IV.G. Hydrology and Water Quality

IV.G.1 Introduction

This section discusses existing surface water and groundwater conditions at LBNL and analyzes the potential for the project to alter drainage patterns, increase stormwater runoff rates, adversely affect ground or surface water quality, or decrease groundwater recharge rates to an extent that the groundwater table is lowered. These factors were analyzed based on existing conditions within the Strawberry Creek Watershed and at the site, the extent and nature of proposed development, and future operation of the proposed facilities.

IV.G.2 Setting

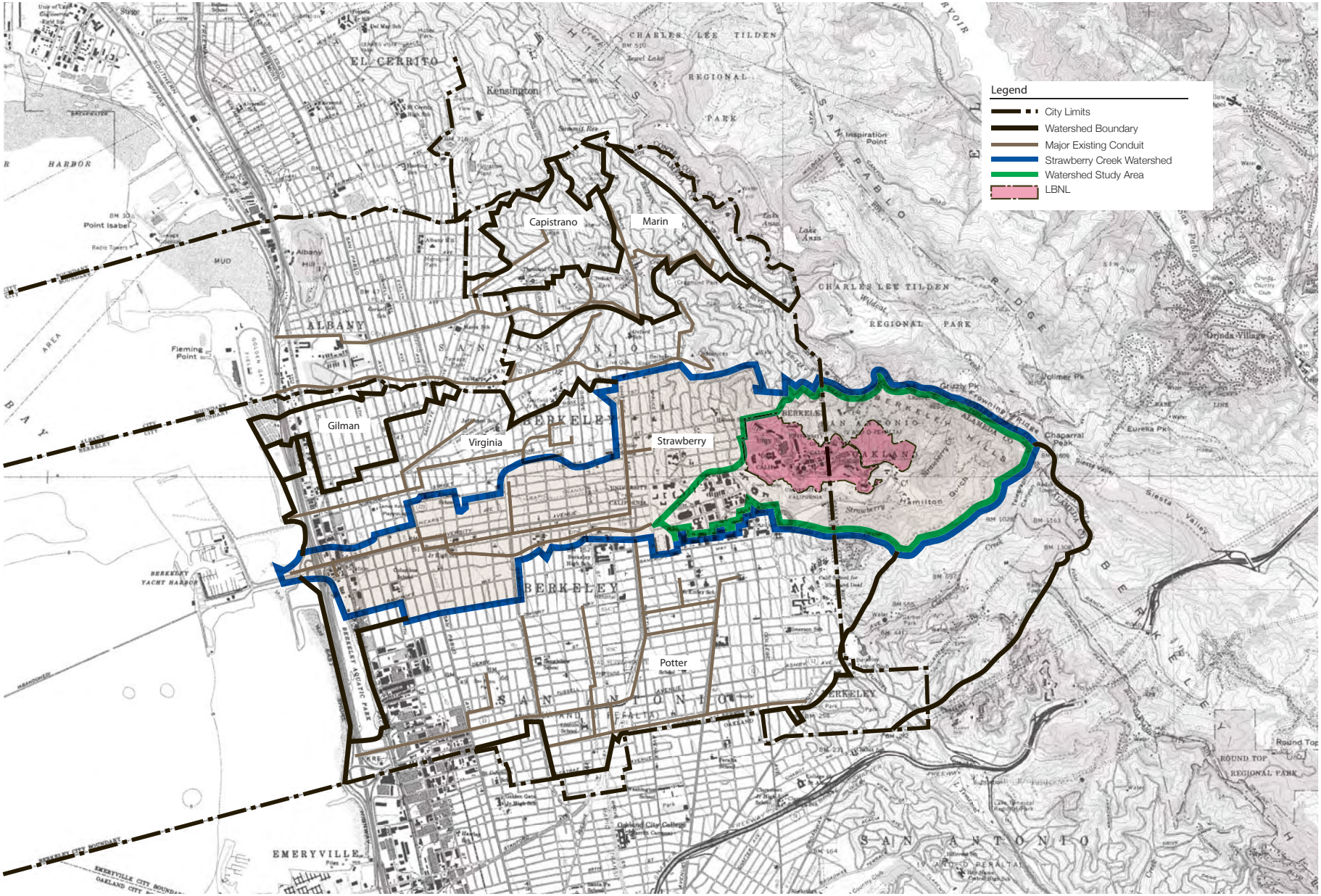
IV.G.2.1 Hydrologic Setting

Surface Water

LBNL is situated within Blackberry and Strawberry Canyons in the East Bay hills, with the vast majority of the site lying within the Strawberry Creek Watershed, as shown in Figure IV.G-1. This watershed has been modified since Native American times, when the area was regularly burned. It was subsequently grazed by animals of Spanish and Mexican settlers, and later farmed and used for dairy production by the Anglo settlers who followed. Beginning in the mid-19th century, the watershed was exploited as a water supply source in order to allow the growth of what has become the City of Berkeley. Thus historical development has resulted in alteration to hydrologic flow patterns and rates within the watershed (UC Berkeley, 1987).

The entire Strawberry Creek Watershed, from the East Bay hills to the San Francisco Bay, is approximately 2,066 acres in size. Berkeley Lab occupies 202 acres or about 10 percent of the total watershed. Traversing from east to west, there are four distinct levels of physical development evident: minimal development (hill area), light development (LBNL area), medium development (UC Berkeley campus), and heavy development (City of Berkeley).

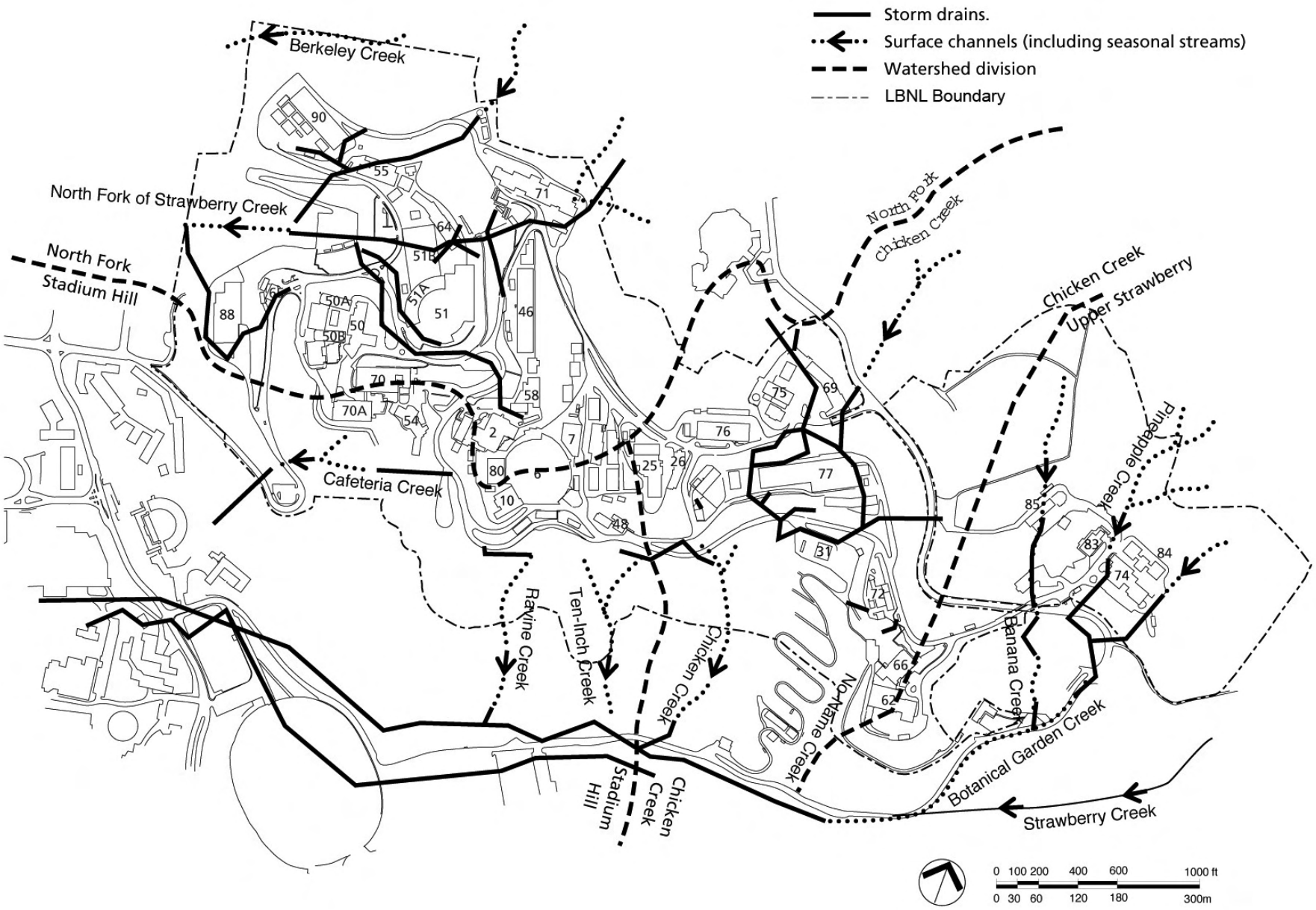
As depicted in Figure IV.G-2, the northwest portion of the LBNL site drains to the North Fork of Strawberry Creek, while the majority of LBNL drains to the South Fork of Strawberry Creek. Most of the contributing drainages are not formally named, but are commonly referred to by local residents and in LBNL publications with names that are used in this document for purposes of identification. The total watershed area of the Strawberry Creek North and South Forks pertinent to LBNL is 878 acres. Of this area, LBNL occupies and manages 202 acres, with the remaining 675 acres managed by UC, City of Berkeley, or City of Oakland. The extreme northwest corner of the Laboratory, approximately 2 acres, lies within the Lincoln/Schoolhouse Creek Watershed; however, this flow was diverted by the City of Berkeley and now also discharges into the North Fork of Strawberry Creek.



SOURCE: Lawrence Berkeley National Laboratory (2006)

LBNL 2006 Long Range Development Plan . 201074

Figure IV.G-1
Strawberry Creek Watershed



SOURCE: Lawrence Berkeley National Laboratory (2003)

LBNL 2006 Long Range Development Plan . 201074

Figure IV.G-2
Stormwater Drainage

In addition to the 202 acres of Lab runoff, LBNL must also manage "run-on" flow from 186 acres uphill and east of the Lab as shown on Figure IV.G-3. These acres are primarily undeveloped University-owned research and ecological study area land, University-owned institutional development, such as the Lawrence Hall of Science, and some Berkeley residential area. This water enters the LBNL storm drain system at six distinct locations. Because of the very steep terrain and areas involved, energy dissipators and other controls have been installed to mitigate peak flows onto the LBNL site.

The North Fork begins in the Campus Hill Area near the Lawrence Hall of Science and flows west, crossing LBNL and exiting the Lab site at the bottom of Blackberry Canyon north of Building 65. The North Fork then passes through a series of check dams and settlement basins before entering a 60-inch culvert above LeConte Avenue in the City of Berkeley and then re-emerges as a surface stream on the UC Berkeley campus. The North Fork is a perennial creek and is partially supplied by hydrauger flows.[1] A few tributary drainages contribute to the North Fork, including Cafeteria Creek, an intermittent stream that is also partially supplied by hydrauger flows. The other contributing drainages are unnamed ephemeral streams.[2] The North Fork watershed contains 53 acres of developed area (of which 35 acres are within LBNL) and 117 acres of undeveloped area (of which 56 acres are within LBNL).

The South Fork of Strawberry Creek begins in the eastern end of Strawberry Canyon and flows west, through a retention basin above the Haas Pool complex ("mid-canyon retention basin"), and is then diverted through 36-inch and 48-inch diameter concrete pipes before re-emerging as a surface stream in the eastern portion of the UC Berkeley campus. Along the way, several tributary drainages contribute to flows in the South Fork. Above the mid-canyon retention basin, contributing subdrainages include Hamilton Creek (a perennial stream), Pineapple and Banana creeks (both ephemeral streams), and a few other unnamed ephemeral creeks. Below the mid-canyon retention basin, contributing subdrainages include "No Name" Creek (an intermittent stream), Chicken Creek (a perennial stream), Ten-Inch Creek and Ravine Creek (both ephemeral streams), and a few other unnamed ephemeral creeks.

The three sub-watersheds along the South Fork to which LBNL contributes are shown on Figure IV.G-4 and consist of Upper Strawberry Creek (508 acres), Chicken Creek (63 acres), and Stadium Hill (67 acres), for a total of 638 acres. A fourth sub-watershed, Panoramic (70 acres), is located on the south side of the canyon across from LBNL, and does not receive any runoff from LBNL (Huffman Broadway Group, Inc., 2004).

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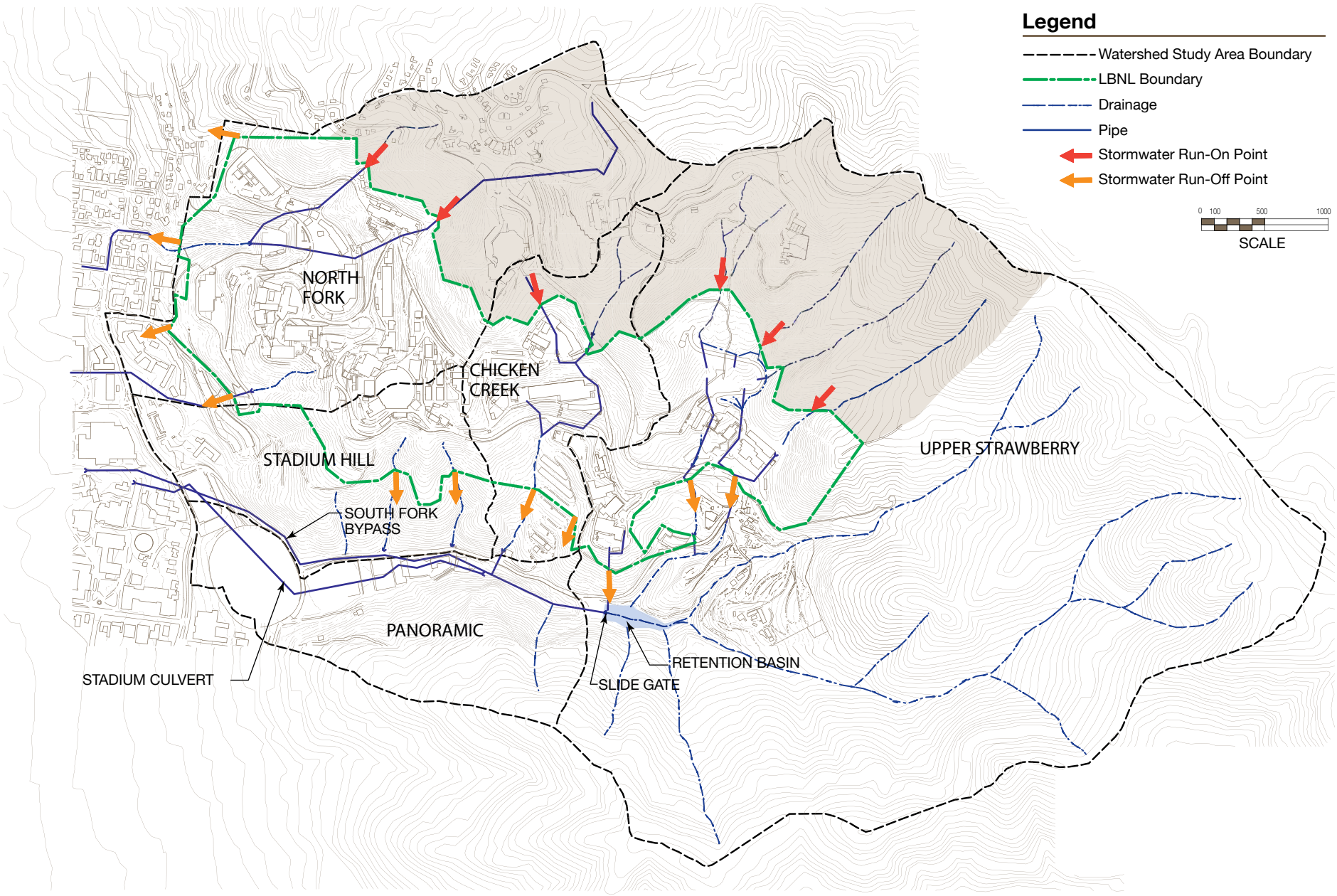
1 Hydraugers are horizontal drain pipes inserted into the hillside to draw off groundwater, some of which otherwise would eventually reach the natural drainage channels and which could, if not drained through by means of the hydraugers, result in slope instability where excessive moisture builds up in the soil.

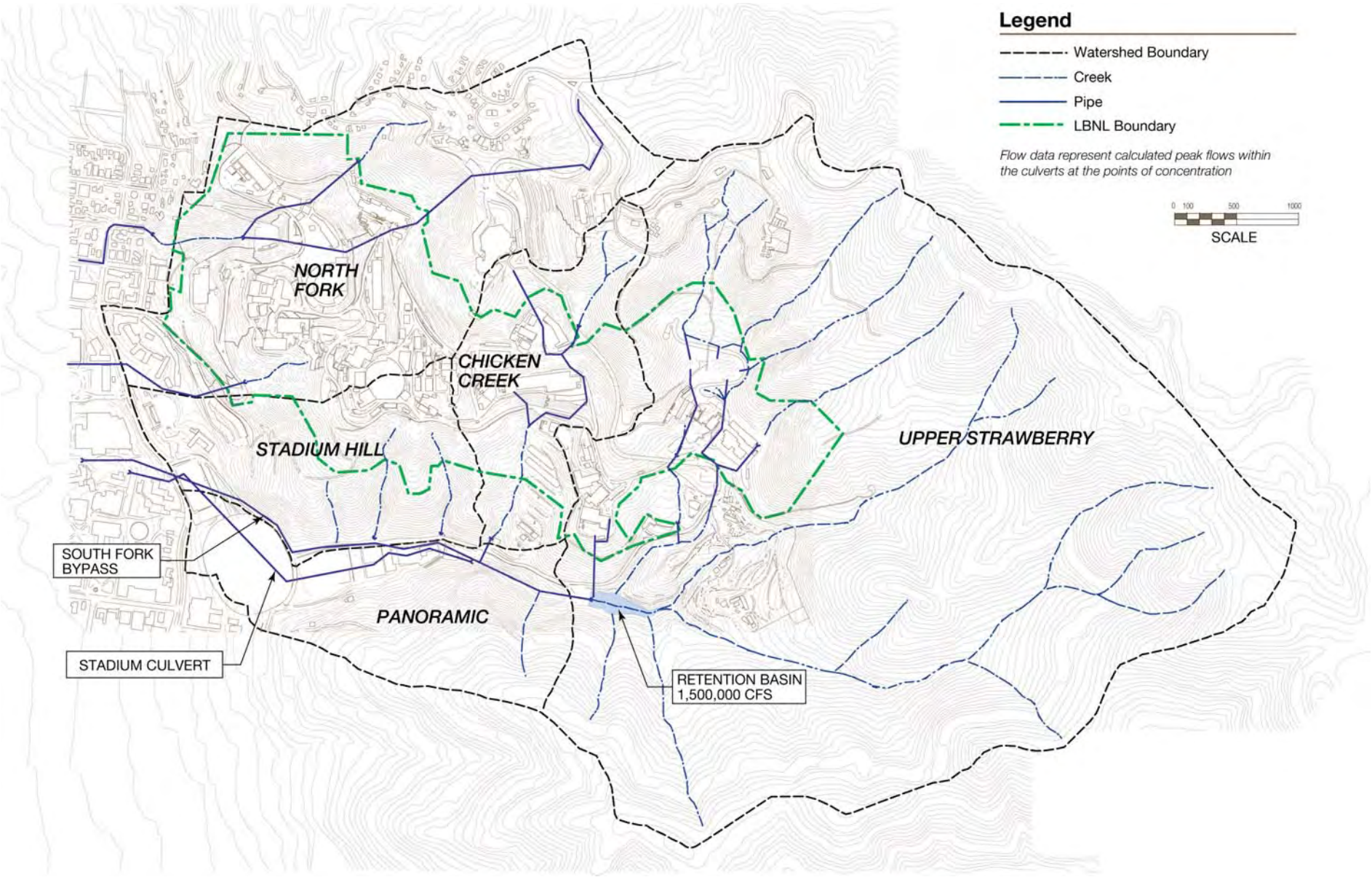
2 An ephemeral stream has flowing water only during, and for a short duration after, precipitation events in a typical year. Runoff from rainfall is the primary source of water for stream flow, and groundwater is not a source of water for the stream. An intermittent stream has flowing water during certain 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.



SOURCE: Lawrence Berkeley National Laboratory (2006)

LBNL 2006 Long Range Development Plan . 201074

Figure IV.G-3
Runoff from and Run-on to LBNL Site



SOURCE: Lawrence Berkeley National Laboratory (2003)

Figure IV.G-4
Strawberry Canyon Subwatersheds

The South Fork watershed consists of largely undeveloped, steeply sloped canyons and hillsides. Developed areas are generally confined to the residential areas and University property on the ridges and plateaus above the LBNL site, plus roads, the University's Botanical Garden, and LBNL itself. Within the watershed, there are 76 acres of developed area and 632 acres of undeveloped areas. Thirty-two acres of this developed area and 78 acres of this undeveloped area are within LBNL.

Surface waters and piped flows from development above the Laboratory run through the site. After leaving LBNL property within Strawberry Canyon, the majority of stream flow and surface runoff in the South Fork of Strawberry Creek is routed through a mid-canyon retention basin on University of California land, above the Haas Pool complex in the Upper Strawberry Creek sub-watershed. This retention basin is located at an elevation of approximately 600 feet and has an estimated flood storage capacity of 11 million gallons (1.5 million cubic feet) although the original design capacity has likely been reduced by siltation and vegetation growth (Kuntz, 2004). Surface water releases from the mid-canyon retention basin are remotely controlled by a hydraulically operated gate, thereby controlling flow rates downstream consistent with the design parameters of the storm drainage systems of UC Berkeley and the City of Berkeley. A substantial portion of the flow from LBNL's eastern area is captured by this retention basin prior to its further progress onto the UC Berkeley campus.

After flowing above ground for a short distance on campus the North and South Forks of Strawberry Creek converge on the western side of the UC Berkeley campus, east of Oxford Street, where they flow into one of three on-campus natural retention basins. These natural retention basins are (1) the West Circle Retention Area (North Fork flows only), (2) the Eucalyptus Grove Retention Area, and (3) the Oxford Inlet Retention Area. They perform important retention and flow moderation roles, and have prevented flooding on numerous occasions. Upon leaving the basins, flow is diverted underground through the Oxford Culvert and remains underground except for a short daylighted stretch in West Berkeley. Surface water flows from LBNL and the larger Strawberry Creek Watershed are ultimately discharged into San Francisco Bay south of the Berkeley Marina at the terminus of the storm drainage system that conveys Strawberry Creek through the City of Berkeley (LBNL, 2002).

Groundwater

Groundwater depths at LBNL vary from zero to approximately 100 feet below ground surface, usually depending on the season. Locally "perched"[3] groundwater and seeps are present. Groundwater flow patterns generally reflect site topography, with groundwater underlying the northwestern portion of the site flowing to the west, while groundwater elsewhere generally flows to the south. Flow velocities vary between approximately 0.003 feet per year to 990 feet per year (LBNL, 2005).

[3] "Perched" groundwater refers to water that sits atop an impermeable layer (rock, clay, etc.) at a lesser depth below grade than is representative of the overall groundwater table.

Historic development at LBNL has included the installation of hydraugers to facilitate hillside drainage and minimize saturation of steep slopes. Groundwater collected in hydraugers is subsequently directed into LBNL's storm drain system, with the exception of groundwater collected in areas surrounding Buildings 6, 7, 46, and 51, where contamination affecting groundwater quality has been found (LBNL, 2001). Flows from hydraugers in these areas are treated and the water is subsequently discharged to the sanitary sewer system, under a wastewater discharge permit from the East Bay Municipal Utility District (EBMUD).

Groundwater in the vicinity of LBNL is controlled by faults, subsurface geologic stratigraphy, and bedrock fractures. Groundwater flow through bedrock is typically characterized by fracture flow that has slow recharge and yield, while groundwater flow in the drainages is unconfined and fluctuates with seasonal precipitation. The soils that underlie the site allow for rapid to very rapid runoff, as discussed in Section IV.E, Geology and Soils, of this document.

LBNL is located above the East Bay Plain, an alluvial aquifer that supplies groundwater for municipal and industrial use. However, there are no production wells at Berkeley Lab, and LBNL and surrounding communities receive their water from EBMUD. The shallow soils located on steep slopes that exist across the majority of LBNL permit rapid runoff and likely do not allow for substantial levels of groundwater recharge to occur.

IV.G.2.2 Topographic Setting

Topographic elevations at LBNL range from approximately 450 to 1,100 feet above mean sea level (amsl). Although slope elevations generally decrease towards the west and south, a series of three main canyons and ridgelines results in a complex, varied topographic profile across the site. Approximately 60 percent of LBNL is located on slopes of greater than 25 percent.

IV.G.2.3 Flooding

The San Francisco Bay Area has a Mediterranean climate with cool, wet winters and warm, dry summers. LBNL receives approximately 30 inches of precipitation annually, 90 percent of which occurs in November through April (LBNL, 2002). The project site does not lie within the 100-year flood plain as determined by Federal Emergency Management Agency (FEMA) flood hazard mapping (ESRI-FEMA, 2004). There are no impounded water bodies upstream from the project site, and therefore flooding associated with failure of a dam is not anticipated to affect the site.[4]

Most of the existing storm drainage system at LBNL is sized to handle flows from a 100-year storm event (LBNL, 2002) based on a storm intensity of 2.95 inches of precipitation per hour. Future improvements to the storm drain system will continue to provide this 100-year storm capacity.

[4] Potential impacts to the project site associated with flooding from seiches or tsunamis are analyzed as seismic hazards in Section IV.E, Geology and Soils, of this document, and were determined to be remote.

There are existing capacity constraints at the Oxford Culvert that pose a risk of flooding on Strawberry Creek "for downtown Berkeley, immediately west of Oxford Street, and to portions of the central UC campus. The North Fork of Strawberry Creek in particular is subject to flash flood conditions in periods of intense rainfall" (City of Berkeley, 2001).

The UC Berkeley campus area just upstream (east) of the Oxford inlet is shown on FEMA maps as being in the 100-year floodplain. This campus floodplain area functions as a retention basin to buffer flash storms and periods of heavy runoff when the capacity of the Oxford Street inlet is exceeded or the inlet becomes blocked by debris.

Since completion of the 11-million-gallon mid-canyon retention basin in Strawberry Creek and other improvements, through a range of usual storms, including El Nino events, there has been no recorded flooding from this inlet attributable to flow volume alone. Flooding onto city streets can, however, result when tree branches block the flow or other debris temporarily reroutes the surface channels. In 1995, such an event caused the creek to overtop its banks near the Oxford Street culvert and flow onto Oxford Street (UC Berkeley, 2004).

The mid-canyon retention basin was constructed to include an overflow flume; when water levels in the retention basin reach elevations of 594 feet, water is diverted onto Centennial Road. A rise in water levels sufficient to result in redirection to the overflow flume can be caused by several factors, including poor management of the slide gate that controls releases from the basin, plugging of the gate by debris, and storm events that generate a peak flow that exceeds the capacity of the system. During a 1997 storm, the gate was either plugged or closed too far, resulting in excessive water levels in the retention basin. The overflow flume is partially controlled by other wooden gates that allow access to Haas Pool complex. These gates were left open during the 1997 storm, and overflow water from the basin was directed into swimming pools rather than Centennial Drive (Kuntz, 2004). Improvements were subsequently made to the basin, and the gate control mechanism was relocated to a more accessible location after this event.

Minimization of stormwater runoff is one of the goals of the Alameda Countywide Municipal National Pollutant Discharge Elimination System (NPDES) Stormwater Permit. LBNL takes this goal into consideration in the design of new facilities, roads, and buildings, and to the extent possible considering topography and geology, minimizes impervious surfaces to reduce the rate of runoff using accepted design guidelines and best management practices (BMP), as described below.

IV.G.2.4 Water Quality

Within LBNL, the major potential sources of stormwater pollutants are motor vehicles and earthwork operations during construction. LBNL has had a stormwater management program in place since 1992. This program consists of a Storm Water Pollution Prevention Plan (SWPPP), plus periodic monitoring, inspecting, and reporting. More on this program is presented in the Regulatory Environment section that follows. Past releases of hazardous materials used at LBNL,

not necessarily directly related to stormwater runoff, have affected groundwater underlying the project site, as discussed in Section IV.F, Hazards and Hazardous Materials, of this document.

Regionally, stormwater runoff is estimated to contribute more heavy metals to San Francisco Bay than direct municipal and industrial discharges do, as well as significant amounts of motor oil, paints, chemicals, debris, grease, and detergents. Runoff in storm drains may also include pesticides and herbicides from lawn care products and bacteria from animal waste. Most stormwater runoff flows untreated into creeks, lakes, and the bay. As point sources of pollution have been brought under control, the regulatory focus has shifted to nonpoint sources,[5] particularly urban runoff.

In 1987, UC Berkeley initiated a comprehensive study of Strawberry Creek (UC Berkeley, 1987). The study began as a water quality management plan, which was later expanded to urban creek and riparian habitat preservation and restoration. An update to the Strawberry Creek Management Plan is being developed by UC Berkeley to reflect progress resulting from program implementation and to expand the scope to address the Strawberry Creek Watershed as a functional eco-hydrological unit.

IV.G.2.5 Regulatory Environment

Regulations exist at both the state and federal levels for the control of surface water quality in California. The major federal legislation governing the water quality aspects of the project is the Clean Water Act. The objective of the Clean Water Act is “to restore and maintain the chemical, physical, and biological integrity of the nation’s waters.” The State of California’s Porter-Cologne Water Quality Control Act (Division 7 of the California Water Code) provides the basis for water quality regulation within California. The State Water Resources Control Board (SWRCB) administers water rights, water pollution control, and water quality functions throughout the state, while the various Regional Water Quality Control Boards (RWQCBs) conduct planning, permitting, and enforcement activities.

State and Regional Water Quality Control Boards

The primary responsibility for the protection and enhancement of water quality in California has been assigned by the California legislature to the SWRCB and the nine RWQCBs. The SWRCB provides state-level coordination of the water quality control program by establishing statewide policies and plans for the implementation of state and federal laws and regulations. The RWQCBs adopt and implement water quality control plans that recognize the unique characteristics of each region with regard to natural water quality, actual and potential beneficial uses, and water quality problems.

[5] Point-source pollution is defined as pollution from industrial and sewage treatment plants. Nonpoint-source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Nonpoint-source pollution is caused by rainfall moving over and through the ground. As the runoff moves, it picks up and carries away natural and man-made pollutants, ultimately depositing them into lakes, rivers, wetlands, coastal waters, and even underground sources of drinking water.

The project area lies within the jurisdiction of the San Francisco Bay RWQCB, which has adopted the Water Quality Control Plan for the San Francisco Bay Region (Basin Plan) to implement plans, policies, and provisions for water quality management. Beneficial uses of surface waters within the San Francisco Bay Region are described in the Basin Plan and are designated for major surface waters and their tributaries. Beneficial uses of the Central San Francisco Bay include ocean, commercial, and sport fishing, estuarine habitat, industrial service supply, fish migration, fish spawning, navigation, rare and endangered species preservation, recreation, shellfish harvesting, and wildlife habitat. None of the surface water bodies at LBNL, such as Strawberry Creek, has any designated beneficial uses in the Basin Plan.

Both the SWRCB and U.S. Environmental Protection Agency (EPA) Region IX have been in the process of developing new water quality objectives and numeric criteria for toxic pollutants for California surface waters since 1994, when a state court overturned the SWRCB's water control plans containing water quality criteria for priority toxic pollutants. The EPA's draft California Toxics Rule (CTR) was published in the August 5, 1997, Federal Register [62 FR 42159], with the Final Rule promulgated on May 18, 2000. The proposed criteria largely reflected the existing criteria contained in the EPA's 304(a) Gold Book (WQ Criteria 1986) and its National Toxics Rule adopted in December 1992 [57 Federal Register 60848], and those of earlier state plans (the *Inland Surface Waters Plan* and the *Enclosed Bays and Estuaries Plan* of April 1991, since rescinded). With promulgation of the Final CTR, these federal criteria are legally applicable in the State of California for inland surface waters including creeks at LBNL and enclosed bays and estuaries for all purposes and programs under the Clean Water Act.

Total Maximum Daily Load (TMDL) – Section 303(d) of the Clean Water Act

California has identified waters that are polluted and need further attention to support their beneficial uses. These water bodies are listed pursuant to Clean Water Act Section 303(d). Specifically, Section 303(d) requires that each state identify water bodies or segments of water bodies that are "impaired" (i.e., not meeting one or more of the water quality standards established by the state). Approximately 500 water bodies or segments have been listed in California. Once the water body or segment is listed, the state is required to establish "Total Maximum Daily Load," or TMDL, for the pollutant causing the conditions of impairment. The TMDL is the quantity of a pollutant that can be safely assimilated by a water body without violating water quality standards. Listing of a water body as impaired does not necessarily suggest that the pollutants are at levels considered hazardous to humans or aquatic life or that the water body segment cannot support the beneficial uses. The intent of the 303(d) list is to identify the water body as requiring future development of a TMDL to maintain water quality and reduce the potential for continued water quality degradation.

In accordance with Section 303(d) of the Water Code, the San Francisco Bay RWQCB has identified impaired water bodies within its jurisdiction and the pollutant or stressor impairing water quality, and prioritized the urgency for developing a TMDL. While San Francisco Bay is included on the Section 303(d) list, Strawberry Creek is not. Pollutants or stressors identified on the Section 303(d) list for Central San Francisco Bay include chlordane, dichlorodiphenyltrichloroethane (DDT), diazinon, dieldrin, dioxin compounds, exotic species,

furan compounds, mercury, non-dioxin-like polychlorinated biphenyls (PCBs), PCBs (dioxin-like), and selenium.

A TMDL has been established for San Francisco Bay for mercury, and the RWQCB is working on TMDLs for the Bay for PCBs, pesticides, and selenium, as well as a revision to the mercury TMDL. The RWQCB has also adopted a TMDL for pesticide toxicity in urban creeks. (TMDLs are also being developed for other water bodies, such as the Napa River, Guadalupe River, and Sonoma Creek.) Although it is not anticipated that any future TMDLs would affect LBNL, due to lack of discharge of such substances, LBNL will comply with applicable regulations.

Construction Activity Permitting

The San Francisco Bay RWQCB monitors and enforces the NPDES stormwater permitting for the region. The SWRCB administers the NPDES Permit Program through its General NPDES Permit. Construction activities of one acre or more are subject to the permitting requirements of the NPDES General Permit for Discharges of Stormwater Runoff Associated with Construction Activity (General Construction Permit). The project sponsor must submit a Notice of Intent to the SWRCB in order to be covered by the General Permit prior to the beginning of construction. The General Construction Permit requires the preparation and implementation of a SWPPP, which must be prepared before construction begins. Components of SWPPPs typically include specifications for BMPs to be implemented during project construction for the purpose of minimizing the discharge of pollutants in stormwater from the construction area. In addition, a SWPPP includes measures to minimize the amount of pollutants in runoff after construction is completed, and identifies a plan to inspect and maintain project BMPs and facilities at the end of the construction project. This plan includes information regarding how the SWPPP was met.

Alameda County

In Alameda County, stormwater discharge from 17 participating agencies and cities, including the City of Berkeley, which ultimately receives runoff generated from within LBNL, is regulated by the Alameda Countywide Clean Water Program (ACCWP) under an NPDES permit issued by the San Francisco Bay RWQCB. The ACCWP has prepared and issued a 2001-2008 Stormwater Management Plan intended to reduce the discharge of pollutants in stormwater to the maximum extent possible and to effectively prohibit non-stormwater discharges into municipal storm drain systems and waterways. The Stormwater Management Plan includes a number of management practices and control techniques to reduce the discharge of pollutants in stormwater in Alameda County and addresses municipal government activities, new development controls, and stormwater treatment. The San Francisco Bay RWQCB renewed ACCWP's NPDES Permit on February 19, 2003 (SFBRWQCB, 2003). This permit renewal included revising Provision C.3 to require on-site treatment and storage of stormwater runoff for development projects that fall under certain use and size characteristics. As noted below under Local Plans and Policies, LBNL is generally exempt from local regulations but seeks to cooperate with local jurisdictions to reduce any physical consequences of potential land use to the extent feasible. For example, LBNL voluntarily makes an effort to comply with the provisions of the ACCWP NPDES permit that are above and beyond its own permit requirements so as to not negatively affect downstream entities.

LBNL Regulatory Compliance

LBNL's Storm Water Pollution Prevention Plan

Stormwater within the LBNL site is currently managed in conformance with the Statewide NPDES General Permit for Stormwater Discharges Associated with Industrial Activity (General Industrial Permit). Oversight and enforcement of this permit is provided by the San Francisco Bay RWQCB and the City of Berkeley. Implementation of the permit requirements is detailed in LBNL's SWPPP (LBNL, 2006) and Stormwater Monitoring Plan (LBNL, 2006). Additionally, LBNL complies with NPDES requirements associated with construction projects that involve one acre or more by applying for coverage under the State General Construction NPDES Permit. All post-construction activities at any project site comply with the General Industrial Permit.

LBNL's SWPPP describes best management practices used to protect stormwater quality. BMPs have been in place since the first general permit was issued by the state in 1992, and are regularly updated. Additionally, a master specification incorporating stormwater management among other environmental, health, and safety concerns is part of contract specifications on all construction projects undertaken by the site. LBNL manages stormwater to address issues such as natural debris and silt migration, slope stability and associated siltation issues, channel cutting and erosion, flow energy dissipation, run-on flow, and runoff retention, as described in more detail below.

LBNL's SWPPP lists potential sources of stormwater contaminants, including a comprehensive list of hazardous substances, chemicals, or other contaminants used throughout the facility. LBNL has implemented multiple source controls (such as containment systems for leak and spill control and maintenance of storm drains and streets to remove organic material and dirt) and management controls (such as preventive maintenance of equipment and the development of spill prevention and response programs) in order to minimize stormwater pollutants. However, treatment controls (such as oil-water separators and infiltration basins) have in the past generally not been used due to the effectiveness of source and management control measures (LBNL, 2002). Water quality samples are collected in accordance with LBNL's SWMP during the wet season, to demonstrate the effectiveness of LBNL's SWPPP and compliance with NPDES requirements (LBNL, 2001).

Stormwater Management

LBNL manages stormwater flows originating from sources upstream of the site and from within the site through engineering controls and management practices. Examples of engineering design features used to control surface water flow include:

- Primary debris interceptors. Structural steel tubes, evenly spaced and embedded in concrete across drainage channels, which remove heavy, floating items such as logs, limbs, stumps, and brush from storm runoff entering the LBNL site from upstream portions of the drainage. Primary debris interceptors prevent blockage of the storm system entrance and potential flooding; as debris collects on the interceptors, these features also function as local seasonal check dams by storing, slowing, and further dissipating energy of larger storm flows.

- Secondary debris interceptors. Heavy vertical grids of rebar spaced more closely together than primary debris interceptors to filter out smaller debris, constructed downstream from primary interceptors to further manage flows originating upstream of the site as they enter LBNL. Fiber rolls and similar instruments are typically placed seasonally at the secondary interceptors to help filter out suspended soil particles from runoff and act as smaller check dams, silting pools, and energy dissipaters.

- Rip-rap. Sharp-edged cobblestone typically placed at all entrances and outfall points in the storm drain system. Rip-rap is frequently cemented together and both dissipates energy and protects slopes and channels.

- Wing walls and head walls. Concrete walls used where open-channel flow enters a piping system to protect embankment and channel walls from erosion. Steel grates on the inlet structure also filter debris which may have bypassed the primary or secondary debris interceptors.

- Concrete v-ditches. Channels used in all earthwork projects along the tops of cut slopes and at intermediate benches on the face of the slope. V-ditches intercept surface runoff to keep the slope face from eroding and channeling.

- Jute mesh. Jute mesh installed on all slopes exposed by construction or grading activities on slopes steeper than 2:1 to prevent erosion until hydroseeding and/or ground cover is well established.[6] Mesh is pinned to the slope with long metal staples and typically reinforces the emerging grasslands for up to 7 years. Fiber rolls are staked at regular intervals across the faces of slopes to slow down and filter surface runoff.

- Down drains. Pipes that convey water down the face of slopes from a collection point at the top of the slope to a lower elevation at a stable outfall point to prevent erosion and damage to the slope face.

- Impervious, semi-pervious and pervious pavements, curbs, berms, and water dispersal systems. Surfaces that convey and control storm runoff to prevent runoff from eroding otherwise unprotected surfaces or from flowing down unprotected slopes.

LBNL's stormwater management practices would be instituted as feasible under LBNL's *Construction Standards and Design Requirements* and would include:

- Stormwater flow management. Management and physical channeling maximize use of the mid-canyon retention basin for both flow originating from development and lands above the site and flow generated within LBNL in order to minimize both localized and downstream impacts from storms.

- General planning. Opportunities to reduce stormwater flow impacts and further improve water quality are integrated into LBNL's overall planning. For example, to minimize impervious surface area per vehicle, LBNL encourages alternative transportation modes to further reduce parking needs and improve LBNL's Transportation Demand Management performance and shifts parking to lots (as opposed to roadside parking). Parking lots and structures can integrate oil/water separators and allow for better management of off-site flows.

6 LBNL hydroseeds with a mixture of native grasses and forbs.

- Project siting and design. Evaluation of the quantity and quality of stormwater runoff is integrated into site planning and design so stormwater flows can be effectively managed. Residual increased flows from new impervious surfaces are ameliorated through project-related BMPs and use of the UC retention/management system. (Refer to BMPs under Impact HYDRO-1.)

- Landscape management. To improve slope stability and reduce erosion, LBNL's landscape management program improves the long-term health of tree stands and encourages native plants.

- Slope stabilization. Slope stabilization measures such as hydraugers and native vegetation reduce general sediment release and erosion and minimize slumps and resulting erosion and sediment production.

- Seasonal controls. Seasonal stormwater runoff controls, such as jute netting and fiber rolls, are installed to reduce sediment release and runoff along road edges and in the landscape. These are maintained by LBNL.

- Construction project controls. Active management of construction-related stormwater flows from development sites is a standard part of contract specifications on all construction projects undertaken by LBNL. Construction projects employ control measures and are monitored by LBNL to manage stormwater flows and potential discharge of pollutants.

- Elimination of all cross-connections. Labeling of stormwater inlets and minimization of sewer system infiltration have been undertaken to maintain clean stormwater flows.

- Publicizing program information. LBNL's annual Site Environmental Report is available to the public and provides an overview of recent actions and sampling results. LBNL also submits a stormwater annual report to the San Francisco Bay RWQCB and makes its SWPPP and SWMP available to the public.

- Engagement with the community. LBNL communicates with the community regarding Strawberry Creek water quality and coordinates with relevant UC Berkeley staff and management personnel on stormwater issues.

- Pollution prevention. LBNL actively promotes pollution prevention and good housekeeping for its Facilities Division operation and maintenance activities, and provides water quality training to Facilities personnel who regularly observe large portions of the site or operate equipment that may potentially discharge liquid. LBNL cleans stormwater inlets prior to the winter storm season and utilizes concrete clean-out basins, responds to any spill of oil, gasoline, or hazardous materials, and applies other, similar BMPs on an ongoing basis. An annual general site inspection ensures the effectiveness of these efforts. LBNL also maintains a Spill Prevention, Control, and Countermeasure (SPCC) plan that covers petroleum-containing tanks.

- Oil–water separators. These are used where an extra measure of protection is advisable, and will continue to be deployed where they can be used effectively.

- Permits. As noted above, LBNL obtained a stormwater permit at the inception of the NPDES program in 1992. LBNL's program is based on appropriate BMPs, and plans are periodically updated to reflect evolving knowledge and practices in this field. These measures, which are meant to reduce the quantity and improve the quality of stormwater runoff, consist of:

- Public education and outreach on stormwater impacts;
- Public involvement and participation;
- Illicit discharge detection and elimination;
- Pollution prevention/good housekeeping for facilities operation and maintenance;
- Construction site stormwater runoff control; and
- Post-construction stormwater management in new development and redevelopment.

A complete guide to LBNL's stormwater management measures can be found in the Lab's Storm Water Pollution Prevention Plan, which is posted on the internet at the following website: http://www.lbl.gov/ehs/esg/tableforreports/tableforreports.htm.

IV.G.2.6 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 in the Berkeley and Oakland general plans.

Berkeley General Plan

Berkeley General Plan policies pertaining to hydrology and water quality relevant to implementation of the LBNL LRDP include the following:

> Policy EM-23 Water Quality in Creeks and San Francisco Bay: Take action to improve water quality in creeks and San Francisco Bay.
>
> *Actions:*
>
> D) Restore a healthy freshwater supply to creeks and the Bay by eliminating conditions that pollute rainwater, and by reducing impervious surfaces and encouraging use of swales, cisterns, and other devices that increase infiltration of water and replenishment of underground water supplies that nourish creeks.
>
> F) Encourage the maintenance and restoration of creeks and wetlands and appropriate planting to cleanse soil, water, and air of toxins.
>
> Policy EM-24 Sewers and Storm Sewers: Protect and improve water quality by improving the citywide sewer system.
>
> E) Ensure that new development pays its fair share of improvements to the storm sewerage system necessary to accommodate increased flows from the development.
>
> F) Coordinate storm sewer improvements with creek restoration projects.
>
> Policy EM-25 Groundwater: Protect local groundwater by promoting enforcement of state water quality laws that ensure non-degradation and beneficial use of groundwater.

Policy EM-27 Creeks and Watershed Management: Whenever feasible, daylight creeks by removing culverts, underground pipes, and obstructions to fish and animal migrations.

Actions:

D) Restrict development on or adjacent to existing open creeks. When creeks are culverted, restrict construction over creeks and encourage design solutions that respect or emphasize the existence of the creek under the site.

F) Work in cooperation with adjoining jurisdictions to jointly undertake creek and wetland restoration projects, to improve water quality and wildlife habitat, to allow people to enjoy creeks as part of urban open space.

G) Regulate new development within 30 feet of an exposed streambed as required by the Creeks Ordinance and minimize impacts on water quality and ensure proper handling of stormwater runoff by requiring a careful review of any public or private development or improvement project proposed in water sensitive areas.

H) Consider amending the Creek Ordinance to restrict parking and driveways on tops of culverts and within 30 feet of creeks.

Policy S-27 New Development: Use development review to ensure that new development does not contribute to an increase in flood potential.

Actions:

C) Require new development to provide for appropriate levels of on-site retention of stormwater.

D) Regulate development within 30 feet of an exposed streambed as required by the Preservation and Restoration of Natural Watercourses (Creeks) Ordinance.

Oakland General Plan

The Open Space, Conservation and Recreation Element of the Oakland General Plan, adopted in 1996, addresses the management of open land, natural resources, and parks in Oakland.

Open Space Objective OS-8 is "To conserve open space along Oakland's creeks, restoring the creeks where feasible and enhancing creek access on public lands." The following policies are relevant to the proposed project:

Policy OS-8.2 Creek Daylighting: Support programs to restore or "daylight" sections of creek that have been culverted or buried in the storm drain system, provided that the following conditions exist: (1) broad-based community support for the project; (2) availability of financial resources for the project; and (3) no significant health, safety, flooding, or erosion hazards would result from the project. Place priority for daylighting on properties where additional opportunities for recreational access would be created.

Conservation Objective CO-5 is "To minimize the adverse effects of urbanization on Oakland's groundwater, creeks, lakes and nearshore waters." The following polices are relevant to the proposed project:

Policy CO-5.2 Improvements to Groundwater Quality: Support efforts to improve groundwater quality, including the use of non-toxic herbicides and fertilizers, the

enforcement of anti-litter laws, the clean-up of sites contaminated by toxics, and ongoing monitoring by the Alameda County Flood Control and Water Conservation District.

Policy CO-5.3 Control of Urban Runoff: Employ a broad range of strategies, compatible with the Alameda Countywide Clean Water Program, to: (a) reduce water pollution associated with stormwater runoff; (b) reduce water pollution associated with hazardous spills, runoff from hazardous material areas, improper disposal of household hazardous wastes, illicit dumping, and marina "live-aboards"; and (c) improve water quality in Lake Merritt to enhance the lake's aesthetic, recreational, and ecological functions.

Conservation Objective CO-6 is "To protect the ecology and promote the beneficial uses of Oakland's creeks, lakes, and nearshore waters." The following polices are relevant to the proposed project:

Policy CO-6.1 Creek Management: 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 that bury creeks or divert them into concrete channels.

IV.G.3 Impacts and Mitigation Measures

IV.G.3.1 Significance Criteria

The impact of LBNL projects on hydrology and water quality would be considered significant if it would exceed the following Standards of Significance, in accordance with Appendix G of the state CEQA Guidelines and the UC CEQA Handbook:

- Violate any water quality standards or waste discharge requirements;
- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted);
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site;
- Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site;
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff;
- Otherwise substantially degrade water quality;
- Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map;

- Place within a 100-year flood hazard area structures which would impede or redirect flood flows;
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam; or
- Cause inundation by seiche, tsunami, or mudflow.

IV.G.3.2 Impact Assessment Methodology

Potential impacts were analyzed based on existing hydrology data and anticipated physical growth under the 2006 LRDP.

Due to site characteristics and the scope of the LRDP, significance criteria associated with placing of housing or other structures within a 100-year flood hazard zone are not relevant to the proposed project. As previously noted, LBNL is not located within a 100-year flood zone. As also previously discussed, LBNL's steep slopes, shallow bedrock, and thin soils presently inhibit significant groundwater recharge of the East Bay Plain, and therefore potential groundwater recharge and supply impacts associated with the project are not considered significant. Potential impacts associated with inundation by seiche or tsunami are not considered significant due to the elevation and location of LBNL relative to the Pacific Ocean and enclosed water bodies, as discussed in Section IV.E, Geology and Soils, of this document. There are no water supply wells on the LBNL main hill site.

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.G.3.3 2006 LRDP Principles, Strategies and LBNL Design Guidelines

2006 LRDP Principles and Strategies

The 2006 LRDP proposes fundamental principles that form the basis for the Plan's development strategies. The three principles most applicable to hydrology and water quality as related to new development are to "Preserve and enhance the environmental qualities of the site as a model of resource conservation and environmental stewardship"; "Build a safe, efficient, cost effective scientific infrastructure capable of long-term support of evolving scientific missions"; and "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 hydrology and water quality 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, and 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 policies 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.
- Improve efficiency and security of Laboratory access through improvements to existing gates and the creation of new gates.
- Reduce the percentage of parking spaces relative to the adjusted daily population.
- Consolidate parking into larger lots and/or parking structures, and 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.
- Utilize native, drought-tolerant plant materials to reduce water consumption; focus shade trees and ornamental plantings at special outdoor use areas.
- Minimize impervious surfaces to reduce storm water run-off and provide landscape elements and planting to stabilize slopes, reduce erosion and sedimentation.
- Maintain a safe and reliable utility infrastructure capable of sustaining the Laboratory's scientific endeavors.
- Design infrastructure improvements to embody sustainable practices.

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 hydrology and water quality:

- Minimize impacts to disturbed slopes.
- Minimize further increases in impermeable surfaces at the Lab.
- Minimize visual and environmental impacts of new parking lots.

IV.G.3.4 Construction[7] and Demolition Impacts

Impact HYDRO-1: Construction pursuant to the LRDP, including earthmoving activities such as excavation and grading, could result in soil erosion and subsequent sedimentation of stormwater runoff or an increase in stormwater pollutants associated with construction-related hazardous materials. (Less than Significant)

Construction-related grading and other activities for all development under the LRDP would follow the Association of Bay Area Governments' (ABAG) Manual of Standards for Erosion and Sediment Control Measures (ABAG, 1995) and the California Stormwater Quality Association (CASQA) Stormwater Best Management Practice Handbook for Construction (CASQA, 2003a). In addition, construction would comply with LBNL's standard stormwater management practices and engineering controls, which require the control and minimization of stormwater pollutants originating from construction sites as a standard part of contract specifications. Disturbed areas would be landscaped and re-seeded at the earliest practical time during construction so that ground cover would be well-established by the next rainy season, as required by Mitigation Measures GEO-3a and GEO-3b, presented in Section IV.E, Geology and Soils. Landscaping would begin as soon as surface disturbances are completed for each relevant area. Implementation of these measures is anticipated to effectively control sedimentation and pollutants in stormwater from construction sites that encompass less than one acre.

Individual projects constructed (or demolished) under the LRDP that involve one acre or more would require LBNL to apply for coverage under the State General Construction NPDES permit, and development of a project-specific SWPPP would therefore be required. As part of the SWPPP, a project-specific erosion control plan would be included in the project design process and implemented during construction to reduce short-term water quality impacts associated with construction. The SWPPP would include the use of BMPs to minimize stormwater pollution from sediments and construction-related contaminants. Such BMPs would include, as feasible:

- The covering of excavated materials.
- Installation of silt traps, fencing, and use of filter fabric as measures to control erosion and sedimentation and prevent such materials from entering surface water discharges.

[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.

- Truck and construction equipment maintenance and storage to minimize pollutants.
- Construction and hazardous materials storage.
- Housekeeping measures.
- Prohibition of cement truck washout to LBNL drains and surfaces.
- Oversight throughout construction by LBNL engineers and environmental specialists.

Compliance with NPDES permit requirements, which include creation of project-specific SWPPPs and, ultimately, implementation of BMPs that would minimize soil erosion and subsequent sedimentation of stormwater runoff or increased stormwater pollution associated with construction hazardous materials, as discussed above, and LBNL's standard stormwater management practices and engineering controls would ensure that potential adverse impacts to surface waters associated with construction under the LRDP would be less than significant.

Mitigation: None required.

Project Variant. 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.

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 to hydrology and water quality. For the reasons stated above, potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario would not result in substantial effects with regard to soil erosion, stormwater sedimentation, or construction-related pollution of stormwater, and the impacts of these specific projects would also be less than significant.

IV.G.3.5 Operations Impacts

Impact HYDRO-2: Implementation of the 2006 LRDP would adversely affect stormwater quality. (Less than Significant)

Urban runoff can carry a variety of pollutants, such as oil and grease, metals, sediment, and pesticide residues from roadways, parking lots, rooftops, and other surfaces, and deposit them in adjacent waterways. Pollutant concentrations in urban runoff are extremely variable and are dependent on storm intensity, land use, elapsed time between storms, and the volume of runoff generated in a given area that reaches a receiving water. The most critical time for urban runoff

effects is in autumn under low flow conditions. Pollutant concentrations are typically highest during the first major rainfall event after the dry season, known as the "first flush."

The LRDP proposes to address transportation impacts through improvements for both private vehicles and alternate modes of transportation. The LRDP would add up to a net total of 500 employee parking spaces to the 2,300 existing parking spaces. To provide additional parking within the topographic constraints of LBNL, the LRDP anticipates that the majority of these new parking spaces would be sited in two parking structures as identified in the Illustrative Development Scenario. These parking structures would contain about 850 parking spaces, and would consolidate a substantial portion of existing roadside parking. New surface lots would consolidate other parking spaces currently located alongside Lab roadways. Increased surface parking areas could create new sources for collection of vehicle-related pollutants. Along with the incremental increase in pollutant loading from the creation of new impervious surfaces associated with general facility development, these parking areas could contribute to degradation of surface water quality by adversely affecting runoff leaving the site. However, because the LRDP anticipates that nearly 40 percent of all parking would be in multi-level parking structures, large areas of new parking would not be exposed to rainfall, and therefore the potential for additional contaminants entering stormwater runoff would be reduced, compared to existing conditions, under which all parking is exposed to the elements.

Implementation of the 2006 LRDP would incrementally intensify urban uses at the site. The 2006 LRDP foresees an increase in the average daily population on the main site, which would affect LBNL's transportation facilities and services, and require the construction of new buildings consistent with the mission of the Laboratory. Approximately 10 acres[8] of impervious surfaces would be added to the site.

Pollutant concentrations under the LRDP may increase due to the increase in vehicles, impervious surface area, and hazardous material use. To manage the amount of pollutants entering the storm drain system or surface water bodies at LBNL, and subsequently Strawberry Creek and the San Francisco Bay, the inclusion of control measures directed toward future development and facilities into LBNL's existing SWPPP and SWMP is part of the proposed project. In compliance with the provisions of the Clean Water Act, LBNL will implement relevant standards from the LBNL NPDES General Industrial Permit and associated SWPPP and SWMP, implement appropriate source control measures as recommended in the California Stormwater Best Management Practice Handbook for New Development and Redevelopment (CASQA, 2003b), and preserve existing pervious surfaces to the greatest extent practicable to minimize the amount of storm runoff, in accordance with the recommendations provided in the Bay Area Stormwater Management Agencies Association (BASMAA) *Start at the Source Design Guidance Manual for Stormwater Quality Protection* (BASMAA, 1999). In this way, LBNL is expected to comply with the Clean Water Act while still meeting the need for more usable space at the Lab.

[8] A projection of approximately 10 acres of new impervious surface is calculated based on the aggregate increase of building, parking lot, and road surface area as posited under the Illustrative Development Scenario.

Among the Objectives and Design Guidelines included in the 2006 LRDP are the following that would reduce potential hydrological impacts of development pursuant to the LRDP:

- To the extent possible, site new projects to replace existing outdated facilities and ensure the best use of limited land sources.
- 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.
- Consolidate parking into larger lots and/or parking structures; locate these facilities near Laboratory entrances to reduce traffic within the main site.
- Minimize impervious surfaces to reduce storm water run-off and provide landscape elements and planting to stabilize slopes and reduce erosion and sedimentation.

As noted, the proposed parking structures would result in less of a contribution to pollutant loading of stormwater runoff than a comparable amount of surface parking, as predominantly only rooftop parking would be exposed to rainfall, thereby reducing the potential for oil and grease from the covered areas to enter the watershed. In accordance with LBNL's stormwater engineering controls and management practices referenced above, and implemented in accordance with the LBNL *Construction Standards and Design Requirements*, runoff from parking structures built pursuant to the LRDP would be filtered as required to remove oil and grease prior to discharge. This can be accomplished through mechanical systems such as pre-manufactured oil-water separators or through natural processes such as bioswales and settlement ponds. Due to the steep terrain of the project site, bioswales or settlement ponds are not likely to be practicable in many locations. Oil and sediment separators or absorbent filter systems would be designed and constructed to reduce water quality impacts from urban runoff. The performance of the filters would be monitored regularly to determine the effectiveness of the water treatment. In addition to treating pollutants originating from parking structures, LBNL would implement structural and treatment best management practices commonly used to reduce sediment and contaminant concentrations, including the use of grass strips, high infiltration substrates, and grassy swales to reduce runoff and provide initial stormwater filtration, and the use of retention basins to allow for infiltration and settling of sediments. These features would be included in proposed projects and implemented where practicable.

Compliance with LBNL's NPDES permit and associated SWPPP and SWMP, implementation of the LRDP design guidelines and development principles, and continued implementation of engineering controls and standard management practices would ensure that potential stormwater quality impacts associated with the LRDP are less than significant.

Mitigation: None required.

Project Variant. 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.

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 to hydrology and water. Potential individual projects under the LRDP such as those identified in the Illustrative Development Scenario would result in effects on stormwater quality that would be less than significant for the reasons stated above.

Impact HYDRO-3: Implementation of the LRDP would increase stormwater runoff rates and volumes, potentially resulting in erosion of creek channels or downstream flooding. (Less than Significant)

Stormwater runoff from both LBNL and the UC Berkeley campus enter the City of Berkeley storm drain system at the western edge of the UC Berkeley campus, at Oxford Street. As detailed below, while growth under the 2006 LRDP would slightly increase the total volume of runoff from the LBNL site, there would be a less than proportional increase in stormwater runoff peak flows leaving the LBNL site and entering the municipal storm drain system. Thus, impacts from increases in the quantity of stormwater runoff would be less than significant.

Projects at Berkeley Lab would be sited and designed so that stormwater flows could be effectively managed through (1) the use of BMPs at sites of new projects, (2) the use of BMPs at other locations on the Laboratory site, (3) the use of the mid-canyon retention basin to detain and control downstream releases of stormwater, and/or (4) joint BMP projects with UC Berkeley. In addition, the Laboratory would continue to maintain, periodically replace, and upgrade portions of its stormwater management system under its maintenance and capital renewal programs. These siting and management considerations would be undertaken as part of LBNL's standard project site selection process and design review process. These considerations are an integral part of the LRDP and would be instituted, as appropriate, in *LBNL Construction Standards and Design Requirements*.

Implementation of the LRDP would add approximately 10 acres of impervious surfaces at LBNL, increasing the amount of impervious surface from 67 to 77 acres across the 202-acre LBNL site. This increased impervious surface area would constitute about 1.1 percent of the 878-acre Strawberry Creek watershed pertinent to LBNL, and would only slightly increase peak flows by about 10 cfs, or about 0.6 percent, over the current estimated total of 1,686 cfs (Table IV.G-1) generated in this watershed during a 100-year storm event (Blair, 2006). Berkeley Lab would work with UC Berkeley to ensure that the retention basin is routinely maintained to ensure that its retention capacity is maximized.

Four of these 10 new acres of impervious surfaces would be located within the Upper Strawberry Creek sub-watershed. Peak flows from these four acres would total about 4 cfs, and would flow to the 11-million-gallon mid-canyon retention basin described earlier. This retention basin, which has ample capacity to contain and gradually release the water retained there, can handle runoff up to and including that from a 100-year storm event. Even though the volume of water entering this basin would increase by 4 cfs during peak flow, the basin's unused capacity and relatively slow release of runoff water would mean that this increase would not exceed the capacity of the downstream municipal storm drainage system (Blair, 2006).

The remaining six acres of new impervious surfaces would be divided between the North Fork of Strawberry Creek (4.1 acres) and Chicken Creek (1.9 acres) sub-watersheds. The estimated additional runoff generated from these areas would increase peak flows by 6 cfs, an increase of about 0.4 percent over the current total from the 878-acre watershed pertinent to LBNL. Compared to the runoff from the entire 2,066-acre Strawberry Creek Watershed, this represents an increase of approximately 0.1 percent. The Laboratory would offset this already small increase in peak flows through use of design policies and BMPs at the sites of new development and/or at other locations, required as part of the Lab's siting and design review processes and integral to the LRDP, which would retard peak flows and otherwise reduce their effects. Depending on site-specific conditions, these would include such things as innovative design elements, such as energy dissipaters, vegetated swales, and settlement basins, to minimize erosion; converting surfaces that presently are impervious to pervious surfaces; diverting runoff that presently does not go to the mid-canyon retention basin to that basin; and temporarily retaining a portion of rainfall at the project site or the immediate area for later, gradual release. These efforts would ensure that, as would be the case for increased peak flows from development in the Upper Strawberry Creek sub-watershed, peak flows from new development in these sub-watersheds would not exceed the capacity of the municipal storm drainage system.

As a result of the above measures, there would be no or negligible effects on erosion and downstream flooding, or other impacts to beneficial uses, and impacts would be less than significant.

Mitigation: None required.

Project Variant. 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.

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 impacts. For the reasons stated above, potential individual projects

under the LRDP such as those identified in the Illustrative Development Scenario would result in no or negligible effects on erosion and downstream flooding or other beneficial uses and the impacts would be less than significant.

IV.G.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—is analyzed as part of the 2006 LRDP because the buildings were in place when the EIR analyses were undertaken. Certification of the Building 51 (Bevatron) EIR and approval of the demolition project are anticipated to be considered in early 2007.) 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 is the Strawberry Creek Watershed. Because Strawberry Creek and its tributaries drain through LBNL, UC Berkeley, and the City of Berkeley, 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.G-18) 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 HYDRO-4: Implementation of the LRDP, when combined with implementation of the UC Berkeley 2020 LRDP and other cumulative development, would not result in significantly adverse hydrologic or water quality impacts. (Less than Significant)

Implementation of the LBNL LRDP and UC Berkeley LRDP would have similar programmatic level results, as both projects would be required to comply with NPDES permit regulations to minimize short-term and long-term degradation of stormwater runoff. Peak flows to the municipal storm drainage system that begins at Oxford Street would not increase significantly as a result of the LBNL LRDP. Therefore, any cumulative impacts would largely be the result of other development. The City of Berkeley General Plan indicates that no significant changes to roadways or the residential pattern in the Upper Strawberry Creek sub-watershed are anticipated. The UC Berkeley 2020 LRDP does not identify any specific projects to be developed on the UC Berkeley-managed lands in this upper watershed area. The UC Berkeley 2020 LRDP projects that approximately 100,000 gross square feet of multi-story building space might be constructed somewhere on UC Berkeley-managed lands in the hill area, but this plan notes that on-site stormwater management features will be incorporated so that there will be no increase in net stormwater runoff flows from the hill site. Similarly, the UC Berkeley LRDP notes that any further development by UC Berkeley on the central campus and adjacent lands will not increase

stormwater flows. Neither the UC Berkeley LRDP nor the City of Berkeley General Plan proposes revegetation actions in the hill area; only ongoing annual fire management work is planned. The City of Berkeley is engaged in a multi-decade project to reduce infiltration to their storm sewer system. This latter effort may result in some modest reduction in storm sewer flows in this drainage system over time. Finally, the EIR for the UC Berkeley Southeast Campus Integrated Projects (SCIP) finds that, with mitigation, the SCIP would neither result in significant hydrological impacts, nor contribute considerably to cumulative hydrologic impacts (UC Berkeley, 2006).

Potential cumulative hydrologic and water quality impacts associated with the proposed LRDP are therefore considered less than significant. Furthermore, other development in the area and the region that could contribute to water quality impacts on San Francisco Bay, for example, would be subject to similar programmatic requirements (NPDES permit regulations, stormwater pollution prevention plans, etc.), thereby further reducing the potential for cumulative adverse impacts.

Mitigation: None required.

Project Variant. The project variant would result in hydrology and water quality impacts substantially similar to the hydrology and water quality impacts that would result from the 2006 LRDP development. The cumulative hydrology and water quality 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 as discussed above, would also, for the reasons stated above, result in cumulative hydrology and water quality impacts that would be less than significant.

IV.G.4 References – Hydrology and Water Quality

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