for CO, which assumes wintertime conditions. Stationary-source emissions are for summer.

SOURCE: Environmental Science Associates, 2004.

Table IV.B-7 shows that criteria pollutant emissions from the LRDP as a whole (i.e., at full implementation) would not exceed any of the BAAQMD-recommended project-level significance thresholds.[11] Therefore, no individual project proposed under the LRDP would exceed the significance thresholds. Therefore, the impact of individual projects developed pursuant to the LRDP, as determined by the BAAQMD-recommended methodology for evaluation of project impacts, would be less than significant.

Mitigation: None required.

Project Variant. The project variant would add about nine percent more LBNL traffic to the streets of Berkeley, assuming that all 350 of the employees shifted from the downtown facility to the Lab hill site would drive. Because some or all of these employees currently drive to the downtown location, however, the change in regional emissions of criteria air pollutants would be negligible, and thus the analysis presented above would be applicable to the variant as well.

Individual Future Projects/ Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP will be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the potential buildings that is included in the scenario might be constructed pursuant to the 2006 LRDP, but the overall amount of construction will be limited to the amount of new construction proposed in the LRDP. Thus the scenario remains an appropriate and conservative basis for the evaluation of the impacts of potential individual projects under the LRDP. Potential individual projects under the 2006 LRDP such as those included in the Illustrative Development Scenario would create operational emissions of criteria air pollutants no greater than those estimated in Table IV.B-7 for all projects proposed under the LRDP. For the reasons stated above, the impact of these emissions would be less than significant.

Impact AQ-3: Proposed development under the LBNL 2006 LRDP would increase carbon monoxide concentrations at busy intersections and congested roadways in the project vicinity. (Less than Significant)

Traffic generated by the project would have the potential to affect carbon monoxide concentrations along surface streets. This increase in traffic would add more vehicles on the road and the increased congestion would cause existing non-project traffic to travel at slower, more polluting speeds. However, carbon monoxide levels have been declining for many years and roadside exceedances of state and federal 1-hour and 8-hour standards are seldom encountered any longer. Worst-case carbon monoxide concentrations in the vicinity of local streets, (e.g., at

[11] This finding also supports an alternative determination, on a plan level, that the LRDP in toto would not result in a significant impact with regard to criteria air pollutants.

the heavily trafficked intersections of San Pablo and University avenues and at University and Shattuck avenues) are well below the state and federal ambient air quality standards.[12]

Development pursuant to the 2006 LRDP would add, at most, 9 percent to the traffic volume at any of the study intersections, with the only exception being the intersections closest to the Laboratory's entrance gates. For example, at Hearst and LeRoy avenues, leading to Cyclotron Road and the Laboratory's main Blackberry Canyon Gate, project traffic would add 7.9 percent to projected future volumes in the afternoon peak hour, and 8.6 percent to (slightly lower) projected future volumes in the morning peak hour. The resulting total volumes, however, would be such that carbon monoxide levels would remain well below state and federal ambient air quality standards. At more heavily traveled intersections, such as Hearst Avenue and Oxford Street, the project's increment would be far less (i.e., approximately 2 percent) and again, resulting total volumes are projected to keep carbon monoxide levels well below state and federal ambient air quality standards.

Further supporting this conclusion, background carbon monoxide levels are projected by CARB to be significantly lower in 2025. The projected lower levels are derived from the CARB emissions model EMFAC2002, and they reflect the phasing out of older, dirtier autos in future years. Despite the addition of project and cumulative traffic, carbon monoxide concentrations at the intersections are expected to decrease over the LRDP implementation period through 2025. Therefore, the long-term increase in project and cumulative traffic would not violate any air quality standard or contribute to an existing or projected air quality violation in the project vicinity. Thus the impact on local carbon monoxide concentrations would be less than significant.

Mitigation: None required.

Project Variant. The project variant would add about nine percent more LBNL traffic to the streets of Berkeley, assuming that all 350 of the employees shifted from the downtown facility to the Lab hill site would drive. Because some or all of these employees currently drive to the downtown location, however, only project study intersections east of Shattuck Avenue would be affected. However, the potential increase in traffic volumes at these intersections would not be sufficient to result in violations of state or federal carbon monoxide standards because, as noted above, carbon monoxide concentrations under the project conditions would be well below the applicable standards.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP will be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the potential buildings that is included in the scenario might be constructed pursuant to

[12] The estimates correspond to a hypothetical location approximately 7 feet from the roadway. These estimates also include background 1-hour-average concentrations of 7.5 parts per million (ppm) and background 8-hour average concentrations of 4.5 ppm in 2005.

the 2006 LRDP, but the overall amount of construction will be limited to the amount of new construction proposed in the LRDP. Thus the scenario remains an appropriate and conservative basis for the evaluation of the carbon monoxide impacts of potential individual projects under the LRDP. Potential individual projects under the LRDP such as those included in the Illustrative Development Scenario would increase carbon monoxide concentrations at busy intersections and congested roadways in the project vicinity, but for the reasons stated above regarding full implementation of the LRDP, the impact would be less than significant.

Impact AQ-4: Implementation of the proposed 2006 LRDP would expose people to toxic air contaminants. (Significant; Less than Significant with Mitigation)

A human health risk assessment was prepared to identify risks resulting from the implementation of the LRDP (Golder, 2007). The health risk assessment examined total lifetime excess risk results to typical on-site workers and off-site residents from development during the LRDP period as well as existing LBNL operations at the start of the LRDP period and the potential cumulative risk from other contributing sources in the vicinity of LBNL.

The health risk assessment was based on the LRDP as originally proposed in the Notice of Preparation, and does not reflect the reduction in scope of the LRDP in response to comments from the City of Berkeley. Such health risk assessments are by their nature highly conservative in their analysis, using assumptions about exposure that tend to significantly overstate the actual pattern of human exposure (for example, it is standard methodology for health risk assessments to assume that a maximally exposure individual remains at the same location for 70 years and during that time is outdoors 24 hours each day). Given that health risk assessments are inherently conservative analyses that tend to overstate risk, it is also appropriate to continue to use the health risk assessment for the LRDP as originally proposed, even though the actual level of potential development under the LRDP is substantially reduced.

Operation – Cancer Risk from Non-Radionuclide Emissions

There are two criteria that can be used from the health risk assessment to assess the degree to which implementation of the 2006 LRDP would expose people to toxic air contaminants. These two criteria are the level of exposure to toxic air contaminants faced by a theoretical maximally exposed individual, and the area which is subject to increases in modeled health risk over the standard accepted threshold of 10 in one million. As explained below, the health risk assessment indicates that the vast majority of health risk attributable to both current and proposed operations of the Lab is attributable to diesel particulate matter. The health risk assessment indicates that, in general, both the risk to the maximally exposed individual will decrease and the area subject to existing modeled exceedances of the health risk threshold will significantly shrink in the future (largely due to improvements in diesel particulate emissions control). Furthermore, the reduction in the area subject to excess health risk would occur with or without implementation of the proposed 2006 LRDP. In fact, the health risk assessment shows that implementation of the 2006 LRDP would slightly reduce health risk when compared to the no-project scenario. While these

decreases in future health risk are projected, the assessment also indicated that on a receptor-by-receptor comparison, there is a small area where the incremental risk will increase.

Off-Site Receptors

With full implementation of the 2006 LRDP in 2025, of the 849 locations modeled in the health risk assessment as potential off-site receptors, not a single receptor returned an increase in cancer risk in excess of 10 in one million, either in comparing future with-project risk to future no-project risk, or in comparing future with-project risk to existing risk. In comparing future no-project conditions to conditions with implementation of the 2006 LRDP, the risk increased at about one-half of the receptors and decreased at the other half. The maximum increase was 8 in one million, and the risk increased by more than 5 in one million at only 3 of 849 off-site receptors, none of which are in residential areas.[13] Comparing existing to future with-project conditions, the risk decreased at 61 percent of receptors, and increased at 39 percent. Because of improvements in emissions quality anticipated due to regulations already in place (primarily targeting diesel particulate matter), no increase in risk was greater than 3 in one million. Additionally, the geographic area exposed to a lifetime cancer risk of 10 in one million or more would decrease in the future, under both no-project and with-project conditions, compared to existing conditions.

Supporting the incremental risk analysis above, the maximum off-site lifetime cancer risk, for a hypothetical 70-year resident, from LBNL sources of non-radionuclide compounds for the hypothetical maximally exposed individual (MEI) is estimated to be 50 in one million, assuming full implementation of the 2006 LRDP. This risk value compares to 80 in one million under existing LBNL operations. The location of the estimated MEI for the project scenario is just outside the LBNL northern fence line, in a non-residential area near the Lawrence Hall of Science.[14] As under existing conditions, diesel particulate matter would again contribute the vast majority of the risk to the MEI – 94.6 percent compared to 94.5 percent under existing conditions. However, of that 94.6 percent, diesel particulate matter from mobile sources would contribute less than 7.3 percent of the risk in this scenario. This minimal contribution rate is due to assumed reductions in mobile diesel emissions relative to stationary sources, and the fact that a proposed new diesel generator may be installed near the MEI receptor location. Stationary sources, including routine testing of diesel generators and operation of equipment such as forklifts, would contribute more than 87 percent of the lifetime cancer risk at this location. Laboratory chemicals and other stationary source chemical emissions would contribute less than 5 percent of the lifetime risk at this location.

For reasons stated above, the impact of non-radionuclide emissions on off-site receptors is determined to be less than significant.

[13] The three off-site receptors with the greatest increase in risk are just outside the Strawberry Canyon gate to the Lab. Therefore, no residential receptor would experience an increase in lifetime cancer risk in excess of 5 in one million.

[14] For the location just outside the west LBNL boundary, in the vicinity of UC Berkeley's Foothill Student Housing, where the MEI was located under existing conditions, the lifetime cancer risk would also decline from 80 in one million to 50 in one million.

On-Site Receptors

A total of 879 on-site locations were modeled as potential receptors. In comparing both existing and future no-project conditions to future conditions due to implementation of the 2006 LRDP only one receptor, located in the northwest portion of LBNL, near Building 90, resulted in an increase in lifetime cancer risk in excess of 10 in one million, which would result in a significant impact. The increase was 20 in one million. Further investigation revealed that this increase in risk at this location was the result of the interaction between the exhaust flow from an existing emergency (standby) generator and the change in air currents that would result from the construction of a specific building identified in the Illustrative Development Scenario, Parking Structure PS-1 (see Figure III-9 in Chapter III, Project Description.)[15] This, and all other diesel generators greater than 50 horsepower, are permitted by BAAQMD for a certain number of hours of operation for maintenance and testing purposes. This permitted level was the number of hours modeled in the health risk assessment.

Subsequent modeling related to the health risk assessment revealed that the significant risk impact at this on receptor could be avoided by changing the configuration of the exhaust stack from this generator. Because the existing generator exhaust is fitted with a fixed rain cap to prevent precipitation and foreign objects from entering the stack, the free flow of exhaust is obstructed when the generator is in operation. In fact, for modeling purposes, the exit velocity from such stacks was assumed to be essentially zero (i.e., 0.01 meters per second). However, removal of the rain cap or its replacement with a hinged cap, which would allow free upward exhaust flow, would reduce the lifetime cancer risk at the receptor location by a factor of 300 (i.e., from 60 in one million to 0.2 in one million), which would avoid any possibility of an increase—due to the project—exceeding 10 in one million.

None of the other on-site receptors registered an increase in lifetime cancer risk in excess of 10 in one million; the greatest value was 9 in one million (when comparing both existing and future no-project conditions to future conditions with implementation of the 2006 LRDP), and only three receptors (in both comparisons) recorded increases of more than 5 in one million. The maximum on-site lifetime cancer risk for a Laboratory employee was calculated at 60 in one million, somewhat higher than under existing conditions. However, this risk would arise in a very localized area due to change in building downwash effects near the existing generator discussed above, and the risk at the second-highest on-site receptor location would be 40 in one million, similar to the maximum value under existing conditions.

Because of the single location where the lifetime cancer risk would increase by more than 10 in one million, the impact of non-radionuclide emissions on on-site (worker) receptors is determined to be significant. However, implementation of Mitigation Measure AQ-4a, below, would reduce the impact to a less-than-significant level.

[15] As stated in the Project Description, Chapter III, one of the purposes in the Lab developing the Illustrative Development Scenario was to "provide a basis for such quantified or modeled studies as the human health risk assessment and visual simulations."

In reviewing toxic air contaminant issues as measured by the health risk assessment, it is important to note the highly conservative or "overly cautious" nature of the analysis. The health risk assessment is a modeled risk assessment based on assumptions that are very conservative, and ensure that the assessment does not underestimate risk. Those assumptions include the supposition that an individual spends a 70-year lifetime at the modeled locations, and (for off-site resident receptors) that an individual consumes some food, such as homegrown fruits and vegetables, produced at that location. While this type of modeling may overestimate health risk, it is standard accepted practice in health risk assessment and is used here for that reason.

Operation – Cancer Risk from Radionuclide Emissions

Off-Site Receptors

For lifetime cancer risk due to radionuclide emissions after implementation of the 2006 LRDP, the maximum off-site (residential and other locations) lifetime risk from LBNL source emissions for the MEI was estimated to be 0.4 in one million for a "typical" resident, compared to 0.3 in one million under existing conditions. The projected slight increase in risk to the MEI is attributable to several proposed research buildings for the southeastern area of the Laboratory. The close proximity of these new buildings to the facility property line is a main reason behind the slightly higher risk value. It is worth noting that this projected MEI is on UC land around the Botanical Gardens that is unlikely to be developed for residential use during the LRDP period. In fact, there is a slight additional reduction in health risk with implementation of the 2006 LRDP. Moreover, with a maximum risk of 0.4 in one million, there would be no location where the increase in risk due to the project would exceed 10 in one million, and the impact would be less than significant.

For a "self-sufficient" resident (i.e., a person who consumes food produced at home, such as home-grown fruits and vegetables) the lifetime cancer risk from radionuclides under the LRDP at full implementation was calculated at 40 in one million, the same as under existing conditions.

The health risk impact from radionuclide emissions is considered less than significant, for two reasons. First, and most importantly, as described above, the health risk estimated at full implementation of the LRDP is substantially the same as under existing conditions. Further, even though the modeled risk shows an exceedance of the commonly applied 10-in-one-million threshold (under existing conditions as well as under the LRDP at full implementation) for the self-sufficient resident scenario, that self-sufficient resident scenario is, for purposes of CEQA analysis, speculative and not reasonably foreseeable. It assumes a lifetime at the same site, with all consumed fruits and vegetables being home-grown or locally produced. Modeling with those types of assumptions, while standard practice in health risk assessments, does not represent a reasonably foreseeable basis for impact evaluation. Furthermore, the risk to the speculative self-sufficient resident attributable to the LRDP itself, i.e., not including that attributable to existing sources, is far below the 10-in-one-million threshold, given that there is no difference between the risk under existing conditions and at full implementation of the LRDP (including the contribution of existing sources).

On-Site Receptors

For on-site workers, the maximum lifetime cancer risk was 0.3 in one million, also the same as under existing conditions. Thus, implementation of the LRDP would result in an increase in risk of far less than 10 in one million, and the impact would be less than significant.

Operation – Non-Cancer Effects

The highest Hazard Index projected for chronic non-cancer health effects at off-site (residential and other locations) receptors under the LRDP development assumptions was 0.1, compared to 0.2 under existing conditions. The same comparison for on-site receptors estimates the project's highest Hazard Index at 0.2, the same as under existing conditions. Thus, with implementation of the LRDP, both off-site and on-site hazard indices due to chronic exposure would be well below the 1.0 Hazard Index that is considered an acceptable non-cancer health effects at all receptor locations, and the effect would be less than significant.

Construction/Demolition

Dispersion modeling based on estimated diesel particulate emissions from construction and demolition activities anticipated as part of the proposed LRDP resulted in maximum annual average ambient concentrations of 0.14 micrograms per cubic meter for off-site receptors and 0.45 micrograms per cubic meter for on-site receptors. These concentrations, along with exposure assumptions applicable to the nature and duration of the construction/demolition activities, provide estimates of maximum cancer risk of 20 in one million for off-site receptors and 10 in one million for on-site receptors. The only off-site receptor locations that would exceed the 10 in one million significance standard are right on the LBNL property boundary next to a potential demolition/construction project conceptually portrayed in the Illustrative Development Scenario and therefore factored into the health risk assessment. There are no residences currently existing at or near this location. In addition, the risk actually associated with the LRDP is less than 10 in one million. Therefore, with no active receptor at the location of greatest off-site risk, the effect would be less than significant.

Corresponding maximum chronic non-cancer hazard indices were less than 0.1 for off-site receptors and 0.1 for on-site receptors. Both hazard indices would be well below the 1.0 Hazard Index that is considered an acceptable non-cancer health effect. Therefore, the effect would be less than significant.

Conclusions

The results of the human health risk assessment indicate that cancer risk and non-cancer hazard for off-site receptors, including residential receptors, resulting from air emissions from LBNL emission sources would not be significant relative to generally accepted regulatory thresholds. The majority of the risk and hazard are, and will continue to be, due to emissions of diesel particulate matter, which is a ubiquitous pollutant in the Berkeley and greater Bay Area. Furthermore, LBNL has already taken steps to help reduce diesel particulate emissions from the Laboratory, including use of a bio-diesel fuel in diesel combustion sources (mobile and stationary) and the addition of control devices (i.e., catalytic oxidation units, diesel particulate

filers) on new emergency back-up electrical generators, both of which reduce emissions of diesel particulate matter and other toxic pollutants. Further, the area subject to the modeled exceedance of health risk will decrease substantially in the future, and this decrease will occur with or without the project. For on-site (worker) receptors, one location was identified where the increase in lifetime cancer risk would exceed the 10-in-one-million threshold, resulting in a significant impact. Implementation of Mitigation Measure AQ-4a, below, would reduce the impact to a less-than-significant level. The impact of non-cancer hazard to on-site receptors would be less than significant.

> **Mitigation Measure AQ-4a:** To avoid the single location where implementation of the 2006 LRDP would result in an increase in health risk in excess of the 10-in-one-million threshold, LBNL shall adjust, prior to the construction of parking structure PS-1 (or similarly configured building), the exhaust system of the existing generator near Building 90 to reduce or eliminate the restriction on upward exhaust flow caused by the existing rain cap. For example, modeling indicates that removal of the rain cap would reduce the risk caused by construction of parking structure PS-1 in proximity to the existing generator to a level below 10 in one million. The Lab could install a hinged rain cap, which would prevent moisture infiltration into the generator but still allow unobstructed exhaust flow and would avoid the significant impact identified in the health risk assessment.
>
> **Significance after Mitigation:** Less than significant.

Project Variant. The project variant would add about nine percent more LBNL traffic to the streets of Berkeley, assuming that all 350 of the employees shifted from the downtown facility to the Lab hill site would drive. Because the variant would not substantially change the layout of development or the nature of uses of facilities on the Lab hill site, it would not be expected to substantially alter the conclusions of the health risk assessment presented above.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. The scenario is intended to provide a conservative basis for the analysis of environmental impacts, and the scenario was the basis for the modeling used in the health risk assessment. Actual overall development that is approved and constructed pursuant to the 2006 LRDP will be less intense than portrayed in the scenario. The scenario was developed before the proposed 2006 LRDP was reduced and scoped in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Given the standard practice of using conservative assumptions in evaluating health risk, however, the scenario remains an appropriate and conservative basis for evaluating the potential air quality impacts and human health risks of the proposed 2006 LRDP. Given that the scenario is an overall assessment of development, any potential individual project under the LRDP such as those included in the Illustrative Development Scenario would generate risks from exposure of people to toxic air contaminants lower than those associated with implementation of the 2006 LRDP, and this impact would therefore, similar to the impact from implementation of the 2006 LRDP, be less than significant, with implementation of Mitigation Measure AQ-4a, as described above.

IV.B.3.5 Cumulative Impacts

This analysis considers cumulative growth as represented by the implementation of the Berkeley and Oakland general plans (and thus includes growth anticipated by the City of Berkeley General Plan EIR), and implementation of the UC Berkeley 2020 LRDP (including the Southeast Campus Integrated Projects) along with implementation of the proposed LBNL 2006 LRDP. (Demolition of the Building 51 complex – housing the Bevatron accelerator – although the subject of a separate project-specific EIR, is analyzed as part of the 2006 LRDP because the buildings were in place when the EIR analyses were undertaken.) Additional projects currently underway at UC Berkeley, described in Section VI.C, Cumulative Impacts, of this EIR, are also accounted for in the cumulative analysis.

The geographic context for this cumulative analysis is the Bay Area Air Basin. This analysis evaluates whether the impacts of the proposed LRDP, together with the impacts of cumulative development, would result in a significant impact (based on the significance criteria on p. IV.B-24) and, if so, whether the contribution of the LRDP to this impact would be considerable. Both conditions must apply in order for the project's cumulative impacts to rise to the level of significance.

Impact AQ-5: The project, together with anticipated future cumulative development in Berkeley and the Bay Area in general, would contribute to regional increases in criteria air pollutants. (Less than Significant)

As discussed under Impact AQ-2, the 2006 LRDP would be consistent with the *Bay Area 2005 Ozone Strategy* because it would not result in employment in excess of the *2005 Ozone Strategy's* projections and would not result in a VMT percentage increase greater than the percentage increase in Laboratory employment; the LRDP would implement transportation control measures identified in the *2005 Ozone Strategy*; and the LRDP would provide appropriate buffer zones around sources of odors and toxics. Further, the emissions of criteria pollutant emissions from the implementation of the entire LRDP would be less than the BAAQMD recommended significance thresholds for individual projects.

Stationary, mobile and area sources associated with the development of the Lab's hill site, together with similar sources associated with growth at UC Berkeley[16] and in the cities of Berkeley and Oakland, and regional growth throughout the Bay Area air basin, would contribute to emissions of criteria pollutants for which the region is in nonattainment status and could hinder attainment efforts. As discussed under Impact AQ-2, however, the LRDP would not directly result in any increase in population to the region and the increased employment generated under the LRDP would be consistent with the job growth on which the *2005 Ozone Strategy* forecasts were based. Therefore, while cumulative emissions from regional growth might result in a significant impact on air quality, the proposed project's contribution to this cumulative impact would not be "cumulatively considerable." Therefore, development pursuant to the LRDP would

16 The Draft EIR for the UC Berkeley Southeast Campus Integrated Projects (SCIP) found that those projects would not result in any adverse impacts related to hazards or hazardous materials, and thus the SCIP would not contribute to any cumulative impacts (UC Berkeley, 2006).

not contribute considerably to cumulative increases in criteria air pollutants, and the cumulative effect would be less than significant.

Mitigation: None required.

Project Variant. The project variant's contribution to regional increases in criteria air pollutants would be substantially similar to the contribution to regional increases in criteria air pollutants from the 2006 LRDP development. Thus, development pursuant to the project variant would not contribute considerably to cumulative increases in criteria air pollutants, and the cumulative effect would be less than significant.

Individual Future Project/Illustrative Development Scenario. A future project identified in the Illustrative Development Scenario, when combined with other projects under the LRDP and other development, would also, for the reasons stated above, result in cumulative impacts related to increases in criteria air pollutants that would be less than significant.

Impact AQ-6: Even though cumulative emissions of toxic air contaminants would decrease, implementation of the LBNL 2006 LRDP, in combination with other potential contributing projects, would contribute to cumulative emissions of toxic air contaminants that result in an excess cancer risk that exceeds, and would continue to exceed, 10 in one million. (Significant and Unavoidable)

The following discussion of cumulative emissions of toxic air contaminants evaluates this cumulative impact both in terms of regional exposure levels as determined by state and local air quality agencies, and also by considering the combination of development pursuant to the LRDP with other development proposed in the vicinity.

First, the other major project in the vicinity of LBNL identified for this cumulative analysis was the nearby UC Berkeley 2020 LRDP, and the development anticipated as a result of implementation of that plan. The LBNL risk assessment included the receptor locations of the top two UC Berkeley residential Maximally Exposed Individuals (MEIs) and the on-campus "sensitive receptor" MEI. (The top two MEIs were located on the northwest border of the UC Berkeley campus along Hearst Avenue several blocks west of LBNL. The on-campus sensitive receptor MEI was located at the Girton Hall Day Care Center.) These receptors were included in the LBNL risk assessment so that LBNL contribution to total potential maximum risk could be specifically added. UC Berkeley results at LBNL's MEI location were also considered in this cumulative analysis.

UC Berkeley incorporated results of the health risk assessment (discussed in Impact AQ-4) into a separate health risk assessment performed for the UC Berkeley 2020 LRDP to evaluate cumulative impacts of development pursuant to both LRDPs together, along with other relevant cumulative development in the vicinity. The results of the two health risk assessments overlaid upon one another indicate that, in a small area of maximum overlap, roughly north of Ridge

Road, east of La Loma Avenue and south of Buena Vista Way in Berkeley, estimates show that the existing cumulative cancer risks from both facilities currently exceeds ten in one million lifetime cancer risk, up to a maximum of approximately 17 in a million at limited locations. Future emissions from the facilities under their respective LRDPs would potentially extend the area exceeding a ten in one million lifetime cancer risk slightly to roughly north of Hearst Avenue, east of LeRoy Avenue and south of Codornices Park up to a maximum of approximately 22 in one million at limited sites. Therefore, the cumulative risk due to toxic air contaminant emissions from stationary and area sources under the LBNL 2004 LRDP and the UC Berkeley 2020 LRDP would be significant. The primary source of this risk is diesel particulate matter, and the assumptions used in this calculation are conservative: it is possible that implementation of the two LRDPs could help reduce this risk, as projects to replace and renovate existing facilities include replacement of existing diesel emitters. Furthermore, as discussed in the Setting and in Impact AQ-4, diesel particulate emissions will be reduced substantially in the future with implementation of new regulations and new technology. Although overall air quality health risks will decrease over time, the incremental effects of the existing and anticipated projects under the 2006 LRDP currently contribute, and will continue to contribute, to an exceedance of the modeled health risk in certain areas. Accordingly, even though the health risk assessment shows that health risk will decrease over time, and also shows that implementation of the 2006 LRDP slightly decreases health risk, the Lab has determined a conservative approach is appropriate and characterized this impact, on a cumulative basis only, as significant and unavoidable, because there are some emissions, primarily diesel particulates, related to Lab operations and implementation of the 2006 LRDP, which contribute to the existing and future exceedance.

Second, in terms of regional exposure levels, as described in the Setting section, the BAAQMD reported, based on 2002 data, an average Bay Area lifetime cancer risk from toxic air contaminants, *excluding* diesel particulate matter, of 162 in one million, or 46 percent less than the risk in 1995. The state Air Resources Board (CARB) put the Bay Area lifetime cancer risk from toxic air contaminants, again excluding diesel particulate, at 111 in one million in 2004. CARB also reported that the lifetime cancer risk from diesel particulate in the Bay Area was about 480 in one million, as of 2000, according to CARB, down from 750 in one million in 1990 and 570 in one million in 1995.

As described in Impact AQ-4, implementation of the proposed 2006 LRDP would not result in a project-specific increase in lifetime cancer risk at off-site receptors in excess of 10 in one million, and this impact would be less than significant. (One on-site receptor would sustain increased cancer risk of greater than 10 in one million, but this significant impact was found to be mitigated with implementation of Mitigation Measure AQ-4a.) Nevertheless, the lifetime cancer risk from exposure to emissions from Berkeley Lab at full implementation of the LRDP, including the contributions from existing sources and including emissions from mobile sources such as shuttle buses, would continue to exceed 10 in one million (as noted, the maximum total risk, for the Maximally Exposed Individual, would be approximately 50 in one million), even though there would be no incremental project-related increases in excess of that threshold. Although the Lab's contribution to total lifetime cancer risk at any location would be relatively small, compared to

the average risk of 480 in one million throughout the Bay Area, this EIR considers the contribution to be considerable, and therefore the cumulative impact would be significant.

Mitigation: Because most of the cancer risk from TACs is due to diesel particulate, measures to reduce the risk (beyond regulations already in place that will substantially reduce diesel particulate emissions in the next 20 years) would include those measures that could reduce vehicular travel to and from Berkeley Lab. Implementation of Mitigation Measure TRANS-1c, development and implementation of a new Transportation Demand Management Program (see Section IV.L, Transportation/Traffic), would result in a concomitant decrease in vehicular emissions, including those of TACs. However, even with implementation of this measure, Berkeley Lab, as a major employer and thus a substantial source of vehicular traffic, would likely continue to contribute to Bay Area-wide emissions of TACs for the foreseeable future.

Project Variant. The project variant's contribution to cumulative emissions of toxic air contaminants would be substantially similar to the contribution to cumulative emissions of toxic air contaminants from the 2006 LRDP development. Thus, cumulative impacts related to emissions of toxic air contaminants from development pursuant to the project variant would be characterized, on a cumulative basis only, as significant and unavoidable for the reasons stated above.

Individual Future Project/Illustrative Development Scenario. A future project identified in the Illustrative Development Scenario, when combined with other projects under the LRDP and other development, would also, for the reasons stated above, result in cumulative impacts related to emissions of toxic air contaminants that would be significant and unavoidable.

IV.B.4 References – Air Quality

Bay Area Air Quality Management District (BAAQMD), Association of Bay Area Governments, and Metropolitan Transportation Commission, *Bay Area 2005 Ozone Strategy*, adopted January 4, 2006. Website: http://www.baaqmd.gov/pln/plans/ozone/2005_strategy/index.htm. Viewed March 31, 2006.

Bay Area Air Quality Management District (BAAQMD), Ambient Air Quality Standards and Bay Area Attainment Status, 2005. Bay Area Air Quality Management District, updated July 14, 2005. Website: http://www.baaqmd.gov/pln/air_quality/ambient_air_quality.htm. (Viewed March 31, 2006.) 2005.

Bay Area Air Quality Management District (BAAQMD), Toxic Air Contaminant Control Program Annual Report: 2002. Bay Area Air Quality Management District, June 2004.

Bay Area Air Quality Management District (BAAQMD), Association of Bay Area Governments, and Metropolitan Transportation Commission, *Revised San Francisco Bay Area Ozone Attainment Plan for the 1-Hour National Ozone Standard*, adopted October 24, 2001. Website: http://www.baaqmd.gov/pln/plans/ozone/2001/oap_2001.pdf. Viewed September 23, 2006

Bay Area Air Quality Management District (BAAQMD), *BAAQMD CEQA Guidelines – Assessing the Air Quality Impacts of Projects and Plans*, December 1999.

California Air Resources Board, 2006 California Almanac of Emissions and Air Quality. Appendix C: Emissions, Air Quality, and Health Risk for Ten Toxic Air Contaminants. Website: http://www.arb.ca.gov/aqd/almanac/almanac06/almanac06.htm. Viewed May 24, 2006.

California Air Resources Board, 2005 Almanac Emissions Projection Data. Available at: http://www.arb.ca.gov/app/emsinv/emssumcat.php. Viewed February 8, 2005a.

California Air Resources Board, 2005 California Almanac of Emissions and Air Quality. Appendix C: Emissions, Air Quality, and Health Risk for Ten Toxic Air Contaminants. Website: http://www.arb.ca.gov/aqd/almanac/almanac05/pdf/appc05.pdf. Viewed February 8, 2005b.

EPA (Environmental Protection Agency), "National Air Toxics Assessment; Glossary of Terms." Available on the internet at http://www.epa.gov/ttn/atw/nata/gloss1.html. (Viewed October 5, 2006.)

Golder Associates, Site-wide Air Quality Human Health Risk Assessment Component of Environmental Impact Report for Lawrence Berkeley National Laboratory Long Range Development Plan, Volume I and II. January 2007.

National Cancer Institute, Surveillance, Epidemiology, and End Results (SEER) Cancer Statistics Review, 1975-2001, Table I-15: Lifetime Risk (Percent) of Being Diagnosed with Cancer by Site, Race and Sex, 12 SEER Areas, 1999-2001." Available on the internet at http://seer.cancer.gov/csr/1975_2001/results_single/sect_01_table.15.pdf. (Viewed May 13, 2005.) 2004.

UC (University of California) Berkeley, *Southeast Campus Integrated Projects Tiered Focused Final Environmental Impact Report (SCH #2005112056)*, October 31, 2006. Available on the internet at http://www.cp.berkeley.edu/SCIP/FEIR/SCIP_FEIR.html.

UC Berkeley, *2020 Long Range Development Plan & Chang-Lin Tien Center for East Asian Studies Final Environmental Impact Report*, sponsored by University of California, Berkeley, prepared by Design, Community & Environment, January 2005. Available on the internet at http://www.cp.berkeley.edu/LRDP_2020.htm. (Viewed September 24, 2006.)

IV.C. Biological Resources

IV.C.1 Introduction

This section discusses existing biological resources at the LBNL hill site and analyzes the potential for implementation of the 2006 LRDP to affect those resources. Biological resources of off-hill Lab-leased sites are not discussed here as they generally take place in fully urbanized areas of Berkeley, Oakland, and Walnut Creek. Information presented in the discussion and subsequent analysis was drawn from site visits (ESA, 2002a-c; ESA, 2003a-c); biological data presented in the California Department of Fish and Game's (CDFG) Natural Diversity Database (CNDDB)[1] and the California Native Plant Society's (CNPS) *Electronic Inventory of Rare and Endangered Vascular Plants of California*; an official species list for the project area from the U.S. Fish and Wildlife Service (USFWS, 2005a); standard biological references (Hickman, 1993; Zeiner et al., 1990; and Stebbins, 1985); LBNL's 1987 LRDP and its associated environmental impact reports; as well as surveys and environmental documents associated with specific LBNL projects. This EIR identifies potential effects of the proposed project on sensitive species and habitats and proposes mitigation measures to reduce those impacts to less-than-significant levels.

IV.C.2 Setting

LBNL is situated on the lower slopes of the Oakland-Berkeley hills and contains a mix of institutional development and open space. The site is located in the San Francisco Bay Area, which is characterized by a Mediterranean climate with moderately warm, dry summers and mild, wet winters. The steep topography of the site is a result of uplift along the Hayward fault. Slopes are dissected by a number of streams.

With two exceptions, drainages at LBNL are ephemeral or intermittent. One stream at LBNL is perennial, maintaining some water flow throughout the year: the North Fork of Strawberry Creek in the lower reaches of Blackberry Canyon (the "North Fork"). In addition, a tributary to the South Fork of Strawberry Creek in the lower reaches of the former Poultry Husbandry Area (and therefore known as Chicken Creek)[2] has been determined during different expert investigations to be either intermittent or perennial; for the purposes of this analysis, this drainage will be assumed to be perennial.[3] These drainages have been culverted through the developed areas of LBNL, and much of the site's drainage has been routed through a stormwater sewer system to the North Fork. Among other components, this stormwater sewer system involves a series of "hydraugers," which are generally horizontal drain pipes inserted into the hillside to draw off groundwater, some of

1 The CNDDB is a computer database of information on the location and distribution of animals and plants that are rare, threatened, endangered, or candidate species, or habitat considered to be of high quality or of limited distribution.

2 In a typical year, an ephemeral stream has flowing water only during and for a short duration after rainfall. Runoff from rainfall is the primary source of water for stream flow, and groundwater is not a source of water for the stream. An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow. A perennial stream has flowing water year-round during a typical year. Groundwater is the primary source and runoff from rainfall is a supplemental source of water for stream flow (Corps, 2002).

3 ESA, 2003c.

which otherwise would eventually reach the natural drainage channels. The remainder of site drainage is routed to tributaries that flow to the South Fork of Strawberry Creek.

The hills surrounding LBNL contain low-to moderate-density residential neighborhoods mixed with open space containing a mosaic of vegetation types and wildlife habitats, including oak and mixed hardwood forests, native and non-native grasslands, chaparral, coastal scrub, marsh and wetland communities, and riparian scrubs and forests. Developed areas of the LBNL hill site have been landscaped with a mix of non-native horticultural species and, more recently, California native plants and other drought-tolerant species suitable for landscaping purposes. Open space at LBNL is dominated by annual grassland, with eucalyptus and conifer stands planted throughout the site. Undeveloped areas along the eastern and southern perimeters of the site support a mosaic of coastal scrub and grassland. Woodlands dominated by oak and bay occur along most drainages at LBNL. Open space vegetation on the site is managed on an annual basis, either by goats or mechanical means, according to the guidelines set forth in LBNL's *Maintenance Vision for a Fire-Safe Sustainable Landscape* (LBNL, 2001).

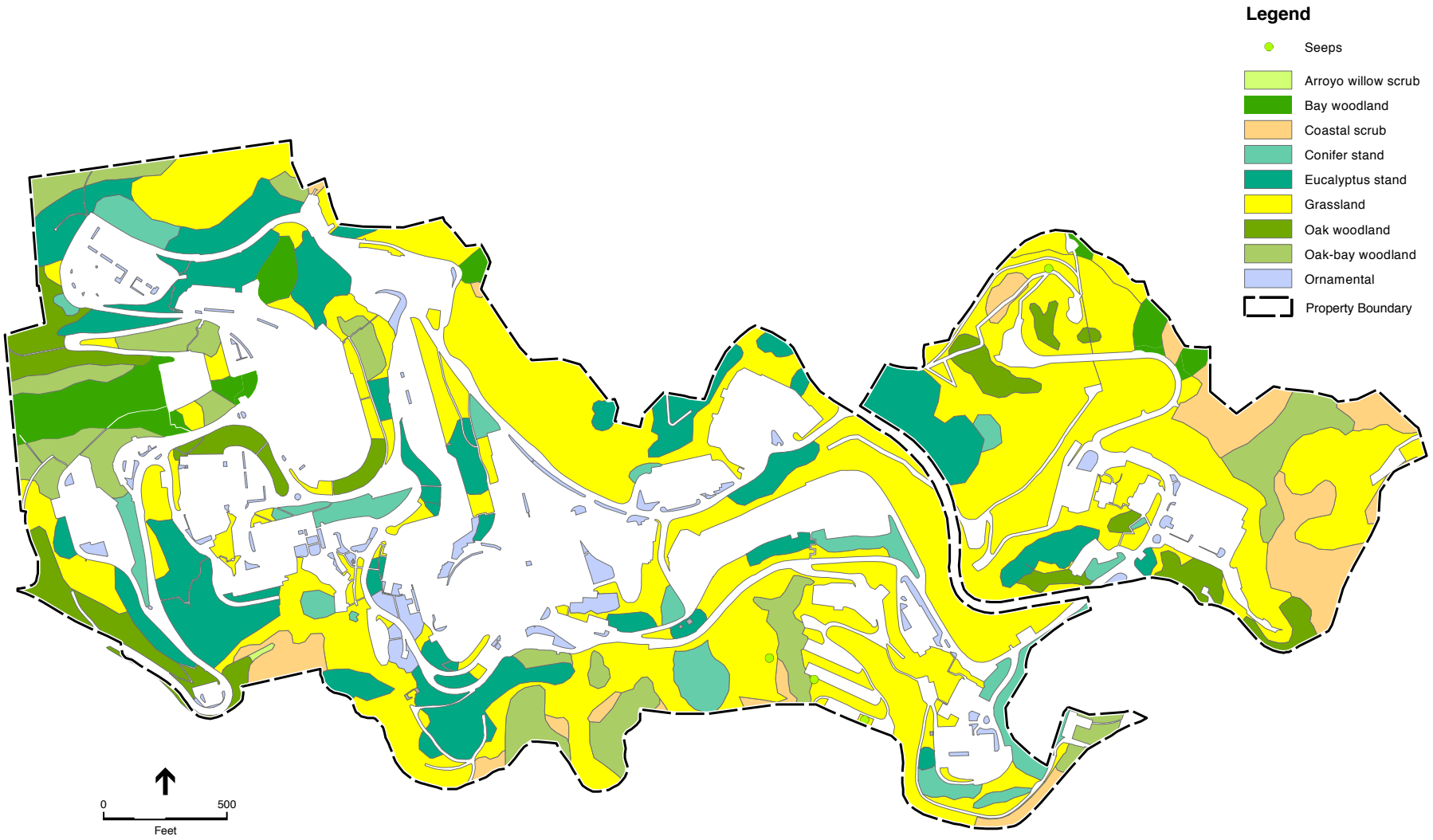
Wildlife observed in the more developed areas at LBNL during field surveys (ESA, 2002a-c; ESA, 2003a-c) includes common species tolerant of human presence such as California mule deer (*Odocoileus hemionus*), California towhee (*Pipilo crissalis*), chestnut-backed chickadee (*Poecile rufescens*), western scrub jay (*Aphelocoma californica*), and Anna's hummingbird (*Calypte anna*). Wildlife common in undeveloped areas throughout the East Bay hills has also been observed in riparian and coastal scrub habitat at LBNL, including northern flicker (*Colaptes auratus*), wrentit (*Chamaea fasciata*), song sparrow (*Melospiza melodia*), ruby-crowned kinglet (*Regulus calendula*), and golden-crowned sparrow (*Zonotrichia atricapilla*).

IV.C.2.1 Plant Communities and Wildlife Habitat

Vegetation communities are assemblages of plant species that occur together in the same area and are defined by species composition and relative abundance. The vegetation/habitat classification system for this project is based on Holland (1986) and influenced by the classification system of Sawyer and Keeler-Wolf (1995). Vegetation communities generally correlate with wildlife habitat types. Wildlife habitats were classified and evaluated using the CDFG's *A Guide to Wildlife Habitats of California* (Mayer and Laudenslayer, 1988). For each description below the name of the vegetation type is given first. When there is a correlated habitat type whose name differs from that of the vegetation type, this name follows. Please see Figure IV.C-1 for the locations of the various plant communities that occur throughout the LBNL site.

Grasslands

Grasslands make up approximately 67 acres on the LBNL site. Two grassland types occur on the LBNL site: annual grassland and mixed grassland. Historical land use practices have resulted in the replacement of much of the area's native perennial grasslands with non-native annual grasslands, scrub communities, and stands of non-native trees. Highly disturbed areas of the project site support non-native annual grassland, whereas areas subject to less disturbance support



SOURCE: LBNL; ESA (2003)

LBNL 2006 Long Range Development Plan . 201074

Figure IV.C-1
Vegetation at LBNL

a mixed grassland consisting of both annual non-natives and remnant native species. In addition, it appears that relatively recent plantings in some areas of the site feature native bunchgrasses.

Annual Grassland

Annual grassland, the dominant vegetation type on the LBNL site, is located primarily on the slopes between Centennial Drive and the developed portions of the site, on the south -facing slopes below Lawrence Road, and north of the Strawberry Canyon Gate. This vegetation type occurs as both an open grassland and as an understory in relatively open eucalyptus and pine stands. Dominant species include non-native annual grasses and other ruderal species, including wild oat (*Avena sativa*), ripgut brome (*Bromus diandrus*), Italian rye-grass (*Lolium multiflorum*), black mustard (*Brassica nigra*), rough cats-ear (*Hypochaeris radicata*), bristly ox-tongue (*Picris echioides*), cut-leaved geranium (*Geranium dissectum*), and Italian thistle (*Carduus pycnocephalus*).

Mixed Grassland

Mixed grassland appears on-site in small patches. This vegetation type is generally restricted to the steepest slopes where soils are not well-developed. Mixed grassland is found on road cuts along Cyclotron Road, in and around rock outcrops, and around the edges of coastal scrub stands. This vegetation type includes a mix of non-native annual and native perennial grasses and herbaceous species, including purple needlegrass (*Nasella pulchra*), blue wild-rye (*Elymus glaucus*), mugwort (*Artemisia douglasiana*), cudweed (*Gnaphalium* sp.), yarrow (*Achillea millefolium*), Pacific sanicle (*Sanicula crassicaulis*), and hedge nettle (*Stachys ajugoides* ssp. *ajugoides*).

Grasslands in the project area may provide habitat for reptiles and amphibians, such as western fence lizard (*Sceloporus occidentalis*), northern alligator lizard (*Elgaria coerulea*), and California slender salamander (*Batrachoseps attenuatus*), as well as birds, including mourning dove (*Zenaida macroura*) and golden-crowned sparrow. Mammals such as Botta's pocket gopher (*Thomomys bottae*), California ground squirrel (*Spermophilus beecheyi*), and striped skunk (*Mephitis mephitis*) may browse and forage within the grassland, and thrive when varied natural habitats are available nearby. Small rodents attract raptors including red-tailed hawk (*Buteo jamaicensis*).

Coastal Scrub

There are approximately 8.5 acres of coastal scrub on the project site. Coastal scrub is a highly variable plant community and occurs at LBNL in two basic forms: California sagebrush scrub and coyote brush scrub.

California Sagebrush Scrub

This vegetation type makes up only a small proportion of the vegetative cover at LBNL and occurs primarily on thin soils and rock outcrops on south-facing slopes. The dominant shrub is California sagebrush (*Artemisia californica*), with sticky monkeyflower (*Diplacus aurantiacus*) and coyote brush sometimes occurring as subdominants. The understory can include mugwort

and coyote mint (*Monardella villosa* ssp. *villosa*), with native perennial grasses such as purple needlegrass occurring in openings in the overstory.

Coyote Brush Scrub

In the Berkeley-Oakland hills, coastal scrub, especially coyote brush scrub, is often the successional phase between grassland and oak woodland. Disturbance sets this phase back to grasslands, and lack of disturbance generally promotes the establishment of oak woodlands and eventually a mixed oak-bay or bay forest (McBride, 1974). Coyote brush stands at LBNL are generally mature, with a nearly closed canopy and very little if any understory. Where an understory does occur it includes, among other species, California honeysuckle (*Lonicera hispidula* var. *vacillans*), bedstraw (*Galium* sp.), and hedge nettle (*Stachys ajugoides* ssp. *ajugoides*).

In moister spots, such as the drainages just to the south of Blackberry Canyon Gate, California blackberry (*Rubus ursinus*) can occur as a codominant with coyote brush (*Baccharis pilularis*), with elderberry (*Sambucus mexicana*), toyon (*Heteromeles arbutifolia*), ocean spray (*Holodiscus discolor*), and coast live oak occurring as widely scattered associates.

Coastal scrub provides nesting and foraging habitat for various birds, including spotted towhee (*Pipilo maculatus*), California towhee, common bushtit (*Psaltriparus minimus*), western scrub jay, and California quail (*Callipepla californica*). Raptors, including Cooper's hawk (*Accipiter* cooperii) and sharp-shinned hawk (*Accipiter striatus*), may forage over such areas and prey on some of these small birds as well as on small mammals and reptiles such as California ground squirrel, brush rabbit (*Sylvilagus bachmani*), and western fence lizard.

Arroyo Willow Riparian Scrub / Riparian Scrub

A small stand of arroyo willow riparian scrub, approximately 0.06 acre in size, is found along the drainage just south of Blackberry Canyon Gate. This area is dominated almost exclusively by arroyo willow (*Salix lasiolepis*), with California blackberry also occurring.

Riparian scrub and surrounding woodlands may support reptiles and amphibians such as western toad *(Bufo boreas)*, California newt (*Taricha torosa*), Pacific treefrog (*Hyla regilla*), and California slender salamander, which feed on plants as well as terrestrial and aquatic invertebrates. Resident and migratory birds often found in willow scrub include song sparrow, spotted towhee, yellow-rumped warbler *(Dendroica coronata)*, and Wilson's warbler (*Wilsonia pusilla*). Scrub jays and black phoebe (*Sayornis nigricans*) commonly forage extensively in riparian habitats. Mammals such as western harvest mouse *(Reithrodontomys megalotis)*, opossum *(Didelphis virginiana)*, and raccoon (*Procyon lotor*) also utilize riparian habitats for nesting and foraging.

Coast Live Oak Woodland

There are approximately nine acres of coast live oak woodland on the LBNL site. This vegetation type ranges in cover from sparse to dense canopy, with oak the only tree species present. Where oaks are widely spaced, annual or mixed grasslands occur in the understory. Where canopy is

dense, primarily in the drainages on the site, understory associates include California blackberry, California honeysuckle, and rush (*Juncus* sp.). In general, oak woodland communities can support an abundant assortment of common reptiles, amphibians, and small mammals such as western skink *(Eumeces skiltonianus)*, Pacific treefrog, northern alligator lizard (*Elgaria coerulea)*, gopher snake (*Pituophis melanoleucus)*, arboreal salamander (*Aneides lugubris*), and deer mouse *(Peromyscus maniculatus).* Resident and migratory bird species found in oak woodlands include spotted towhee, brown creeper (*Certhia americana*), oak titmouse *(Parus inornatus)*, Hutton's vireo *(Vireo huttoni)*, western scrub jay, northern flicker, dark-eyed junco *(Junco hyemalis)*, downy woodpecker *(Picoides pubescens)*, and orange-crowned warbler *(Vermivora celata)*. Raptors that breed and nest in local woodland communities include red-tailed hawk (*Buteo jamaicensis*), sharp-shinned hawk *(Accipiter striatus)*, Cooper's hawk *(Accipiter cooperii)*, and others. Oak woodland can also provide breeding and roosting habitat for bats, including fringed myotis (*Myotis thysanodes*) and long-eared myotis (*Myotis evotis*).

California Bay Woodland

California bay woodlands dominate many of the drainages at LBNL, most notably in Blackberry Canyon. This vegetation type covers approximately 5.5 acres and is dominated by California bay, with coast live oak and big-leaf maple (*Acer macrophyllum*) occurring occasionally. Understory species are often absent where the tree canopy is most dense; when they do occur, in more open stands, understory species can include fairy bells (*Disporum hookeri*), coastal wood fern (*Dryopteris arguta*), California honeysuckle, Stebbin's grass (*Erharta erecta*), and hedge nettle.

California bay woodlands provide habitat for slender salamanders and varied thrush (*Ixoreus naevius*), and potential nesting habitat for American robin (*Turdus migratorius*), western scrub jay, and Steller's jay (*Cyanocitta stelleri*). Other species that may use this woodland type include California black-tailed deer, raccoon, and opossum.

Oak-Bay Woodland

This vegetation type, covering approximately 12 acres at LBNL, is similar to the two preceding types but is dominated by a mix of coast live oak and California bay. Understory is variable according to canopy density, and the composition of the wildlife community expected in oak-bay woodland is similar to that for the woodlands dominated by a single species, as described above.

Eucalyptus Stands

Non-native eucalyptus stands make up approximately 22 acres of the vegetative cover at LBNL. Mature blue gum eucalyptus (*Eucalyptus globulus*) is generally the only species in the overstory canopy. Beginning in the late 1800s, this species was widely planted throughout the Oakland-Berkeley hills. Understory vegetation is typically sparse and consists primarily of non-native weedy species, including Italian thistle (*Carduus pycnocephalus*), bristly ox-tongue (*Picris echiodes*), and a variety of grasses, including wild oat (*Avena* sp.) and zorro grass (*Vulpia myuros*). Occasionally, where the eucalyptus overstory is widely spaced, shrubs such as coyote brush can be found in the understory.

Mature eucalyptus groves provide nesting habitat for a number of raptors, including red-tailed hawks, red-shouldered hawks (*Buteo lineatus*), and great horned owls (*Bubo virginianus*). Eucalyptus may also provide roosting and nursery sites for several bat species, including fringed myotis and long-eared myotis.

Conifer Stands

Conifer stands consisting of tree species that are not native to the Oakland-Berkeley hills occur throughout LBNL and cover approximately seven acres of the vegetation. These stands are often made up of a single species, are generally even-aged, consist of mature trees, and have a relatively open canopy. Conifer species found at LBNL include coast redwood (*Sequoia sempervirens*), Monterey pine (*Pinus radiata*), Torrey pine (*Pinus torreyana*), and Canary Island pine (*Pinus canariensis*). The understory in conifer stands is most often made up of non-native grasses and can be sparse where thick layers of duff have formed. As is the case with eucalyptus stands, nesting raptors may make use of mature trees. Pines with cavities and dead trees may provide nesting habitat for American kestrel and woodpeckers, and roosting and nursery sites for bats.

Freshwater Seep / Fresh Emergent Wetland

At least four freshwater seeps occur at LBNL (ESA, 2003b and 2003c). One of these is located in a drainage at the eastern perimeter near the new water tower. This seep had standing water in late October 2003, when the continuing drainage below was dry, and supports seep monkeyflower (*Mimulus guttatus*), nutsedge (*Cyperus eragrostis*), and willow herb (*Epilobium ciliatum*). Another seep occurs in the Poultry Husbandry Area, apparently created by the installation of a hydrauger to drain the hillside just upslope. Surface flow from the hydrauger supplies the seep with a fair amount of water. This flow appears to continue downslope, probably subsurface, as there is a stand of willow scrub just beyond the fenceline. The seep appears to have been in existence for quite some time, due to the fact that it supports several mature willows. Other vegetation near this seep includes cattail (*Typha latifolia*) and watercress (*Rorippa nasturtium-aquaticum*). Two other seeps occur along the slopes to the west of the Poultry Husbandry area, one on either side of Chicken Creek. Both of these are dominated almost exclusively by a single unidentified sedge, with California blackberry and poison oak contributing a very small amount of total cover. These seeps had moist, but not saturated, soils at the time of observation (ESA, 2003c).

Seep habitat with perennial water can provide an important source of water for animals during the dry season, including amphibians such as slender salamander and Pacific treefrog, California mule deer, raccoon, and a wide variety of birds.

Aquatic Habitat

Most of the drainages at LBNL are ephemeral and only provide aquatic habitat for a limited time during and shortly after rainfall events. Aquatic habitat in these drainages is further limited in value due to the small size of the drainages, the lack of habitat diversity, the absence of perennial stream-flow, and the lack of direct connection to larger waters capable of supporting fish and

amphibians. These drainages may provide some instream habitat for aquatic invertebrates. However, it is highly improbable that fish are present in these drainages, and the general lack of instream vegetation makes it highly unlikely that amphibians would use these streams for breeding purposes. The North Fork of Strawberry Creek and Chicken Creek have, for most of their lengths through LBNL, been filled and culverted. These perennial streams receive stormwater runoff from the developed areas of LBNL, as well as groundwater. While there is perennial flow in these streams, the gradient is high and little instream vegetation is present. In the aboveground portions of these creeks, the beds are scoured to bedrock in places, as is the case with the North Fork, or have been hardened in places, as is the case with Chicken Creek. Due to culverting and hardening, these streams are no longer directly hydrologically connected to Strawberry Creek and, in addition, currently receive greater peak flows than they would naturally due to development in their watersheds. These factors combine to provide poor habitat for most aquatic organisms. The North Fork supports aquatic macroinvertebrates, but in lower numbers and diversity than in the upper reaches of the South Fork of Strawberry Creek (Charbonneau, 1987). Chicken Creek likely supports limited numbers of aquatic macroinvertebrates as well. However, neither of these streams appears to possess the characteristics necessary to support fish or breeding populations of amphibians.

Landscaped Areas

Landscaped areas throughout LBNL are primarily confined to areas adjacent to buildings. Plants in these areas are often common horticultural species. Landscaping installed since the 1987 LRDP generally consists of drought-tolerant species, including a mix of non-native and native plants. Landscaped areas can provide foraging and nesting habitat for a variety of bird species, especially those that are tolerant of disturbance and human presence. Birds commonly found in such areas include the non-native English sparrow (*Passer domesticus*), house finch (*Carpodacus mexicanus*), dark-eyed junco (*Junco hyemalis*), and Anna's hummingbird. Reptiles using this type of habitat may include garter snake (*Thamnophis* sp.) and western fence lizard.

IV.C.2.2 Special-Status Species

For the purposes of this EIR, the term "special-status species" includes species that are listed and receive specific protection defined in federal or state endangered species legislation, as well as species not formally listed as threatened or endangered but designated as species "of concern," or as "rare" or "sensitive" on the basis of adopted policies and expertise of federal or state resource agencies or organizations with acknowledged expertise, including the U.S. Fish and Wildlife Service, California Department of Fish and Game, National Marine Fisheries Service (now known as "NOAA Fisheries"[4]), and the California Native Plant Society. Specifically, the following categories are included: federally listed endangered and threatened species; species proposed for listing as endangered or threatened; candidates for such listing; federally identified species of concern and species of local concern; state-listed endangered and threatened species,

[4] The National Oceanic and Atmospheric Administration Fisheries Service, or NOAA Fisheries, formerly the National Marine Fisheries Service or NMFS, has responsibility for fisheries resources, but has no jurisdiction over upland areas where there is no stream access for anadromous fish, such as LBNL.

and rare (plants only) species; California Species of Special Concern; species designated "special animals" by the state; "fully protected" species (of which there are about 35, most of which are also listed as either endangered or threatened); and raptors (birds of prey), which are specifically protected by Fish & Game Code Section 3503.5, which prohibits the take, possession, or killing of raptors and owls, their nests, and their eggs.[5] (The project area does not contain any applicable special-status species designated by local agencies.) These species are referred to collectively as "special-status species" following a convention that has developed in practice but has no official sanction. Special-status species in the project area are protected under the federal and California Endangered Species Acts, the California Native Plant Protection Act, or the California Fish and Game Code, which are discussed under Federal and State Regulatory Setting, p. IV.C-25.

A list of special-status plant and animal species reported to occur in the vicinity of the project site was compiled on the basis of data in the California Natural Diversity Database (CDFG, 2005), the California Native Plant Society Electronic Inventory (CNPS 2005), special-status species information from the U.S. Fish and Wildlife Service (USFWS, 2005a), and biological literature of the region. Table IV.C-1 is intended to be comprehensive and includes species for which potential habitat (i.e., general habitat types) occurs within or in the vicinity of the project site. With the exception of Cooper's hawk, a California species of concern, and red-tailed hawk and American kestrel, both protected under Section 3503.5, no special-status plants or wildlife were identified at LBNL during recent field surveys (ESA, 2005; ESA, 2002a, 200b2b, 2002c; and ESA, 2003a, 2003b, 2003c), although other special-status species are judged to have at least a moderate potential to occur, based on habitat conditions, as discussed below.[6]

Animal Species Assessed in Detail

Potential impacts of the project on special-status species were assessed based on the literature review, professional judgment, and the following procedure:

1) Determination of Susceptibility. This determination is a three-level process that evaluated for each species: (a) potential occurrence in the study area (generally, the terrestrial and aquatic habitats of the project site); (b) potential occurrence within the project footprint (i.e., the area proposed for future construction[7] under the LRDP); or (c) absence from either the study area or proposed construction sites. Federally or state endangered or threatened species were fully considered if potential suitable habitat exists at the project site, no matter how marginal. Species for which no potential suitable habitat exists at the project site (i.e. the species only occurs in chaparral or sandy washes) were given no further consideration.

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5 The inclusion of birds protected by Fish & Game Code Section 3503.5 is in recognition of the fact that these birds are substantially less common in California than most other birds, having lost much of their habitat to development, and the recognition that the populations of these species are therefore substantially more vulnerable to further loss of habitat and to interference with nesting and breeding than are most other birds. It is noted that a number of raptors and owls are already specifically listed as threatened or endangered by state and federal wildlife authorities.

6 CEQA Guidelines Section 15380 provides that a plant or animal species, even if not on one of the official lists, may be treated as "rare or endangered" if, for example, it is likely to become endangered in the foreseeable future.

7 For the purposes of this EIR, the term "construction," unless specifically indicated otherwise, includes activities that involve construction of new facilities, major rehabilitation or modification of existing facilities, and demolition of existing facilities.

TABLE IV.C-1
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
SPECIES LISTED OR PROPOSED FOR LISTING				
Invertebrates				
Bay checkerspot butterfly *Euphydryas editha bayensis*	FT/--/--	Serpentine bunchgrass grassland, larvae feed on *Plantago erecta*	**Unlikely.** Grasslands in project area do not occur on serpentine and are not known to support larval host plants.	March–May
Callippe silverspot butterfly *Speyeria callippe callippe*	FE/--/--	Coastal areas in dunes, prairie, scrub, and grasslands supporting *Viola pedunculata*	**Unlikely.** Species' host plant is not known to occur in the grasslands on the project site.	Spring
Fish				
Central California coastal steelhead *Oncorhynchus mykiss*	FT/CSC/--	Unblocked Bay Area and coastal rivers and streams	**Unlikely.** Strawberry Creek contains downstream barriers to migration of this species. With the exception of the North Fork, drainages at LBNL are not large enough to support the species.	Year-round
Winter-run chinook salmon *Oncorhynchus tshawytscha*	FE/CE/--	Unblocked Bay Area and coastal rivers and streams	**Unlikely.** Strawberry Creek contains downstream barriers to migration of this species. Most on-site drainages are not large enough to support the species.	Winter
Amphibians				
California tiger salamander *Ambystoma californiense*	FT/CSC/--	Wintering sites occur in grasslands occupied by burrowing mammals; breed in ponds and vernal pools	**Unlikely.** Suitable aquatic habitat for this species is not present within the project area.	November–May
California red-legged frog *Rana aurora draytonii*	FT/CSC/--	Breed in stock ponds, pools, and slow-moving streams with emergent vegetation for escape cover and egg attachment	**Unlikely.** On-site drainages do not provide suitable aquatic habitat for this species. No species occurrences are reported within several miles of the project site.	May–November
Reptiles				
Alameda whipsnake *Masticophis lateralis euryxanthus*	FT/CT/--	Inhabits open to partially open scrub communities, including coyote bush scrub and chamise chaparral on primarily south-facing slopes	**Low to moderate potential.** Low-quality suitable habitat for this species is present within the project area. Unlikely that occupied territory is present on-site, but species may disperse through the site.	Spring
Birds				
American peregrine falcon *Falco peregrinus*	Delisted/CE/--	Forages in marshes and grasslands; nesting habitat includes high, protected cliffs and ledges near water	**Unlikely.** Suitable nesting habitat is not present within the project area. May forage in the vicinity of the project area.	Year-round
Bald eagle *Haliaeetus leucocephalus*	FT/CE/--	Nests and forages on inland lakes, reservoirs, and rivers; winter foraging at lakes and along major rivers	**Unlikely**. No suitable foraging or nesting habitat in project vicinity.	Winter

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
SPECIES LISTED OR PROPOSED FOR LISTING (cont.)				
Plants				
Large-flowered fiddleneck *Amsinckia grandiflora*	FE/CE/1B.1	Valley grassland, foothill woodland, annual grassland	**Low potential.** Project site contains marginally suitable habitat; however, only three natural occurrences are known, the nearest in east Alameda County (CNPS, 2005).	April–May
Pallid manzanita *Arctostaphylos pallida*	FT/CE/1B.1	Broadleaved upland forest, cismontane woodland, closed-cone coniferous forest, chaparral, and coastal scrub; found in siliceous shale, sandstone, or gravelly substrates	**Unlikely.** The project site does not contain suitable soils for this species. Species is readily recognizable and not seen during ESA's field surveys.	December–March
Robust spineflower *Chorizanthe robusta var. robusta*	FE/--/1B.1	Sandy or gravelly openings in cismontane woodland; also coastal dunes and coastal scrub	**Unlikely.** Suitable habitat is not present on the project site (i.e., tree and shrub cover is too dense). Not seen in Alameda or adjacent counties since the 1890s; presumed extirpated in Bay Area (CNPS, 2005).	April–September
Presidio clarkia *Clarkia franciscana*	FE/CE/1B.1	Serpentine outcrops in coastal scrub and valley and foothill grassland	**Unlikely.** Although grassland is present, no serpentine outcrops observed in project area.	May–July
Santa Cruz tarplant *Holocarpha macradenia*	FT/CE/1B.1	Light, sandy, or sandy clay soil in coastal prairie and scrub and in valley and foothill grassland; often with non-native associates	**Unlikely.** Marginally suitable habitat is present in the project area, but naturally occurring populations have been extirpated from the Bay Area (CNPS, 2005).	June–October
San Francisco popcorn flower *Plagiobothrys diffusus*	FSC/CE/1B.1	Coastal prairie and valley and foothill grassland	**Low potential.** The project site provides marginally suitable habitat. Species is known from fewer than 10 occurrences.	April–June
FEDERAL OR STATE SPECIES OF CONCERN				
Invertebrates				
Monarch butterfly *Danaus plexippus*	--/*/--	Winters in eucalyptus groves; winter roosting sites protected by the state	**Low potential.** Suitable habitat exists on-site, but the species has not been documented as wintering within the project area.	Winter
Bridges' Coast Range shoulderband snail *Helminthoglypta nickliniana bridgesi*	FSC/--/--	Inhabits open hillsides; prefers rock piles but can be found under tall grasses and weeds	**Low potential.** Marginally suitable habitat is present in the project area, but all sightings are historic.	Year-round
Ricksecker's water scavenger beetle *Hydrochara rickseckeri*	FSC/--/--	Specific habitat requirements are unknown; requires calm, shallow water of ponds and streams	**Low potential.** Suitable aquatic habitat is not present in the project area.	Unknown

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
FEDERAL OR STATE SPECIES OF CONCERN (cont.)				
Invertebrates (cont.)				
Lee's micro-blind harvestman *Microcina leei*	--/*/--	Requires undisturbed rocks in native grasslands and woodlands	**Observed.** Known to be present in Blackberry Canyon.	Year-round
San Francisco lacewing *Nothochrysa californica*	FSC/--/--	Coastal scrub and woodlands	**High potential.** May occur in woodland and coastal scrub habitat on the project site. Known to occur in Strawberry Canyon.	January–July
Birds				
Cooper's hawk *Accipiter cooperi*	--/CSC/--	Nests in riparian growths of deciduous trees and live oak woodlands	**Observed.** Nesting habitat is available on-site. Observed with kill at Bldg. 49 site (ESA, 2003a).	March–July
Sharp-shinned hawk *Accipiter striatus*	--/CSC/--	Nests in riparian growths of deciduous trees and live oaks	**Moderate potential.** Potential nesting habitat is present on the larger streams at LBNL.	March–July
Tricolored blackbird *Agelaius tricolor*	FSC/CSC/--	Riparian thickets and emergent vegetation	**Unlikely.** Typical nesting habitat used by this species is not present in large enough amounts in the project area.	Spring
Grasshopper sparrow *Ammodramus savannarum*	FSC/--/--	Dry, dense grasslands, especially with a variety of grasses and tall forbs and scattered shrubs	**Low potential.** Suitable habitat is present on the project site, but species frequents more arid areas.	April–July
Bell's sage sparrow *Amphispiza belli belli*	FSC/CSC/--	Inhabits arid areas with low, fairly dense stands of shrubs, including chamise chaparral and coastal sage scrub	**Low potential.** Suitable scrub habitat is present on the project site, but species frequents more arid areas.	Year-round
Golden eagle *Aquila chrysaetos*	--/CSC/--	Nests in canyons and large trees in open habitats; prefers to forage in habitat with dense ground squirrel populations	**Unlikely.** While suitable foraging habitat exists, nesting habitat is not present on-site.	Year-round
Burrowing owl *Athene cunicularia*	FSC/CSC/--	Nests in mammal burrows in open, lowland grasslands; also uses man-made structures	**Unlikely.** Suitable nesting habitat is not present at LBNL.	February–June
Oak titmouse *Baelophus inornatus*	FSLC/--/--	Inhabits open oak woodlands and oak savannah	**Low potential.** Species is relatively rare on western slopes of East Bay hills due to generally high density of oak habitat.	Year-round
Great horned owl *Bubo virginianus*	--/3503.5/--	Often uses abandoned nests of corvids or squirrels; nests in large oaks, conifers, eucalyptus	**Moderate potential.** Suitable nesting habitat occurs in eucalyptus and conifer stands at LBNL.	Year-round
Red-tailed hawk *Buteo jamaicensis*	--/3503.5/--	Usually nests in large trees, often in woodland or riparian deciduous habitats	**Observed.** Suitable nesting habitat is present in stands of large trees. Observed foraging at LBNL (ESA, 2002a).	Year-round

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
FEDERAL OR STATE SPECIES OF CONCERN (cont.)				
Birds (cont.)				
Lark sparrow *Chondestes grammacus*	FSC/--/--	Inhabits sparse valley foothill hardwood, open mixed chaparral and brushy habitats, grasslands with scattered trees or shrubs	**Unlikely.** Suitable nesting habitat is not present in the project area, as the canopy cover is too dense.	Year-round
Northern harrier *Circus cyaneus*	--/CSC/--	Most commonly found foraging over marshes and open fields. Nests on slightly elevated ground or in thick vegetation.	**Unlikely.** Suitable nesting habitat is not present in the project area. May be occasional forager in open grasslands on-site.	Year-round
Olive-sided flycatcher *Contopus cooperi*	FSC/--/--	Inhabits open conifer or mixed woodlands; nests in large coniferous trees	**Moderate potential.** Suitable habitat is present at LBNL, but species relatively rare in East Bay hills.	May-August
White-tailed kite *Elanus leucurus*	FSC/CFP	Nests near wet meadows and open grasslands, in dense oak, willow, or other tree stands	**Low potential.** Open foraging habitat is located in the project area; however, this species rarely seen in the Oakland-Berkeley hills.	March–July
Pacific-slope flycatcher *Empidonax difficilis*	FSC/--/--	Warm, moist woodlands, including valley foothill and montane riparian, coastal and blue oak woodlands, and montane hardwood-conifer habitats	**Moderate potential.** Potential nesting habitat is located in riparian vegetation at LBNL.	Summer
California horned lark *Eremophila alpestris actia*	--/CSC/--	Nests and forages in short-grass prairie, mountain meadow, coastal plain, fallow fields, and alkali flats	**Unlikely.** Project site does not provide suitable habitat.	March–July
Merlin *Falco columbarius*	--/CSC/--	Breeds outside California; inhabits coastlines, open grasslands, savannahs, and woodlands	**Unlikely.** May visit site in winter or during migration to breeding habitat outside California.	September–May
American kestrel *Falco sparverius*	--/3503.5/--	Frequents generally open grasslands, pastures, and fields; primarily a cavity nester	**Observed.** Observed on-site (ESA, 2003b). Potential nesting habitat available in cavities in mature oaks or pines.	Year-round
Yellow-breasted chat *Icteria virens*	--/CSC/--	Nests in riparian corridors with willows or other dense foliage	**Low potential.** Riparian vegetation present and may provide nesting habitat for this species, but small patch size makes nesting unlikely.	March–September
Loggerhead shrike *Lanius ludovicianus*	FSC/CSC/--	Nests in shrublands and forages in open grasslands	**Unlikely.** Suitable grassland habitat is not present in the project area.	March–September
Lewis' woodpecker *Melanerpes lewis*	FSC/--/--	Nests in cavities of dead or burned out trees in open, deciduous, and conifer habitats with brushy understory	**Low potential.** Rarely occurs on the west side of East Bay hills in oak woodland habitat in winter. Oak woodland habitat too dense to be suitable for nesting.	Winter

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
FEDERAL OR STATE SPECIES OF CONCERN (cont.)				
Birds (cont.)				
Rufous hummingbird *Selasphorus rufus*	FSC/--/--	Inhabits riparian areas, open woodlands, chaparral, and other habitat with nectar-producing flowers; breeding does not occur in San Francisco Bay Area	**Low potential.** May forage on the project site and in surrounding areas.	February–April
Allen's hummingbird *Selasphorus sasin*	FSC/--/--	Inhabits coastal scrub, valley foothill hardwood, and riparian habitats	**High potential.** Trees and shrubs within riparian corridors provide potential nesting habitat.	January–July
Red-breasted sapsucker *Sphyrapicus ruber*	FSC/--/--	Breeds in coastal forests of Northern California and Oregon	**Unlikely.** May occur occasionally and locally in winter, but does not breed in the area.	November–March
Bewick's wren *Thryomanes bewickii*	FSC/--/--	Inhabits chaparral, scrub, and landscaped areas; may also be found in riparian and edges of woodland habitats	**Moderate potential.** Preferred habitat is present throughout LBNL.	Year-round
California thrasher *Toxostoma redivivum*	FSC/--/--	Moderate to dense chaparral and scrub, open valley foothill riparian thickets	**Moderate potential.** Low-quality suitable habitat is present on the project site.	Year-round
Mammals				
Pallid bat *Antrozous pallidus*	CSC/--	Day roosts include rock outcrops, mines, caves, hollow trees, buildings and bridges. Recent research suggests high reliance on tree roosts	**Moderate potential.** Suitable roost habitat present on-site in trees and buildings. Suitable foraging habitat on the project site.	March-August
Townsend's big-eared bat *Corynorhinus townsendii*	FSC/CSC/--	Inhabits a variety of habitats, requires caves, mines, or man-made structures for roosting	**Low potential.** Suitable roosting habitat is not present on the project site, but the species may forage in the area.	March-August
Berkeley kangaroo rat *Dipodomys heermanni berkeleyensis*	FSC/--/--	Open, grassy hilltops and open spaces in chaparral and blue oak/gray pine woodland	**Low potential.** Marginally suitable habitat is present in the project area; species is presumed extinct; however, USFWS has special concern.	Year-round
Greater western mastiff bat *Eumops perotis californicus*	FSC/CSC/--	Breeds in rugged, rocky canyons and forages in a variety of habitats	**Low potential.** Suitable roosting habitat is not present in the project area, but the species may forage in the area.	March–August
Long-eared myotis *Myotis evotis*	FSC/--/--	Inhabits woodlands and forests up to approximately 8,200 feet in elevation; roosts in crevices and snags	**Moderate potential.** Suitable foraging and roosting habitat is present in the project area.	March–August
Fringed myotis Myotis thysanodes	FSC/--/--	Inhabits a variety of woodland habitats, roosts in crevices or caves, and forages over water and open habitats	**Moderate potential.** Suitable foraging and roosting habitat is present on the project site.	March–August

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
FEDERAL OR STATE SPECIES OF CONCERN (cont.)				
Mammals (cont.)				
San Francisco dusky-footed woodrat *Neotoma fuscipes annectens*	FSC/CSC/--	Forests with moderate canopy and moderate to dense understory	**Low potential.** Although the project site provides marginally suitable habitat for this species, it does not tend to occur in areas where human presence is high.	Year-round
Plants				
Bent-flowered fiddleneck *Amsinckia lunaris*	FSLC/--/1B.2	Coastal bluff scrub, woodland, and valley and foothill grassland	**Low potential.** Marginally suitable habitat is present on the project site, but records from Oakland-Berkeley hills are historic only.	March–June
Big-scale balsamroot *Balsamorhiza macrolepis* var. *macrolepis*	FSLC/--/1B.2	Woodland and valley and foothill grassland, sometimes on serpentine soils	**Moderate potential.** Low-quality suitable habitat is present on the project site.	March–June
Mt. Diablo fairy-lantern *Calochortus pulchellus*	FSLC/--/1B.2	Woody and shrubby slopes of chaparral, cismontane, and riparian woodland, and valley and foothill grassland	**Low potential.** Marginally suitable habitat is present on the project site, but the species is not known from Oakland-Berkeley hills.	April–June
Western leatherwood Dirca occidentalis	FSLC/--/1B.2	On brushy slopes and mesic areas of chaparral, riparian woodland and forest, and broadleaf or coniferous forest	**Low potential.** Suitable habitat is present on the project site. However, the species was not observed during site surveys (ESA, 2002 and 2003).	January–April
Round-leaved filaree *Erodium macrophyllum*	--/--/2.1	On clay soils in woodland and valley and foothill grasslands	**Low potential.** Marginally suitable habitat is present on the project site; however, most collections are historical (CNPS, 2005).	March–May
Diablo helianthella *Helianthella castanea*	FSC/--/1B.2	Broadleaf upland forest, cismontane woodland, chaparral, coastal scrub, riparian woodland, and valley and foothill grassland	**Moderate potential.** Low-quality suitable habitat is present on the project site.	April–June
Fragrant fritillary *Fritillaria liliacea*	FSC/--/1B.2	Cismontane woodland, coastal prairie and scrub, valley and foothill grasslands, often on serpentine soils	**Low potential.** Serpentine soils are not present on the project site. The species is unlikely to be found on other soils due to competition with non-native species.	February–April
Kellogg's horkelia *Horkelia cuneata* spp. *sericea*	FSC/--/1B.1	In sandy or gravelly openings of closed-cone coniferous forest, chaparral and coastal scrub	**Low potential.** Suitable habitat is not present on the project site. Presumed extirpated in Alameda County (USFWS, 2005a).	April–September
Large-flowered leptosiphon (linanthus) *Leptosiphon grandiflorus* (formerly *Linanthus grandiflorus)*	FSC/--/4.2	Cismontane woodlands, valley and foothill grassland, coastal scrub	**Moderate potential.** While habitat is of low quality, the species was recently documented from Wildcat Peak (CalFlora, 2003).	April–August

TABLE IV.C-1 (Continued)
SPECIAL-STATUS SPECIES CONSIDERED IN THE EVALUATION OF THE LBNL LONG RANGE DEVELOPMENT PLAN

Common Name *Scientific Name*	Listing Status USFWS/ CDFG/CNPS	General Habitat	Potential for Species Occurrence Within the Project Area	Period of Identification
FEDERAL OR STATE SPECIES OF CONCERN (cont.)				
Plants (cont.)				
Oregon meconella *Meconella oregano*	FSC/--/1B.1	Coastal scrub and prairie	**Moderate potential.** Low-quality suitablehabitat is present at LBNL. Known only from five occurrences, including Oakland East, Richmond, and Briones Valley quads.	March–April
Robust monardella *Monardella villosa* ssp. *globosa*	FSLC/--/1B.2	In clay or sandy soils of coastal prairie and scrub, and valley and foothill grassland	**Moderate potential.** Low-quality suitable habitat is present on the project site.	June–July
Most beautiful jewel-flower *Streptanthus albidus* ssp. *peramoenus*	FSC/--/1B.2	Ridges and slopes with chaparral, valley and foothill grassland, and woodland; on serpentine outcrops	**Low potential.** Although mixed grasslands occur on-site, no serpentine soils or outcrops were observed in the project area.	April–June

STATUS CODES:

High potential = High to moderate quality habitat present and site within the geographic range; species expected to occur.

Moderate potential = Low to moderate quality habitat present, or habitat suitable but not within species' reported geographic range.

Low potential = Habitat highly limited or only marginally suitable or species may not be reported within the region.

Unlikely = Habitat does not meet species requirements as currently understood in the scientific community and/or site not within currently known species distribution or range.

Federal: (U.S. Fish and Wildlife Service)

FE = Listed as endangered (in danger of extinction) by the federal government
FT = Listed as threatened (likely to become endangered within the foreseeable future) by the federal government
PE/PT = Proposed for listing as endangered or threatened or threatened
FC = Candidate to become a *proposed* species
FSC = Former federal species of concern; may be endangered or threatened, but not enough biological information has been gathered to support listing at this time
FSLC = Former federal species of local concern. FWS no longer lists FSC and FSLC species.

State: (California Department of Fish and Game)

CE = Listed as endangered by the State of California
CT = Listed as threatened by the State of California
CR = Listed as rare by the State of California (plants only)
CSC = California Species of Special Concern
CFP = California Fully Protected
* = Species designated as "Special Animals" by the state
3503.5 = California Fish and Game Code Section 3503.5, Protection for nesting species of Falconiformes (hawks) and Strigiformes (owls)

California Native Plant Society

List 1A=Plants presumed extinct in California
List 1B=Plants rare, threatened, or endangered in California and elsewhere
List 2= Plants rare, threatened, or endangered in California but more common elsewhere
List 3= Plants about which more information is needed
List 4= Plants of limited distribution

An extension reflecting the level of threat to each species is appended to each rarity category as follows:
.1 – Seriously endangered in California
.2 – Fairly endangered in California
.3 – Not very endangered in California

SOURCES: CalFlora, 2003; CDFG, 2004; CNPS, 2006; USFWS, 2005a; Zeiner et al., 1990.

2) Further Analysis of Species Occurrence. If a species was determined to have the potential to occur in the project study area, further analyses were made of life history, habitat requirements, and the suitability of habitat for the species found within the study area or its immediate vicinity. The results of this determination for each species are provided in the "Potential for Species Occurrence Within the Project Area" column of Table IV.C-1.

3) Analysis of Project Effects. If suitable habitat was determined present within the proposed project vicinity, and the species had been documented as observed within the project area or had at least a moderate potential to occur, additional analysis considered whether the species would be affected by the project. Both direct effects (e.g., displacement of habitat) and indirect effects (e.g., noise) were considered. In addition, life history and habitat requirements were evaluated to ascertain the likelihood and severity of impact.

Of the special-status plants and animals presented in Table IV.C-1, p. IV.C-11, only the following species, which were observed or determined to have at least a moderate potential to occur within the project vicinity, are fully considered in the impact analysis:

- Lee's micro-blind harvestman
- San Francisco lacewing
- Alameda whipsnake
- Cooper's hawk
- Sharp-shinned hawk
- Red-tailed hawk
- American kestrel
- Great horned owl
- Olive-sided flycatcher
- Pacific-slope flycatcher
- Allen's hummingbird
- Bewick's wren
- California thrasher
- Pallid bat
- Long-eared myotis
- Fringed myotis
- Big-scale balsamroot
- Diablo helianthella
- Large-flowered leptosiphon (linanthus)
- Oregon meconella
- Robust monardella

Lee's Micro-Blind Harvestman

This arachnid was first identified at LBNL in the 1960s and again in the 1980s. A site at LBNL on the south-facing slope of Blackberry Canyon has been identified as the type locality[8] for this harvestman species. The species is only known from one other occurrence in Claremont Canyon (Briggs and Ubick, 1989). A limited area of known habitat for this species at LBNL consists of a nearly closed canopy oak-bay woodland with undisturbed sandstone rocks that are embedded in the soil and that have moist conditions underneath (McClure, 2004; Ubick, 2003). The LBNL site was mapped for the 1997 SEIR so that this spider would not be disturbed as a result of vegetation management. In the 1990s, the species was identified, along with five other harvestman spiders, as a potential candidate for listing as endangered or threatened (USFWS, 1994). However, it has never been listed as such (USFWS, 2005a and 2005b) and is no longer proposed for listing (USFWS, 2005c), although several other harvestman species are now listed as species of concern. Lee's micro-blind harvestman is currently listed as a special animal by the state (CDFG, 2004); however, due to lack of information about the species, it has no official status. Although the species has no formal status, its known habitat at LBNL will continue to be protected from development by its designation as a fixed constraint under the 2006 LRDP.

8 A species' *type locality* is the location from which the species was first collected and identified.

San Francisco Lacewing

The USFWS has designated the San Francisco lacewing, an insect formerly known throughout the Coast Ranges from Mendocino to Los Angeles, as a federal species of special concern due to its shrinking geographic range. This lacewing is known to inhabit coastal scrub and woodland habitat and is known to occur in Strawberry Canyon. The species is active from January through July, but little else is known about the species' biology or habitat preferences (Arnold, 1997). Implementation of the 2006 LRDP is not expected to affect this species, as impacts to native woodland or coastal scrub habitat under the LRDP would be minimal.

Alameda Whipsnake

Alameda whipsnake (*Masticophis lateralis euryxanthus*) is listed as threatened under both federal and state law and is found in open-canopied shrub communities, including coastal scrub and chaparral, and adjacent habitats including oak woodland/savanna and grassland areas (Swaim, 1994). Habitats adjacent to shrub communities may be crucial to Alameda whipsnakes, which remain in grassland habitats near shrub areas for up to several weeks at a time (USFWS, 2000). Other critical habitat elements for this species include rock outcrops and talus, where prey may be found and whipsnakes may find shelter, and small mammal burrows. Prey of the whipsnake include western fence lizard *(Sceloporus occidentalis)* as well as other snakes, frogs, small birds and mammals, and insects (Swaim, 1994). Alameda whipsnakes are most often found on east-to-southeast and south-facing slopes, where shrub cover is generally lower. Coastal scrub and adjacent habitats in the eastern and southern portions of the project site would be most likely to support this species (Swaim, 2006).

Cooper's Hawk

Cooper's hawk ranges over most of North America and may be seen throughout California, most commonly as a winter migrant. Nesting pairs have declined throughout the lower-elevation, more populated parts of the state. Cooper's hawk forages in open woodlands and wooded margins and nests in tall trees, often in riparian areas (Ehrlich et al., 1988; National Geographic, 1987; Baicich, 1997). This species has been observed foraging at LBNL (ESA, 2003b); coast live oak as well as conifers and eucalyptus may provide nesting habitat for the species at LBNL.

Sharp-Shinned Hawk

Sharp-shinned hawk occurs throughout most of North America and is a resident species throughout California. Although this species was not observed during site surveys, coast live oak and non-native conifers at LBNL may provide nesting habitat for sharp-shinned hawks (Ehrlich et al., 1988; National Geographic, 1987; Harrison, 1979).

Red-Tailed Hawk

Red-tailed hawks are commonly found in woodlands and open country with scattered trees. These large hawks feed primarily on small mammals, but will also prey on other small vertebrates, such as snakes and lizards, as well as on small birds and invertebrates. Red-tailed hawks nest in a variety of trees in woodland and agricultural habitats. Large coast live oaks at LBNL, as well as

taller non-native trees such as eucalyptus and pine, may be used by red-tailed hawks for nesting. This species has been observed foraging at LBNL (ESA, 2002a-c; ESA, 2003a-c).

American Kestrel

American kestrel have been observed foraging in grassland habitat at LBNL (ESA, 2003b). This relatively small member of the falcon family preys on small birds and on mammals, lizards, and insects. The kestrel is most common in open habitats, such as grasslands or pastures. American kestrels usually nest in tree cavities (Sibley, 2001; Erlich et al., 1988); coast live oak and conifers at LBNL may provide this species with nesting habitat.

Great Horned Owl

Great horned owls occur throughout North America and are found in a variety of wooded habitats. These large raptors prey on small to medium-sized mammals such as voles, rabbits, skunks, and squirrels. Great horned owls can often be seen and heard at dusk, perched in large trees. They roost and nest in large trees such as pines or eucalyptus. They often use the abandoned nests of crows, ravens, or sometimes squirrels (Erlich et al., 1988; Sibley, 2000). Great horned owls may use large eucalyptus and pines located at LBNL for roosting or nesting and may forage over the grasslands on-site for voles and other small mammals.

Olive-Sided Flycatcher

Olive-sided flycatcher frequents a variety of forest and woodland habitats throughout most of California. Preferred nesting habitat includes coniferous and mixed hardwood-conifer forests. The species forages for insects over the forest canopy or adjacent grasslands and prefers tall conifers for both nesting and roosting. These flycatchers will often use the tallest trees in a locale for singing posts and hunting perches. Olive-sided flycatcher may make use of tall conifers and grasslands at LBNL for nesting and foraging purposes.

Pacific-Slope Flycatcher

Pacific-slope flycatcher nests locally in riparian or other moist habitat in woodlands and forests with dense canopy cover. This migrant may be found outside of riparian habitat in the non-breeding season; however, shade is an important habitat requirement during both nesting and migration. Potential nesting habitat for this species is located along the drainages at LBNL, and tall trees preferred for perching and foraging are present as well.

Allen's Hummingbird

Allen's hummingbirds inhabit chaparral, scrub, riparian, and woodland habitats that support nectar-producing plants. Insects and spiders are consumed as well. Trees and the dense coastal scrub habitat present at LBNL provide potential nesting and foraging habitat for Allen's hummingbird.

Bewick's Wren

Chaparral and scrub are the primary habitats for this insectivorous species, though riparian and woodland habitats with brushy understory, as well as urban landscaped areas, may also support

Bewick's wren. Nests are located in cavities on the ground, in trees, or in man-made structures. Dense, shrubby vegetation provides cover and protection from raptors and other predators during foraging activities. This species is most likely to occur and nest within willow scrub and coastal scrub habitats at LBNL.

California Thrasher

California thrashers are residents of moderate to dense chaparral and scrub habitats throughout California. Riparian thickets also may provide nesting habitat. This species rarely strays far from dense shrub cover during forays for terrestrial invertebrates and seeds. Shrub cover is also important for protection of the nest from predators such as domestic cats, skunks, and scrub jays. Riparian scrub and coastal scrub at LBNL may provide nesting habitat for California thrasher.

Pallid Bat

This species is found from Mexico north through Oregon and Washington into Canada, in a variety of habitats. Roosting occurs in deep crevices on rock faces, buildings, bridges and tree hollows (especially oaks). Pallid bat prey both aerially and terrestrially, on species such as Jerusalem crickets, moths, grasshoppers, June beetles and scorpions. Oak cavities may provide suitable roosting habitat on the LBNL.

Fringed Myotis

Fringed myotis occurs throughout California and is most frequent in coastal and montane forests and near mountain meadows (Jameson and Peeters, 1988). This species uses echolocation to find moths, beetles, and other prey and forms nursery colonies in caves and old buildings (Jameson and Peeters, 1988). Fringed myotis often use separate day and night roosts. Potential roosting habitat in the project area consists of peeling bark in eucalyptus or oak habitat.

Long-eared myotis

Long-eared myotis inhabits nearly all brushlands, woodlands, and forests, seeming to prefer coniferous forests and woodlands. Roosts include caves, buildings, snags, and crevices in tree bark. Caves provide night roosts. This species is highly maneuverable in its forays for arthropods over water, open terrain, and in habitat edges. Eucalyptus trees as well as oak woodland habitat in the project area may provide potential roosting habitat for long-eared myotis.

Special-Status Plants

A thorough review and analysis of special-status plant species, listed by the USFWS (2005), CDFG (2005), and CNPS (2005) databases as occurring in the project vicinity, indicate that the likelihood of adverse project impacts for most of the species listed is extremely low for the following reasons:

- Suitable habitat for the species either never existed on the project site or no longer exists due to historical and ongoing disturbance of soils and vegetation.
- The species is not documented within the general vicinity of the project site (i.e., the western side of the Oakland-Berkeley hills).

- Only historical occurrences for the species are documented from the area; or
- The species has been extirpated from the quadrangle or county.

Generally, the potential for special-status plant species to occur at LBNL is low; none have been observed in past environmental studies for LBNL, and none were observed during recent general biological resource surveys (ESA 2002a-c, 2003a-c). The site has been subject to ongoing disturbance, first in the form of grazing and then in the form of development, for the past 200 years. These types of disturbance, combined with the introduction of highly competitive non-native plant species, have resulted in the extirpation of a number of plant species that were documented in the Berkeley area in the late 1800s and early 1900s. In addition, the suppression of fire in the urbanized hills has resulted in mature stands of scrub and woodland with dense canopy cover and little understory. Since many herbaceous species tend to grow only in canopy openings in these habitat types, such species are unlikely to occur on the project site, as they can neither compete with the dense shrubs for soil moisture and nutrients nor obtain enough sunlight through the dense canopy. LBNL aggressively manages vegetation on virtually the entire hill site for fire protection. Through the reintroduction of grazing, as well as fuel reduction by mechanical means, LBNL has converted both coastal scrub habitat and stands of eucalyptus and French broom to grassland in recent years. Although small areas of patchily distributed native grasses remain scattered throughout LBNL, the native herbaceous species observed in these areas are those that are commonly found throughout the Oakland-Berkeley hills (ESA, 2002a-c, 2003a-c). Generally, rarer species in the hills tend to be found on serpentine or other ultramafic soils or on thin soils, such as occur in road cuts, where non-native species do not compete as readily. These types of soils were not observed at LBNL during ESA's field surveys.

The following grassland, coastal scrub, and woodland species were determined to have a moderate potential to occur on the project site, and are described below.

Big-scale balsamroot is a former federal species of local concern and a CNPS List 1B.2 species, which means it is considered rare, threatened or endangered in California. This yellow flowered perennial herb is a member of the daisy family and blooms from March through June. The species grows in woodlands and grassland openings, sometimes on serpentine soils and sometimes on other substrates.

Diablo helianthella is a relatively large herbaceous perennial (measuring 20 to 45 centimeters [8 to 18 inches] in height) that is a former federal species of concern and a CNPS List 1B.2 (rare, threatened or endangered in California) species. From April to May, this rock-rose produces bright, large, solitary, yellow flowers. This species occurs on grassy hillsides in valley grassland or foothill woodland habitat between 500 and 4,000 feet in elevation. It has been reported from Alameda, Contra Costa, San Mateo, and San Francisco Counties.

Large flowered leptosiphon (linanthus) is an herbaceous annual that is a former federal species of concern and is a CNPS List 4.2 species, meaning that it is considered of limited distribution and to be fairly endangered in California. This species occupies cismontane (on the west side of the Sierra Nevada) woodlands, valley and foothill grassland, and coastal scrub habitats and its showy white flowers may bloom from April through August.

Oregon meconella is a former federal species of concern and a CNPS List 1B.1 plant, which means that the species is rare, threatened, or endangered in California and elsewhere and considered seriously endangered in California. This member of the poppy family is an annual herb that blooms from March through April and inhabits coastal prairie as well as coastal scrub habitat.

Robust monardella is a former federal species of local concern and a CNPS List 1B.2 (rare, threatened or endangered in California) plant. A member of the mint family, this species can be found growing in clay or sandy soils in a variety of habitats, including coastal prairie, coastal scrub, and valley and foothill grassland.

IV.C.2.3 Special-Status Plant Communities

The CNDDB lists several sensitive natural communities, including northern maritime chaparral, serpentine bunchgrass, and valley needlegrass grassland, as occurring in the U.S. Geological Survey quadrangles searched. However, none of these communities, as described by Holland (1986), occurs on or in the vicinity of the project site. The CDFG considers riparian plant communities and freshwater marsh and seep communities in a generally arid climate to be sensitive habitat important to the species that depend on them.

IV.C.2.4 Sensitive Habitat

For the purposes of this EIR, the following habitats at LBNL were determined to be sensitive:

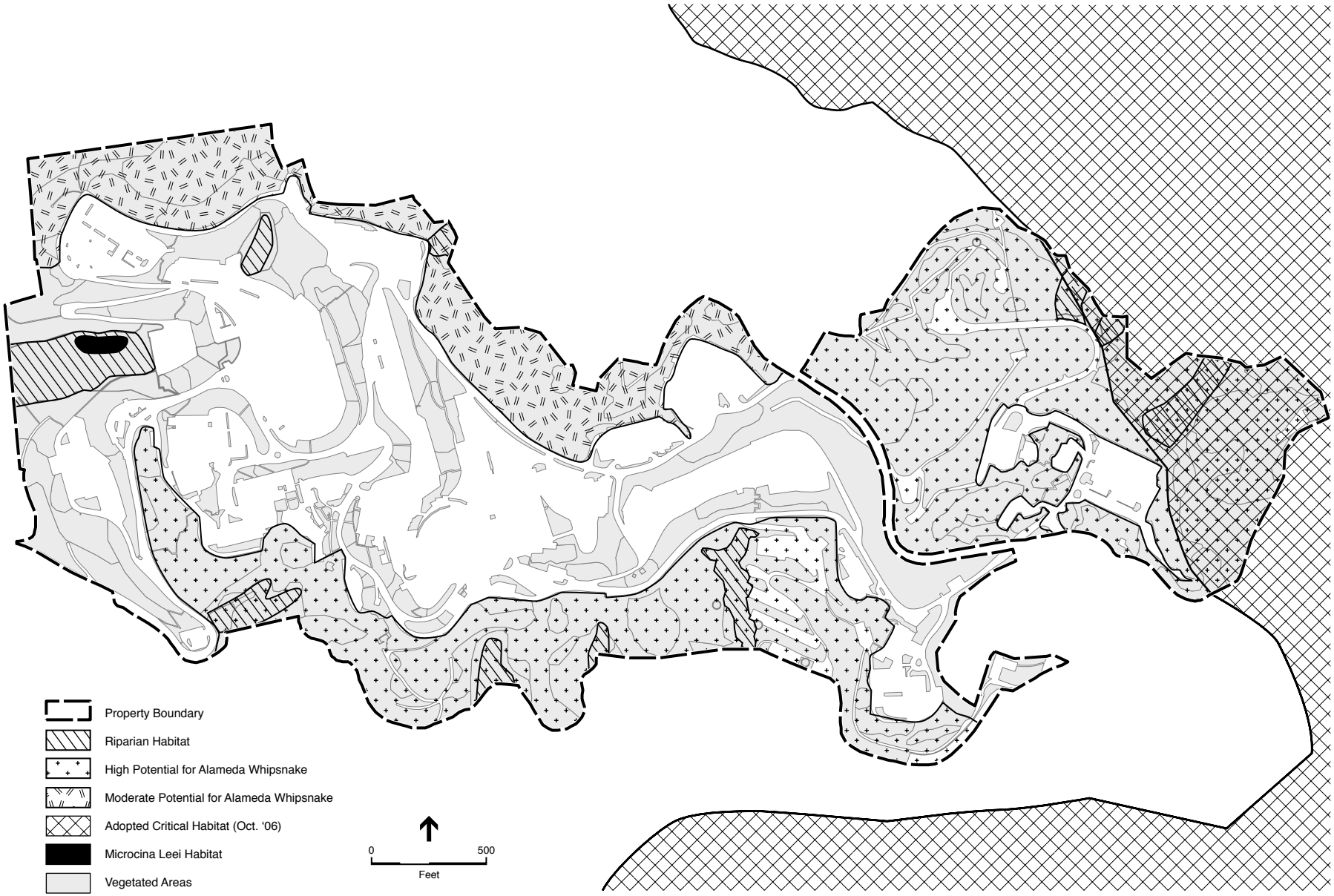
- Known habitat of Lee's micro-blind harvestman (*Microcina leei*);
- Potential Alameda whipsnake habitat;
- Critical Alameda whipsnake habitat, as adopted by USFWS in October 2006;[9] and
- Riparian and wetland habitat that is potentially jurisdictional under federal or state law.

The locations of these habitats are shown on Figure IV.C-2.

IV.C.2.5 Waters of the United States and Waters of the State

As noted earlier, all of the drainages at LBNL are ephemeral or intermittent, except for the North Fork of Strawberry Creek and Chicken Creek. In total there are 13 potentially jurisdictional features present at LBNL that are potentially jurisdictional under Section 404 of the Clean Water Act, 33 U.S.C. §§ 1251, et seq. (see Figure IV.C-3, p. IV.C-24). These include reaches of the North Fork of Strawberry Creek, Chicken Creek, and the headwater tributaries to these creeks, as well several headwater tributaries to the South Fork of Strawberry Creek. All of these drainages have incised beds and banks and an ordinary high water mark and may be considered jurisdictional as "other waters of the U.S." by the Army Corps of Engineers and as "waters of the state" by the CDFG. In addition, most of these drainages support a narrow corridor of riparian habitat, averaging approximately 25 feet from the top of each bank, that the CDFG might consider jurisdictional. Potentially jurisdictional features at LBNL include four freshwater seeps,

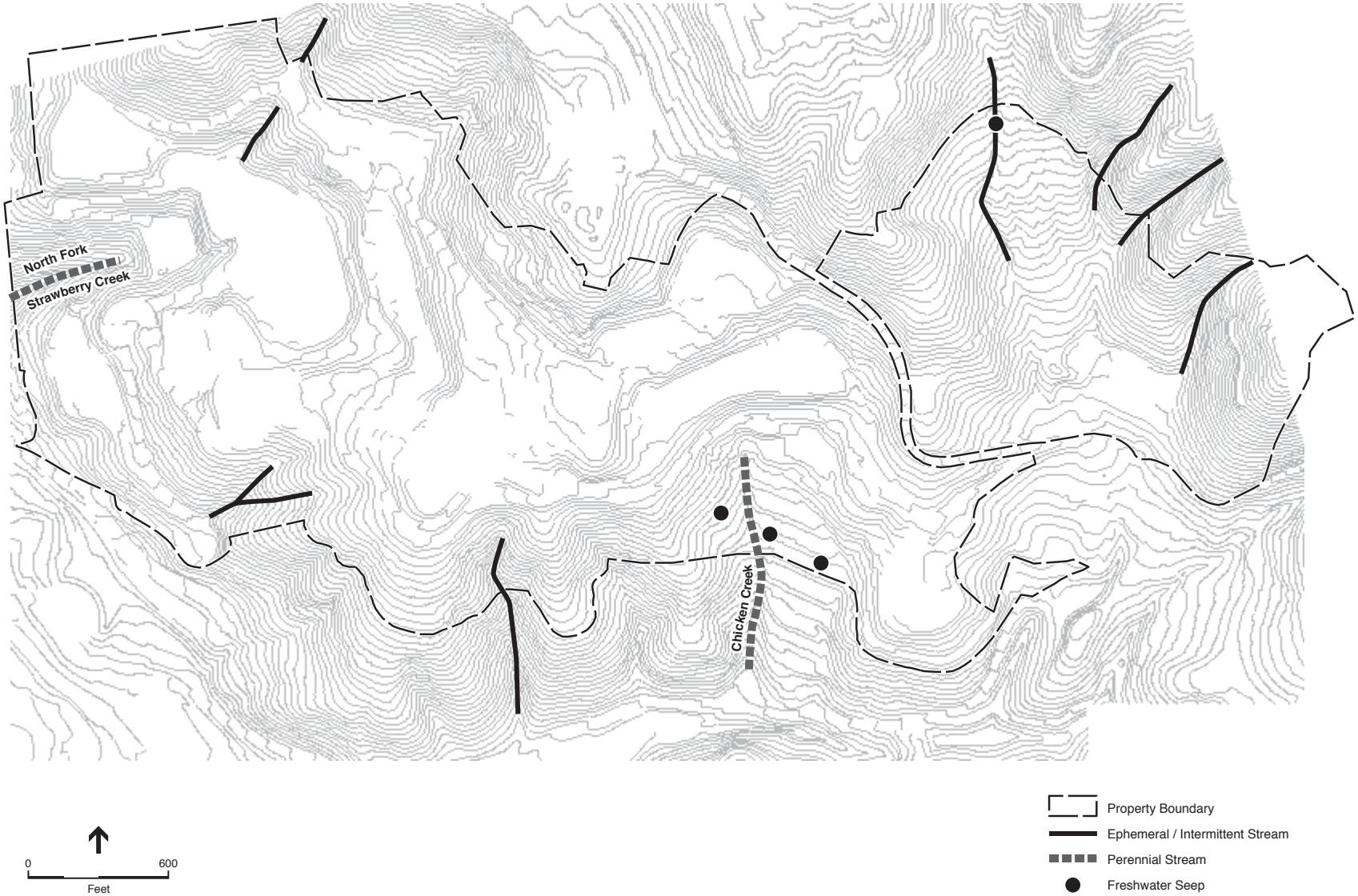
[9] See discussion under Impact BIO-5, p. IV.C-49.



SOURCE: LBNL; ESA (2006)

LBNL 2006 Long Range Development Plan . 201074

Figure IV.C-2
Sensitive Habitat at LBNL



SOURCE: ESA

LBNL 2006 Long Range Development Plan . 201074

Figure IV.C-3
Potentially Jurisdictional Waters at LBNL

which were described above under Plant Communities and Wildlife Habitat and are mapped on Figure IV.C-1 and Figure IV.C-3.

While some reaches of drainages at LBNL remain above ground, almost all drainage reaches have been culverted under developed areas. Ephemeral or intermittent drainages, especially upslope of the developed area culverts, have usually been significantly altered from their original states. These drainages may have rock energy dissipators to prevent erosion and/or sections of paved open channels. Often, their courses follow an artificial draw created as part of an earthmoving or fill project. Some flows are supplied solely by hydraugers. Culverting and an increase in impervious surfaces have created greater peak flows than existed under historical natural conditions. UC Berkeley has placed a detention basin on the Upper South Fork of Strawberry Creek to manage any increase in peak flows caused by development. Managing these peak flows in this manner prevents stream bank and bed erosion and consequent degradation of aquatic habitat along the main campus Strawberry Creek watershed course.

IV.C.2.6 Federal and State Regulatory Setting

Federal Regulations and Policies

The primary federal agency responsible for managing biological fish and wildlife resources in the area of LBNL is the USFWS.[10] The mission of the USFWS is to conserve, protect, and enhance the nation's fish and wildlife and their habitats for the continuing benefit of people. USFWS programs include management of wildlife sanctuaries, regulation of international and intrastate commerce related to wildlife, management of migratory species that move between states, wildlife management research, and identification and protection of endangered species.

Federal Endangered Species Act

Under the Federal Endangered Species Act (FESA), the Secretary of the Interior and the Secretary of Commerce have joint authority to list a species as threatened or endangered (16 United States Code [USC] 1533[c]). Pursuant to the requirements of the FESA, an agency reviewing a proposed project within its jurisdiction must determine whether any federally listed or proposed species may be present in the project region, and whether the proposed project would result in a "take" [11] of such species. The "take" provision of the FESA applies to actions that would result in injury, death, or harassment of a single member of a species protected under the Act. In addition, the agency is required to determine whether the project is likely to jeopardize the continued existence of any species proposed to be listed under the FESA, or result in the destruction or adverse modification of critical habitat for such species (16 USC 1536[3][4]).

[10] The National Marine Fisheries Service (NMFS) also has responsibility for fisheries resources, but has no jurisdiction over upland areas where there is no stream access for anadromous fish, such as LBNL.

[11] "Take," as applied in Section 9 of the FESA, means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect or to attempt to engage in any such conduct." "Harass" is further defined by the USFWS (50 C.F.R. § 17.3) as an intentional or negligent act or omission that creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, and sheltering. "Harm" is defined as "an act which actually kills or injures wildlife." This may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering.

Substantial, adverse project-related impacts to FESA-listed species or their habitats would be considered significant in this EIR.

Proposed species are granted limited protection under the act and must be addressed in Biological Assessments (under Section 7 of the act); proposed species otherwise have no protection from "take" under federal law, unless they are emergency-listed species.[12] Candidate species are afforded no protection under the act. However, the USFWS recommends that candidate species and species proposed for listing also be considered in informal consultation during a project's environmental review.

Migratory Bird Treaty Act and Bald Eagle Protection Act

The federal Migratory Bird Treaty Act (16 USC, Section 703, Supplement I, 1989) prohibits killing, possessing, or trading in migratory birds, except in accordance with regulations prescribed by the Secretary of the Interior. The act encompasses whole birds, parts of birds, and bird nests and eggs.[13]

The federal Bald Eagle Protection Act prohibits people within the United States (or other places subject to U.S. jurisdiction) from "possessing, selling, purchasing, offering to sell, transporting, exporting or importing any bald eagle or any golden eagle, alive or dead, or any part, nest or egg thereof."

Clean Water Act

The Federal Water Pollution Control Act of 1972, often referred to as the Clean Water Act, is the nation's primary law for regulating discharges of pollutants into waters of the United States. The objective of the Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The regulations adopted pursuant to the act deal extensively with the permitting of actions in waters of the United States, including wetlands. The act's statutory sections and implementing regulations provide more specific protection for riparian and wetland habitats than any other federal law. The U.S. Environmental Protection Agency (EPA) has primary authority under the Clean Water Act to set standards for water quality and for effluents, but the U.S. Army Corps of Engineers (Corps) has primary responsibility for permitting the discharge of dredge or fill materials into streams, rivers, and wetlands.

Draft Recovery Plan for Chaparral and Scrub Community Species

Under the FESA, the USFWS must prepare a recovery plan for listed species. A recovery plan details the actions needed to foster self-sustaining wild populations of listed species so they no longer need protection under the FESA. The USFWS published the *Draft Recovery Plan for Chaparral and Scrub Community Species East of San Francisco Bay, California* ("Recovery Plan") in November 2002. This draft plan is habitat-based and covers six species of plants and

12 Note, however, that protection from "take" begins at this stage under California law.

13 The act covers hundreds of birds, including varieties of loon, grebe, albatross, booby. pelican, cormorant, heron, stork, swan, goose, duck, vulture, eagle, hawk, falcon, fail, plover, avocet, sandpiper, phalarope, gull, tern, murre, puffin, dove, cuckoo, roadrunner, owl, swift, hummingbird, kingfisher, woodpecker, swallow, jay, magpie, crow, wren, thrush, mockingbird, vireo, warbler, cardinal, sparrow, blackbird, finch, and many others.

animals that occur primarily in chaparral and scrub habitats of the East Bay. Potential habitat for two of these species, the Alameda whipsnake and the Berkeley kangaroo rat, occurs at LBNL. While this draft plan has not yet been adopted, it may be adopted in its current or modified form during the time period covered by the 2006 LRDP. UC Berkeley is identified as a major stakeholder in the recovery process. Should the plan be formally adopted, LBNL would be subject to the plan's requirements during any federal permitting process involving the Lab.

LBNL lands that were previously designated as part of a critical habitat unit for the Alameda whipsnake are now designated as part of Recovery Unit 6 for the species. The major threats to Alameda whipsnake in this recovery unit are fire suppression, presence of non-native plants and animals, and loss of habitat and habitat fragmentation due to urban development (USFWS, 2002). Elements of the recovery strategy for Unit 6 that may be relevant to LBNL include:

- Conservation of existing open space;
- Control of encroachment of invasive non-native plant species, such as eucalyptus and French broom; and
- Conduct of fuel management programs in such a way as to enhance or restore habitat for the whipsnake (e.g., reintroducing or mimicking natural disturbance regimes).

The Berkeley kangaroo rat is presumed extirpated (extinct) in the Oakland-Berkeley hills (USFWS, 2002). However, the recovery plan recommends that, if and when surveys are carried out in the plan area for Alameda whipsnake or other species that may occur in chaparral or scrub communities, habitat assessment for the kangaroo rat be included as well. If appropriate habitat with burrows and scat are present, then trapping surveys should be conducted to identify species using the burrows (USFWS, 2002).

State Regulations and Policies

The CDFG is the primary state agency responsible for managing biological resources. The mandate of the CDFG is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public. In particular, the CDFG is required under various state statutes to conserve species through listing, habitat acquisition and protection, review of local land use planning, multi-species conservation planning, stewardship, recovery, research, and education.

California Endangered Species Act

Under the California Endangered Species Act (CESA), the CDFG has the responsibility for maintaining a list of threatened and endangered species (California Fish and Game Code Section 2070). The CDFG also maintains a list of "candidate species," which are species formally under review for addition to either the list of endangered species or the list of threatened species. In addition, the CDFG maintains lists of "species of special concern," which serve as watch lists. Pursuant to the requirements of the CESA, an agency reviewing a proposed project within its jurisdiction must determine whether any state-listed endangered or threatened species could be present on the project site and determine whether the proposed project could have a potentially significant impact on such species. In addition, the CDFG encourages informal consultation on

any proposed project that may affect a candidate species. Project-related impacts to species on the CESA endangered or threatened lists would be considered significant in this EIR. Impacts to "species of concern" would be considered significant if the species met the criteria set forth under CEQA Guidelines Section 15380, or if the species were also protected under any of the other statutes or policies discussed in this section.

California Native Plant Protection Act

State listing of plant species began in 1977 with the passage of the California Native Plant Protection Act (NPPA), which directed the CDFG to carry out the legislature's intent to "preserve, protect, and enhance endangered plants in this state." The NPPA gave the California Fish and Game Commission the power to designate native plants as endangered or rare and to require permits for collecting, transporting, or selling such plants. The CESA expanded upon the original NPPA and enhanced legal protection for plants. The CESA established threatened and endangered species categories, and grandfathered all rare animals—but not rare plants—into the act as threatened species. Thus, there are three listing categories for plants in California: rare, threatened, and endangered.

California Fish and Game Code

The California Fish and Game Code provides a variety of protections for species that are not federally or state-listed as threatened, endangered, or of special concern.

- Section 3503 protects all breeding native bird species in California by prohibiting the take,[14] possession, or needless destruction of nests and eggs of any bird, with the exception of non-native English sparrows and European starlings (Section 3801).

- Section 3503.5 protects all birds of prey (in the orders Falconiformes and Strigiformes) by prohibiting the take, possession, or killing of raptors and owls, their nests, and their eggs.

- Section 3513 of the code prohibits the take or possession of migratory nongame birds as designated in the Migratory Bird Treaty Act or any parts of such birds except in accordance with regulations prescribed by the Secretary of the Interior.

- Section 3800 of the code prohibits the taking of nongame birds, which are defined as birds occurring naturally in California that are not game birds or fully protected species.

- Section 3511 (birds), Section 5050 (reptiles and amphibians), and Section 4700 (mammals) designate certain wildlife species as fully protected in California.

Special-Status Natural Communities

Special-status natural communities are identified as such by CDFG's Natural Heritage Division and include those that are naturally rare and those whose extent has been greatly diminished through changes in land use. The CNDDB tracks 135 such natural communities in the same way that it tracks occurrences of special-status species: information is maintained on each site's location, extent, habitat quality, level of disturbance, and current protection measures. The CDFG

[14] "Take" in this context is defined in Section 86 of the California Fish and Game Code as to "hunt, pursue, catch, capture, or kill, or to attempt to hunt, pursue, catch, capture, or kill."

is mandated to seek the long-term perpetuation of the areas in which these communities occur. While there is no statewide law that requires protection of all special-status natural communities, CEQA requires consideration of the potential impacts of a project to biological resources of statewide or regional significance.

Waters of the United States and Waters of the State

The term "waters" under both federal and State regulations (C.F.R. § 328.3[a]; 40 C.F.R. § 230.3[s]; California Water Code, Division 7, Chapter 2, § 13050 [e]) includes streams, rivers, lakes, ponds, wetlands, and sloughs as well as a variety of other water bodies and their tributaries.[15] Wetlands are ecologically productive habitats that support a rich variety of both plant and animal life. The importance of wetlands has increased due to their value as recharge areas and filters for water supplies and their widespread filling and destruction to enable urban and agricultural development. In a jurisdictional sense, there are two commonly used definitions of a wetland, one definition adopted by the Corps and a separate definition, originally developed by USFWS, which has been adopted by the agencies in the State of California that have regulatory authority over wetlands. Both definitions are presented below.

Federal Wetlands Definitions

Pursuant to Section 404 of the Clean Water Act, wetlands are defined as a subset of "waters of the United States." The term "waters of the United States," as defined in the Code of Federal Regulations (33 C.F.R. § 328.3[a]; 40 C.F.R. § 230.3[s]), refers to any of the following:

1. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide.

2. All interstate waters including interstate wetlands. (Wetlands are defined by the federal government [33 C.F.R. § 328.3(b)] as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.).

3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation, or destruction of which could affect interstate or foreign commerce including any such waters:

   – which are or could be used by interstate or foreign travelers for recreational or other purposes; or

   – from which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

   – which are used or could be used for industrial purposes by industries in interstate commerce.

[15] The State definition includes groundwater as well.

4. All impoundments of waters otherwise defined as waters of the United States under the definition.

5. Tributaries of waters identified in paragraphs (1) through (4).

6. Territorial seas.

7. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (1) through (6).

Waters of the United States do not include prior converted cropland. Notwithstanding the determination of an area's status as prior converted cropland by any other federal agency, for the purposes of the Clean Water Act, the final authority regarding Clean Water Act jurisdiction remains with EPA (33 CFR 328.3[a][8]).

Wetland determination under the federal wetland definition adopted by the Corps requires the presence of three factors: (1) wetland hydrology, as defined above under point 2; (2) plants adapted to wet conditions; and (3) soils that are routinely wet or flooded [33 C.F.R. § 328.3(b)].

State of California Wetland Definitions

Agencies with regulatory authority over wetlands in the State of California have several different wetland definitions. The Regional Water Quality Control Boards, which have the primary state authority over wetlands, use the same definition as the Corps (see above), since their regulatory authority rests in Section 401 of the Clean Water Act (33 C.F.R. § 1341[a]).

The CDFG has adopted the Cowardin et al. (1979) definition of wetlands used by the USFWS (California Fish and Game Commission, 1987):[16]

> Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface of the land or is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes (at least 50 percent of the aerial vegetative cover); (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is non-soil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Under normal circumstances, the federal definition of wetlands requires all three wetland identification parameters to be met, whereas the Cowardin definition requires the presence of at least one of these parameters. For this reason, identification of wetlands by the CDFG consists of the union of all areas that are periodically inundated or saturated, or in which at least seasonal dominance by hydrophytes may be documented, or in which hydric soils are present. The CDFG does not normally have direct jurisdiction over wetlands unless they are subject to jurisdiction under streambed alteration agreements or they support state-listed endangered species.

[16] The California Coastal Commission uses yet another wetland definition that is based on the Cowardin definition.

Regulation of Activities in Jurisdictional Waters

The U.S. Army Corps of Engineers has primary federal responsibility for administering two key statutes regulating waters of the United States, including "other waters" and wetlands: (1) the Rivers and Harbors Act (Sections 9 and 10), which governs specified activities in "navigable waters"; and (2) the Clean Water Act (Section 404), which governs specified activities in "waters of the United States," including wetlands. The Corps requires that a permit be obtained if a project proposes placing structures within navigable waters (Rivers and Harbors Act) or placing dredged or fill material into waters of the U.S. below the ordinary high-water mark in non-tidal waters.

The State's authority in regulating activities in other waters and wetlands resides primarily with the CDFG and the State Water Resources Control Board (SWRCB). In addition, the California Coastal Commission has review authority for projects within its jurisdiction. The CDFG provides comment on Corps permit actions under the Fish and Wildlife Coordination Act. The CDFG is also authorized under the California Fish and Game Code, Sections 1600–1616, to enter into a Streambed Alteration Agreement with an applicant and develop mitigation measures when a proposed project would obstruct the flow or alter the bed, channel, or bank of a river or stream in which there is a fish or wildlife resource, including intermittent and ephemeral streams. The SWRCB, acting through the nine Regional Water Quality Control Boards, must certify (or issue a waiver) that a Corps permit action meets state water quality objectives (Section 401, Clean Water Act).

IV.C.2.7 Local Plans and Policies

LBNL is a federal facility operated by the University of California and conducting work within the University's mission on land that is owned or controlled by The Regents of the University of California. As such LBNL is generally exempted by the federal and state constitutions from compliance with local land use regulations, including general plans and zoning. However, LBNL seeks to cooperate with local jurisdictions to reduce any physical consequences of potential land use conflicts to the extent feasible. This section summarizes relevant polices contained in both the Berkeley and Oakland General Plans, as well as other City of Berkeley and City of Oakland documents relevant to biological resources at LBNL.

Berkeley General Plan

City of Berkeley General Plan policies pertaining to natural resources that are relevant to implementation of the LBNL LRDP include the following:

> Policy EM-28 Creeks and Watershed Management: Whenever feasible, daylight creeks by removing culverts, underground pipes, and obstructions to fish and animal migrations.
>
> Policy EM-28 Natural Habitat: Restore and protect valuable, significant, or unique natural habitat areas.
>
> Policy EM-30 Native Plants: Use native tree and plant species to enhance ecological richness.

Policy EM-31 Landscaping: Encourage drought-resistant, rodent-resistant, and fire-resistant plants to reduce water use, prevent soil erosion, improve habitat, reduce fire danger, and minimize degradation of natural resources.

Policy EM-32 Inter-jurisdictional Coordination: Encourage efforts by neighboring jurisdictions and agencies, such as the East Bay Regional Parks District, University of California, Berkeley, and the Lawrence Berkeley National Laboratory, to restore historic coastal grasslands in the hill area to provide natural habitat and reduce fire danger in the area.

City of Berkeley Coast Live Oak Removal Ordinance

The Berkeley City Council adopted ordinances declaring a moratorium on the removal of coast live oak trees within the city (Ordinance No. 6321-N.S., as amended by Ordinance No. 6462-N.S and Ordinance No. 6550-N.S.). These ordinances prohibit the removal of any single-stem coast live oak with a circumference of 18 inches or greater, as measured at a distance of 4 feet above ground level, and the removal of any multi-stemmed coast live oak with an aggregate circumference of 26 inches or greater. Exceptions may be made if the tree poses a danger to people and/or property and the only reasonable solution is tree removal.

City of Berkeley Creek Ordinance

Title 17, Chapter 17.08 of the Berkeley Municipal Code, Preservation and Restoration of Natural Watercourses, establishes policies on the issuance of permits for culverting open creeks, the rehabilitation and restoration of open waterways, and the management of watersheds. The ordinance defines a creek as a "…naturally occurring swale or depression, which carries water either seasonally or year-round, and which appears as an aboveground creek on the Geological Survey Map and in the 1975 Berkeley creeks map prepared by the planning department to show the approximate undergrounding of the watercourse." The ordinance prohibits the filling, obliteration, obstruction, and interference with any natural watercourse in Berkeley, as well as the construction of structures within 30 feet of the centerline of a creek without a permit. The ordinance also prohibits the culverting or riprapping of a creek without a permit issued by the city engineer. No permit will be issued without the submittal of plans, and any work carried out under the permit must be supervised by the city engineer or his designee. A permit will not be granted if less destructive solutions are feasible. Such alternatives include clearing of debris within the creek channel; restoration of the creek to re-establish natural stream morphology, geometry, or channel roughness; removal of structures when feasible; and bank stabilization using bioengineering techniques.

Oakland General Plan

The Open Space, Conservation, and Recreation (OSCAR) Element of the City of Oakland General Plan was adopted in 1996. OSCAR policies pertaining to natural resources with relevance to implementation of the LBNL LRDP include the following:

Policy CO-6.1: Protect Oakland's remaining natural creek segments by retaining creek vegetation, maintaining creek setbacks, and controlling bank erosion. Design future flood control projects to preserve the natural character of creeks and incorporate provisions for

public access, including trails, where feasible. Strongly discourage projects which bury creeks or divert them into concrete channels.

Policy CO-7.1: Protect native plant communities, especially oak woodlands, redwood forests, native perennial grasslands, and riparian woodlands, from the potential adverse impacts of development. Manage development in a way which prevents or mitigates adverse impacts to these communities.

Policy CO-7.3: Make every effort to maintain the wooded or forested character of tree-covered lots when development occurs on such lots.

Policy CO-7.4: Discourage the removal of large trees on already developed sites unless removal is required for biological, public safety, or public works reasons.

Policy CO-8.1: Work with federal, state, and regional agencies on an ongoing basis to determine mitigation measures for development which could potentially impact wetlands. Strongly discourage development with unmitigatable adverse impacts.

Policy CO-9.1: Protect rare, endangered, and threatened species by conserving and enhancing their habitat and requiring mitigation of potential adverse impacts when development occurs within habitat areas.

Policy CO-11.1: Protect wildlife from the hazards of urbanization, including loss of habitat and predation by domestic animals.

Policy CO-11.2: Protect and enhance migratory corridors for wildlife. Where such corridors are privately owned, require new development to retain native habitat or take other measures which help sustain local wildlife population and migratory patterns.

The following policy is from the Land Use and Transportation Element:

Policy W3.3: Native plant communities, wildlife habitats, and sensitive habitats should be protected and enhanced.

City of Oakland Tree Ordinance

Title 12, Chapter 12.36 of the Oakland Municipal Code provides protection to coast live oaks measuring 4 inches in diameter (12 inches in circumference) and to any other tree measuring 9 inches in diameter (28 inches in circumference), when measured at a height of 4 feet above grade. Protected trees may not be removed without a tree removal permit. Permits may be issued with conditions of approval that include, but are not limited to, the protection of any other protected trees in the vicinity of the tree(s) to be removed and replacement plantings. Replacement plantings are not required for the removal of non-native species when trees are removed for the benefit of remaining trees or when there is insufficient space for a mature tree of the species being considered. Replacement trees must be trees appropriate to the area: coast live oak, coast redwood, madrone, California buckeye, or California bay.

City of Oakland Creek Ordinance

Title 13, Chapter 13.16, City of Oakland Creek Protection, Storm Water Management, and Discharge Control Ordinance, provides a high level of protection for creeks within Oakland's city limits. The ordinance defines a creek as "…a watercourse that is a naturally occurring swale or depression, or engineered channel that carries fresh or estuarine water either seasonally or year-around." In addition, under the ordinance definition, a creek channel must be hydrologically connected to a waterway above or below a project site, and the channel must exhibit a defined bed and bank. A creek protection permit is required whenever work is to be undertaken on a creekside property. The ordinance prohibits, among other things, the discharge of concentrated stormwater or other modification of the natural flow of water in a watercourse, development within a watercourse or within 20 feet from the top of the bank, and the deposition or removal of any material within a watercourse without a permit. Depending on the type of activity being permitted, conditions of approval may include the submittal of a creek protection plan and/or a hydrology report, revegetation with native plant species, the use of soil bioengineering techniques for bank stabilization and erosion control, and implementation of stormwater quality protection measures. The following activities, among others, are typically not permitted:

- Removal of riparian vegetation
- Culverting or undergrounding of a creek
- Moving the location of a creek
- Structures spanning a creek
- Riprap, rock gabions, or concrete within the bed or on the creek banks

The City of Oakland Creek Protection Ordinance was adopted in 1997. The ordinance is currently undergoing a clarification and revision process, and new guidelines for implementation are being developed.

UC Berkeley Strawberry Creek Management Plan

The Strawberry Creek Management Plan was originally prepared in 1987. The streams that dissect LBNL's slopes represent a significant portion of the upper Strawberry Creek watershed. The plan contains recommendations on best management practices for the Strawberry Creek watershed to control nonpoint-source pollution and reduce degradation of water quality. LBNL's has its own best management practices related to non-point-source pollution and reduction of degradation of water quality.

UC Berkeley Management Plan for Strawberry and Claremont Canyons

In 1979, the University Committee on Conservation and Environmental Quality prepared the *Management Plan for Strawberry and Claremont Canyons* (Beatty, 1979). This plan details guidelines for the management of vegetation and wildlife, fuel levels, watercourses, recreation, and land use in the Strawberry and Claremont Canyon areas and provides vegetation and fuel management prescriptions. Guidelines relevant to activities that may occur under the LBNL LRDP include the following:

- The Strawberry Canyon area should be managed to promote those natural succession processes that will result in a mosaic of native vegetation types.
- As non-native tree stands become decadent, they should be evaluated individually for replanting or conversion to native habitat.
- Planting of native species should be carried out with stock propagated from local materials.
- Herbicides should not be used to remove unwanted vegetation.
- Further increases in impervious surfaces throughout Strawberry Canyon should be minimized.
- Culverts should be cleaned at the end of each summer and inspected and cleaned after each rainstorm throughout the rainy season.
- Road cuts and fill areas should be inspected for erosion and seeded with appropriate species if erosion is present.
- Stream channels should be inspected and cleaned up annually. Debris, including brush, tree branches, and garbage, that can be moved downstream during peak flows should be removed.

The plan also provides guidelines for management of the University's 300-acre Ecological Study Area, which was established in 1969 and which lies adjacent to LBNL along a portion of its southern perimeter. This area is set aside for field research and natural resource investigations as well as passive recreational use by the general public. Relevant guidelines for Ecological Study Area management contained in the plan include the following:

- A new boundary should be established that would reduce the Ecological Study Area by a 100-foot strip in areas where it is adjacent to residential areas and roads. This buffer would provide for a fuel management zone along the perimeter of the Ecological Study Area.
- Within the fuel management zone:
  - Fuel over 3 inches in diameter, with the exception of downed logs over 12 inches in diameter on bare soil, will be removed.
  - The density of shrubs and trees should be reduced within the fuel management zone to break up both horizontal and vertical continuity.
  - Low-growing tree branches should be pruned to eliminate fuel ladders.
  - Growth of annual vegetation within 6 feet of roads should be cut and removed each year at the end of the growing season.

The 2020 UC Berkeley LRDP incorporates three previously proposed expansions of the Ecological Study Area boundary, as well as a further expansion to extend the Ecological Study Area boundary west to the Field Station for Behavioral Research. The 2020 LRDP also adjusts the eastern boundary of the Ecological Study Area to align with the watershed divide separating Claremont and Strawberry Canyons.

IV.C.3 Impacts and Mitigation Measures

IV.C.3.1 Significance Criteria

Evaluation of potential project impacts on the biological resources of a site and its surroundings requires analysis of the individual elements of the project and how introduction of those elements (separately or collectively) would affect the existing resources of the site.

For the purposes of this EIR, implementation of the 2006 LBNL LRDP may have a significant effect on biological resources if it would exceed the following Standards of Significance, based on Appendix G of the CEQA Guidelines and the UC CEQA Handbook:

- Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations, or by CDFG or USFWS;
- Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by CDFG or USFWS;
- Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means;
- Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites;
- Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan; or
- Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance.

IV.C.3.2 Impact Assessment Methodology

Potential impacts resulting from implementation of the LBNL 2006 LRDP were evaluated using the following methods and sources:

- Review of existing resource maps and aerial photographs of the project site. Preparation of graphics including vegetative cover, potentially jurisdictional waters, and sensitive habitat areas.
- Multiple field surveys (ESA, 2002a-c; ESA, 2003a-c).
- A review of biological data presented in the CNDDB and the CNPS *Electronic Inventory of Rare and Endangered Vascular Plants of California*, and an official species list for the project area from the USFWS (2005).
- Review of standard biological references (e.g., Hickman, 1993; Zeiner et al., 1990; and Stebbins, 1985).

- Review of LBNL's 1987 LRDP and its associated environmental impact reports, as well as surveys and environmental documents associated with specific LBNL projects and programs.

- Review of other available literature regarding the natural resources of the area (e.g., Beatty, 1979; Charbonneau, 1987; McBride, 1974; and Swaim, 1994).

Once site surveys were completed and all sources reviewed, a list was prepared of special-status species that were observed or had the potential to occur due to the presence of basic habitat types. Species were then evaluated to determine their potential to occur. Species determined unlikely to occur are species whose known current distribution or range does not include the LBNL site, for whom specific habitat requirements (i.e., serpentine grasslands, as opposed to grasslands occurring on other soils) are not present, or that are presumed to have been extirpated from the project area or region. Species with low potential to occur are those for whom limited or marginally suitable habitat is present at LBNL, even though they have not been observed during general biological or focused surveys conducted at LBNL and/or the species may not be documented in the general vicinity. Species with moderate potential to occur are those for whom low to moderate quality habitat is present at LBNL and that may or may not be documented as occurring in the vicinity. A species was determined to have high potential for occurrence if moderate to high quality habitat is present at LBNL and the site is included in the documented range of the species. Species designated as observed are documented as having been observed at LBNL.

For the analysis presented below, impacts resulting from implementation of the 2006 LRDP were considered to be significant if they would:

- Have a substantial adverse effect on special-status species that were found to have moderate or high potential to occur and/or special-status species that have been observed at LBNL;

- Result in the fill of or otherwise cause degradation of potentially jurisdictional waters;

- Have a substantial adverse effect on areas designated as sensitive habitat in this EIR; or

- Otherwise exceed the significance criteria presented above.

Development projects proposed under the 2006 LRDP could disturb common wildlife species that exist within the proposed project area, including California mule deer, raccoon, striped skunk, and gopher snake. Animals within these habitats, such as small mammals and reptiles, could be temporarily displaced during habitat removal or subjected to noise and other human disturbances as well as to direct mortality. The amount of habitat for these animals permanently lost as a result of the project is insignificant compared to the amount of similar habitat present in the general vicinity. Habitat temporarily disturbed during project construction would be revegetated similar to pre-project conditions. Disturbances to common wildlife species that could occur with implementation of the 2006 LRDP would not meet any of the significance criteria listed above, and are therefore not discussed further in this impact section.

In addition to providing the environmental impact analysis for the LRDP, the analysis in this EIR will be used in connection with later approvals of specific activities pursuant to the LRDP. The

Lab will evaluate the impacts on biological resources of any later activity implemented pursuant to the LRDP and compare those impacts with the evaluation in this program EIR. If specific project differences from the presentation of the Illustrative Development Scenario and the 2006 LRDP EIR are such that the project is not within the scope of the LRDP EIR or the specific impact statements and mitigation measures do not cover the individual project pursuant to CEQA Guidelines Sections 15168(c)(2) and 15168(c)(5), then appropriate, project-specific CEQA analysis will be tiered from this 2006 LRDP EIR in accordance with CEQA Guidelines Section 15168(d)(1-3). In addition, this determination regarding the extent of further review that is required will be based on the limitations on further use of this EIR imposed in response to the City of Berkeley comments, as described in Chapter I.

IV.C.3.3 2006 LRDP Principles, Strategies and LBNL Design Guidelines

2006 LRDP Principles and Strategies

The 2006 LRDP proposes four fundamental principles that form the basis for the Plan's development strategies provided for each element of the Plan. The one principle most applicable to the biological aspect of new development is to "Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship."

Development strategies provided by the 2006 LRDP are intended to minimize potential environmental impacts that could result from implementation of the 2006 LRDP (see Chapter III, Project Description for further discussion, and see Appendix B for a full listing of principles, strategies and design guidelines). Development strategies set forth in the 2006 LRDP applicable to biological resources include the following:

- Protect and enhance the site's natural and visual resources, including native habitats, riparian areas, and mature tree stands by focusing future development primarily within the already developed areas of the site.

- Continue to use sustainable practices in selection of plant materials and maintenance procedures.

- Develop all new landscape improvements in accordance with the Laboratory's vegetation management program to minimize the threat of wildland fire damage to facilities and personnel.

- Utilize native, drought-tolerant plant materials to reduce water consumption; focus shade trees and ornamental plantings at special outdoor use areas.

LBNL Design Guidelines

The LBNL Design Guidelines were developed in parallel with the LRDP and are proposed to be adopted by the Lab following The Regents' consideration of the 2006 LRDP. The LBNL Design Guidelines provide specific guidelines for site planning, landscape and building design as a means to implement the LRDP's development principles as each new project is developed.

Specific design guidelines are organized by a set of design objectives that essentially correspond to the strategies provided in the LRDP. The LBNL Design Guidelines provide the following specific planning and design guidance relevant to the biological resources related aspects of new development to achieve these design objectives:

- Projects or portions of projects which fall within the Rustic Landscape zones identified on the LRDP Landscape Framework Map shall provide new plantings consistent with this zone.
- Projects or portions of projects which fall within the Rustic Riparian Landscape zones identified on the LRDP Landscape Framework Map shall provide new plantings consistent with this zone.
- Projects or portions of projects which fall within the Ornamental Landscape zones identified on the LRDP Landscape Framework Map shall provide new plantings consistent with this zone.
- Minimize impacts of disturbed slopes.
- Create a cohesive identity across the Lab as a whole by following established precedents for new landscape elements.
- Minimize further increases in impermeable surfaces at the Lab

IV.C.3.4 Impacts and Mitigation Measures

Impact BIO-1: Development proposed under the 2006 LRDP would result in the permanent and/or temporary removal of some existing native and non-native vegetation. (Less than Significant)

New proposed development under the 2006 LRDP occurring in areas not subject to previous construction would result in an increase of impervious surfaces at LBNL by an estimated total of approximately 9.5 acres, with a corresponding permanent decrease in the extent of existing vegetation. In addition, development of new buildings and parking lots would result in the temporary removal of existing vegetation in association with excavation and grading, the construction of temporary access roads, and other related activities. Under the 2006 LRDP, development of new buildings, roads, and parking lots would be restricted to the proposed developable areas. Although they contain some undeveloped and/or vegetated spaces between or contiguous to development, these areas encompass primarily those portions of the Laboratory site that have been developed or otherwise disturbed in the past. The major vegetation types occurring in these areas are non-native grassland, eucalyptus and conifer stands, and landscaped areas. These vegetation types are dominated by non-native species and, while permanent loss of this vegetation could adversely affect common wildlife species locally, the impact to vegetation types that are common throughout the Oakland-Berkeley hills would be less than significant because of the existing abundance of these non-special-status species.

Incorporation of the LRDP Development Principles and Design Guidelines, as well as the following best practices currently undertaken by Berkeley Lab in connection with development

projects, would further reduce the degree of the impact. Among these practices are the following. Revegetation of disturbed areas (not covered by active buildings or parking lots), including slope stabilization sites, using native shrubs, trees, and grasses is included as a part of all new projects to the extent feasible and in keeping with the Lab's vegetation management program. Invasive plant species and other undesirable plants, such as French broom, yellow star-thistle, and Italian thistle, are controlled as appropriate under the Laboratory's vegetation management program. Removal of native trees and shrubs is minimized and, to the extent feasible, the removal of large coast live oak and California bay trees is avoided. To the extent feasible, disturbance to the LBNL perimeter buffer zones (i.e., undeveloped and vegetated areas around the Lab perimeter, particularly those areas falling within the area designated as Perimeter Open Space) is avoided or minimized, particularly in areas that are contiguous with natural or otherwise undeveloped areas outside of Lab boundaries or within areas designated as having fixed constraints (i.e. riparian habitat). Additionally, to the extent feasible, LBNL minimizes activity and encroachment in Blackberry Canyon. To date, these practices have been effective or have made important contributions towards minimizing erosion and slope instability, controlling invasive plant species, minimizing the removal of native trees and shrubs, and in maintaining the vegetated areas along the Lab's perimeter with a minimum of disturbance.

Mitigation: None required.

Project Variant. Compared to the 2006 LRDP, the project variant would not result in any change in buildings or structures (including roads, parking lots, etc.) developed, and therefore impacts would be the same as those described for the proposed project, and would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of biological impacts. Potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario for previously undeveloped areas where native vegetation may remain include Buildings S-1, S-13, and S-15. Individual projects identified in the Illustrative Development Scenario that include a combination of previously developed as well as undeveloped areas include Buildings S-4, S-5, S-8, S-9, S-12, and S-14, as well as Parking Structures and Lots PS-2, PL-3, and PL-9 (along with Road 2). Development in these areas would result in removal of some existing native and non-native vegetation. For the reasons stated above, with incorporation of the LRDP Development Principles and Design Guidelines, as well as the above-noted best practices, implementation of these future projects under the LRDP would have a less-than-significant impact on native vegetation.

Impact BIO-2: Development under the 2006 LRDP could result in adverse impacts to drainages and/or wetlands subject to Corps and CDFG jurisdiction, including permanent or temporary fill,[17] and accidental discharges of fill materials or other deleterious substances during construction. (Significant; Less than Significant with Mitigation)

Implementation of the 2006 LRDP could result in adverse impacts to potentially jurisdictional waters, including drainages and wetlands, at LBNL. Any LRDP development project resulting in permanent or temporary fill of jurisdictional waters would most likely be subject to provisions of Sections 401 and 404 of the Clean Water Act and Sections 1600 through 1616 of the California Fish and Game Code. Such projects may qualify for authorization under a Nationwide Permit (NWP) from the Corps. The most likely applicable NWP for projects occurring under the LRDP would be Nationwide Permit 39, *Residential, Commercial, and Institutional Developments.* Although the qualifications vary by nationwide permit, under NWP 39, impacts to waters under the jurisdiction of the Corps must be less than 0.5 acre in area, and no more than 300 linear feet of intermittent or perennial stream may be filled in order to qualify for authorization. Even if these limitations are met, the Corps has discretion under certain circumstances to require an individual permit. When a project does not meet the criteria for a nationwide permit, an applicant must also apply for an Individual Permit. Under NWP 39, fill of greater than 300 linear feet of perennial stream would require an Individual Permit and fill of greater than 300 linear feet of intermittent stream would require an Individual Permit or a waiver of 300 foot limit from the Corps' district engineer, who must determine that the proposed activity otherwise complies with the terms and conditions of the Nationwide Permit and that adverse environmental effects are minimal both individually and cumulatively, and must waive the limitation in writing before the permittee can proceed with project implementation. In the event that the district engineer will not waive the fill limit, an Individual Permit would be required.

In addition, any project requiring Corps authorization would require a Section 401 Regional Water Quality Control Board certification or waiver and most such projects would also require a Streambed Alteration Agreement from the CDFG. These permits must be obtained prior to project implementation and would contain conditions of approval designed to minimize adverse effects on wetland resources. Acquisition of these permits is a regulatory requirement and is not considered in and of itself mitigation for loss of waters of the U.S. However, the processes for obtaining any state or federal wetlands permits involve the development of compensatory actions similar to CEQA-derived mitigation in scope and intent. In addition to the acquisition of necessary permits, implementation of the mitigation measures listed below (BIO-2a through BIO-2c) would serve to reduce potential impacts on jurisdictional waters to less-than-significant levels.

As described in detail in Section IV.G, Hydrology and Water Quality, LBNL currently employs, and would continue to employ, a wide array of construction-period "best management practices" to minimize the potential for accidental discharges of fill or other materials into jurisdictional waters. Active management of construction-related stormwater flows from development sites is a

[17] Fill is a technical term used by the Corps and defined as "any material placed in an area to increase surface elevation" (Wetland Training Institute, 1995).

standard part of contract specifications on all construction projects undertaken by LBNL. Construction projects incorporate control measures and are monitored to manage stormwater flows and potential discharge of pollutants. For example, LBNL's standard construction specifications include requirements for installation of erosion control netting and riprap to protect slopes and minimize adverse effects of runoff; protection of existing plant materials; application and maintenance of hydroseeding (sprayed application of seed and reinforcing fiber on graded slopes); no washout of concrete trucks to the storm drain system; and proper disposal of waste water resulting from vehicle washing. LBNL also implements spill prevention and response programs to minimize pollutants in runoff. Construction sites are replanted as soon as practicable following construction. In addition, the Lab's construction specifications require that contractors properly maintain construction vehicles to minimize fluid leaks and that contractors not refuel construction equipment in proximity to waterways. These ongoing programs would reduce the potential for accidental discharge during construction to adversely affect jurisdictional waters. In addition to the acquisition of necessary permits and employment of LBNL best management practices, implementation of the following mitigation measures (BIO-2a through BIO-2c) would reduce the potential impact on jurisdictional waters and accidental discharges of fill or other deleterious substances during construction to a less-than-significant level.

Mitigation Measure BIO-2a: Future development under the 2006 LRDP shall avoid, to the extent feasible, the fill of potentially jurisdictional waters. Therefore, during the design phase of any future development project that may affect potentially jurisdictional waters, a preliminary evaluation of the project site shall be made by a qualified biologist to determine if the site is proximate to potentially jurisdictional waters and, if deemed necessary by the biologist, a wetlands delineation shall be prepared and submitted to the Corps for verification.

Most development projected under the 2006 LRDP would have no potential for impacts on jurisdictional waters. However, development in specific locations including Buildings S-2 and S-0, as well as Parking Structures and Lots PS-1 and PL-9 and Roads R-2 and R-5, could require fill of or create the potential for accidental discharges to jurisdictional waters. It should be noted that the preferable form of mitigation recommended by the Corps is avoidance of jurisdictional waters. To the extent practicable, new development under the 2006 LRDP shall be located so as to avoid the fill of jurisdictional waters.

Mitigation Measure BIO-2b: Any unavoidable loss of jurisdictional waters shall be compensated for through the development and implementation of a project-specific Wetlands Mitigation Plan.

In the event that potential impacts to streams resulting from a 2006 LRDP development project are identified, compensation for loss of jurisdictional waters would be based on the Corps-verified wetlands delineation identified in Mitigation Measure BIO-2.a. During the permit application process for specific development project(s) with identified impacts on jurisdictional drainages or wetlands, LBNL would consult with the Corps, CDFG, and Regional Water Quality Control Board regarding the most appropriate assessment and mitigation methods to adequately address losses to wetland function that could occur as a result of the development project(s). A project-specific wetland mitigation plan would be developed prior to project implementation and submitted to permitting agencies for their approval. The plan may include one or more of the following mitigation options:

restoration, rehabilitation, or enhancement of drainages and wetlands in on-site areas that remain unaffected by grading and project development or off-site at one or more suitable locations within the project region; creation of on-site or off-site drainages or wetlands at a minimum of a 1:1 functional equivalency or acreage ratio (as verified by the Corps); purchase of credits in an authorized mitigation bank acceptable to the Corps and CDFG; contributions in support of restoration and enhancement programs located within the project region (such as those operated by local non-profit organizations including the Friends of Strawberry Creek, the Urban Creeks Council, or the Waterways Restoration Institute); or other options approved by the appropriate regulatory agency at the time of the specific project approval.

All mitigation work proposed in existing wetlands or drainages on- or off-site shall be authorized by applicable permits.

Mitigation Measure BIO-2c: To the extent feasible, construction projects that might affect jurisdictional drainages and/or wetlands could be scheduled for dry-weather months.

Avoiding ground-disturbing activities during the rainy season would further decrease the potential risk of construction-related discharges to jurisdictional waters.

Significance after Mitigation: Less than significant.

Project Variant. Compared to development pursuant to the 2006 LRDP, the project variant would not result in any change in buildings or structures developed, and therefore impacts would be the same as those described for the proposed project. With implementation of Mitigation Measures BIO-2a through BIO-2c, the impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on jurisdictional drainages and/or wetlands. For the reasons stated above, construction of specific potential projects under the LRDP such as those identified in the Illustrative Development Scenario could adversely affect jurisdictional drainages and/or wetlands or result in accidental discharges. The above impact statement would also apply to the Illustrative Development Scenario and, with implementation of Mitigation Measures BIO-2a through BIO-2c, the impact on jurisdictional waters and from potential accidental discharges would be less than significant.

Impact BIO-3: Construction activities proposed under the 2006 LRDP could adversely affect special-status nesting birds (including raptors) such that they abandon their nests or such that their reproductive efforts fail. (Significant; Less than Significant with Mitigation)

The removal of large, mature trees within a future development project footprint as well as any unusually loud noise level generated by project construction activities have the potential to disturb nesting raptors or other special-status nesting birds using the trees, or to result in the destruction or abandonment of special-status bird nests, eggs, or fledglings. Cooper's hawk, a California species of concern, as well as red-tailed hawk and American kestrel, both of which are protected under Section 3503.5 of the California Fish and Game Code, have been observed foraging on-site and may nest at LBNL as well. Based on the presence of suitable habitat, a number of other bird species of concern (see Table IV.C-1, p. IV.C-10) should be considered as potentially present and possibly using the area for nesting purposes. Tree removal or tree pruning could result in the loss of active nests of the above-noted raptors, and possibly of nests of other special-status bird species identified in Table IV.C-1. This would constitute a significant adverse impact.

Ambient noise level in developed areas of the Lab is typically generated mostly by vehicle traffic, especially diesel trucks and the Lab's shuttle bus fleet (also diesel-powered), which circulates the Lab at 10-minute intervals throughout the day, as well as automobiles and motorcycles. Stationary sources, including heating, ventilating, and air-conditioning equipment associated with buildings, and other stationary equipment at the Lab, including pumps, generators, cooling towers, exhaust hoods, and machine shop equipment, also generate noise. Noise measurements taken in July 2003 and January 2004 indicate that hourly average noise levels at locations around the Lab range between 52 and 68 decibels (dBA, Leq[18]). Maximum noise levels measured were between 61 and 83 dBA, with the higher levels most likely the result of shuttle bus traffic on the hill.[19]

As stated in Section IV.I, Noise, noise levels associated with typical construction and demolition equipment (other than the noisiest equipment, such as a hoe-ram impact hammer) range from 74 to 77 dBA. Operation of multiple pieces of equipment typically results in noise levels a few decibels higher. While much of the available research on noise effects on wildlife focuses on longer-term effects related to disturbance from recreational users and military operations (e.g., snowmobiles in national parks, military aircraft overflights in wilderness areas), this analysis conservatively assumes that disturbances from construction and demolition noise could potentially result in the abandonment of special-status bird nests, eggs, or fledglings present in the trees adjacent to the site. On one hand, one source reports, in terms of effects of continuous noise on bird communities, "An increase of 10 dBA above background noise is probably acceptable in most situations" (Nicholoff, 2003). On the other hand, a 10-dBA increase in noise level is perceived by the human ear as a doubling in loudness, potentially causing an adverse response. Wildlife perception of noise appears to be generally more sensitive than that of humans; therefore, it is assumed for the purposes of this EIR that a 10-dBA increase in noise (a doubling

[18] Frequency A-weighting follows an international standard methodology of frequency de-emphasis and is typically applied to community noise measurements; Leq represents the constant sound level that would contain the same acoustic energy as the varying sound level.

[19] All noise readings were based on measurements 15 minutes in duration.

of loudness) over the existing maximum levels should be considered to be material for birds, as well as other wild animals. Under many circumstances involving demolition and construction in already developed areas of the Lab, construction-generated noise levels would not be expected to exceed ambient noise levels by 10 dBA or more. Additionally, these noise levels would not be continuous (i.e., an individual piece of construction equipment frequently operates for several minutes to an hour or two before stopping while equipment is repositioned, haul trucks depart, and so forth), and therefore such activities would not be considered sufficient to cause a significant impact on nesting special-status birds. In cases when particularly noisy equipment was employed, i.e., causing noise that would substantially exceed ambient noise levels in sensitive habitat areas nearby), noise impacts would have the potential to cause a significant adverse noise or vibration impact to wildlife. Project-specific noise analysis could be required for future projects to determine whether such impacts would occur. Whatever the noise and demolition activity levels on the project site, there would be no adverse effect to biological resources, and therefore no significant impact, so long as the project would not interfere with the successful nesting of raptors and other special-status birds.

In addition to CEQA impacts, any removal or destruction of active nests and any killing of migratory birds would violate the federal Migratory Bird Treat Act and/or the California Fish and Game Code, Sections 3500-3516. (As noted, raptors protected by Fish and Game Code Section 3503.5 are considered special-status species for the purposes of this EIR, and are therefore listed in Table IV.C-1.)

With implementation of Mitigation Measure BIO-3 below, project effects with regard to nesting birds would not result in a substantial adverse effect on special-status species, nor interfere substantially with the movement of any resident or migratory species or impede the use of native wildlife nursery sites, and therefore the effect would be less than significant. This measure would apply to all project sites where trees and shrubs suitable for nesting birds were present.

> **Mitigation Measure BIO-3:** Direct disturbance, including tree and shrub removal or nest destruction by any other means, or indirect disturbance (e.g., noise, increased human activity in area) of active nests of raptors and other special-status bird species (as listed in Table IV.C-1) within or in the vicinity of the proposed footprint of a future development project shall be avoided in accordance with the following procedures for Pre-Construction Special-Status Avian Surveys and Subsequent Actions. No more than two weeks in advance of any tree or shrub removal or demolition or construction activity involving particularly noisy or intrusive activities (such as concrete breaking) that will commence during the breeding season (February 1 through July 31), a qualified wildlife biologist shall conduct pre-construction surveys of all potential special-status bird nesting habitat in the vicinity of the planned activity and, depending on the survey findings, the following actions shall be taken to avoid potential adverse effects on nesting special-status nesting birds:
>
> 1. Pre-construction surveys are not required for demolition or construction activities scheduled to occur during the non-breeding season (August 1 through January 31).
>
> 2. If pre-construction surveys indicate that no nests of special-status birds are present or that nests are inactive or potential habitat is unoccupied, no further mitigation is required.

3. If active nests of special-status birds are found during the surveys, a no-disturbance buffer zone will be created around active nests during the breeding season or until a qualified biologist determines that all young have fledged. The size of the buffer zones and types of construction activities restricted within them will be determined through consultation with the CDFG, taking into account factors such as the following:

    a. Noise and human disturbance levels at the project site and the nesting site at the time of the survey and the noise and disturbance expected during the construction activity;

    b. Distance and amount of vegetation or other screening between the project site and the nest; and

    c. Sensitivity of individual nesting species and behaviors of the nesting birds.

4. Noisy demolition or construction activities as described above (or activities producing similar substantial increases in noise and activity levels in the vicinity) commencing during the non-breeding season and continuing into the breeding season do not require surveys (as it is assumed that any breeding birds taking up nests would be acclimated to project-related activities already under way). However, if trees and shrubs are to be removed during the breeding season, the trees and shrubs will be surveyed for nests prior to their removal, according to the survey and protective action guidelines 3a through 3c, above.

5. Nests initiated during demolition or construction activities would be presumed to be unaffected by the activity, and a buffer zone around such nests would not be necessary.

6. Destruction of active nests of special-status birds and overt interference with nesting activities of special-status birds shall be prohibited.

7. The noise control procedures for maximum noise, equipment, and operations identified in Section IV.I, Noise, of this EIR shall be implemented.

Implementation of the above measures would mitigate for the possible loss of individual active nests and ensure significance thresholds are not exceeded. No mitigation is proposed for the general loss of bird habitat. In addition to the numerous trees and shrubs within the proposed developable areas that are suitable for nesting and not proposed for removal, suitable and more extensive nesting and foraging habitat for special-status birds is available within protected, undeveloped lands adjacent to LBNL in the UC Berkeley Strawberry Canyon Ecological Study Area and within one mile of LBNL at Tilden Park and Claremont Canyon Regional Preserve. The abundance and proximity of protected habitat similar in structure and composition suggests that population effects on these birds resulting from project activities would be minor. Therefore, based on the temporary nature of the tree removal (in general trees that are removed would be replaced per LBNL's revegetation policies), the availability of suitable nesting habitat outside the construction disturbance zone, and permanently protected habitat generally within the range of the species, proposed development projects allowed under the 2006 LRDP, with implementation of Mitigation Measure BIO-3 above, would not significantly affect habitat for nesting birds potentially occurring at LBNL.

Significance after Mitigation: Less than significant.

Project Variant. Compared to the LRDP, the project variant would not result in any change in buildings or structures developed, and therefore impacts would be the same as those described for the proposed project. With implementation of Mitigation Measure BIO-3, the impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on special-status birds. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario could adversely affect nesting raptors or other special-status birds, and the above impact statement would also apply to the Illustrative Development Scenario. With implementation of Mitigation Measure BIO-3, impacts of potential future LRDP projects identified in the Illustrative Development Scenario on nesting raptors or other special-status birds would be less than significant.

Impact BIO-4: Removal of trees and other proposed construction activities during the breeding season could result in direct mortality of special-status bats. In addition, construction noise and human disturbance could cause maternity roost abandonment and subsequent death of young. (Significant; Less than Significant with Mitigation)

The USFWS lists a number of bat species as species of federal concern, due to nationwide declines in many bat populations. Special-status bats that may occur at LBNL include fringed myotis and long-eared myotis. Special-status bats may use crevices in exfoliating tree bark and/or hollow cavities in trees located at LBNL, as well as abandoned buildings. This type of bat behavior would be most likely to occur in perimeter areas of the site. With implementation of Mitigation Measure BIO-4 below, project effects with regard to bats would not result in a substantial adverse effect on special-status species, nor interfere substantially with the movement of any resident or migratory species or impede the use of native wildlife nursery sites, and therefore the effect would be less than significant. This measure would apply to all project sites where trees suitable for use as maternity roosts for bats are present.

> **Mitigation Measure BIO-4:** Project implementation under the 2006 LRDP shall avoid disturbance to the maternity roosts of special-status bats during the breeding season in accordance with the following procedures for Pre-Construction Special-Status Bat Surveys and Subsequent Actions. No more than two weeks in advance of any demolition or construction activity involving concrete breaking or similarly noisy or intrusive activities, that would commence during the breeding season (March 1 through August 31), a qualified bat biologist, acceptable to the CDFG, shall conduct pre-demolition surveys of all potential

special-status bat breeding habitat in the vicinity of the planned activity. Depending on the survey findings, the following actions shall be taken to avoid potential adverse effects on breeding special-status bats:

1. If active roosts are identified during pre-construction surveys, a no-disturbance buffer will be created by the qualified bat biologist, in consultation with the CDFG, around active roosts during the breeding season. The size of the buffer will take into account factors such as the following:

    a. Noise and human disturbance levels at the project site and the roost site at the time of the survey and the noise and disturbance expected during the construction activity;

    b. Distance and amount of vegetation or other screening between the project site and the roost; and

    c. Sensitivity of individual nesting species and the behaviors of the bats.

2. If pre-construction surveys indicate that no roosts of special-status bats are present, or that roosts are inactive or potential habitat is unoccupied, no further mitigation is required.

3. Pre-construction surveys are not required for demolition or construction activities scheduled to occur during the non-breeding season (September 1 through February 28).

4. Noisy demolition or construction activities as described above (or activities producing similar substantial increases in noise and activity levels in the vicinity) commencing during the non-breeding season and continuing into the breeding season do not require surveys (as it is assumed that any bats taking up roosts would be acclimated to project-related activities already under way). However, if trees are to be removed during the breeding season, the trees would be surveyed for roosts prior to their removal, according to the survey and protective action guidelines 1a through 1c, above.

5. Bat roosts initiated during demolition or construction activities are presumed to be unaffected by the activity, and a buffer is not necessary.

6. Destruction of roosts of special-status bats and overt interference with roosting activities of special-status bats shall be prohibited.

7. The noise control procedures for maximum noise, equipment, and operations identified in Section IV.I, Noise, of this EIR shall be implemented.

Significance after Mitigation: Less than significant.

Project Variant. Compared to the LRDP, the project variant would not result in any change in buildings or structures developed, and therefore impacts would be the same as those described for the proposed project. With implementation of Mitigation Measure BIO-4, the impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on special bats. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario could adversely affect special-status bats, and the above impact statement would apply. For the reasons stated above, and with implementation of Mitigation Measure BIO-4, the impact of such projects on special-status bats would be less than significant.

Impact BIO-5: Implementation of the 2006 LRDP could result in take or harassment of Alameda whipsnakes. (Significant; Less than Significant with Mitigation)

There has never been a reported sighting of an Alameda whipsnake on the LBNL hill site or its immediate vicinity. Though habitat types and features used by Alameda whipsnakes may vary, home ranges typically are centered on areas of scrub habitats with open to partially open canopy, on south-, southeast-, east-, and southwest-facing slopes. Rock outcrops are important for protection from predators and as habitat for western fence lizards and other prey species (Swaim, 1994). However, recent surveys and studies undertaken elsewhere in the region have shown that Alameda whipsnake can be found in a wider variety of habitats than previously thought. For example, whipsnakes have been found in grasslands with very little scrub present, in coastal scrub with dense canopy cover, and in patches of scrub less than one-half acre in size (Swaim, 2003). These recent findings suggest the possibility that whipsnakes could be inhabiting, or disperse through, areas of the LBNL site where coastal scrub habitat occurs in a mosaic with other habitat types such as grassland or woodland. A recent whipsnake habitat assessment of the LBNL hill site (Swaim, 2005) found that potential whipsnake occurrence would be most likely in the easternmost portion of the Lab that is contiguous with open space to the north and east and along the south-facing slopes of Strawberry Canyon. Both of these areas are primarily open space with a mosaic of grassland, coastal scrub, riparian woodland, and stands of non-native trees and provide a potential dispersal corridor from areas identified as critical habitat for the species (USFWS, 2006) to areas of coastal scrub with potential suitability for the whipsnake.

The 2005 LBNL habitat assessment identified and mapped potential for Alameda whipsnake occurrence based on habitat types present and other factors, including habitat fragmentation and existing land uses. Areas designated as having high potential for whipsnakes were those that included relatively large patches of coastal scrub in a mosaic of other habitat types and that were contiguous with larger open space areas and known occupied habitat and/or proposed critical habitat. Based on these factors, these are areas where whipsnakes are considered to have a high

potential to occur (Swaim, 2005). Areas designated as having moderate potential were those that contained smaller patches of scrub in a mosaic with other habitat types but where there was also a fairly significant degree of fragmentation and habitat degradation and a lesser degree of contiguity with larger areas of less disturbed potential habitat. These areas may support a small whipsnake population (Swaim 2005). The habitat assessment found that the whipsnake would not be expected to use the remainder of the site (i.e., existing highly developed areas) on any predictable basis (Swaim, 2005).

After conducting site visits during the summer of 2000, the USFWS determined that most of the LBNL site, including areas with existing facilities, should be excluded from its final critical habitat listing[20,21] (USFWS, 2000). The 2000 designation of critical habitat was rescinded in 2003 but a new critical habitat designation was proposed in 2005 and adopted in October 2006 that, similar to the 2000 designation, includes the easternmost portion of the LBNL site.[22] This area is designated as a fixed constraint under the 2006 LRDP. Based on the habitat assessment, areas with moderate to high potential for whipsnake occurrence were mapped as sensitive habitat in Figure IV.C-2 in this document and should be avoided to the extent feasible. With the exception of potential development in the eastern portions of the hill site, the majority of development proposed under the 2006 LRDP can be considered infill development and would not occur in or near areas that provide suitable habitat for the Alameda whipsnake or within areas proposed as critical habitat. Mitigation Measures (BIO-5a through BIO-5f) would be implemented as directed below at project sites located within areas identified as having moderate to high potential for whipsnake occurrence to ensure that the species is protected to the greatest extent possible during project construction (see Figure IV.C-2).

> **Mitigation Measure BIO-5a:** With the approval of the USFWS on a case-by-case basis, relocate any snake encountered during construction that is at risk of harassment; cease construction activity until the snake is moved to suitable refugium. Alternatively, submit a general protocol for relocation to the USFWS for approval prior to project implementation.

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20 Critical habitat for the Alameda whipsnake was rescinded by court order on May 9, 2003. For the purposes of this analysis, the concept is still relevant in that the designation of critical habitat implies a high likelihood of species' presence where critical habitat elements are found. Even though critical habitat has been rescinded, the species is still fully protected under the FESA. In addition, the USFWS (2002) published a draft recovery plan that includes the species, and areas that were formerly designated as critical habitat units are now designated as recovery units under the plan. Finally, critical habitat for the species was re-proposed in October 2005 (USFWS, 2005d) and, as adopted in October 2006 (USFWS, 2006), includes the easternmost portion of the Lab site.

21 As noted in Chapter I, Introduction, because the LRDP is a University-mandated planning document, it is not subject to review under the National Environmental Policy Act (NEPA). NEPA review would be required for LRDP development projects subject to an authorization or decision by the U.S. Department of Energy or another federal agency. In such instances, consultation with the USFWS would be required prior to implementation of the LRDP, pursuant to Section 7 of the FESA. This consultation would likely be informal and consist of documentation presented to the USFWS by the federal lead agency for the project indicating that the development project would have no impacts on Alameda whipsnake or whipsnake habitat.

22 The adopted critical habitat, while smaller than that proposed in 2005 (155,000 acres adopted, compared to 203,000 acres proposed), includes the same part of the Lab main site as included in the proposed critical habitat. Most of the 48,000 acres excluded from the adopted critical habitat are in eastern Contra Costa County, although smaller areas were excluded in the Easy Bay hills in western Contra Costa and southern Alameda counties.

Mitigation Measure BIO-5b: Conduct focused pre-construction surveys for the Alameda whipsnake at all project sites within or directly adjacent to areas mapped as having high potential for whipsnake occurrence. Project sites within high potential areas shall be fenced to exclude snakes prior to project implementation. This would not include ongoing and non-site specific activities such as fuel management.

Methods for pre-construction surveys, burrow excavation, and site fencing shall be developed prior to implementation of any project located within or adjacent to areas mapped as having high potential for whipsnake occurrence. Such methods would be developed in consultation or with approval of USFWS for any development taking place in USFWS officially designated Alameda whipsnake critical habitat. Pre-construction surveys of such project sites shall be carried out by a permitted biologist familiar with whipsnake identification and ecology (Swaim, 2002). These are not intended to be protocol-level surveys but designed to clear an area so that individual whipsnakes are not present within a given area prior to initiation of construction. At sites where the project footprint would not be contained entirely within an existing developed area footprint and natural vegetated areas would be disturbed any existing animal burrows shall be carefully hand-excavated to ensure that there are no whipsnakes within the project footprint. Any whipsnakes found during these surveys shall be relocated according to the Alameda Whipsnake Relocation Plan. Snakes of any other species found during these surveys shall also be relocated out of the project area. Once the site is cleared it shall then be fenced in such a way as to exclude snakes for the duration of the project. Fencing shall be maintained intact throughout the duration of the project.

Mitigation Measure BIO-5c: (1) A full-time designated monitor shall be employed at project sites that are within or directly adjacent to areas designated as having high potential for whipsnake occurrence, or (2) Daily site surveys for Alameda whipsnake shall be carried out by a designated monitor at construction sites within or adjacent to areas designated as having moderate potential for whipsnake occurrence.

Each morning, prior to initiating excavation, construction, or vehicle operation at sites identified as having moderate potential for whipsnake occurrence, the project area of applicable construction sites shall be surveyed by a designated monitor trained in Alameda whipsnake identification to ensure that no Alameda whipsnakes are present. This survey is not intended to be a protocol-level survey. All laydown and deposition areas, as well as other areas that might conceal or shelter snakes or other animals, shall be inspected each morning by the designated monitor to ensure that Alameda whipsnakes are not present. At sites in high potential areas the monitor shall remain on-site during construction hours. At sites in moderate potential areas the monitor shall remain on-call during construction hours in the event that a snake is found on-site. The designated monitor shall have the authority to halt construction activities in the event that a whipsnake is found within the construction footprint until such time as threatening activities can be eliminated in the vicinity of the snake and it can be removed from the site by a biologist permitted to handle Alameda whipsnakes. The USFWS shall be notified within 24 hours of any such event.

Mitigation Measure BIO-5d: Alameda whipsnake awareness and relevant environmental sensitivity training for each worker shall be conducted by the designated monitor prior to commencement of on-site activities.

All on-site workers at applicable construction sites shall attend an Alameda whipsnake information session conducted by the designated monitor prior to beginning work. This session shall cover identification of the species and procedures to be followed if an individual is found on-site, as well as basic site rules meant to protect biological resources, such as speed limits and daily trash pickup.

Mitigation Measure BIO-5e: Hours of operation and speed limits shall be instituted and posted.

All construction activities that take place on the ground (as opposed to within buildings) at applicable construction sites shall be performed during daylight hours, or with suitable lighting so that snakes can be seen. Vehicle speed on the construction site shall not exceed 5 miles per hour.

Mitigation Measure BIO-5f: Site vegetation management shall take place prior to tree removal, grading, excavation, or other construction activities. Construction materials, soil, construction debris, or other material shall be deposited only on areas where vegetation has been mowed.

Areas where development is proposed under the 2006 LRDP are subject to annual vegetation management involving the close-cropping of all grasses and ground covers; this management activity would be performed prior to initiating project-specific construction. Areas would be re-mowed if grass or other vegetation on the project site becomes high enough to conceal whipsnakes during the construction period. In areas not subject to annual vegetation management, dense vegetation would be removed prior to the onset of grading or the use of any heavy machinery, using goats, manual brush cutters, or a combination thereof.

Most of the above mitigation measures are based on avoidance measures developed in informal consultation with the USFWS during site surveys for the water tank and fire road realignment components of the LBNL Sitewide Water Distribution Upgrade project, which was located in the easternmost portion of LBNL. The incorporation of these mitigation measures into that project resulted in an informal determination by the USFWS that the Sitewide Water Distribution Upgrade project would not be likely to adversely affect Alameda whipsnake or its critical habitat (USFWS, 2000; LBNL, 2001a; Philliber, 2002).

The incorporation of these measures, including the measures identified above under Mitigation Measures BIO-5a for all project sites and BIO-5b and BIO-5c for sites within high potential areas, would reduce potential impacts resulting from implementation of projects under the LRDP to less-than-significant levels. Mitigation Measure BIO-5a is not necessary prior to LRDP project activities to reduce a potentially significant impact to a less-than-significant level, as a project could be halted until a whipsnake relocation plan was approved. However, LBNL intends to voluntarily enact this mitigation measure proactively to minimize potential project delays if whipsnake were encountered.

Significance after Mitigation: Less than significant.

Project Variant. Compared to the LRDP, the project variant would not result in any change in buildings or structures developed, and therefore impacts would be the same as those described for the proposed project. With incorporation of Mitigation Measures BIO-5a through BIO-5f, the impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on the Alameda Whipsnake. Locations of buildings, configurations, uses, and other features of actual development may vary from the scenario. All development (demolition or construction) occurring within or directly adjacent to the areas mapped as having high to moderate potential for Alameda whipsnake occurrence in Figure IV.C-2 would incorporate the mitigation measures presented above. This development could include Illustrative Development Scenario buildings S-1, S-8, S-9, S-11, S-12, S-13, S-14, and S-15. Also included would be roads R-1, R-2, and R-5; parking lots PL-8, PL-9, and PL-10; and parking structure PS-2. For the reasons stated above, potential development in these areas could result in take or harassment of Alameda whipsnakes.

Mitigation Measures BIO-5a, BIO-5b, and BIO-5c(1) through BIO-5f would apply to projects that would occur within or directly adjacent to areas mapped as having high potential for whipsnake occurrence. This development would include, but not be limited to, development identified in the Illustrative Development Scenario as S-9, S-11, S-12, S-13, S-14, and S-15; R-1 and R-2; PL-8, PL-9 and PL-10; and PS-2.

Mitigation Measures BIO-5a, BIO-5c(2) through BIO-5f would apply to projects that would occur within or directly adjacent to areas mapped as having moderate potential for whipsnake occurrence. This development would include, but not be limited to, development identified in the Illustrative Development Scenario as S-1, S-8, and R-5. No mitigation would be required for development projects occurring in already highly developed areas.

With implementation of Mitigation Measures BIO-5a through BIO-5f as indicated above, the impact from potential individual projects under the LRDP such as those described in the Illustrative Development Scenario associated with potential take of Alameda whipsnake would not result in a substantial adverse effect on special-status species, nor interfere substantially with the movement of any resident or migratory species or impede the use of native wildlife nursery sites, and therefore the impact of such projects on the whipsnake would be reduced to a less-than-significant level.

Impact BIO-6: Project activities allowed under the LRDP, including facilities and road construction in areas designated for use as Research and Academic, Central Commons, and Support Services zones, as well as vegetation management activities in designated Perimeter Open Space, could result in the take of special-status plant species. Construction activities, as well as vegetation management activities, have the potential to disturb or result in mortality of these species or eliminate their habitat. (Significant; Less than Significant with Mitigation)

Although no special-status plants have been observed within the LBNL property to date (LBNL 1992, LBNL, 1994; LBNL, 1997; SAIC, 1994; ESA, 2002a, 2002b, 2002c; 2003a, 2003b, 2003c), the project site provides habitat for a number of special-status plant species with potential to occur in the area.

These species, their periods of identification, and their habitat are:

Species	Period of Identification	Habitat
Big-scale balsamroot	March–June	woodland and grasslands
Diablo helianthella	April–June	woodland, scrub, grasslands
Large-flowered leptosiphon (linanthus)	April–August	woodland, scrub, grasslands
Oregon meconella	March–April	scrub
Robust monardella	June–July	coastal prairie, scrub, grasslands

Floristic surveys have not been conducted recently during the period of identification for some of these sensitive plant species, and some of these species were not considered in previous surveys. The combined blooming period (or period of identification) for the above species is March through July. Prior to implementation of specific development projects under the LRDP, site floristic surveys should be conducted and timed to coincide with the bloom period for special-status species for which suitable habitat is present. The area designated as Open Space (see Chapter III, Project Description, Figure III-3) under the 2006 LRDP is currently managed under the Lab's existing Vegetation Management Plan, which is in the process of being updated. Briefly, this zone has been managed to minimize damage to the Lab's structures from wildland fire through the application of a variety of pruning, mowing, grazing, and habitat conversion techniques. The Lab's vegetation management would continue under the 2006 LRDP and is described in more detail in Chapter III, Project Description. Construction and vegetation management activities have the potential to result in adverse impacts on special-status plants at LBNL. Implementation of the following mitigation measures will reduce these potential impacts to less-than-significant levels.

> **Mitigation Measure BIO-6a:** Floristic surveys for special-status plants shall be conducted at specific project sites where suitable habitat is present. Floristic surveys shall also be conducted in designated Perimeter Open Space. All occurrences of special-status plant populations, if any, shall be mapped.
>
> Although no special-status plants have been observed at LBNL during past biological resource surveys, the distribution and size of plant populations often vary from year to year, depending on climatic conditions. Therefore, a baseline survey of all non-developed areas,

including the designated Perimeter Open Space areas, where there is potential for future development or vegetation management activities, should be conducted in accordance with USFWS and CDFG guidelines by a qualified botanist during the period of identification for all special-status plants. During this initial survey, any special-status plant populations found, as well as areas with high potential for supporting special-status plants (i.e., less disturbed areas, rock outcrops and other areas of thin soils, areas supporting a relatively high proportion of native plant species) would be identified and mapped. Thereafter, surveys of Perimeter Open Space areas where ongoing vegetation management (i.e., active vegetation removal to minimize potential wildland fire damage to facilities and personnel) activities would be undertaken, and that are mapped as supporting or having potential to support special-status plant species, would be conducted in April and June every five years.

In those proposed LRDP development sites where suitable habitat is present for special-status species identified as having a moderate to high potential for occurrence (see Table IV.C-1, p. IV.C-10), protocol-level rare plant surveys would be conducted prior to construction. Surveys should be conducted during the periods of identification for all species under consideration at each applicable development site, the timing and scope to be directed by a qualified botanist. During the initial survey, any special-status plant populations found, as well as all areas with high potential for supporting special-status plants (i.e. less disturbed areas, rock outcrops and other areas of thin soils, areas supporting a relatively high proportion of native plant species) would be identified and mapped.

Mitigation Measure BIO-6b: Seeds or cuttings shall be collected from sensitive plant species found within developable areas and open space and at risk of being any adversely affected, or sensitive plants found in these areas shall be transplanted.

If special-status plants are found during floristic surveys and are at risk of being adversely affected, a qualified botanist working in conjunction with an expert in native plant horticulture, CNPS, and CDFG, would collect seeds, bulbs, and cuttings for propagation and planting in specific project revegetation efforts as well as restoration of native habitat within designated Open Space. Perennial species could be transplanted, if found in undeveloped locations that have a high likelihood for future development. Due to its unreliability, translocation alone should not be relied upon as a sole means of mitigation; however, healthy individuals of any special-status plant species should be transplanted to areas of suitable habitat that are protected in perpetuity. The relocation sites may be located either on or off the LBNL hill-site. If the areas for transplanting are located off-site, they should be within a 20-mile radius of the project site. Plants should be relocated to areas with ecological conditions (slope, aspect, microclimate, soil moisture, etc.) as similar to those in which they were found as possible. Existing plants could also be held in containers for specific post-project revegetation efforts on-site.

With implementation of Mitigation Measures BIO-6a and BIO-6b, effects on special-status plants due to development pursuant to the LRDP would not result in a substantial adverse effect on special-status species, nor have a substantial adverse effect on any riparian habitat or other sensitive natural community, and therefore the effect would be less than significant.

Significance after Mitigation: Less than significant.

Project Variant. Compared to the LRDP, the project variant would not result in any change in buildings or structures developed, and therefore impacts would be the same as those described for the proposed project. With implementation of Mitigation Measures BIO-6a and BIO-6b, the impact would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts special-status plant species. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario could adversely affect special-status plant species. The above impact statement would also apply to the Illustrative Development Scenario, and the impact of a future project identified in the Illustrative Development Scenario on special-status plant species would be less than significant with implementation of Mitigation Measures BIO-6a and BIO-6b.

IV.C.3.5 Cumulative Impacts

This section evaluates whether implementation of the 2006 LRDP, in combination with other past, present, and reasonably foreseeable future LBNL and non-LBNL projects, would result in significant cumulative impacts on the biological resources examined in this EIR. This analysis includes the impacts of cumulative growth potentially resulting from implementation of the Berkeley and Oakland general plans and the implementation of the UC Berkeley 2020 LRDP (including the Southeast Campus Integrated Projects).[23]

The geographic context for analysis of cumulative impacts to biological resources includes the areas encompassed by the LBNL LRDP, the UC Berkeley LRDP, the City of Berkeley hills neighborhoods, hills areas north of Claremont Canyon included within the City of Oakland, and Tilden Regional Park, which is managed by the East Bay Regional Park District (EBRPD). These lands are contiguous and represent a continuum from relatively undisturbed wildlands to the wildland-urban interface to downtown urban land uses. They are connected by riparian corridors and areas of open space.

This analysis evaluates whether the impacts of the proposed LRDP, together with the impacts of cumulative development, would result in a significant impact (based on the significance criteria on p. IV.C -36) and, if so, whether the contribution of the LRDP to this impact would be

[23] The EIR for the UC Berkeley Southeast Campus Integrated Projects (SCIP) found that those projects would not result in any adverse biological impacts, and thus the SCIP would not contribute to any cumulative impacts (UC Berkeley, 2006).

considerable. Both conditions must apply in order for the project's cumulative impacts to rise to the level of significance.

Impact BIO-7: Development pursuant to the 2006 LRDP, when combined with development under the UC Berkeley LRDP as well as surrounding (primarily residential) development in the Oakland-Berkeley hills, would contribute to a reduction of open space and, consequently, habitat for native plants and wildlife, including special-status species. (Less than Significant)

Projects considered under the 2006 LBNL and 2020 UC Berkeley LRDPs, as well as residential development taking place under the Berkeley and Oakland general plans within the geographic context outlined above, would combine to reduce open space and available habitat for both common and special-status wildlife and plants. However, open space currently comprises a significant portion of the geographic context for cumulative impacts analysis in this section. The majority of the LBNL hill site and the UC Berkeley Hill Campus are currently in open space, as is the vast majority of Tilden Regional Park. New development occurring under the Berkeley or Oakland general plans in the area would primarily be considered infill in areas zoned as residential and there are no large developments pending in the area under these plans. The East Bay Regional Park District currently has no plans for large facilities development or reductions in open space at Tilden Park. Implementation of the LBNL LRDP would result in the development of approximately 9.5 acres of available open space and habitat at the site. Implementation of the UC Berkeley 2020 LRDP could result in the development of less than 5 acres of existing open space in the Hill Campus. Therefore, growth under these plans would not result in a substantial reduction in open space or wildlife habitat and this impact is considered to be less than significant.

The magnitude of cumulative effects of development on biological resources is in large part determined by the extent to which resources are protected in plans and during specific project implementation. The LBNL and UC Berkeley LRDPs, as well as the East Bay Regional Park District's Master Plan and the City of Oakland and City of Berkeley general plans, all contain policies and guidelines for protecting natural resources, including special-status species, sensitive natural communities, and jurisdictional waters. All development under the LBNL and UC Berkeley LRDPs and any development under the East Bay Regional Park District's Master Plan would also take place in a regulatory context of federal, state, and local laws that combine to avoid and minimize impacts to special-status species, sensitive natural communities, jurisdictional waters, and wildlife migratory corridors and nurseries through a variety of tools including the creation of resource-specific management plans and the application of mitigation measures. Mitigation measures and best management practices applied to specific projects would help to ensure that they would not result in substantial adverse impacts to biological resources. Therefore, cumulative impacts to biological resources resulting from the proposed LBNL 2006 LRDP and the other projects considered in this section would be less than significant.

Mitigation: None required.

Project Variant. The project variant would result in traffic impacts substantially similar to the biological resources impacts that would result from the 2006 LRDP development. The cumulative biological resources impacts of the project variant would therefore be less than significant as described above.

Individual Future Project/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of development under the LRDP. A future project under the LRDP such as conceptually portrayed in the Illustrative Development Scenario, when combined with other projects under the LRDP and other development, would, for the reasons stated in the impact statement above, result in cumulative biological resources impacts that would be less than significant.

IV.C.4 References – Biological Resources

Arnold, R., Bombay Project in Santa Cruz: Report on San Francisco Lacewing and Unsilvered Fritillary. Letter report from Richard Arnold, President, Entomological Services, Ltd. to Meredith Marquez, Principal Planner, City of Santa Cruz Department of Planning and Community Development, August 18, 1997.

Baicich, P.J. and C.J.O. Harrison, *A Guide to the Nests, Eggs, and Nestlings of North American Birds, 2nd edition*, San Diego, CA, Academic Press, 1997.

Beatty, R.A., *Management Plan for Strawberry and Claremont Canyons*, prepared by J. McBride for UC Berkeley Committee on Conservation and Environmental Quality, 1978, revised by R.A. Beatty, 1979. Available online at: http://www-laep.ced.berkeley.edu/classes/radke_materials/materials/221-98hi/la221-ax/management/1979.html, 1979.

Briggs, T.S. and D. Ubick, *The harvestman family Phalangodidae: 2. The new genus Microcina (Opiliones, Laniatores),* The Journal of Arachnology 17: 207-220. 1989.

CalFlora, Information on California Plants for Education, Research, and Conservation. [web application]. Berkeley, California: The Calflora Database [a nonprofit organization]. Available online: http://www.calflora.org. 2003.

California Department of Fish and Game (CDFG), Wildlife Habitat and Data Analysis Branch, *California Natural Diversity Database, Version 3.0.3,* data request for the Oakland East, Oakland West, Briones Valley, San Leandro, and Richmond 7.5-minute USGS topographic quadrangles, January 18, 2005.

California Department of Fish and Game (CDFG), *Special Animals List,* Available online at: http://www.dfg.ca.gov/whdab/pdfs/SPAnimals.pdf. August 2004.

California Fish and Game Commission, *Comment to the Department of Fish and Game on the Wetland Policy Implementation Proposal,* Available online at: http://www.fgc.ca.gov/html/compolcy.html, December 3, 1987.

California Native Plant Society (CNPS), *Electronic Inventory of Rare and Endangered Plants of California, Version 6-05a 1-09-05*, data request for the Oakland East, Oakland West, Briones Valley, and Richmond 7.5-minute USGS topographic quadrangles, 2005. Available online at: http://www.cnps.org/inventory. Accessed online January 31, 2005.

Charbonneau, R.B., *Strawberry Creek Management Plan*, prepared for the Office of Environmental Health and Safety, University of California, Berkeley, 1987.

City of Berkeley, City of Berkeley Draft General Plan EIR, prepared by LSA Associates for the City of Berkeley, Available online at: http://www.ci.berkeley.ca.us/planning/landuse/plans/generalPlan/EIR/00toc.html. 2001.

City of Berkeley, *City of Berkeley General Plan*, 2002.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. La Roe. *Classification of Wetlands and Deepwater Habitats of the United States*. U.S. Fish and Wildlife Service, Office of Biological Services, Washington, D. C. Publication No. FWS/OBS-79/31. 1979.

East Bay Regional Park District, *Master Plan 1997*, Adopted by the East Bay Regional Park District Board of Commissioners December 17, Resolution No. 1996-12-349, 1996. Available online at: http://www.ebparks.org/resources/pdf/misc/RPM_Plan97.pdf

Ehrlich, P.R., D.S. Dobkin, and O. Wheye, *The Birder's Handbook: A Field Guide to the Natural History of North American Birds*, New York, NY, Simon and Schuster, 1988.

Environmental Science Associates (ESA), Field survey of proposed Molecular Foundry project site, March 13, 2002a.

Environmental Science Associates (ESA), Field survey of proposed Building 49 project site, July 30, 2002b.

Environmental Science Associates (ESA), Field survey of proposed Building 49 and G-4 lot project sites, December 12, 2002c.

Environmental Science Associates (ESA), Field survey of proposed Lot G-4 project site, June 25, 2003a.

Environmental Science Associates (ESA), Field survey of LBNL site, October 30, 2003b.

Environmental Science Associates (ESA), Field survey of LBNL site, November 6, 2003c.

Hickman, J.C. (editor), *The Jepson Manual of Higher Plants of California*, University of California Press, Berkeley, CA, 1993.

Holland, R.F., *Preliminary Descriptions of the Terrestrial Natural Communities of California*, California Department of Fish and Game, Sacramento, CA, 1986.

Jameson, E.W. and H.J. Peeters, *California Mammals*, University of California Press, Berkeley, California, 1988.

Lawrence Berkeley National Laboratory (LBNL), NEPA/CEQA Program, *Project Description for the Proposed Sitewide Water Distribution Upgrade, Phase 1* (submitted in support of request for a Categorical Exemption), October 2001a.

Lawrence Berkeley National Laboratory (LBNL), *Maintenance Vision for a Fire-Sustainable Landscape*, September 2001b.

Lawrence Berkeley National Laboratory (LBNL), *Supplemental Environmental Impact Report Addendum for the Proposed Renewal of the Contract Between the United States Department of Energy and the Regents of the UC for the Operation and Management of the Lawrence Berkeley Laboratory*, SCH# [19]91093068, September 1997.

Lawrence Berkeley National Laboratory (LBNL), *Draft Environmental Impact Report: Human Genome Laboratory*, April 1994.

Lawrence Berkeley National Laboratory (LBNL), *Draft and Final Supplemental Environmental Impact Report (SEIR) for the Proposed Renewal of the Contract Between the United States Department of Energy and the Regents of the UC for the Operation and Management of the Lawrence Berkeley Laboratory*, SCH# [19]91093068, prepared by the University of California and Lawrence Berkeley Laboratory, with the assistance of Ira Fink and Associates, Inc., September 1992.

Lawrence Berkeley National Laboratory (LBNL), *Draft and Final Environmental Impact Report for the 1987 Site Development Plan*, (SCH# [19]85112610), August 1987.

Mayer, K.E. and W.F. Laudenslayer (editors), *A Guide to Wildlife Habitats of California*, California Department of Fish and Game, Sacramento, CA, 1988. Available online at: http://www.dfg.ca.gov/whdab/html/wildlife_habitats.html

McBride, J., Plant succession in the Berkeley Hills, Madrono 22: 517-529, 1974.

McClure, R., Planner, Lawrence Berkeley National Laboratories, personal communication [conversation] regarding on-site field surveys for *Microcina leei*. 2004.

Philliber, J., Planner, NEPA/CEQA Program, Lawrence Berkeley National Laboratories, personal communication [email] regarding Alameda Whipsnake, August 30, 2002.

Sawyer, J.O. and T. Keeler-Wolf, *A Manual of California Vegetation*, California Native Plant Society, Sacramento, CA, 1995. Available online at: http://davisherb.ucdavis.edu/cnpsActiveServer/front.html

Science Applications International Corporation (SAIC), *Biological Survey for Threatened and Endangered Species and Unique Biological Resources on Lawrence Berkeley Laboratory Perimeter Areas*, September 21, 1994.

Sibley, D.A., *The Sibley Guide to Bird Life and Behavior*, Alfred A. Knopf, Inc., New York, 2001.

Sibley, D.A., *The Sibley Guide to Birds*, Alfred A. Knopf, Inc., New York, 2000.

Stebbins, R.C., *A Field Guide to Western Reptiles and Amphibians*, Houghton Mifflin, Boston, MA, 1985.

Swaim, K.E., *Alameda Whipsnake Habitat Assessment Lawrence Berkeley National Laboratory City of Berkeley, Alameda County, California*, prepared for Environmental Science Associates by Swaim Biological, Inc., July 10, 2006.

Swaim, K.E., Principal, Swaim Biological Consulting, personal communication [conversation] with Martha Lowe regarding habitat preferences of the Alameda whipsnake, December, 2003.

Swaim, K., *Results of surveys for special status reptiles at the Site 300 facilities of Lawrence Livermore National Laboratory*, Swaim Biological, Inc., 2002.

Swaim, K.E., *Aspects of the Ecology of the Alameda Whipsnake (Masticophis lateralis euryxanthus)*, Masters Thesis, California State University, Hayward, CA, 140 pp., 1994.

Ubick, D., Entomologist, California Academy of Sciences, personal communication [email] regarding *Microcina leei*, December 2003.

U.S. Army Corps of Engineers (Corps), *Issuance of Nationwide Permit; Notice*. Federal Register 67 (10): 2020-2095 January 15, 2002.

U.S. Army Corps of Engineers (Corps), Regulatory Guidance Letter No. 02-2. *Guidance on Compensatory Mitigation Projects for Aquatic Resource Impacts Under the Corps Regulatory Program Pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899*. December 24, 2002.

U.S. Army Corps of Engineers (Corps), *Letter of Agreement Between the U.S. Army Corps of Engineers, South Pacific Division, and the National Fish and Wildlife Foundation Concerning the Establishment and Operation of the South Pacific Wetlands Conservation Account*. November 20, 2000.

U.S. Fish and Wildlife Service (USFWS), *Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Alameda Whipsnake; Final Rule.* Federal Register Vol. 71, No. 190, October 2, 2006.

U.S. Fish and Wildlife Service (USFWS), Official Species List for Lawrence Berkeley National Laboratories Long Range Development Plan, Alameda County, California, January 31, 2005a.

U.S. Fish and Wildlife Service (USFWS), Threatened and Endangered Species System, *Proposed and Candidate Species as of 02/08/05*. Available online at: http://ecos.fws.gov/tess_public/TESSWebpageNonlisted?listings=O&type=both#I, 2005b.

U.S. Fish and Wildlife Service (USFWS), *Animal Species of Concern*, updated January 19, 2005. Available online at: http://sacramento.fws.gov/es/spp_lists/animal_sp_concern.cfm, 2005c.

U.S. Fish and Wildlife Service (USFWS), *Endangered and Threatened Wildlife and Plants; Proposed Designation of Critical Habitat for the Alameda Whipsnake*. Federal Register Vol. 70, No. 2000, October 18, 2005d.

U.S. Fish and Wildlife Service (USFWS), *Draft Recovery Plan for Chaparral and Scrub Community Species East of San Francisco Bay*, CA, November 2002.

U.S. Fish and Wildlife Service (USFWS), *Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Alameda Whipsnake (Masticophis lateralis euryxanthus)*, Federal Register Volume 65, Number 192, October 3, 2000.

U.S. Fish and Wildlife Service (USFWS), *Endangered and Threatened Wildlife and Plants; Animal Candidate Review for Listing as Endangered or Threatened Species*, Federal Register Volume 59, Number 219, November 15, 1994.

UC (University of California) Berkeley, *Southeast Campus Integrated Projects Tiered Focused Final Environmental Impact Report (SCH #2005112056)*; October 31, 2006. Available on the internet at: http://www.cp.berkeley.edu/SCIP/FEIR/SCIP_FEIR.html

U.C. Berkeley, *2020 Long Range Development Plan & Chang-Lin Tien Center for East Asian Studies Final Environmental Impact Report*, sponsored by University of California, Berkeley, prepared by Design, Community & Environment, April 15, 2004.

Wetland Training Institute, *Field Guide for Wetland Delineation; 1987 Corps of Engineers Manual*, Glenwood, New Mexico, [WTI 02-1], 1995.

Zeiner, D.C., W.F. Laudenslayer, K.E. Mayer, and M. White, *California's Wildlife. Vols. I, II and III*, California Statewide Wildlife Habitat Relationships System (Version 7.0), California Department of Fish and Game, Sacramento, CA. Available online at: http://www.dfg.ca.gov/whdab/html/cawildlife.html, 1990.

IV.D. Cultural Resources

IV.D.1 Introduction

This section evaluates the potential impacts on cultural (historical and archaeological) resources that could result from implementation of the proposed 2006 LRDP for the LBNL.

A summary of site history is presented using information from technical studies prepared for the project area. These technical studies include archival research at the California Historical Resources Information System's Northwest Information Center completed on December 1, 2003; a cultural resources evaluation and survey completed by Archaeological Research Services in 1986; an archaeological survey report (Kielusiak, 2000); and the first of a series of reports being prepared by D.W. Harvey (2003) of the Pacific Northwest National Laboratory as part of an inventory and evaluation of potential historically significant buildings and structures at Berkeley Lab.

IV.D.2 Setting

IV.D.2.1 Regional and Local Context

Early Regional and Local History

The beginning date for the prehistoric Native American occupation of Northern California is generally agreed to be about 2,000 B.C., at least in the San Francisco Bay region. Linguistic evidence suggests that the Native Americans that lived in the area spoke Chochenyo, one of the Costanoan[1] languages. In 1770, the Costanoan-speaking people lived in approximately 50 separate and politically autonomous nations or tribelets. Early Spanish diaries record a number of small villages along the foothills of the East Bay area. Ethnographic sources indicate that one settlement, named Huchiu-n, may have been situated in the general vicinity of the present city of Berkeley (Kroeber, 1925). During the mission period, 1770-1835, the Costanoan people experienced cataclysmic changes in almost all areas of their life, particularly a massive decline in population due to introduced diseases and declining birth rate. Following the secularization of the missions by the Mexican government in the 1830s, most Native Americans gradually left the missions to work as manual laborers on the ranchos that were established in the surrounding areas. Native American archaeological sites in this portion of Alameda County tend to be situated along ridgetops, midslope terraces, alluvial flats, near ecotones,[2] and near sources of water including springs.

In 1820, Sergeant Luis Peralta obtained Mission San Antonio, the present-day sites of the cities of Oakland, Berkeley, and Alameda. The land was later (in 1842) divided among his four sons. In

1 "Costanoan" is derived from the Spanish word Costanos meaning "coast people." No native name of the Costanoan people as a whole existed in prehistoric times as the Costanoan were neither a single ethnic group nor a political entity.

2 An "ecotone" is defined as the zone of transition between adjacent ecological systems, having a set of characteristics uniquely defined by space and time scales and by the strength of interactions between them.

1860, the University of California was established as the College of California on 160 acres, and in 1864 a Homestead Association was established in the adjacent areas. This led to increased development in the vicinity of the university and incorporation of the town of Berkeley in April 1878. During this time, the present-day LBNL site was largely undeveloped, and remained so until the late 1930s.

Development of Lawrence Berkeley National Laboratory

Lawrence Berkeley National Laboratory was founded in 1931 as the University of California Radiation Laboratory on the UC Berkeley main campus. The Radiation Laboratory (the former Civil Engineering Test lab) was established as an accelerator laboratory by UC President Robert Gordon Sproul for physics professor Ernest Orlando Lawrence. A couple of years earlier (in 1929), on the UC Berkeley campus, Lawrence had built the world's first cyclotron, a 4-inch circular particle accelerator. With the establishment of the Radiation Laboratory, Lawrence and his associates had the opportunity to expand their research.

In 1939, Lawrence was awarded the Nobel Prize in Physics for the invention and development of the cyclotron, in recognition of the importance of his research and its effect on the field of physics and in the production of artificial radioactive elements. As the scale and scope of the Radiation Laboratory's experiments grew, additional space was needed and, in 1940, the first building was constructed on the present-day LBNL site to house the next-generation, 184-inch cyclotron (Building 6). Further expansion of the physical size of the Laboratory's hill site during World War II was partly due to an increase in nuclear fission research, which prompted the need for higher-energy accelerators and more room for locating them. Growth of the hill site is also attributed to the fame and publicity Lawrence received for the Nobel Prize, which helped to attract research funding.

During the 1950s and 1960s, research growth and development at the Lab was guided mainly by high-energy physics research. Buildings constructed at the LBNL hill site were associated with the 184-inch cyclotron and other accelerators, including research labs, craft and maintenance shops, and offices. The Bevatron, completed in 1954 at the hill site, was the Laboratory's largest accelerator at the time and the nation's leading high-energy physics facility. It "was in the vanguard of physics research because of its capacity to generate the highest energies produced by an accelerator of that period. The Bevatron was the most powerful accelerator in the world from 1954–1959, and dominated the field of high-energy physics until the early 1960s" (Harvey, 2003). (See further discussion of the Bevatron under "Potential Historical and Archaeological Resources" below.)

The Heavy Ion Linear Accelerator, or HILAC, located in Building 71, opened in 1957 and was one of the first accelerators built specifically for the study of heavy ions (ions heavier than helium). The HILAC underwent several modifications and upgrades during the 1960s to become the SuperHILAC. Several chemical elements were discovered in Building 71 research labs, including nobelium (102) and seaborgium (106). The 88-Inch Cyclotron (Building 88) was built between 1958 and 1962. It was used for heavy ion research and was one of the new generations of sector-focused cyclotrons built after 1960.

The late 1960s through the early 1970s was a period of reduced program activity at LBNL. Following 1973 and the oil embargo, the Lab's activities began to diversify, although the Lab still retained its importance in high-energy and nuclear physics research. In 1974 "the Bevatron was combined with the HILAC to form the Bevalac and the Laboratory regained its position as a world-leading accelerator facility, this time for heavy-ion nuclear physics research" (Harvey, 2003). By the late 1970s, multi-program research efforts at LBNL were divided into nine research divisions with the following major programs: Accelerator and Fusion Research, Applied Science (energy and environment), Biology and Medicine, Chemical Biodynamics, Computing, Earth Science, Materials and Molecular Research, Nuclear Science, and Physics. At present, the Laboratory includes 18 divisions organized within the areas of Computing Sciences, Physical Sciences, Energy Sciences, Biosciences, General Sciences, and Resources.

By 1980, 25 percent of the Laboratory's activity was in high-energy and nuclear physics, down from 75 percent 10 years earlier. The Laboratory had become a multi-program national lab, with more emphasis on basic energy sciences and life sciences, while maintaining historically important roles in high-energy and nuclear physics. The Advanced Light Source accelerator, housed under the dome of the 184-Inch Cyclotron, was completed in 1993. This accelerator and electron storage ring produce the world's brightest soft x-ray and ultraviolet light.

The most notable accomplishments by LBNL scientists since the 1930s include:

- Invention of the Alvarez linear accelerator, and the proton synchrotron;
- Receipt of ten Nobel Prizes;
- Identification of over a dozen new chemical elements, including plutonium;
- Establishment of one of the world's major centers of heavy ion nuclear physics research;
- Operation of the SuperHILAC, Bevalac, and 88-inch cyclotron accelerators as national facilities for nuclear physics and biomedical research;
- Founding of the science of nuclear medicine;
- Contributions to discoveries and developments in high-energy physics;
- Invention of the chemical laser;
- Discovery of the first antiproton and antineutron;
- COBE satellite recordation of the seeds of the early universe;
- Human Genome Project, in which the Lab was named one of two DOE centers for mapping and sequencing human genome;
- Discovery of "dark energy" by the Supernova Cosmology Project;
- Superconducting magnet that breaks the TESLA record;
- Identification of good and bad cholesterol; and
- Development of the Extra Cellular Matrix theory that links breast cancer development to the breakdown in the micro-environment surrounding breast cells.

Appendix I contains a list of the Lab's achievements that the Lab prepared to mark its 75th anniversary in 2006.

IV.D.2.2 Potential Historical and Archaeological Resources

Previous Studies

Site-Wide Studies

As part of the environmental analysis for the 1987 LRDP EIR, as amended,[3] all undeveloped land and then-proposed building locations were examined for potential historical and archaeological resources. All reasonably accessible parts of the LBNL area were examined. Special attention was given to areas of relatively flat land or rock outcrops. The steep hillsides were not examined intensively, although transects were made through accessible areas. Based on the findings of the historic and archaeological resources survey, no indications of historic or prehistoric archaeological resources were encountered in any location at the project site. The 1987 LRDP EIR, as amended, included the analysis of four facilities at LBNL for potential eligibility for listing on the National Register of Historic Places. The Department of Energy (DOE), in consultation with the State Historic Preservation Officer, determined that only one of these facilities, Building 51 "the Bevatron" (and Building 51A), was eligible for listing on the National Register of Historic Places. An EIR evaluating the proposed demolition of Building 51 is currently anticipated to be considered for certification in early 2007.

EIR on Demolition of Building 51 Complex (the Bevatron)

DOE has proposed to demolish the Bevatron and the structure housing it, Building 51, at Berkeley Lab. During its operation from 1954 until 1993, the Bevatron was among the world's leading particle accelerators, and during the 1950s and 1960s, four Nobel Prizes were awarded for work conducted in whole or in part there. The Bevatron is approximately 180 feet in diameter. Building 51 is a large (approximately 126,500-gross-square-foot) shed-like structure built to shelter the Bevatron apparatus and its associated mechanical, electrical, shop, and office functions. Since the end of the Bevatron's operations in 1993, Building 51 has had limited use for equipment storage, office space, and dry laboratories.

The Bevatron and Building 51 are no longer needed by LBNL. The Bevatron has not operated since 1993 and is non-functional. The Building 51 structure housing the Bevatron is deteriorating and consumes disproportionate maintenance resources. It does not meet current building codes, the roof leaks in several locations, and portions of the structure do not comply with current seismic design standards. In addition, removal of the building and its contents would free up the site for future development. However, while development of the site is likely at some point in the future, at this time there are no firm plans for future development that have reached the level of a proposed or reasonably foreseeable action.

The project site is approximately four acres in size, including parking and staging areas. Of this total, approximately 2.25 acres would be converted from developed area (i.e., occupied by Building 51) to an undeveloped area for an indeterminate time, until another project is proposed,

[3] The 1987 LRDP EIR, as amended, refers to the 1987 LRDP EIR and the subsequent environmental documents that permit incremental growth at LBNL, including the 1992 Supplemental Environmental Impact Report (SEIR) and the 1997 SEIR Addendum for the Proposed Renewal of the Contract Between the United States Department of Energy and The Regents of the UC for the Operation and Management of the Lawrence Berkeley Laboratory.

approved, and initiated. Under the proposed project, the concrete shielding blocks that surround the Bevatron would be removed, the Bevatron apparatus would be disassembled, Building 51 and the shallow foundation underneath the building demolished, and the resulting debris and other materials removed. The site would then be backfilled, and the fill compacted and leveled. The duration of the physical work for the project may vary from three and a half to seven years, and the work is currently anticipated to start in early 2008 (if the demolition is approved), and contingent upon funding and results of material sampling. For the purposes of conservative impact assessment, where impacts presumably are intensified in a shorter project timeframe, the project is assumed to take place over a three-and-one-half–year period.

Approximately half of the materials that would be removed would consist of non-hazardous debris and other items typical of building demolition projects. Hazardous waste, low-level radioactive waste, and mixed waste also would be shipped from the site. The project would seek to reuse or recycle materials (e.g., uncontaminated metals and concrete) where feasible. Items that could not be reused or recycled would be handled and disposed in accordance with applicable policies and regulations. An estimated maximum of about 4,700 one-way truck trips to ship items off-site, and to bring in such things as equipment and fill material for bringing the site back to a level condition, would be required over the course of the project. A maximum of about 50 temporary workers would be used by the project at any one time.

The EIR on the Building 51 project concludes that the Bevatron demolition would not result in any significant impacts that could not be mitigated to less-than-significant levels through implementation of mitigation measures included in the 1987 LRDP EIR, as amended, and/or project-specific mitigation measures, except for the significant unavoidable impacts on historic resources resulting from the demolition. Mitigation measures for potential environmental impacts of the project include conducting pre-demolition special-status avian and bat surveys and restricting the frequency of truck trips (loaded or empty) to a maximum of (a) one every 10 minutes (six truck trips per hour) during the a.m. and p.m. peak commute hours, and (b) one every five minutes (12 truck trips per hour) during periods other than the a.m. and p.m. peak commute hours.

Current Studies of Historical Resources

To evaluate the potential for historically significant buildings or structures at the Lab, LBNL has retained the Pacific Northwest National Laboratory team of licensed cultural resource professionals to conduct field surveys and historic research at LBNL. In coordination with LBNL, DOE, and the State Office of Historic Preservation, the team is systematically investigating and reporting on all buildings and structures at the Lab. The team will complete a series of reports to identify, survey, and evaluate approximately 245 buildings and structures at the LBNL site for potential eligibility for listing in the National Register. These studies have been undertaken pursuant to Section 110 of the National Historic Preservation Act, which requires that federal agencies, such as DOE, survey the lands under their control and evaluate all historic properties (including buildings and the equipment contained therein) for eligibility for listing in the National Register. These reports will then be submitted to the State Historic Preservation Officer for concurrence. Approximately 150 of the Lab's 245 buildings have been investigated thus far.

The results of this ongoing work indicate that, among the structures analyzed thus far, the Building 51 and 51A "Bevatron" complex was the only structure considered eligible for listing in the National Register of Historic Places. The complex was therefore also included as eligible in the California Register of Historical Resources. For background, see discussion of the National Register of Historic Places and State Office of Historic Preservation under "Federal and State Regulatory Environment" below.

In accordance with the National Historic Preservation Act and a 1997 Memorandum of Agreement (MOA) among DOE, the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation, LBNL prepared an Historic American Engineering Record (HAER) report for the Bevatron, a subatomic particle accelerator located in Buildings 51 and 51A (LBNL, 1997).[4] The HAER included a written historical and architectural description of the building and accelerator and extensive photographic recordation in accordance with the MOA's stipulations. The HAER documentation was submitted to and accepted by the U.S. Department of Interior National Park Service (NPS) in March 1998. As also required in the 1997 MOA, LBNL has consulted with the NPS regarding proper mitigation and documentation necessary to offset the demolition and removal of the Bevatron. The NPS determined that an addendum to the HAER report would meet the requirements of the Historic American Building Survey (HABS) for pre-demolition documentation of Building 51 and would serve as partial mitigation for the loss of the building.

The addendum was required by the NPS to provide further and more detailed documentation of the Building 51 complex. The addendum has been completed and is currently under review by the NPS. Demolition cannot commence until the NPS accepts the document. In addition, as part of the EIR for the demolition of Building 51, LBNL indicated that it plans to commemorate the scientific achievements attributed to the Bevatron with a monument and/or a display listing the historic discoveries that occurred there. Along with the previously completed HAER documentation, which included a written historical and architectural description of the building and accelerator, and extensive photographic recordation, and the HABS addendum to the HAER, the Lab's proposed monument and/or display will reduce the effects of demolition of Building 51, but not to a less-than-significant level. Accordingly, the *Demolition of Building 51 and the Bevatron EIR* found that demolition will result in a significant, unavoidable impact on cultural resources that cannot be fully mitigated (LBNL, 2006). This EIR is currently anticipated to be considered for certification in early 2007.

Current Studies of Archaeological Resources

Field surveys and archival research at the California Historical Resources Information System's Northwest Information Center have been undertaken to determine whether any archaeological resources have been discovered at LBNL. (For details about the Northwest Information Center, see discussion of the State Office of Historic Preservation under "Federal and State Regulatory Environment" below.) The Northwest Information Center has indicated there is a "low potential

[4] Building 51A is an integral addition to Building 51. Hereafter, unless otherwise required, the two structures are referred to as Building 51.

for Native American sites in the project area" and thus "a low possibility of identifying Native American or historic-period archaeological deposits in the project area" (Northwest Information Center, 2003). Additionally, field studies conducted at various times at LBNL have not encountered any archaeological resources. Native American archaeological sites in this portion of Alameda County tend to be situated on terraces along ridgetops, midslope terraces, alluvial flats, near ecotones, and near sources of water, including springs. LBNL is situated on a steep slope adjacent to Strawberry Creek. Therefore, there is a low-to-moderate potential for Native American sites on the project site.

IV.D.2.3 Federal and State Regulatory Environment

National Register of Historic Places

The National Register of Historic Places is the nation's master inventory of known historic resources. The National Register is administered by the National Park Service and includes listings of buildings, structures, sites, objects, and districts that possess historic, architectural, engineering, archaeological, or cultural significance at the national, state, or local level. Properties are nominated to the National Register of Historic Places by the State Historic Preservation Officer of the state in which the property is located, by the Federal Preservation Officer for federally owned or controlled property, or by the Tribal Preservation Officer for tribally owned property. Generally, structures, sites, buildings, districts, or objects must be at least 50 years old or "exceptionally important" to be considered eligible for listing in the National Register as significant historic resources.

State Office of Historic Preservation

The State Office of Historic Preservation maintains the California Register of Historical Resources, an authoritative listing of the state's significant historic resources as well as architectural, archaeological, and cultural resources. The California Register includes properties listed in or formally determined eligible for the National Register, pursuant to Section 4851(a) of the Public Resources Code, and lists selected California Registered Historical Landmarks. The State Office of Historic Preservation also maintains the *Directory of Properties in the Historic Property Data File*. Properties on the Property Data File are not protected or regulated.

The State Office of Historic Preservation sponsors the California Historical Resources Information System (CHRIS), a statewide system for managing information on the full range of historical resources identified in California. CHRIS is a cooperative partnership among the citizens of California, historic preservation professionals, 11 information centers, and various agencies (Office of Historic Preservation, 2003). CHRIS provides an integrated database that furnishes site-specific archaeological and historical resources information on known resources and surveys to government, institutions, and individuals. CHRIS also supplies a list of qualified consultants. Information for the project area is available through CHRIS's Northwest Information Center.

IV.D.2.4 Local Plans and Policies

LBNL is a federal facility operated by the University of California and conducting work within the University's mission on land that is owned or controlled by The Regents of the University of California. As such, LBNL is generally exempted by the federal and state constitutions from compliance with local land use regulations, including general plans and zoning. However, LBNL seeks to cooperate with local jurisdictions to reduce any physical consequences of potential land use conflicts to the extent feasible. The western part of the LBNL site is within the Berkeley city limits, and the eastern part is within the Oakland city limits. This section summarizes relevant policies contained in the Berkeley and Oakland general plans, as well as other city provisions relevant to cultural resources at LBNL.

Berkeley General Plan

The Urban Design and Preservation Element of the City of Berkeley General Plan contains policies relating to the development and preservation of cultural resources in the city. None of the facilities at LBNL are listed by City of Berkeley as a historical resource (City of Berkeley, 2002). Urban Design and Preservation Element policies pertaining to the proposed LRDP are as follows:

> Policy UD-5 Architectural Features: Encourage, and where appropriate require, retention of ornaments and other architecturally interesting features in the course of seismic retrofit and other rehabilitation work.
>
> Policy UD-6 Adaptive Reuse: Encourage adaptive reuse of historically or architecturally interesting buildings in cases where the new use would be compatible with the structure itself and the surrounding area.
>
> Policy UD-10 The University of California: Strongly support actions by the University to maintain and retrofit its historic buildings, and strongly oppose any University projects that would diminish the historic character of the campus or off-campus historic buildings…
>
> Policy UD-36 Information on Heritage: Promote, and encourage others to promote, understanding of Berkeley's built and cultural heritage, the benefits of conserving it, and how to sensitively do that.

City of Berkeley Landmarks Preservation Ordinance

The City of Berkeley's Landmarks Preservation Ordinance, adopted in 1974, requires the City to establish a list of potential buildings that should be considered for landmark, historic district, or structure of merit status. The ordinance outlines procedures for designating properties as landmarks and for reviewing proposed physical changes to landmark buildings. A Landmarks Preservation Commission appointed by the City Council and City staff administers the ordinance. To be designated as landmarks or as structures of merit, buildings must meet criteria for consideration set forth in the ordinance. The criteria consist of three levels of designation for historic buildings: properties of exceptional significance (landmarks), structures of merit, and properties that do not meet landmark criteria but are worthy of preservation as part of a neighborhood, block, or street front. In late 2006, the Bevatron machine and site, but not its housing structure (Building 51), were designated as City of Berkeley landmarks. The landmark

designation is currently pending appeal to the Berkeley City Council. No other structures at the LBNL main site are listed as City of Berkeley historical resources.

Oakland General Plan

The Oakland General Plan Historic Preservation Element, adopted in 1994 and revised in 1998, identifies several categories of historical resources. Designated Historic Properties include three classes of City Landmarks (1 through 3, in declining order of importance); two classes of Preservation Districts (Areas of Primary Importance and Areas of Secondary Importance); and Heritage Properties, which are historic resources (designated by the Landmarks Preservation Advisory Board or Planning Commission) that are not Landmarks or Preservation Districts.[5] The Element also defines a category of Potential Designated Historic Properties (PDHPs), which are those properties that have an existing or contingency rating of "A" (highest importance), "B" (major importance), or "C" (secondary importance) in either the Oakland Cultural Heritage Survey (OCHS), a project of the City's Planning Department, or the Reconnaissance Survey, or have been determined by the surveys to contribute (or potentially contribute, based on contingency rating) to an Area of Primary Importance or Area of Secondary Importance. PDHPs are so identified by their survey rating; unlike Designated Historic Properties, PDHPs are not formally designated by any City body. None of the facilities at LBNL or in the nearby vicinity are listed as a City of Oakland historical resource.

Historic Preservation Element goals and policies applicable to the 2006 LRDP include the following:

> Historic Preservation Goal 2: To preserve, protect, enhance, perpetuate, use, and prevent the unnecessary destruction or impairment of properties or physical features of special character or special historic, cultural, educational, architectural or aesthetic interest or value. Such properties or physical features include buildings, building components, structures, objects, districts, sites, natural features related to human presence, and activities taking place on or within such properties or physical features.
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> Policy 3.1 Avoid or Minimize Adverse Historic Preservation Impacts Related to Discretionary City Actions: The City will make all reasonable efforts to avoid or minimize adverse effects on the Character-Defining Elements of existing or Potential Designated Historic Properties which could result from private or public projects requiring discretionary City actions.
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> Policy 3.5 Historic Preservation and Discretionary Permit Approvals: For additions or alterations to Heritage Properties or Potential Designated Historic Properties requiring discretionary City permits, the City will make a finding that: (1) the design matches or is compatible with, but not necessarily identical, to the property's existing or historical design; or (2) the proposed design comprehensively modifies and is at least equal in quality to the existing design and is compatible with the character of the neighborhood; or (3) the

[5] Eligibility requirements for designation as a Heritage Property include an existing or contingency Oakland Cultural Heritage Survey (OCHS) rating of A, B, or C; an existing or contingency Reconnaissance Survey rating of A or B; or is a contributor (or potential contributor based on contingency rating) to a potentially eligible Preservation District. The Heritage Property category was developed in the Historic Preservation Element to replace the City's Preservation Study List. However, as of 2006, the City has not initiated designation of a list of Heritage Properties.

existing design is undistinguished and does not warrant retention and the proposed design is compatible with the character of the neighborhood.

For any project involving complete demolition of Heritage Properties or Potential Designated Historic Properties requiring discretionary City permits, the City will make a finding that: (1) the design quality of the proposed project is at least equal to that of the original structure and is compatible with the character of the neighborhood; or (2) the public benefits of the proposed project outweigh the benefit of retaining the original structure; or (3) the existing design is undistinguished and does not warrant retention and the proposed design is compatible with the character of the neighborhood.

Policy 3.8 Definition of "Local Register of Historical Resources" and Historic Preservation "Significant Effects" for Environmental Review Purposes: For purposes of environmental review under the California Environmental Quality Act, the following properties will constitute the City of Oakland's Local Register of Historic Resources:

1) All Designated Historic Properties, and

2) Those Potential Designated Historic Properties that have an existing rating of "A" or "B" or are located within an Area of Primary Importance.

3) Until complete implementation of Action 2.1.2 (Redesignation), the "Local Register" will also include the following designated properties: Oakland Landmarks, S-7 Preservation Combining Zone properties, and Preservation Study List properties.

IV.D.3 Impacts and Mitigation Measures

IV.D.3.1 Significance Criteria

In accordance with Appendix G of the CEQA Guidelines and the UC CEQA Handbook, the impacts of the proposed 2006 LRDP and its resulting projects on cultural resources would be considered significant if they would exceed the following Standards of Significance:

- Cause a substantial adverse change in the significance of a historical resource as defined in CEQA Guidelines Section 15064.5;
- Cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5;
- Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature; or
- Disturb any human remains, including those interred outside of formal cemeteries.

These impact criteria constitute the significance standards for this environmental topic. The significance standards for the first and second bulleted impact criteria are further explained and defined below. In considering the third bulleted criterion, the Initial Study (see Appendix A) found that the 2006 LRDP would have no significant impact on a unique paleontological resource or site or a unique geologic feature at LBNL. During the course of development at LBNL, extensive excavation for buildings and infrastructure has not revealed the presence of unique

paleontological or geologic resources, and thus implementation of the 2006 LRDP would not affect such resources. Therefore, no additional analysis of this criterion is required.

Section 15064.5 of the CEQA Guidelines defines a historical resource as including the following:

(1) A resource listed in, or determined to be eligible by the State Historical Resources Commission for listing in, the California Register of Historical Resources.

(2) A resource included in a local register of historical resources, as defined in Section 5020.1(k) of the Public Resources Code or identified as significant in a historical resource survey meeting the requirements of Section 5024.1(g) of the Public Resources Code, shall be presumed to be historically or culturally significant. Public agencies must treat any such resource as significant unless the preponderance of evidence demonstrates that it is not historically or culturally significant.

(3) Any object, building, structure, site, area, place, record, or manuscript which a lead agency determines to be historically significant or significant in the architectural, engineering, scientific, economic, agricultural, educational, social, political, military, or cultural annals of California may be considered to be a historical resource, provided the lead agency's determination is supported by substantial evidence in light of the whole record. Generally, a resource shall be considered by the lead agency to be "historically significant" if the resource meets the criteria for listing on the California Register of Historical Resources (Public Resources Code Section 5024.1, Title 14 CCR, Section 4852).

Public Resources Code (PRC) Section 5020.1 and CEQA Guidelines Section 15064.5(b)(1) define a significant effect as one that would materially impair the significance of a historical resource. According to CEQA Guidelines Section 15064.5(b)(2), material impairment of a resource's historic significance could result if the project would:

- Demolish or materially alter in an adverse manner those physical characteristics of a historical resource that convey its historical significance and that justify its inclusion in, or eligibility for inclusion in, the California Register of Historic Resources;

- Demolish or materially alter in an adverse manner those physical characteristics that account for its inclusion in a local register of historical resources pursuant to local ordinance or resolution (PRC Section 5020.1[k]), or its identification in a historical resources survey meeting the requirements of PRC Section 5024.1(g), unless a preponderance of evidence establishes that the resource is not historically or culturally significant; or

- Demolish or materially alter in an adverse manner those physical characteristics of a resource that convey its historical significance and that justify its eligibility for its inclusion in the California Register, as determined by the lead agency.

Generally, if a project follows the Secretary of the Interior's guidelines, its impact on a historical resource will be considered mitigated to a less-than-significant level (CEQA Guidelines Section 15064.5(b)(3)).

CEQA Guidelines Section 15064.5(c) applies to effects on archaeological sites. Effects on non-unique archaeological resources are not considered significant. Regarding unique archaeological

resources, lead agencies may require that reasonable efforts be made to permit such resources to be preserved in place or left in an undisturbed state. To the extent that unique archaeological resources are not preserved in place or disturbed, mitigation measures to protect such resources are required (PRC Section 21083.2(c)). Additionally, mitigation measures may be imposed to make provisions for archaeological sites accidentally discovered during construction.[6]

IV.D.3.2 Impact Assessment Methodology

The project site has undergone cultural resources analyses in the form of archival research and field reconnaissance, which have been conducted by qualified archaeologists. The historic architectural resource analysis was completed by qualified architectural historians who visited LBNL to inspect the property, take photographs, review historical documentation on the buildings and structures (including previous environmental review projects), and complete archival research. Information gathered was used to evaluate whether the proposed LRDP activities would cause impacts on historic or cultural resources. The Lab will evaluate whether the cultural resources impacts of any later activity implemented pursuant to the LRDP were examined in this program EIR before finding the activity to be within the scope of the project covered by the program EIR. If specific project differences from the presentation of the Illustrative Development Scenario and the 2006 LRDP EIR are such that the project is not within the scope of the LRDP EIR or the specific impact statements and mitigation measures do not cover the individual project pursuant to CEQA Guidelines Sections 15168(c)(2) and 15168(c)(5), then appropriate, project-specific CEQA analysis will be tiered from this 2006 LRDP EIR in accordance with CEQA Guidelines Section 15168(d)(1-3).

IV.D.3.3 2006 LRDP Principles, Strategies, and LBNL Design Guidelines

2006 LRDP Principles and Strategies

The 2006 LRDP proposes four fundamental principles that form the basis for the development strategies provided for each element of the LRDP. The one principle most applicable to the cultural resources aspect of new development is to "Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship."

Development strategies provided by the 2006 LRDP are intended to minimize potential environmental impacts on valued cultural resources that could result from implementation of the 2006 LRDP. (See Chapter III, Project Description for further discussion, and see Appendix B for a full listing of principles, strategies, and design guidelines.)

[6] For the purposes of this EIR, the term "construction," unless specifically indicated otherwise, includes activities that involve construction of new facilities, major rehabilitation or modification of existing facilities, and demolition of existing facilities.

LBNL Design Guidelines

The LBNL Design Guidelines were developed in parallel with the LRDP and are proposed to be adopted by the Lab following The Regents' consideration of the 2006 LRDP. The LBNL Design Guidelines provide specific guidelines for site planning, landscape and building design as a means to implement the LRDP's development principles as each new project is developed. Specific design guidelines are organized by a set of design objectives that essentially correspond to the strategies provided in the LRDP. The LRDP Design Guidelines provide the following specific planning and design guidance relevant to cultural resources to achieve these design objectives (including by encouraging pedestrian travel on the main hill site, with the potential for commensurate reduction in vehicle travel):

- Complement building aesthetics and enhance visual value through creation of land form elements that are consistent with design on the Hill. Mass and site buildings to minimize their visibility and to "ensure each building contributes to a cohesive and coherent architectural expression through the Laboratory site."

- Each Research Cluster, because of topography, historic buildings, plant palette, and so on will develop a unique identity.

- Preserve the Hill's rustic landscape through provision of screening landscape elements for large buildings and the integration of buildings into the overall landscape using appropriate materials.

- There are many interesting historic objects scattered around the Lab. These artifacts are important reminders of the Lab's legacy as well as items of interest which stimulate interaction. Placement of these artifacts at major pedestrian nodes and at prominent locations in each commons is encouraged.

- Designers shall examine the architectural precedents, especially of historic buildings, present in the Research Cluster where their project is to be located. A clear rationale based on precedent for the architectural expression of each project will be developed.

IV.D.3.4 Impacts and Mitigation Measures – 2006 LRDP

Impact CUL-1: Implementation of the 2006 LRDP could cause a substantial adverse change in the significance of historical resources, as defined in CEQA Guidelines Section 15064.5, including historical resources that have not yet been identified. (Significant and Unavoidable)

As described under "Setting" above, demolition of Building 51 has been analyzed in a separate EIR. That EIR is currently anticipated to be considered for certification in early 2007. That EIR concluded that there would be a significant unavoidable impact to historic resources from the demolition of the Building 51, including the Bevatron equipment within that building, that would cause a substantial adverse change in the significance of a historic resource as defined in CEQA, and that this impact is unavoidable. That EIR also concluded that all other impacts would either be less then significant or mitigated to a less-than-significant level. In accordance with the National Historic Preservation Act and a Memorandum of Agreement among DOE, the California State Historic Preservation Officer, and the Advisory Council on Historic Preservation, LBNL

has consulted with the NPS, which determined that an addendum to a previously prepared Historic American Engineering Record (HAER) report would meet the requirements of the Historic American Building Survey (HABS) for pre-demolition documentation of Building 51; this pre-demolition documentation would serve as partial mitigation for the loss of the building. In addition, as part of the EIR for the demolition of Building 51, LBNL indicated that it plans to commemorate the scientific achievements attributed to the Bevatron with a monument and/or a display listing the historic discoveries that occurred there. Along with the previously completed HAER documentation, which included a written historical and architectural description of the building and accelerator, and extensive photographic recordation, and the HABS addendum to the HAER, the Lab's proposed monument and/or display would reduce the effects of demolition of Building 51, but not to a less-than-significant level. Accordingly, the *Demolition of Building 51 and the Bevatron EIR* found that demolition will result in a significant, unavoidable impact on cultural resources that cannot be fully mitigated (LBNL, 2006). Demolition of Building 51 would represent a significant and unavoidable impact of the 2006 LRDP, as well. (See discussion of the Bevatron and the Building 51 complex in Chapter III, Project Description.)

Concerning other potential historical resources, as discussed under "Setting" above, LBNL has retained the Pacific Northwest National Laboratory to complete a series of reports to identify, survey, and evaluate approximately 245 buildings and structures at the LBNL site for potential eligibility for listing in the National Register. The Pacific Northwest National Laboratory's series of reports is not yet complete, nor have the reports been submitted to the State Historic Preservation Officer for concurrence. Preliminary findings of the surveys and research conducted by the Pacific Northwest National Laboratory suggest that Building 71 and Building 88 may be eligible for listing in the National Register. There are no current plans to demolish Buildings 71 and 88. However, should the buildings prove to be eligible for National Register listing, their demolition under the 2006 LRDP would result in a significant and unavoidable impact and implementation of Mitigation Measure D.2 would be required. (See Appendix E for additional discussion of Buildings 71 and 88.)

The 2006 LRDP proposes building demolition and replacement at various locations on the site. Thus, there is potential for activity under the LRDP to affect historically significant resources that have not yet been identified by the State Office of Historic Preservation as eligible for listing in the National Register. Should SHPO identify other buildings at LBNL as eligible for listing on the National Register, their demolition under the 2006 LRDP would also result in a significant and unavoidable impact and implementation of Mitigation Measure CUL-1 would be required. It is not currently anticipated that additional buildings will be identified for listing on the National Register beyond those discussed above.

> **Mitigation Measure CUL-1:** Mitigation for the demolition or substantial physical alteration of Buildings 71 and 88, and other historical buildings and structures at LBNL found to be significant historical resources at the completion of the ongoing surveys and research, shall include the development of a Memorandum of Agreement (MOA) among the Department of Energy, the State Historic Preservation Officer, and the Advisory Council on Historic Preservation. Full implementation of the MOA's stipulations shall also be required as part of this mitigation measure.

The above mitigation measure is included, with regard to Building 51, in the EIR for the proposed demolition of that structure, including the Bevatron, and that mitigation is applicable to the LRDP, as well.

Based on the CEQA Guidelines, removal of buildings determined eligible for listing on the National Register would result in a substantial adverse change that cannot be fully mitigated; thus**,** the impact after mitigation would remain significant and unavoidable.

Significance after Mitigation: Significant and unavoidable.

Project Variant. The project variant proposes structural modifications that would be identical to those proposed under the 2006 LRDP. Therefore, the impact discussion and mitigation measure listed above would also apply to the project variant, and the project variant would result in a significant and unavoidable impact by causing a substantial adverse change in the significance of historical resource(s) as defined in CEQA Guidelines Section 15064.5.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. The locations of buildings, configurations, uses and other features of actual development may vary from the scenario. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of cultural resource impacts. The Illustrative Development Scenario includes several projects, such as the demolition of Building 51and construction of new buildings at the site of the Building 51 complex and the Old Town area, that would affect identified historical resources and potential historic resources. For the reasons stated above, potential projects under the 2006 LRDP such as those included in the Illustrative Development Scenario could affect other Lab buildings that might be deemed eligible for listing on the National Register in the future. The demolition of Building 51, or the demolition of any other buildings deemed eligible for listing on the National Register, would result in a significant and unavoidable impact, as would the LRDP, as described above.

Impact CUL-2: The proposed 2006 LRDP would allow demolition of buildings and structures at LBNL that have been found to be ineligible for listing in the National Register individually or as a district. (Less than Significant)

Implementation of the 2006 LRDP would result in a series of development and redevelopment projects at LBNL over the course of the next 20 years, including demolition and redevelopment of a substantial portion of the Lab's "Old Town" area. The Old Town area is approximately 15 acres in size and is the oldest section at LBNL. Many of the 30 buildings and structures in the

Old Town area would be demolished and replaced with development clusters according to the LBNL Design Guidelines developed pursuant to the proposed LRDP. The buildings and structures within these areas have been evaluated for historical significance by a qualified cultural resources team. Despite the fact that most Old Town buildings are over 50 years old, the findings are that none of the buildings or structures evaluated are individually, or as a district, determined to be eligible for listing in the National Register (Harvey, 2003). Their demolition and the subsequent redevelopment of this area would result in a less-than-significant impact.

Building 6, which houses the Advanced Light Source, is considered to be an important visual landmark at LBNL, and it is associated with the former 184-inch cyclotron at LBNL. While it is part of the Old Town area, it is not considered for demolition or replacement under the proposed 2006 LRDP.

Mitigation: None required.

Project Variant. Similar to the 2006 LRDP, the project variant proposes the demolition of buildings and structures within the Old Town area at LBNL that have been found to be ineligible for listing in the National Register individually or as a district. Therefore, their demolition and the subsequent redevelopment of this area would result in a less-than-significant impact on a historical resource defined under CEQA.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a reasonably foreseeable conceptual portrayal of potential development under the 2006 LRDP. The locations of buildings, configurations, uses and other features of actual development may vary from the scenario. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on archeological resources. Potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario, such as the demolition of buildings within the Old Town area, would affect buildings determined ineligible for listing in the National Register in the same manner as would the LRDP, as discussed above. This would result in a less-than-significant impact.

Impact CUL-3: Implementation of the proposed 2006 LRDP could cause a substantial adverse change in the significance of an archaeological resource pursuant to CEQA Guidelines Section 15064.5. (Significant; Less than Significant with Mitigation)

As already noted, the potential for Native American sites to exist on the project site is considered low to moderate, based on field surveys and archival research at the Northwest Information

Center. In the unlikely event that archaeological artifacts are discovered during construction (including grading, excavation, and other earthmoving activities), the following project-specific mitigation measure, which is included as part of the LBNL facilities construction specifications, would be implemented.

> **Mitigation Measure CUL-3:** If an archaeological artifact is discovered on-site during construction under the proposed LRDP, all activities within a 50-foot radius shall be halted and a qualified archaeologist shall be summoned within 24 hours to inspect the site. If the find is determined to be significant and to merit formal recording or data collection, adequate time and funding shall be devoted to salvage the material. Any archaeologically important data recovered during monitoring shall be cleaned, catalogued, and analyzed, with the results presented in a report of finding that meets professional standards.
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> **Significance after Mitigation:** Less than significant.

Project Variant. The project variant proposes structural modifications that would be identical to those proposed under the 2006 LRDP. Therefore, the impact discussion and mitigation measure listed above would also apply to the project variant. Implementation of Mitigation Measure CUL-3 would reduce potential impacts on archeological resources associated with the project variant to a less-than-significant level.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of impacts on archeological resources. The locations of buildings, configurations, uses and other features of actual development may vary from the scenario. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario, including construction of new buildings at the site of the Building 51 complex and Old Town area, could affect subsurface archeological resources in the same manner as would the LRDP. Although the likelihood of discovering subsurface archeological resources is relatively low due to prior development, such resources could be uncovered. To ensure that potential impacts on archeological resources would be less than significant, Mitigation Measure CUL-3 would apply to projects under the LRDP such as those identified in the Illustrative Development Scenario.

Impact CUL-4: Implementation of the proposed 2006 LRDP could disturb human remains, including those interred outside of formal cemeteries. (Significant; Less than Significant with Mitigation)

As discussed under the previous impact, there is no known evidence of prehistoric habitation at LBNL, nor any indication that the site has been used for burial purposes in the recent or distant past. Thus, encountering human remains at the LBNL site would be unlikely. However, if human remains should be encountered during excavation and construction, work would be halted and the following project-specific Mitigation Measure CUL-4 would be implemented.

Mitigation Measure CUL-4: In the event that human skeletal remains are uncovered during construction or ground-breaking activities resulting from implementation of the 2006 LRDP at the LBNL site, CEQA Guidelines Section 15064.5(e)(1) shall be followed:

- In the event of the accidental discovery or recognition of any human remains in any location other than a dedicated cemetery, the following steps should be taken:

  (1) There shall be no further excavation or disturbance of the site or any nearby area reasonably suspected to overlie adjacent human remains until:

  (A) The coroner of the county in which the remains are discovered must be contacted to determine that no investigation of the cause of death is required, and

  (B) If the coroner determines the remains to be Native American: (1) The coroner shall contact the Native American Heritage Commission within 24 hours. (2) The Native American Heritage Commission shall identify the person or persons it believes to be the most likely descended from the deceased Native American. (3) The most likely descendent may make recommendations to the landowner or the person responsible for the excavation work, for means of treating or disposing of, with appropriate dignity, the human remains and any associated grave goods as provided in Public Resources Code Section 5097.98, or

  (2) Where the following conditions occur, the landowner or his authorized representative shall rebury the Native American human remains and associated grave goods with appropriate dignity on the property in a location not subject to further subsurface disturbance.

  (A) The Native American Heritage Commission is unable to identify a most likely descendent or the most likely descendent failed to make a recommendation within 24 hours after being notified by the commission;

  (B) The descendant identified fails to make a recommendation; or

  (C) The landowner or his authorized representative rejects the recommendation of the descendant, and the mediation by the Native American Heritage Commission fails to provide measures acceptable to the landowner.

Significance after Mitigation: Less than significant.

Project Variant. Demolition and new construction proposed under the project variant would be similar to that proposed by the 2006 LRDP. Therefore, Impact CUL-4 and Mitigation Measure CUL-4, listed above, would also apply to the project variant. Implementation of Mitigation Measure CUL-4 would reduce potential impacts on human remains attributed to the project variant to a less-than-significant level should human remains be encountered during excavation and construction.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a reasonably foreseeable conceptual portrayal of potential development under the 2006 LRDP. The locations of buildings, configurations, uses and other features of actual development may vary from the scenario. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of potential impacts on human remains. For the reasons stated above, potential individual projects identified in the Illustrative Development Scenario, including the construction of new buildings at the site of the Building 51 complex and the Old Town area, could affect human remains in the same manner as would the LRDP. The likelihood of encountering human remains at the Old Town area is low because of prior development and subsurface alterations associated with construction of the existing Old Town buildings. In the event that human remains should be encountered during excavation and construction, for a potential project under the LRDP such as those identified in the scenario, Mitigation Measure CUL-4 would apply and would reduce any potential impacts relating to the possible discovery of the human remains.

IV.D.3.6 Cumulative Impacts

This analysis considers cumulative growth as represented by the implementation of the Berkeley and Oakland general plans (and thus includes growth anticipated by the City of Berkeley General Plan EIR), and implementation of the UC Berkeley 2020 LRDP (including the Southeast Campus Integrated Projects) along with implementation of the proposed LBNL 2006 LRDP. (Demolition of the Building 51 complex – housing the Bevatron accelerator – although the subject of a separate project-specific EIR, is analyzed as part of the 2006 LRDP because the buildings were in place when the EIR analyses were undertaken.) Additional projects currently underway at UC Berkeley, described in Section VI.C, Cumulative Impacts, of this EIR, are also accounted for in the cumulative analysis.

The geographic context for this cumulative analysis includes the City of Berkeley, including the UC Berkeley campus, and the City of Oakland, and the analysis considers development in those areas and not exclusively at LBNL. This analysis evaluates whether the impacts of the proposed

LRDP, together with the impacts of cumulative development, would result in a significant impact (based on the significance criteria on p. IV.D-10) and, if so, whether the contribution of the LRDP to this impact would be considerable. Both conditions must apply in order for the project's cumulative impacts to rise to the level of significance. Specifically, with regard to cultural resources, the LRDP would contribute considerably to a significant cumulative impact only if the historical resources affected by the LRDP share historic significance with other resources that would be adversely affected by cumulative development.

Impact CUL-5: Implementation of the proposed 2006 LRDP would not combine with other cumulative projects to result in an adverse change to the significance of historical resources that share historic significance with resources that could be lost at Berkeley Lab. (Less than Significant)

The Southeast Campus Integrated Projects (SCIP) would result in significant and unavoidable impacts with regard to historical resources due to changes to Memorial Stadium, demolition of several structures, and alterations to buildings and landscape along Piedmont Avenue. For the most part, the buildings and facilities that would be adversely affected by the SCIP do not share historical associations with the Building 51 complex or with other facilities at LBNL. However, there is one potential exception: Calvin Laboratory, a UC Berkeley building occupied by LBNL staff and researchers that would be demolished under the SCIP. Although constructed in 1964 and therefore less than 50 years old—the normal minimum age for designation as a historical resource—Calvin Laboratory was identified in the SCIP Draft EIR as a historical resource because of its association with Melvin Calvin, a Nobel laureate who made significant contributions to science, especially in his research on photosynthesis. Calvin, a 1961 Nobel Laureate in chemistry, was a longtime UC Berkeley faculty member and was also one of the first chemists to join Ernest O. Lawrence's Radiation Laboratory, the predecessor to Berkeley Lab. Calvin and his research team mapped the route that carbon travels through a plant during photosynthesis and showed that sunlight acts on the chlorophyll in a plant to fuel the manufacturing of organic compounds, rather than on carbon dioxide as was previously believed. Calvin, like Lawrence, was a believer in interdisciplinary, collaborative science. In 1995, Berkeley Lab named one of the roads on the main hill site after Calvin (LBNL, 1997). Despite the connection between Calvin Laboratory and LBNL, the 2006 LRDP would not adversely affect buildings with particular historical association to Melvin Calvin, whose pioneering work was undertaken in facilities on the UC Berkeley campus. Moreover, it would be the UC Berkeley SCIP that would demolish Calvin Laboratory. Therefore, the LBNL 2006 LRDP would not result in a considerable contribution to any cumulative adverse impact on historical resources related to association with Melvin Calvin.

Concerning other potential cumulative impacts, the areas surrounding LBNL are either built out or would be retained as open space under the 2006 LRDP, thus limiting development opportunities in undisturbed areas. Therefore, the potential for the proposed LRDP to result in the discovery of historic architectural resources or other cultural resources is low. As there are no known or reasonably foreseeable projects in the immediate areas adjacent to LBNL that could combine with LRDP projects, cumulative impacts on cultural resources would not be considered cumulatively considerable.

Furthermore, as specific projects are proposed in the vicinity and LBNL and in the region, lead agencies would have to determine, on a case-by-case basis, whether the potential for historical or archaeological resources to be disturbed or adversely affected exists at a particular site. In the case of historical resources, it is frequently, but not always, known in advance of project consideration whether a building is so qualified. It is not uncommon, however, for additional research to be required in order to determine conclusively whether a building proposed for alteration or demolition is considered a historical resource for purposes of CEQA. In the case of subsurface (archaeological) resources, it is only seldom that it is possible to know of the existence of such resources ahead of project consideration. Therefore, site-specific research on the presence of historical and/or archaeological resources is frequently one of the first considerations in project planning and CEQA review. Accordingly, while it cannot be stated with certainty the nature of the cumulative impact, the fact that the LRDP's impacts would be relatively minimal, combined with the site- and project-specific considerations that must be given to subsequent projects elsewhere in the vicinity and the region, implementation of the LRDP is not expected to result in a considerable contribution to any potential cumulatively significant effects on historical and archaeological resources.

Mitigation: None required.

Project Variant. The analysis above would apply to the project variant. Because the impacts of the project variant on historical resources would be relatively minimal, combined with the site- and project-specific considerations that must be given to subsequent projects elsewhere in the vicinity and the region, implementation of the LRDP is not expected to result in a considerable contribution to any potential cumulatively significant effects on historical and archaeological resources.

Individual Future Project/Illustrative Development Scenario. A future project identified in the Illustrative Development Scenario, when combined with other projects under the LRDP and other development as discussed above, would also, for the reasons stated above, result in a cumulative impact on historical and archeological resources that would be less than significant.

IV.D.4 References – Cultural Resources

City of Berkeley, City of Berkeley General Plan, *Urban Design and Preservation Element, Figure 25: City-Designated Landmarks, Structures of Merit and Districts as of November 2001*, adopted April 23, 2002.

Dobkin, M. and M. Corbett. *Final Historic Architectural Evaluation of Building 7, Lawrence Berkeley Laboratory, University of California*, November 1992.

Harvey, D.W. *Identification and Evaluation of Old Town Buildings, Ernest Orlando Lawrence Berkeley National Laboratory,* January 2003.

Kielusiak, C. *Archaeological Survey of 70 Acres of Land and Recordation and Evaluation of Four Historic Resources at the Lawrence Berkeley National Laboratory*, February 2000.

Kroeber, A.L. *Handbook of the Indians of California. Bureau of American Ethnology*, Bulletin 78, Smithsonian Institution, Washington, DC (Reprint by Dover Publications, Inc., New York, 1976), 1925.

Lawrence Berkeley National Laboratory (LBNL). *Demolition of Building 51 and the Bevatron EIR*, Draft EIR. October 21, 2005.

Lawrence Berkeley National Laboratory (LBNL). *Demolition of Building 51 and the Bevatron EIR*, Draft EIR. October 21, 2005.

Lawrence Berkeley National Laboratory (LBNL). *Historic American Engineering Record, University of California Radiation Laboratory, Bevatron (Ernest Orlando Lawrence Berkeley National Laboratory, Buildings 51/51A)*, HAER No. CA-186-A, National Park Service, Department of the Interior, San Francisco, California (including 2006 addendum), September 1997.

Lawrence Berkeley National Laboratory (LBNL). "Melvin Calvin, Who Unraveled the Secrets of Photosynthesis, Dies." News Release, January 9, 1997; available on the internet at http://www.lbl.gov/Science-Articles/Archive/Melvin-Calvin-obit.html.

Northwest Information Center. Records Search for Lawrence Berkeley National Laboratory, December 2003.

Office of Historic Preservation, State of California. Historic Properties Listing, by City (through June 2003). State of California Office of Historic Preservation, Sacramento, CA, 2003.

UC (University of California) Berkeley, *Southeast Campus Integrated Projects Tiered Focused Final Environmental Impact Report (SCH #2005112056)*; October 31, 2006. Available on the internet at http://www.cp.berkeley.edu/SCIP/FEIR/SCIP_FEIR.html.

IV.E. Geology and Soils

IV.E.1 Introduction

This section discusses the potential project effects related to geology and soils that could result from continued University operation of LBNL, including continued facility development and operation under the 2006 LRDP.

The following discussion describes LBNL's regional geologic and seismic setting and analyzes potential geologic and seismic hazards that may affect the proposed project based upon the site conditions and location. The analysis focuses on increased exposure of people and structures to hazards such as surface fault rupture, groundshaking, landsliding, and erosion.

IV.E.2 Setting

IV.E.2.1 Geologic Setting

LBNL lies within the geologic region of California referred to as the Coast Ranges geomorphic province.[1] Discontinuous northwest-trending mountain ranges, ridges, and intervening valleys composed of ancient seafloor rocks characterize this province. The Coast Ranges are composed primarily of sedimentary rocks from the Jurassic Age to Miocene Epoch (approximately 206 to 5 million years ago).

LBNL is located on the western slopes of the Oakland-Berkeley hills within the central region of the Coast Ranges geomorphic province. The Miocene Orinda Formation, deposited between 13 and 10.5 million years ago and composed of poorly indurated (relatively soft), non-marine mudstone and sandstone, underlies the majority of LBNL. The western and southern portions of the site are underlain by marine mudstone and sandstones deposited in the late Cretaceous (99 to 65 million years ago) as part of the Great Valley Group. Some of the higher elevation portions of LBNL, as well as a portion of the eastern part of the site, are underlain by paleolandslide deposits comprised of Moraga Formation rocks. These deposits are composed of andesitic breccia with a small proportion of interbedded volcaniclastic sandstone and conglomerate. A small portion of the very eastern extent of LBNL is underlain by the middle to late Miocene (16 to 5 million years ago) San Pablo Group, consisting of shallow marine sandstones, and the early to middle Miocene (24 to 12 million years ago) Claremont Formation, consisting of well-consolidated, interbedded chert and shale with minor amounts of sandstone (LBNL, 2000).

[1] A geomorphic province is an area that possesses similar bedrock, structure, history, and age. California has 11 geomorphic provinces.

IV.E.2.2 Mineral Resources

The California Department of Conservation, Geological Survey (CGS, formerly Division of Mines and Geology) has classified lands within the San Francisco–Monterey Bay Region into Aggregate and Mineral Resource Zones (MRZs) based on guidelines adopted by the California State Mining and Geology Board, as mandated by the Surface Mining and Reclamation Act of 1974 (Stinson et al., 1983). LBNL is mapped by the CGS as MRZ-1, an area where no significant mineral or aggregate deposits are present (Stinson et al., 1983).

IV.E.2.3 Soils

The U.S. Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) (formerly known as the Soil Conservation Service) has characterized the majority of on-site soils as Xerorthens-Millsholm complex, 30 to 50 percent slope. These are well-drained soils that generally allow for rapid runoff of precipitation and are highly susceptible to erosion, although rainwater runoff is known to be minimal in vegetated areas of the Lab. The southern portion of LBNL is underlain by Altamont Clay, 30 to 50 percent slope. This is a deep, well-drained soil that has a high shrink-swell and erosion potential. The southwest corner of LBNL is underlain by Maymen loam, 30 to 75 percent slope. Maymen loam is a shallow, fine-grained soil that exhibits rapid runoff and is highly susceptible to erosion. The eastern portion of the site is partially underlain by Maymen-Los Gatos complex, 30 to 75 percent slope. These are shallow to moderately deep soils that are highly susceptible to erosion (USDA NRCS, 1981). Soil characteristics at LBNL vary somewhat from the above, however, due to historic grading activities that have altered native soil profiles.

IV.E.2.4 Topographic Setting

Topographic elevations at LBNL range from approximately 450 to 1,100 feet above mean sea level (amsl). Although elevations generally decrease towards the west and south, a series of small canyons and ridgelines associated with surface water drainages results in a complex, varied topographic profile across the site. As noted on Figure IV.G-1 in Section IV.G, Hydrology and Water Quality, the site is in the Strawberry Creek Watershed.

IV.E.2.5 Groundwater

Depth to groundwater throughout the site varies significantly and seasonally from zero to approximately 100 feet below ground surface, due to the steep slopes and varying rock types at LBNL (LBNL, 2004). Historic development at LBNL has included the installation of hydraugers[2] to facilitate hillside drainage and minimize saturation of steep slopes; groundwater collected in hydraugers is subsequently directed both back out onto stable slopes at lower elevations, and into LBNL's storm drain system, as further explained in Section IV.G, Hydrology and Water Quality.

[2] Hydraugers are horizontal drain pipes inserted into the hillside to draw off groundwater, some of which otherwise would eventually reach the natural drainage channels and which could, if not drained by means of the hydraugers, result in slope instability when excessive moisture builds up in the soil.

IV.E.2.6 Seismicity

The San Francisco Bay Area contains both active and potentially active faults and is considered a region of high seismic activity (see Figure IV.E-1).[3] The 2001 California Building Code locates the entire Bay Area within Seismic Risk Zone 4. Areas within Zone 4 are expected to experience maximum magnitudes and damage in the event of an earthquake (Lindeburg, 1998). On the basis of research conducted since the 1989 Loma Prieta earthquake, the U.S. Geological Survey (USGS) and other scientists, comprising the Working Group on California Earthquake Probabilities, have concluded that there is a 62-percent probability of at least one magnitude 6.7 or greater earthquake striking the San Francisco Bay Area before 2032 (USGS, 2003).

The estimated (moment) magnitudes shown in Table IV.E-1 represent characteristic earthquakes on particular faults in the San Francisco Bay Area.[4] While magnitude is a measure of the energy released in an earthquake, intensity is a measure of the groundshaking effects at a particular location. Ground movement during an earthquake can vary depending on the overall magnitude, distance to the fault, focus of earthquake energy, and type of geologic material. The composition of underlying soils, even those relatively distant from faults, can intensify groundshaking. The Modified Mercalli (MM) intensity scale (see Table IV.E-2, p. IV.E-6) is commonly used to measure earthquake effects due to groundshaking. The MM values range from I (earthquake not felt) to XII (damage nearly total), and values ranging from IV to X could cause moderate to significant structural damage.[5] At LBNL, maximum groundshaking resulting from an earthquake generated on the Hayward fault, as discussed below, is anticipated to be violent to very violent (MM IX to MM X) (ABAG, 2003a).

IV.E.2.7 Regional Faults

The Hayward Fault Zone traverses the western edge of the LBNL site; the San Andreas Fault Zone is located approximately 19 miles southwest (see Figure IV.E-1). The San Andreas and Hayward faults exhibit strike-slip orientation and have experienced movement within the last 150 years.[6] Other principal faults in the vicinity of LBNL that are capable of producing significant groundshaking at the project site are listed on Table IV.E-1 and include the San Gregorio–Hosgri, Calaveras, Concord–Green Valley, Marsh Creek–Greenville, and Rodgers Creek faults.

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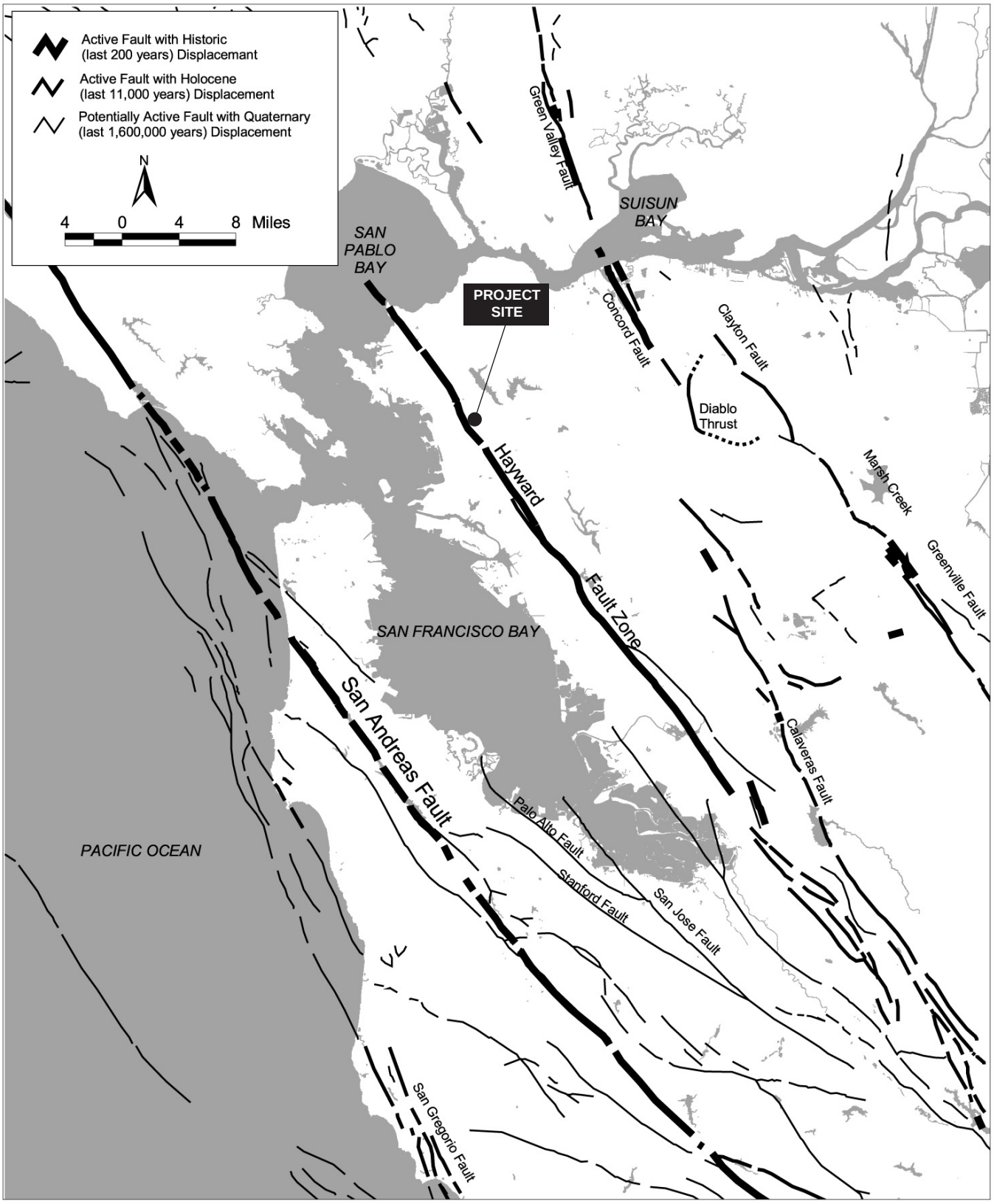
3 An "active" fault is defined by the State of California as a fault that has had surface displacement within Holocene time (approximately the last 11,000 years). A "potentially active" fault is defined as a fault that has shown evidence of surface displacement during the Quaternary (last 1.6 million years), unless direct geologic evidence demonstrates inactivity for all of the Holocene or longer. This definition does not, of course, mean that faults lacking evidence of surface displacement are necessarily inactive. "Sufficiently active" is also used to describe a fault if there is some evidence that Holocene displacement occurred on one or more of its segments or branches (Hart, 1997).

4 Moment magnitude is related to the physical size of a fault rupture and movement across a fault. The Richter magnitude scale reflects the maximum amplitude of a particular type of seismic wave. Moment magnitude provides a physically meaningful measure of the size of a faulting event (CGS, 1997b). The concept of "characteristic" earthquake means that we can anticipate, with reasonable certainty, the actual earthquake that can occur on a fault.

5 The damage level represents the estimated overall level of damage that will occur for various MM intensity levels. The damage, however, will not be uniform. Some buildings will experience substantially more damage than this overall level, and others will experience substantially less damage. Not all buildings perform identically in an earthquake. The age, material, type, method of construction, size, and shape of a building all affect its performance (ABAG, 1998).

6 A strike-slip fault is a fault on which movement is parallel to the fault's strike (Bates and Jackson, 1984).



SOURCE: California Department of Conservation,
California Geological Survey (After Jennings, 1994), 2003

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Figure IV.E-1
Fault Map

TABLE IV.E-1
ACTIVE FAULTS IN THE VICINITY OF LBNL

Fault	Distance and Direction from LBNL	Recency of Movement	Fault Classification[a]	Historical Seismicity[b]	Maximum Moment Magnitude Earthquake (MM)[c]
Hayward	Bisects western edge of site	Historic (1868, southern segment) Holocene	Active	M6.8, 1868 Many <M4.5	7.1
Concord–Green Valley	14 miles northeast	Historic (1955) Holocene	Active	Historic active creep	6.9
San Andreas	19 miles southwest	Historic (1906; 1989) Holocene	Active	M7.1, 1989 M8.25, 1906 M7.0, 1838 Many <M6	7.9
Calaveras	18 miles southeast	Historic (1861) Holocene	Active	M5.6–M6.4, 1861 M4–M4.5 swarms 1970, 1990	6.8
Rodgers Creek	23 miles north	Historic Holocene	Active	M6.7, 1898 M5.6, 5.7, 1969	7.0
Marsh Creek–Greenville	25 miles east	Historic (1980) Holocene	Active	M5.6 1980	6.9
San Gregorio–Hosgri	26 miles southwest	Holocene – Late Quaternary	Active	Many M3–6.4	7.3

[a] Refer to footnote 3.
[b] Richter magnitude (M) and year for recent and/or large events. The Richter magnitude scale reflects the maximum amplitude of a particular type of seismic wave.
[c] Moment magnitude is related to the physical size of a fault rupture and movement across a fault. Moment magnitude provides a physically meaningful measure of the size of a faulting event (CGS, 1997b). The Maximum Moment Magnitude Earthquake (MM) derived from the joint CGS/USGS Probabilistic Seismic Hazard Assessment for the State of California, 1996. (CGS OFR 96-08 and USGS OFR 96-706).

SOURCES: Hart, 1997; Jennings, 1994; Peterson, 1996.

Hayward Fault Zone

The Hayward Fault Zone is the southern extension of a fracture zone that includes the Rodgers Creek fault (north of San Pablo Bay), the Healdsburg fault (Sonoma County), and the Maacama fault (Mendocino County). The Hayward fault trends to the northwest within the East Bay, extending from San Pablo Bay in Richmond 60 miles south to San Jose, where it converges with the Calaveras fault, a similar type fault that extends north to Suisun Bay. Historically, the southern portion of the Hayward fault generated a large to major earthquake in 1868. The USGS Working Group on California Earthquake Probabilities estimates there is a 27-percent chance the Hayward–Rodgers Creek Fault System will experience an earthquake of M 6.7 or greater by 2032 (USGS, 2003).

TABLE IV.E-2
MODIFIED MERCALLI INTENSITY SCALE

Intensity Value	Intensity Description	Average Peak Acceleration
I	Not felt except by a very few persons under especially favorable circumstances.	< 0.0017 g[a]
II	Felt only by a few persons at rest, especially on upper floors on buildings. Delicately suspended objects may swing.	< 0.014 g
III	Felt noticeably indoors, especially on upper floors of buildings, but many people do not recognize it as an earthquake. Standing motor cars may rock slightly, vibration similar to a passing truck. Duration estimated.	< 0.014 g
IV	During the day felt indoors by many, outdoors by few. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound. Sensation like heavy truck striking building. Standing motor cars rocked noticeably.	0.014–0.039 g
V	Felt by nearly everyone, many awakened. Some dishes and windows broken; a few instances of cracked plaster; unstable objects overturned. Disturbances of trees, poles may be noticed. Pendulum clocks may stop.	0.039–0.092 g
VI	Felt by all, many frightened and run outdoors. Some heavy furniture moved; and fallen plaster or damaged chimneys. Damage slight.	0.092–0.18 g
VII	Everybody runs outdoors. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable in poorly built or badly designed structures; some chimneys broken. Noticed by persons driving motor cars.	0.18–0.34 g
VIII	Damage slight in specially designed structures; considerable in ordinary substantial buildings, with partial collapse; great in poorly built structures. Panel walls thrown out of frame structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned. Sand and mud ejected in small amounts. Changes in well water. Persons driving motor cars disturbed.	0.34–0.65 g
IX	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb; great in substantial buildings, with partial collapse. Buildings shifted off foundations. Ground cracked conspicuously. Underground pipes broken.	0.65–1.24 g
X	Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations; ground badly cracked. Rails bent. Landslides considerable from riverbanks and steep slopes. Shifted sand and mud. Water splashed (slopped) over banks.	> 1.24 g
XI	Few, if any, (masonry) structures remain standing. Bridges destroyed. Broad fissures in ground. Underground pipelines completely out of service. Earth slumps and land slips in soft ground. Rails bent greatly.	> 1.24 g
XII	Damage total. Practically all works of construction are damaged greatly or destroyed. Waves seen on ground surface. Lines of sight and level are distorted. Objects are thrown upward into the air.	> 1.24 g

[a] g (gravity) = 980 centimeters per second squared. 1.0 g of acceleration is a rate of increase in speed equivalent to a car traveling 328 feet from rest in 4.5 seconds.

SOURCES: Bolt, 1988; California Geological Survey, 2003a.

San Andreas Fault Zone

The San Andreas Fault Zone is the longest in the state, extending from the Salton Sea in Southern California near the border with Mexico to north of Point Arena, where the fault trace extends out into the Pacific Ocean. The main trace of the San Andreas fault through the Bay Area trends northwest through the Santa Cruz Mountains and the eastern side of the San Francisco Peninsula. As the principal strike-slip boundary between the Pacific plate to the west and the North American plate to the east, the San Andreas is often a highly visible topographic feature, such as between the city of Half Moon Bay and Interstate 280, where Crystal Springs Reservoir and San Andreas Lake clearly mark the rupture zone.

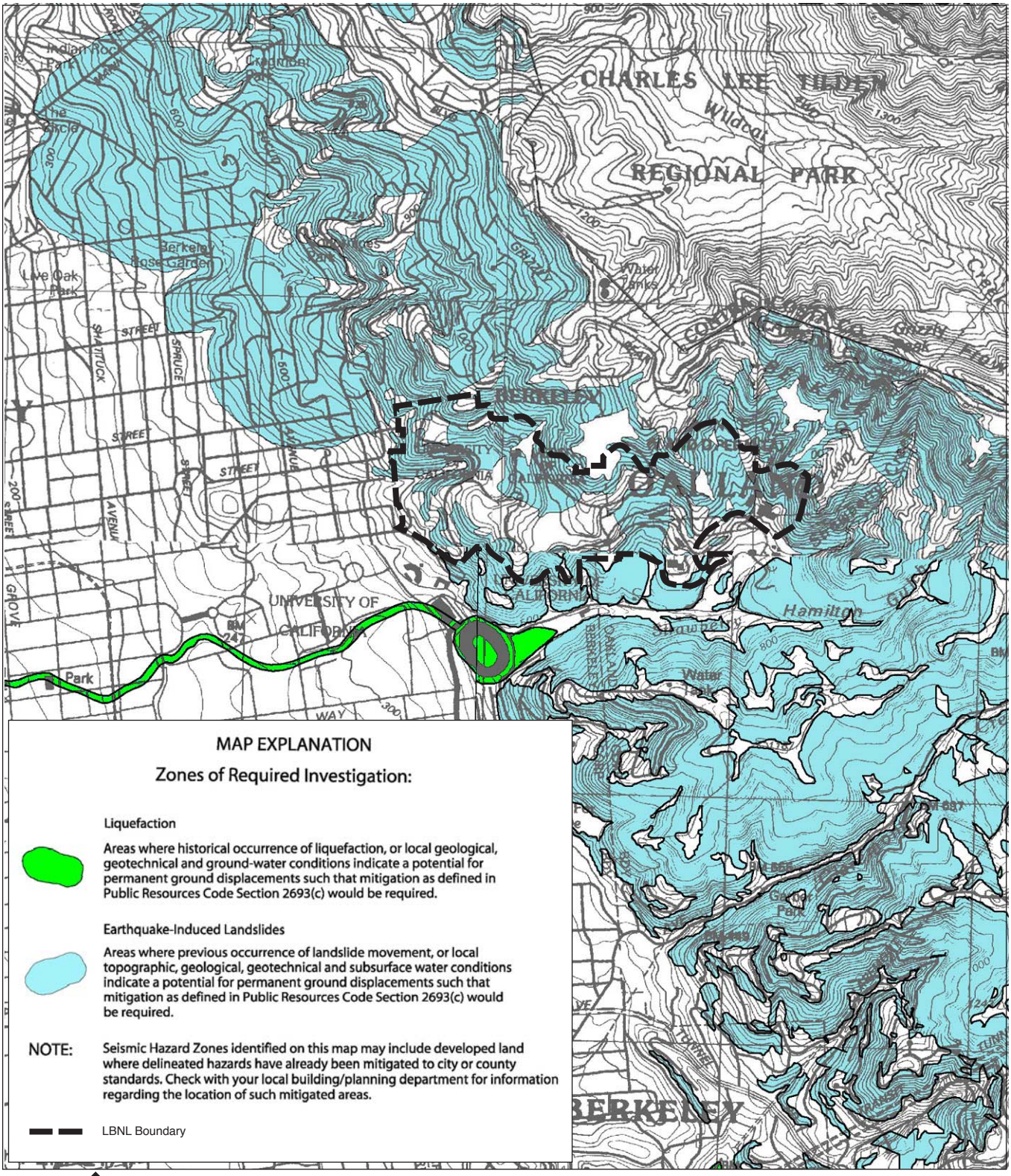
The San Andreas Fault Zone was the source of the two major seismic events in recent history that resulted in widespread damage throughout the San Francisco Bay region: the 1906 San Francisco earthquake (M 8.25), and the more recent 1989 Loma Prieta earthquake (M 7.1). The USGS Working Group on California Earthquake Probabilities estimates there is a 21-percent chance of the San Andreas fault experiencing an earthquake of M 6.7 or greater by 2032 (USGS, 2003).

IV.E.2.8 Geologic Hazards

Slope Failure

Slope failure can occur due any combination of the following factors: site slope, geology, precipitation amount and intensity, modifications due to grading, or seismic events. A slope failure is a mass of rock, soil, and/or debris displaced down a slope by sliding, flowing, or falling. Steep slopes and downslope creep of surface materials characterize landslide-susceptible areas. Approximately 60 percent of LBNL is located on slopes of greater than 25 percent and approximately 27 percent of the site is located on slopes greater than 45 percent. Due to steep topography, geology including landslide deposits, existing development of LBNL, the presence of shallow groundwater, and modification due to grading during development LBNL has numerous unstable slopes. Figure IV.E-2 illustrates the areas within LBNL identified by the CGS as Seismic Hazard Zones for earthquake-induced landslides (CGS, 1990 and 2003b). Although a majority of the Lab site is within these zones, most of the developed area is not.

Some of the unstable slopes have experienced ground failure during the history of LBNL. Due to these failures, LBNL has undertaken detailed study and mapping of unstable slopes within the site. Figure IV.E-3 depicts areas within LBNL prone to slope instability and classifies the risk potential of these areas to experience landslide activity (high, medium, and low risk). In addition, Figure IV.E-3 identifies areas where slope stabilization efforts have repaired the hillside and stabilized historic landslides (LBNL, 1999). Most of the mapped landslides or potential landslides at LBNL, as shown on Figure IV.E-3, are located within the earthquake-induced landslide hazard zones, as shown on Figure IV.E-2. As shown on Figure IV.E-3, Buildings 90, 46 and 46A are founded on landslides. The landslide beneath Buildings 46 and 46A and the portion of the landslides beneath Building 90 have been repaired and no longer represent a hazard to the buildings. In addition, a historic landslide was recently discovered under part of Building 85. LBNL is working with its geotechnical contractors to identify the steps necessary to repair this landslide, and will be promptly implementing those steps upon completion of the reports from the



SOURCE: California Department of Conservation, California Geologic Survey, 2003

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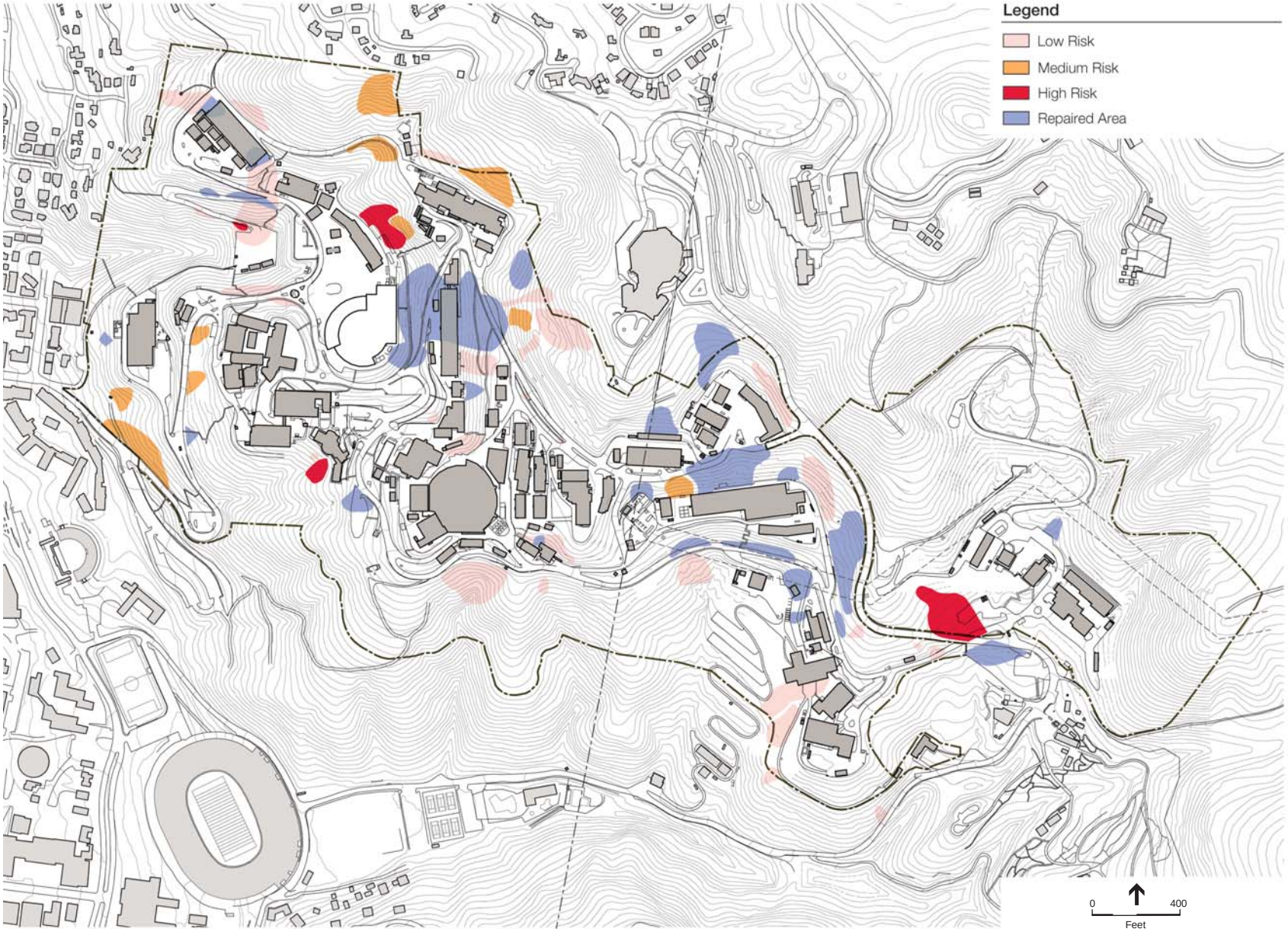
Figure IV.E-2
Seismic Hazard Zone Map



SOURCE: Lawrence Berkeley National Laboratory (2003)

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Figure IV.E-3
Slope Stability Map

geotechnical contractor. In addition, LBNL has implemented operational protections to avoid release of hazardous materials in the event of a slope failure. Note that earthquake-induced slope failure is addressed below under Seismic Hazards.

Expansive Soils

Expansive soils possess a "shrink-swell" characteristic. Shrink-swell is the cyclic change in volume (expansion and contraction) that occurs in clay soils from the process of wetting and drying. While all clay soils exhibit this behavior, the volume change is of sufficient magnitude to require mitigation in only some clay soils. In these soils, structural damage may occur over a long period of time, usually the result of inadequate soil and foundation engineering or the placement of structures directly on expansive soils. The soil that underlies the majority of LBNL (Xerorthens-Millsholm complex, 30 to 50 percent slope) is not an expansive soil, due to its low percentage of fine-grained materials (clays). Similarly, the soils that underlie the eastern and southwest portions of the site possess a low to moderate shrink-swell potential. However, the Altamont Clay that underlies much of the southern portion of LBNL is a highly expansive soil, and shrink-swell hazards are present in this area of the site.

Soil Erosion

Soil erosion is a process whereby soil materials are worn away and transported to another area, either by wind or water. Rates of erosion can vary depending on the soil material and structure, placement, and human activity. Soil containing high amounts of silt can be easily eroded, while sandy soils are less susceptible. Excessive soil erosion can eventually damage building foundations and roadways. Erosion is most likely to occur on sloped areas with exposed soil, especially where unnatural slopes are created by cut-and-fill activities. Soil erosion rates can be higher during the construction phase. Typically, the soil erosion potential is reduced once the soil is graded and covered with concrete, structures, or asphalt. Soils throughout LBNL are highly susceptible to soil erosion due to LBNL's steeply sloping topography, particularly when vegetation and surficial material is stripped for construction purposes.

IV.E.2.9 Seismic Hazards

The seismic hazards discussed below include those hazards that could reasonably be expected to occur within LBNL during a major earthquake on any of the Bay Area fault zones, especially the Hayward fault. Some hazards are more severe than others, depending on the location, underlying materials, and level of groundshaking. Certain of these hazards might not occur, or could occur with minor consequences.

Surface Fault Rupture

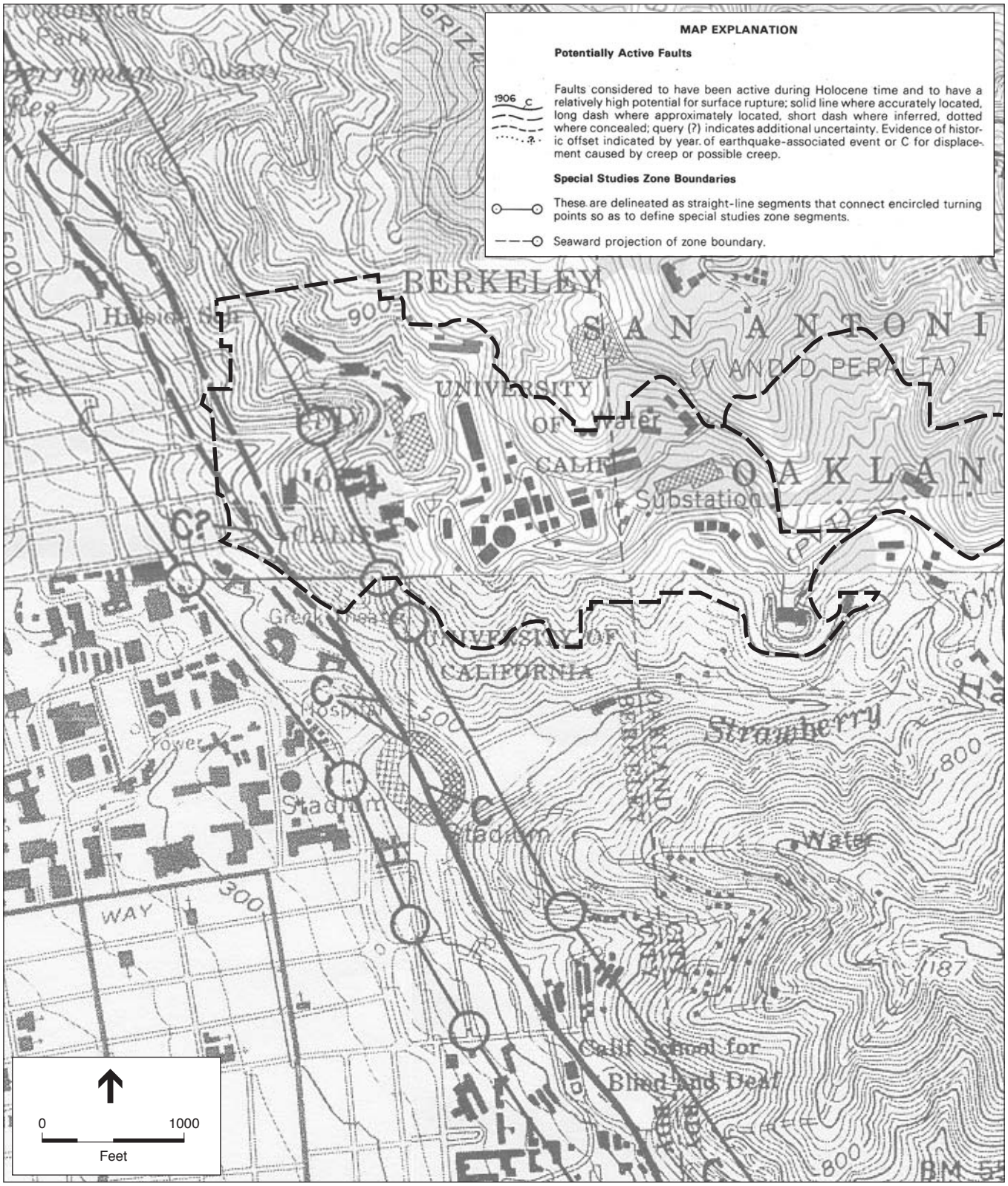
Fault rupture is defined as the differential displacement of the ground surface across a fault trace. Not all earthquakes result in fault rupture. For instance, the 1989 Loma Prieta and 1994 Northridge earthquakes did not result in fault rupture. Fault rupture generally occurs primarily on the trace of the fault which generated the earthquake. However, small ruptures have also been observed on fault traces other than that of the fault which generated the earthquake.

The magnitude and nature of fault ruptures can vary for different faults or even along different strands of the same fault. Surface ruptures can damage or collapse buildings, cause severe damage to roads and other paved areas, and cause failure of overhead as well as underground utilities. Fault rupture is considered more likely along active faults, which are referenced above. Future fault ruptures are generally expected along different strands of the same fault (CGS, 1997b).

The western edge of LBNL is located within an Alquist-Priolo Earthquake Fault Zone (Alquist-Priolo Zone) for the Hayward fault, as designated by the Alquist-Priolo Earthquake Fault Zoning Act (discussed below) and depicted on Figure IV.E-4, p. IV.E-12 (CGS, 1982a and 1982b). A fault rupture hazard study was conducted at LBNL during planning and design of what was then identified as Building 49, which is located within the Alquist-Priolo Zone (Fugro, 2002c). This study confirmed that active traces of the Hayward fault traverse LBNL; the Main Trace is approximately 350 feet downslope and west of the western edge of the then-proposed Building 49 footprint, and the West Trace is an additional 100 to 150 feet west.[7] The study confirmed that no active trace of the Hayward fault exists beneath this proposed building. (HLA, as cited in Fugro, 2002c). Construction or redevelopment within the Alquist-Priolo Zone under the LRDP could be subject to surface fault rupture hazards from the Hayward fault, particularly in areas nearest the Main or West Traces. The University Seismic Safety Policy precludes construction of new buildings over the trace of an active fault.

Historic development activities have also included study of fault rupture potential associated with the Wildcat fault during planning for the Biomedical Laboratory II project, adjacent to the Building 74 complex (Harding Lawson Associates, 1980), and the East Canyon fault during planning for Building 85 (Geo/Resource Consultants, 1994). These faults parallel the Hayward fault. The northern portion of the Wildcat fault near San Pablo was previously classified as an active fault under the Alquist-Priolo Act. However, following additional study, the northern portion of the Wildcat fault was reclassified as potentially active and therefore removed from regulation under the Alquist-Priolo Act. The portion of the Wildcat fault that traverses the LBNL site has never been classified as active. The above-mentioned studies confirmed the absence of evidence needed to classify either the Wildcat fault or the East Canyon fault as active, such as displacement of Quaternary deposits or fault-related topographic features; consequently, the studies concluded there was a low potential for fault rupture hazards at the proposed building locations. Additionally, the exposure of the Wildcat fault during grading for Building 84 revealed fault-crossing features which indicate surface rupture has not occurred during at least the last hundreds to thousands of years, confirming the results of the earlier study. Historic study of the Wildcat fault at LBNL has not revealed evidence that the fault should be considered active.

[7] Building 49 is no longer proposed; however, the LRDP Illustrative Development Scenario identifies a Building S-1 that is within the Alquist-Priolo Zone, just south of the former Building 49 site.



SOURCE: California Geological Survey

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Figure IV.E-4
Alquist-Priolo Earthquake Fault Zone

Groundshaking

Strong ground movement from a major earthquake could affect LBNL. Earthquakes on the active faults (listed in Table IV.E-1, p. IV.E-5) are expected to produce a range of groundshaking intensities at the project site. Groundshaking may affect areas hundreds of miles distant from the earthquake's epicenter. A major seismic event on any of these active faults could cause significant groundshaking at the site, as experienced during earthquakes in recent history, namely the 1989 Loma Prieta earthquake (ABAG, 2003b).

According to CGS probabilistic seismic hazard maps, peak ground acceleration in the LBNL region could reach or exceed 0.7 g (Peterson et al., 2003).[8] A probabilistic seismic hazard map represents the severity of groundshaking from earthquakes that geologists and seismologists agree could occur, but which has a 90-percent chance of not being exceeded in 50 years (an annual probability of being exceeded of 1 in 475). It is "probabilistic" in the sense that the analysis takes into consideration the uncertainties in the size and location of earthquakes and the resulting ground motions that can affect a particular site, and expresses the probability of exceeding a certain ground motion.[9]

Historic geotechnical investigations have estimated peak bedrock accelerations of 0.7 g could occur within LBNL from an earthquake on the Hayward fault (Bolt, 1992). As a comparison, ground motion during the 1989 Loma Prieta earthquake at the Santa Cruz Mountains epicenter reached 0.64 g (CGS, 1990)

Slope Failure

Slope failures occur during earthquakes due to the effect of the dynamic forces on hillside soil and rock masses. As discussed above, the CGS has delineated earthquake-induced landslide hazard zones. Within these zones, the CGS has determined the potential for earthquake-induced landslides to occur is sufficiently high to require site-specific analysis of the hazard prior to development, as per the Seismic Hazards Mapping Act of 1990 (discussed below on p. IV.E-16). If such analysis determines that earthquake-induced slope failure is likely to occur, then appropriate design measures must be implemented as a condition of development.

Liquefaction

Liquefaction is a phenomenon whereby unconsolidated and/or near-saturated soils lose cohesion and are converted to a fluid state as a result of severe vibratory motion. The relatively rapid loss of soil shear strength during strong earthquake shaking results in temporary, fluid-like behavior of the soil. Soil liquefaction causes ground failure that can damage roads, pipelines, underground

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8 Peak ground acceleration is used as a measure of earthquake intensity because it can be related to the horizontal force exerted on a building, and therefore can be translated into building code standards. Peak ground acceleration is the greatest rate of increase in velocity of ground movement in an earthquake.

9 The CGS probabilistic seismic hazard map for 10-percent probability of exceedance in 50 years represents ground motions that geologists and seismologists do not think will be exceeded in the next 50 years. This probability level of groundshaking is used for formulating building codes and designing buildings in highly active seismic areas. Seismic maps are prepared using consensus information on historical earthquakes and faults (Peterson et al., 1999).

cables, and buildings with shallow foundations. Liquefaction can occur in areas characterized by shallow, water-saturated, cohesionless, granular materials, or in saturated unconsolidated or artificial fill sediments located in reclaimed areas along the margin of San Francisco Bay. Liquefaction potential is highest in areas underlain by Bay fills, Bay Mud, and unconsolidated alluvium. The CGS has not designated any portion of LBNL as a Seismic Hazard Zone for liquefaction, as shown on Figure IV.E-2 (CGS, 2000 and 2003b). Liquefaction hazards may be present at LBNL in areas underlain by shallow groundwater and poorly engineered fill or alluvial materials. However, the thin soil profile on hillside slopes and shallow bedrock serve to minimize potential liquefaction hazards at the site.

Earthquake-Induced Settlement

Settlement is the depression of the bearing soil when a load, such as that of a building or new fill material, is placed upon it. Soils tend to settle at different rates and by varying amounts depending on the load weight, and this tendency is referred to as differential settlement. Areas are susceptible to differential settlement if underlain by compressible sediments, such as poorly engineered artificial fill or the Bay Mud present in the marshland on the San Francisco Bay margin. Settlement can be accelerated and accentuated by earthquakes. Hazards associated with earthquake-induced settlement would be present for projects involving cut-and-fill activities. During an earthquake, settlement can occur as a result of the relatively rapid rearrangement, compaction, and settling of subsurface materials (particularly loose, noncompacted, and variable sandy sediments). Settlement can occur both uniformly and differentially (i.e., where adjoining areas settle at different rates). Areas susceptible to earthquake-induced settlement would include those underlain by thick layers of colluvial material or unengineered fill. The soil profile throughout LBNL is relatively shallow due to steep slopes, although natural drainages contain thicker deposits of colluvial and, to a lesser degree, alluvial materials. Construction or development that might alter LBNL's existing natural drainage channels is addressed under the 2006 LRDP Land Use Map and the LBNL Design Guidelines. Further, the Illustrative Development Scenario analyzed in this EIR calls for potential development at locations that would avoid major drainage channels and riparian areas.

Tsunami

Tsunamis are waves that are typically caused by underwater landslides, volcanic eruptions, or seismic events. These waves are longer in period and faster moving than typical, wind-generated ocean waves. Tsunami amplitudes range from inches to tens of feet. Due to their long wavelength and speed, larger tsunamis can run onto and inundate land a considerable distance with a considerable amount of energy. Areas that are highly susceptible to tsunami inundation tend to be located in low-lying coastal areas such as tidal flats, marshlands, and former bay margins that have been artificially filled but are still at or near sea level. The tsunami hazard at LBNL is extremely low to nonexistent, as the site is located a minimum of 450 feet above mean sea level.

Seiche

A seiche is a free or standing wave oscillation of the water surface in an enclosed or semi-enclosed basin, such as San Francisco Bay, that may be initiated by an earthquake.[10] Due to its location high in the Berkeley hills, LBNL is not subject to seiches in San Francisco Bay. There are no enclosed water bodies located upslope of LBNL. Potential seiche hazards are primarily associated with the detention pond located on Strawberry Creek near the southern site perimeter; however, there are no facilities located in close enough proximity to the pond to present seiche hazards, nor does the LRDP plan construction in this area.

IV.E.2.10 Regulatory Environment

University of California Seismic Safety Policy

On January 17, 1995, the University of California adopted and updated the Policy on Seismic Safety, which established University policy "to acquire, build, maintain, and rehabilitate buildings and other facilities which provide an acceptable level of earthquake safety." The policy applies to Berkeley Lab, which is operated by the University. The level of safety is also defined in the following University policy:

- *New Buildings and Other Facilities*. The design of new buildings shall, at a minimum, comply with the current provisions of the California Building Code, or local seismic requirements, whichever is more stringent. Provisions shall also be made for adequate anchoring of nonstructural building elements. No new University structures may be constructed on the trace of a known active fault. All plans shall be reviewed by a consultant structural engineer who must, prior to release of funds, certify that the structure complies with the University Policy on Seismic Safety.

Proposed projects under the 2006 LRDP that involve a facility lease between a third-party developer and the University would also be required to comply with the University's Seismic Safety Policy for Leased Buildings.

Alquist-Priolo Earthquake Fault Zoning Act

The Alquist-Priolo Earthquake Fault Zoning Act (formerly the Alquist-Priolo Special Studies Zones Act), signed into law in December 1972, requires the delineation of zones along active faults in California. The zones vary in width, but average about one-quarter-mile wide.[11] The purpose of the act is to regulate development on or near fault traces to reduce the hazard of fault rupture and to prohibit the location of most structures for human occupancy across these traces. Cities and counties must regulate certain development projects within the zones, which includes withholding permits until geologic investigations demonstrate that development sites are not threatened by future surface displacement (Hart, 1997). Surface fault rupture is not necessarily restricted to areas within an Alquist-Priolo Zone, as designated under the Alquist-Priolo Act. The

[10] The "sloshing" produced by seiches within enclosed water bodies during earthquakes commonly occurs on a small scale in swimming pools.

[11] California Geological Survey, Alquist-Priolo Fault Zones web page; available on the internet at: http://www.consrv.ca.gov/cgs/rghm/ap/index.htm. Viewed October 8, 2006.

western portion of LBNL near the Blackberry Canyon Gate (an area of approximately 17 acres) is located within an Alquist-Priolo Zone that is associated with the Hayward fault.

Seismic Hazards Mapping Act

The Seismic Hazards Mapping Act was developed to protect the public from the effects of strong groundshaking, liquefaction, landslides, or other ground failure, and from other hazards caused by earthquakes. This act requires the State Geologist to delineate various seismic hazard zones and requires cities, counties, and other local permitting agencies to regulate certain development projects within these zones. Before a development permit is granted for a site within a Seismic Hazard Zone, a geotechnical investigation of the site must be conducted and appropriate mitigation measures incorporated into the project design. Geotechnical investigations conducted within Seismic Hazard Zones must incorporate standards specified by CGS Special Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards* (CGS, 1997c). The CGS has designated much of LBNL as a Seismic Hazard Zone for earthquake-induced landslides, as shown by Figure IV.E-2 (p. IV.E-8).

California Building Code

The California Building Code is another name for the body of regulations known as the California Code of Regulations (CCR), Title 24, Part 2, which is a portion of the California Building Standards Code (CBSC, 1995). Title 24 is assigned to the California Building Standards Commission, which, by law, is responsible for coordinating all building standards. Under state law, all building standards must be centralized in Title 24 or they are not enforceable (Bolt, 1988).

The current (2001) California Building Code is based on the 1997 Uniform Building Code (UBC) and includes necessary California amendments that include criteria for seismic design. About one-third of the text within the California Building Code has been tailored for California earthquake conditions (ICBO, 1997). The California Building Code requires extensive geotechnical analysis and engineering for grading, foundations, retaining walls, and structures, with the nature and degree of analysis and engineering differentiated by zones. Berkeley, Oakland and the greater San Francisco Bay Area are located within Zone 4, which, of the four seismic zones designated in the United States, is expected to experience the greatest effects from earthquake groundshaking and therefore the California Building Code has the most stringent requirements for seismic design.

IV.E.2.11 Local Plans and Policies

LBNL is a federal facility operated by the University of California and conducting work within the University's mission on land that is owned or controlled by The Regents of the University of California. As such, LBNL is generally exempted by the federal and state constitutions from compliance with local land use regulations, including general plans and zoning. However, LBNL seeks to cooperate with local jurisdictions to reduce any physical consequences of potential land use conflicts to the extent feasible. The western part of the LBNL site is within the Berkeley city limits, and the eastern part is within the Oakland city limits. This section summarizes relevant local plans, policies, and ordinances promulgated by the cities of Berkeley and Oakland.

Berkeley General Plan

Berkeley General Plan policies pertaining to geology and seismicity relevant to implementation of the LBNL LRDP include the following:

> Policy S-14 Land Use Regulation. Require appropriate mitigation in new development, redevelopment/reuse, or other applications.
>
> *Actions:*
>
> A) When appropriate, utilize the environmental review process to ensure avoidance of hazards and/or mitigation of hazard-induced risk.
>
> B) Require soil investigation and/or geotechnical reports in conjunction with development/redevelopment on sites within designated hazard zones such as areas with high potential for soil erosion, landslide, fault rupture, liquefaction, and other soil-related constraints.
>
> C) Place structural design conditions on new development to ensure that recommendations of the geotechnical/soils investigation are implemented.
>
> D) Encourage owners to evaluate their buildings' vulnerability to earthquake hazards, fire, landslides, and floods, and to take appropriate action to minimize the risk.
>
> Policy S-15 Construction Standards. Maintain construction standards that minimize risks to human lives and property from environmental and human-caused hazards for both new and existing buildings.
>
> *Actions:*
>
> A) Periodically update and adopt the California Building Standards Code with local amendments to incorporate the latest knowledge and design standards to protect people and property against known fire, flood, landside, and seismic risks in both structural and non-structural building and site components.
>
> B) Ensure proper design and construction of hazard-resistant structures through careful plan review/approval and thorough and consistent construction inspection.
>
> Policy S-18 Public Information. Establish public information programs to inform the public about seismic hazards and the potential hazards from vulnerable buildings.

Oakland General Plan

The Open Space, Conservation and Recreation Element, adopted in 1996, addresses the management of open land, natural resources, and parks in Oakland.

Open Space Objective OS-1 is "To conserve and appropriately manage undeveloped areas in Oakland which have high natural resource value, scenic value, or natural hazards which preclude safe development." The following polices are relevant to the proposed project:

> Policy OS-1.3 Relate New Development to Slope. Limit intensive urban development to areas where the predominant slope is less than 15 percent. Design development on slopes

between 15 and 30 percent to minimize alteration of natural landforms. Strongly discourage development on slopes greater than 30 percent. To the extent permitted by law, when land is subdivided into two or more lots, retain areas with slopes over 30 percent as private, public, or common open space.

Open Space Objective OS-3 is "To retain major institutional and functional open space areas and enhance their recreational and aesthetic benefits." The following polices are relevant to the proposed project:

Policy OS-3.1 University, College, and Institutional Open Space. Retain open space at Oakland's universities, colleges, and other institutions where such open space provides recreational, aesthetic, conservation, or historic benefits. Where such open spaces are publicly owned, as at the community colleges, support the permanent retention of athletic fields and other recreational areas as open space. Such areas should not be converted to development unless they are replaced in kind with comparable areas or facilities in the immediate vicinity.

Policy OS-3.1.1 Conservation of UC Hill Property. After creating the new Resource Conservation Zone,[12] work with the University of California to include in the zone portions of the campus designated for conservation in the campus Long Range Development Plan.

Open Space Objective OS-9 is "To retain Oakland's natural features and topography wherever possible and recognize their important role in defining the character and image of the city and its neighborhoods." The following polices are relevant to the proposed project:

Policy OS-9.1 Protection of Natural Landforms. Design new development to preserve natural topography and terrain. Enhance prominent topographic features where appropriate by parks, plazas, or architectural expressions.

Conservation Objective CO-2 is "To minimize safety hazards, environmental impacts, and aesthetic impacts associated with development on hillsides and in seismic high-risk areas." The following polices are relevant to the proposed project:

Policy CO-2.1 Slide Hazards. Encourage development practices which minimize the risk of landsliding.

Policy CO-2.2 Unstable Geologic Features. Retain geologic features known to be unstable, including serpentine rock, areas of known landsliding, and fault lines, as open space. Where feasible, allow such lands to be used for low-intensity recreational uses.

Policy CO-2.4 Hillside Cuts and Fills. Minimize hillside cuts and fills and the removal of desirable vegetation. Limit large-scale grading to those areas where it is essential to development. Where hillside grading does occur, reshape the terrain in smooth, naturally appearing contours rather than flat, terraced benches. Immediately replant and reseed graded areas to reduce soil loss.

[12] Pursuant to Open Space Action 1.1.1.

In addition, the 1974 Environmental Hazards Element of the General Plan contains policies to ensure "a reasonable level of safety from geologic [and] seismic … hazards within Oakland" (General Policy 1); avoid construction on "known faults or land subject to landslides, erosion, or flooding" (Geologic Hazards Policy 1); discourage development on slopes greater than 30 percent (Geologic Hazards Policy 3); "utilize lands subject to severe seismic and geologic hazards for low intensity park and recreational activities or open space" (Seismic Hazards Policy 2); and "not locate public facilities for human occupancy in fault zone areas unless all other available sites are infeasible" (Seismic Hazards Policy 3).

IV.E.3 Impacts and Mitigation Measures

IV.E.3.1 Significance Criteria

The potential exposure of LBNL projects to unstable geologic and soil conditions would be considered significant if it would exceed the following Standards of Significance, in accordance with Appendix G of the CEQA Guidelines and the UC CEQA Handbook:

- Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:
  - Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area, or based on other substantial evidence of a known fault (refer to CGS Special Publication 42);
  - Strong seismic groundshaking;
  - Seismic-related ground failure, including liquefaction; or
  - Landslides.
- Result in substantial soil erosion or the loss of topsoil;
- Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in onsite or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse;
- Be located on expansive soil, as defined in Table 18-1-B of the California Building Code, creating substantial risks to life or property; or
- Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of wastewater.

IV.E.3.2 Impact Assessment Methodology

This section describes the potential geology and soils impacts resulting from implementation of the proposed 2006 LRDP, based on the Standards of Significance. Potential impacts were analyzed based on existing site data and the generalized scope of facility development analyzed in this EIR. LBNL will evaluate whether the geology and soils impacts of any later activity implemented pursuant to the LRDP were examined in this program EIR before determining what appropriate level of tiered project-specific CEQA analysis might be necessary, or whether the

scope of the future activity were to fall within the scope of the analysis covered by the program EIR. If specific project differences from the presentation of the Illustrative Development Scenario and the 2006 LRDP EIR are such that the project is not within the scope of the LRDP EIR or the specific impact statements and mitigation measures do not cover the individual project pursuant to CEQA Guidelines Sections 15168(c)(2) and 15168(c)(5), then appropriate, project-specific CEQA analysis will be tiered from this 2006 LRDP EIR in accordance with CEQA Guidelines Section 15168(d)(1-3).

Significance criteria associated with installation of septic tanks or alternative waste disposal systems are not relevant to the proposed project, as septic tanks or alternative waste disposal systems are not proposed; thus, there would be no potential impacts associated with the capability of onsite soils to support these uses.

IV.E.3.3 2006 LRDP Principles, Strategies and LBNL Design Guidelines

2006 LRDP Principles and Strategies

The 2006 LRDP proposes four fundamental principles that form the basis for the Plan's development strategies provided for each element of the LRDP. The principle most applicable to geology and soils as related to new development is to "Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship" and to "Build a more campus-like research environment."

Development strategies provided by the 2006 LRDP are intended to minimize potential environmental impacts that could result from implementation of the 2006 LRDP (see Chapter III, Project Description for further discussion, and see Appendix B for a full listing of principles, strategies and design guidelines). Development Strategies set forth in the 2006 LRDP applicable to geology and soils include the following:

- Protect and enhance the site's natural and visual resources, including native habitats, streams and mature tree stands by focusing future development primarily within the already developed areas of the site.

- Increase development densities within the most developed areas of the site to preserve open space, enhance operational efficiencies and access.

- To the extent possible site new projects to replace existing outdated facilities and ensure the best use of limited land resources.

- To the extent possible site new projects adjacent to existing development where existing utility and access infrastructure may be utilized.

- Site and design new facilities in accordance with University of California energy efficiency and sustainability policy to reduce energy, water and material consumption and provide improved occupant health, comfort and productivity.

- Exhibit the best practices of modern sustainable development in new projects as a way to foster a greater appreciation of sustainable practices at the Laboratory.
- Reduce the percentage of parking spaces relative to the adjusted daily population.
- Consolidate parking into larger lots and/or parking structures, locate these facilities near Laboratory entrances to reduce traffic within the main site.
- Remove parking from areas targeted for outdoor social spaces and service areas.
- Consolidate service functions wherever possible in the Corporation Yard.
- Preserve and enhance the native rustic landscape and protect sensitive habitats.
- Minimize impervious surfaces to reduce storm water run-off and provide landscape elements and planting to stabilize slopes, reduce erosion and sedimentation.
- Consolidate utility distribution into centralized utility corridors that generally coincide with major roadways.

LBNL Design Guidelines

The LBNL Design Guidelines were developed in parallel with the LRDP. The LBNL Design Guidelines are proposed to be adopted by the Lab following The Regents' consideration of the 2006 LRDP. The LBNL Design Guidelines provide specific guidelines for site planning, landscape and building design as a means to implement the Plan's development strategies as each new project is developed. Specific design guidelines are organized by a set of design objectives that essentially correspond to the strategies provided in the LRDP. The LBNL Design Guidelines provide the following specific planning and design guidance relevant to geologic resources:

- Minimize impacts of Disturbed Slopes.
- Reduce the amount of impermeable surfaces at the Lab.

IV.E.3.4 Impacts and Mitigation Measures

Impact GEO-1: Future construction projects within the Alquist-Priolo Zone could expose people or structures to surface fault rupture. (Significant; Less than Significant with Mitigation)

The western edge of LBNL is located within a CGS-designated Alquist-Priolo Zone for the northern segment of the Hayward fault, one of the major active faults in the San Andreas System. The eastern limit of the Alquist-Priolo Zone passes through LBNL near the Blackberry Canyon entrance, as shown in Figure IV.E-4, p. IV.E-12 (CGS, 1982a and 1982b).

Future construction within the Alquist-Priolo Zone would require additional Fault Rupture Hazard Investigations, in compliance with CGS Publication 49, *Guidelines for Evaluating the Hazard of Surface Fault Rupture* (CGS, 1997a). Proposed facility placement would be restricted based on the results of these studies, which would effectively prevent the siting of structures on

known, active traces of the Hayward fault. Compliance with the requirements of the CGS and the Alquist-Priolo Act would minimize potential fault rupture hazards associated with new construction of facility space to a less-than-significant level, as the entire purpose of the act is to avoid risk due to construction atop an active fault; hence the requirement for specific studies within the Alquist-Priolo Zones.

Nevertheless, ancillary features of LBNL, such as parking lots, roadways, sidewalks, and utility infrastructure, are not bound by the restrictions of the Alquist-Priolo Act. Construction of these features within the Alquist-Priolo Zone could result in significant hazards, primarily if they were to result in complications during emergency conditions. Should fault rupture occur following an earthquake on the Hayward fault, potential damage could include damaged utilities, cracked pavement or roadway failure, which could hinder or prevent emergency access to LBNL through the Blackberry Canyon entrance.

In addition to the active Hayward fault, the Wildcat fault passes through the LBNL site. Potential fault rupture hazards associated with Wildcat fault are considered less than significant, as the fault has not displayed evidence of fault activity during the Holocene (11,000 years to the present) and is not classified as active under the Alquist-Priolo Act.

> **Mitigation Measure GEO-1:** Seismic emergency response and evacuation plans for LBNL shall incorporate potential inaccessibility of the Blackberry Canyon entrance and identify alternative ingress and egress routes for emergency vehicles and facility employees in the event of roadway failure from surface fault rupture.
>
> Implementation of the above mitigation measure would reduce potential impacts associated with surface fault rupture on the Hayward fault to a less-than-significant level.
>
> **Significance after Mitigation:** Less than significant.

Project Variant. The project variant would alter the on-site adjusted daily population but would not result in any change in demolition or new construction compared to what is contemplated under the LRDP. Therefore, the surface fault rupture impacts of future construction projects associated with the project variant would be the same as those described for the LRDP.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of surface fault rupture impacts related to future construction projects.

The Illustrative Development Scenario shows the proposed sites of a new building, S-1, and a parking structure PS-1, as being located at least partially within the Alquist-Priolo Zone shown in

Figure IV.E-4. As noted above, specific fault trace studies would be required prior to construction of the two newly identified structures in the Alquist-Priolo Zone (as was the case with the previously approved Building 49), and construction would not be permitted if active fault traces were identified. Therefore, no construction would be permitted atop traces of the Hayward fault, and potential fault rupture hazards associated with these two projects would be less than significant. Other potential future projects under the LRDP such as those identified in the Illustrative Development Scenario might expose people or structures to surface fault rupture for the reasons stated above regarding full implementation of the LRDP. With implementation of Mitigation Measure GEO-1, other future projects identified in the Illustrative Development Scenario that might expose people or structures to surface fault rupture would be less than significant.

Impact GEO-2: Implementation of the LRDP would expose people and structures to seismic hazards such as groundshaking and earthquake-induced landsliding. (Significant; Less than Significant with Mitigation)

As described earlier, the Working Group on California Earthquake Probabilities has concluded there is a 62-percent probability of at least one magnitude 6.7 or greater quake striking the San Francisco Bay Area before 2032. The LBNL site could experience a range of groundshaking effects during an earthquake on one of the active earthquake faults in the Bay Area. Excessive groundshaking could also cause secondary ground failure, such as seismically induced landslides or differential settlement, which could expose people to the risk of injury and cause structural damage to buildings.

Due to the proximity of LBNL to Hayward fault, levels of groundshaking as strong as Very Violent (Modified Mercalli Intensity X) are possible. Groundshaking intensities from a major seismic event on the Hayward fault could generate ground motion approaching or exceeding a peak ground acceleration of 0.7 g. Additionally, portions of LBNL are located within a CGS-designated Seismic Hazard Zone for earthquake-induced landslides, and numerous historic landslide areas are present throughout the site, some of which LBNL has identified as "high risk" for future instability.

Construction under the 2006 LRDP would comply with requirements of the 2001 California Building Code (or future editions relevant to the date of project planning and construction), University of California seismic design safety policies, LBNL's Facilities Department Project and Design Management Procedures Manual *Lateral Force Design Criteria*, and federal standards. Design of LBNL structures under the LRDP would therefore exceed the requirements of the California Building Code (CCR Title 24) and comply with the more stringent local building code (LBNL Standard RD 3.22). Sites located within the CGS Seismic Hazard Zone for landsliding would be required to comply with CGS Publication 117, *Guidelines for Evaluating and Mitigating Seismic Hazards*. Under such design requirements, buildings at LBNL would be designed to withstand a force of a magnitude 7+ earthquake on the Hayward fault or a magnitude 8.3 earthquake on the San Andreas fault without collapse.

Mitigation Measure GEO-2: A site-specific, design-level geotechnical investigation shall occur during the design phase of each LBNL building project, and prior to approval of new building construction within the LBNL hill site. This investigation shall be conducted by a licensed geotechnical engineer and include a seismic evaluation of potential maximum ground motion at the site. Geotechnical investigations for sites within either a Seismic Hazard Zone for landslides or an area of historic landslide activity at LBNL, as depicted on Figures IV.E-2 and IV.E-3, or newly recognized areas of slope instability at the inception of project planning, shall incorporate a landslide analysis in accordance with CGS Publication 117. Geotechnical recommendations shall subsequently be incorporated into building design.

Earthquakes and groundshaking in the Bay Area are unavoidable and may occur at some time during the period covered by the LRDP. Although some structural damage is typically not avoidable, building codes and local construction requirements have been established to protect against building collapse and to minimize injury during a seismic event. Considering that the future individual buildings would be constructed in conformance with the California Building Code, LBNL requirements, federal regulations and guidelines, and Mitigation Measure GEO-2, the risks of injury and structural damage from groundshaking and earthquake-induced landsliding would be reduced and the impacts, therefore, would be considered less than significant.

Furthermore, as described in the Project Description, some of the buildings constructed pursuant to the LRDP would be occupied by staff relocated from other, older LBNL facilities, some of which were constructed in accordance with less stringent building code requirements than those that would apply to future construction. As of 2003, 14 percent of LBNL buildings were over 60 years old. Many of these buildings were constructed as temporary structures that were never replaced. The LRDP specifically proposes the demolition of some 30 outdated buildings that together include approximately 250,000 square feet. In this regard, implementation of the LRDP would result in a beneficial seismic safety impact.

Significance after Mitigation: Less than significant.

Project Variant. The project variant would alter the on-site adjusted daily population but would not result in any change in demolition or new construction compared to what is contemplated under the LRDP. Therefore, construction effects associated with the project variant would be the same as those described for the LRDP.

With implementation of Mitigation Measure GEO 2, impacts of the project variant related to exposure of people and structures to seismic hazards such as groundshaking and earthquake-induced landsliding would be less than significant.

Individual Future Projects/Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP.

Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of seismic hazards such as groundshaking and earthquake induced landsliding. Potential future projects under the LRDP such as those identified in the Illustrative Development Scenario would expose people and structures to seismic hazards such as groundshaking and earthquake-induced landsliding for the reasons stated above. With implementation of Mitigation Measure GEO-2, this impact of a potential project identified in the Illustrative Development Scenario would be reduced to a less than significant level.

Impact GEO-3: Implementation of the LRDP would result in construction on soils that could be subject to erosion and instability. (Significant; Less than Significant with Mitigation)

The southern portion of the site is underlain by Altamont Clay, soil that is subject to shrink-swell hazards. Future excavation, grading, and construction activities at LBNL, particularly on sloped sites, could result in soil erosion or create slope instability. Compliance with California Building Code standards and Mitigation Measure GEO-2 would require the development of a site-specific geotechnical report for future building development that identifies potential hazards posed by site soils (such as expansiveness) and recommends appropriate measures to minimize these hazards. Additionally, construction-related grading and other activities would comply with the Association of Bay Area Governments' (ABAG) *Manual of Standards for Erosion and Sediment Control Measures* (ABAG, 1995), and the California Stormwater Quality Association's (CASQA) *Stormwater Best Management Practice Handbook for Construction* (CASQA, 2003) (or subsequent editions thereof).

> **Mitigation Measure GEO-3a:** Construction under the LRDP shall be required to use construction best management practices and standards to control and reduce erosion. These measures could include, but are not limited to, restricting grading to the dry season, protecting all finished graded slopes from erosion using such techniques as erosion control matting and hydroseeding or other suitable measures.
>
> **Mitigation Measure GEO-3b:** Revegetation of areas disturbed by construction activities, including slope stabilization sites, using native shrubs, trees, and grasses, shall be included as part of all new projects.
>
> Compliance with California Building Code standards and compliance with Mitigation Measures GEO-2, GEO-3a, and GEO-3b would reduce potential impacts associated with expansive soils and soil erosion to a less-than-significant level.
>
> **Significance after Mitigation:** Less than significant.

Project Variant. The project variant would alter the on-site adjusted daily population but would not result in any change in demolition or new construction compared to what is contemplated under the LRDP. Therefore, construction effects associated with the project variant would be the

same as those described for the LRDP. Compliance with California Building Code standards and implementation of Mitigation Measures GEO-2, GEO-3a, and GEO-3b would reduce potential impacts associated with expansive soils and soil erosion to a less-than-significant level.

Individual Future Projects/ Illustrative Development Scenario. The Illustrative Development Scenario is a conceptual portrayal of potential development under the 2006 LRDP. Actual overall development that is approved and constructed pursuant to the 2006 LRDP would be less intense than portrayed in the scenario. The scenario was developed before the 2006 LRDP was reduced in scope in response to comments from the City of Berkeley, and thus the scenario includes an overall level of potential development that is greater than is being proposed in the 2006 LRDP. Each of the proposed buildings that is included in the scenario, however, might be constructed pursuant to the 2006 LRDP, and thus the scenario remains an appropriate and conservative basis for the evaluation of erosion and instability impacts. For the reasons stated above, potential future construction projects under the LRDP such as those identified in the Illustrative Development Scenario would expose people or structures to geologic hazards such as expansive soils. Future construction projects, including earthmoving activities that involve excavation and grading, could also result in soil erosion. Compliance with California Building Code standards and implementation of Mitigation Measures GEO-2, GEO-3a, and GEO-3b would reduce potential impacts of a future construction project identified in the Illustrative Development Scenario to a less-than-significant level.

IV.E.3.5 Cumulative Impacts

This analysis considers cumulative growth as represented by the implementation of the Berkeley and Oakland general plans (and thus includes growth anticipated by the City of Berkeley General Plan EIR), and implementation of the UC Berkeley 2020 LRDP (including the Southeast Campus Integrated Projects) along with implementation of the proposed LBNL 2006 LRDP. (Demolition of the Building 51 complex—housing the Bevatron accelerator—although the subject of a separate project-specific EIR, is analyzed as part of the 2006 LRDP because the buildings were in place when the EIR analyses were undertaken.) Additional projects currently underway at UC Berkeley, described in Section VI.C of this EIR, are also accounted for in the cumulative analysis.

The geographic context for this cumulative analysis includes the City of Berkeley and the areas of northern Alameda and western Contra Costa counties proximate to the northern segment of the Hayward fault. This analysis evaluates whether the impacts of the proposed LRDP, together with the impacts of cumulative development, would result in a significant impact (based on the significance criteria on p. IV.E-19) and, if so, whether the contribution of the LRDP to this impact would be considerable. Both conditions must apply in order for the project's cumulative geology impacts to rise to the level of significance.

Impact GEO-4: The proposed 2006 LRDP, when combined with cumulative growth, would increase the population exposed to geologic and seismic hazards. (Less than Significant)

Development pursuant to the 2006 LRDP, along with development at UC Berkeley under the campus' 2020 LRDP, would increase both the population and employment concentration in the area of northeastern Berkeley and Oakland that is occupied by the UC Berkeley campus and the LBNL hill site. In addition, other cumulative development in the surrounding area could result in population growth of approximately 13 percent in Berkeley and 20 percent or more in northern Alameda County and western Contra Costa County by 2025 (see Section IV.J, Population and Housing, for more information). Together, this cumulative growth would increase the population in the Bay Area, and particularly in proximity to the Hayward fault, that would be subject to strong groundshaking in a major earthquake. Additionally, cumulative hillside development, either in the UC Berkeley hill area or on private property in the Oakland-Berkeley hills, would increase the number of persons at risk of seismically induced landslides and other potential slope-related hazards.

However, these hazards would be mitigated to the extent practicable through implementation of and compliance with adopted General Plan policies, building codes, and regulations. It is not possible to eliminate the risk from construction in earthquake-prone areas, nor is it possible to fully avoid all geologic hazards. The State of California and local jurisdictions have limited power to prohibit construction on private lands, except in the case of the most seismically or geologically at-risk lands. As noted above, earthquakes and groundshaking in the Bay Area are unavoidable and, while some structural damage may not be preventable, building codes and local construction requirements have been established to protect against building collapse and major injury during a seismic event. Construction in conformance with the California Building Code, local building codes, where applicable, and other pertinent regulations and guidelines would reduce the risks of injury and structural damage from groundshaking, earthquake-induced landsliding, and other seismic and geologic hazards to a less-than-significant level. Moreover, the LBNL LRDP, while it would result in some increased employment on the Lab main site, would not directly result in increased population in the Bay Area that would be subject to earthquake hazards. To the extent that the LRDP could indirectly increase the local population subject to earthquake hazards, the increase would not be considerable in the context of Bay Area population and regional growth, and therefore the cumulative impact would not be significant.

The EIR for the UC Berkeley Southeast Campus Integrated Projects (SCIP) finds that the SCIP would result in significant unavoidable impacts due to the presence of the Hayward fault, which traverses the SCIP site and runs below Memorial Stadium (UC Berkeley, 2006). However, because these impacts would be the direct result of the SCIP being undertaken within an active fault zone, the LBNL 2006 LRDP would not contribute to this site-specific impact, and therefore cumulative impacts would be less than significant.

Mitigation: None required for cumulative impacts, although Measures GEO-1, GEO-2, GEO-3a, and GEO-3b would be implemented, as identified above.

Project Variant. Although, when combined with cumulative growth, the project variant would increase the population exposed to geologic and seismic hazards, the cumulative impact would be less than significant for the reasons stated above. Although no mitigation would be required, Mitigation Measures GEO-1, GEO-2, GEO-3a, and GEO-3b would be implemented, as identified above.

Illustrative Development Scenario/Potential Future Projects. A future project identified in the Illustrative Development Scenario, when combined with other projects under the LRDP and other development, would also, for the reasons stated above, result in a cumulative impact associated with an increase in the population exposed to geologic and seismic hazards that would be less than significant.

IV.E.4 References – Geology and Soils

Association of Bay Area Governments (ABAG), *Earthquake Hazard Maps for Berkeley/Albany*, http://www.abag.ca.gov/bayarea/eqmaps/pickcity.html, 2003a.

Association of Bay Area Governments (ABAG), *Modeled Shaking Intensity Map for Berkeley/Albany, 1989 Loma Prieta Earthquake*, http://www.abag.ca.gov/bayarea/eqmaps/eq98.html, 2003b.

Association of Bay Area Governments (ABAG), *Manual of Standards for Erosion and Sediment Control Measures*, 1995.

Association of Bay Area Governments (ABAG), *The San Francisco Bay Area -- On Shaky Ground*, Supplement Report (Excerpts) 1998.

Bates, R.L., J.A. Jackson, *Dictionary of Geological Terms*, prepared by American Geological Institute, 1984.

Bolt, Bruce A., *Earthquakes*, W.H. Freeman and Company, New York, New York, 1988.

Bolt, Bruce A., *Strong Seismic Ground Motion for Design Purposes at the Lawrence Berkeley Laboratory*, June 1992.

California Building Standards Commission (CBSC), *California Building Code, Title 24, Part 2*, 1995.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), ShakeMap Working Group (California Geological Survey, Pacific Gas & Electric, University of California Berkeley, and United States Geological Survey), http://quake.usgs.gov/research/strongmotion/effects/shake/about.html, accessed April 2003a.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *Richmond Quadrangle Official Map, Seismic Hazard Zones*, February 14, 2003b.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *Parts of the Oakland East, Briones Valley, and Las Trampas Ridge Quadrangles Official Map, Seismic Hazard Zones*, March 30, 2000.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *Guidelines for Evaluating the Hazard of Surface Fault Rupture*, CDMG Note 49, 1997a.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *How Earthquakes Are Measured*, CDMG Note 32, 1997b.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *Guidelines for Evaluating and Mitigating Seismic Hazards*, CDMG Special Publication 117, 1997c.

California Department of Conservation, Geological Survey (CGS) (formerly Division of Mines and Geology), *The Loma Prieta (Santa Cruz Mountains), California, Earthquake of 17 October 1989*, Special Publication 104, 1990.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), Special Publication 78: *Earthquake Planning Scenario for a Magnitude 7.5 Earthquake on the Hayward Fault*, 1987.

California Department of Conservation Geological Survey (CGS) (formerly California Division of Mines and Geology), *Richmond Revised Official Map, Special Studies Zones*, January 1, 1982a.

California Department of Conservation, Geological Survey (CGS) (formerly California Division of Mines and Geology), *Oakland East Revised Official Map, Special Studies Zones*, January 1, 1982b.

California Stormwater Quality Association (CASQA), *Stormwater Best Management Practice Handbook for New Development and Redevelopment*, http://www.cabmphandbooks.org/, prepared by Camp Dresser & McKee and Larry Walker Associates, January 2003.

City of Berkeley: General Plan, *Environmental Management Element*, April 2002

City of Berkeley General Plan, *Disaster Preparedness and Safety Element*, April 2002.

Fugro West, Inc., *Geotechnical Investigation, Proposed Building 50X, Lawrence Berkeley National Laboratory*, August 5, 2002a.

Fugro West, Inc., *Preliminary Geotechnical Evaluation, Building 70A Parking Lot, Lawrence Berkeley National Laboratory*, September 2002b.

Fugro West, Inc., *Fault Rupture Hazard Investigation, Proposed Building 50X, Lawrence Berkeley National Laboratory*, August 2002c.

Geo/Resource Consultants, Inc., *Fault Investigation, Building 85 Hazardous Waste Handling Facility, Lawrence Berkeley Laboratory*, Berkeley, California, March 1994.

Harding Lawson Associates, *Wildcat Fault Study, Biomedical Laboratory II Project, Lawrence Berkeley Laboratory*, Berkeley, California, February 19, 1980.

Hart, E.W., California Division of Mines and Geology, personal communication, 1998.

Hart, E.W., *Fault-Rupture Hazard Zones in California: Alquist-Priolo Earthquake Fault Zoning Act of 1972 with Index to Earthquake Fault Zones*, California Geological Survey (formerly known as California Division of Mines and Geology), Special Publication 42, 1990, revised and updated 1997.

International Conference of Building Officials (ICBO), Uniform Building Code, Whittier, California, 1997.

Jennings, C.W., *Fault Activity Map of California and Adjacent Areas*, California Geological Survey (formerly California Division of Mines and Geology) Data Map No. 6, 1:750,000, 1994.

Kleinfelder, Geotechnical Investigation, *Proposed Molecular Foundry Building, Lawrence Berkeley National Laboratory*, January 29, 2002.

Lawrence Berkeley National Laboratory (LBNL), Environmental Health and Safety Division, *Site Environmental Report for 2003*, July 2004.

Lawrence Berkeley National Laboratory (LBNL), Draft Final RCRA Facility Investigation Report for the Lawrence Berkeley National Laboratory, Environmental Restoration Program, September 2000.

Lawrence Berkeley National Laboratory (LBNL), *Slope Stability Evaluation Map*, revised March 1999.

Lindeburg, M., *Seismic Design of Building Structures: A Professional's Introduction to Earthquake Forces and Design Details*, Professional Publications Inc., 1998.

Oakeshott, Gordon B., *California's Changing Landscapes*, McGraw-Hill Publishing Company, 1978.

Oakland Office of Fire Services, Captain Donald R. Parker, *The Oakland-Berkeley Hills Fire: An Overview*, http://www.sfmuseum.org/oakfire/overview.html, January 1992.

Peterson, et al., California Geological Survey (formerly California Division of Mines and Geology), *Seismic Shaking Hazard Maps of California*, revised April 2003.

Peterson, M.D., W.A. Bryant, C.H. Cramer, *Probabilistic Seismic Hazard Assessment for the State of California*, California Geological Survey (formerly California Division of Mines and Geology) Open-File Report issued jointly with U.S. Geological Survey, CDMG 96-08 and USGS 96-706, 1996.

San Francisco Bay Regional Water Quality Control Board, Alameda Countywide Municipal *Stormwater Permit*, Order R2-2003-0021, NPDES Permit No. CAS0029831, February 13, 2003.

Stinson, M. C., M. W. Manson, J. J. Plappert, and others, *Mineral Land Classification: Aggregate Materials in the San Francisco-Monterey Bay Area, Part II, Classification of Aggregate Resource Areas South San Francisco Bay Production-Consumption Region*, California Division of Mines and Geology Special Report 146, 1983.

U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS) (formerly Soil Conservation Service), Soil Survey of Alameda County, Western Part, March 1981.

U.S. Geological Survey (USGS) Working Group on California Earthquake Probabilities (WG02), *Earthquake Probabilities in the San Francisco Bay Region: 2003-2032 – A Summary of Findings*, http://quake.usgs.gov/research/seismology/wg02/summary/, 2003.

U.S. Geological Survey (USGS), *7.5-Minute Quadrangle, Richmond*, 1959, photo-revised 1980.

UC (University of California) Berkeley, *Southeast Campus Integrated Projects Tiered Focused Final Environmental Impact Report (SCH #2005112056)*; October 31, 2006. Available on the internet at: http://www.cp.berkeley.edu/SCIP/FEIR/SCIP_FEIR.html