J. HYDROLOGY AND WATER QUALITY

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The following section discusses water quality and hydrological issues within the City of Berkeley including drainage, flooding, groundwater, and water quality. The setting information in the following section has been concentrated so that it directly pertains to potential hydrological impacts of the *Draft General Plan* outlined in Section 2 below, based on the criteria of significance set forth in Section 2b of this section.

1 Setting

a0 Hydrology. Hydrology in the City of Berkeley is described below under three subheadings: natural drainage, flooding and groundwater.

(1) Natural Drainage. Berkeley's natural drainage features historically consisted of several small to medium-sized creeks, including Codornices, Schoolhouse, Strawberry, Potter and Derby creeks, that flowed from the Berkeley Hills into the San Francisco Bay.[1] As Berkeley grew in the early 1900s, the flood plains of most of these creeks were paved, and their channels were gradually placed in covered culverts. Today, Codornices Creek still flows largely uncovered and unculverted with an established riparian corridor. Strawberry Creek runs above ground through portions of the Lawrence Berkeley Laboratory grounds and the University Central Campus. South of the campus, it is culverted, and has been daylighted briefly in Strawberry Creek Park in west Berkeley. The creek also daylights for short segments in several private backyards. The remainder of Berkeley's creeks have been culverted and converted into the main trunks for the City's storm drainage system. Historic and currently daylighted creeks, as well as the City=s storm drainage system, are shown in Figure IV.J-1.

(2) Flooding. The risk of flooding is addressed for storm-related events, potential dam failure, and coastal hazards.

(a) Storm-Related Flooding. Most flooding in Berkeley is caused by either: (1) heavy rainfall and subsequent runoff volumes that cannot be adequately conveyed by

[1] City of Berkeley, 1972. Map of Berkeley Creeks, Department of Public Works, Engineering Division.

the existing storm drainage system and surface water; or (2) flooding along the waterfront when flows out of the storm drainage system are limited by the Abackwater@ effects of the high tide. Flood prone areas are shown on Figure IV.J-2.

Areas subject to flooding are mainly found on the western side of the City in the tidal basin areas south of Third Street between Codornices Creek and Gilman Street and between University Avenue and Ashby Avenue (Aquatic Park). Strawberry Creek poses a flood hazard 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.

The National Flood Insurance Act of 1968 called for the identification of flood plain hazard areas prone to flooding in major storm events. These flood hazard maps, known as Flood Insurance Rate Maps (FIRMs), are used by the Federal Emergency Management Agency (FEMA) to determine eligibility areas for inclusion in the federal flood insurance program. Portions of the City are located within the 100-year and 500-year flood hazard zones as mapped by FEMA,[2] and are defined by FEMA as Aflood prone.@ Except for small areas located within the 100- and 500-year flood zones, as shown in Figure IV.J-2, the majority of Berkeley is defined by FEMA as being subject to minimal flooding.

(b) Dam Failure Inundation. The City could be impacted if one or both of the dams serving the two reservoirs east of the City (Summit and Berryman Reservoirs) were to fail catastrophically. Catastrophic structural dam failure can be caused by earthquake or rain overflow. Inundation could affect those areas downhill, or west, of the Berryman and Summit Reservoirs. The Summit Reservoir, located in the City of El Cerrito, would affect areas along Berkeley's border between Grizzly Peak Boulevard and The Alameda. The Berryman Reservoir, adjacent to Codornices Park, could potentially inundate a large portion of the City, including neighborhoods between Hopkins and Cedar Streets and in North and West Berkeley, especially at Aquatic Park, and areas east of the I-80 freeway.

The lands below the 37 million gallon Summit Reservoir may be vulnerable to inundation if a seismic event exceeded magnitude 7.5 on the Hayward Fault, or 8.5

[2] Federal Emergency Management Agency (FEMA), 1978. Flood Insurance Rate Map, Community Panel Number 060004 0002 A.

Figure IV.J-1: Berkeley Creeks and storm drain system 8 x 11

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Figure IV.J-2: Flood prone areas 8**2** x 11

on the San Andreas Fault according to an evaluation of the reservoir embankments conducted in 1992.[3]

The inundation threat from the Berryman Reservoir is short-term as the City has plans for the replacement of the Berryman Reservoir with two 1.5-million gallon steel tanks.[4] The reservoir is scheduled for closure in October 2001.[5] Reservoir inundation hazard areas, including the existing short-term threat from the Berryman Reservoir, are shown in Figure IV.J-3.

(c) Coastal Hazards. The location of the City adjacent to the San Francisco Bay results in the waterfront area being potentially affected by coastal hazards, such as tsunamis, extreme high tides, or sea level rise. Because they are products of seismic activity, tsunamis are discussed in Section I, Geologic and Seismic Hazards, in this EIR.

(1) Extreme High Tides. Extreme high tides in San Francisco Bay result from the combined effects of astronomical high tides (related to the lunar cycle) and other factors including winds, barometric pressure, ocean temperatures, and fresh water runoff.[6] In California, the highest astronomical tides occur in the summer and winter, and therefore extreme high tides occur during these times. A tide elevation of 6.0 feet above NGVD in 1983 was the highest tide ever recorded in the San Francisco Bay.

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[3] The analysis was reviewed and approved by the California Division of Safety of Dams, which has jurisdiction over the facility.

[4] East Bay Municipal Utility District (EBMUD), August 1998. *Berryman Reservoir Replacement Recirculated Draft EIR,* prepared by Parsons Engineering Science.

[5] Kirkpatrick, William, Manager of Water Distribution Planning, East Bay Municipal Utility District, May 24, 1999. *Written communication* with Andrew Thomas of the City of Berkeley.

[6] U.S. Army Corps of Engineers, September 1989. *San Mateo and Northern Alameda Counties Interim San Francisco Bay Shoreline Study*.

Based on the 129-year record (1855-1983) of daily high tide, the U.S. Army Corps of Engineers[7] (Corps) has developed estimated 100-year high tide elevations for various locations on the Bay. The estimated elevation of the 100-year tide at the City of Berkeley coastline is approximately 6.3 feet above NGVD.[8]

[7] Ibid.

[8] U.S. Army Corps of Engineers, October 1984. *San Francisco Bay, Tidal Stage vs. Frequency Study*.

Figure IV.J-3 Reservoir Inundation Areas 8**2** x 11

(2) *Sea Level Rise*. Over the last 100 years, the temperature of the earth=s surface has risen approximately 0.6 degree Celsius.[9] Global warming causes thermal expansion of the upper layers of the ocean, which increases the volume of water, as well as melting of the earth=s glaciers and polar ice fields. Tidal gauge measurements collected over the last 100 years indicate that sea level is rising relative to the land surface in many locations throughout the world.[10] Many experts believe that sea level will continue to rise in response to global warming. Such increases in sea level, if sustained over long periods of time, could create or exacerbate existing flooding problems. The amount of rise expected at a specific location over a given time period must be quantified in order to plan for, and mitigate, potential flooding problems associated with sea level rise. Since the EPA released their first major study on sea level rise in 1983, estimates for amount of predicted sea level rise have steadily decreased from a predicted 5.7-foot rise at the Berkeley waterfront by 2100 [11] to a 1995 prediction of a 1.2-foot rise by the year 2100.[12]

(3) Groundwater. Berkeley is part of the East Bay Plain groundwater basin. The City of Berkeley has groundwater conditions that are typical of shallow, unconfined or partially confined aquifers that do not have laterally continuous low permeability layers between the water table and the ground surface. Groundwater under these conditions occurs in a series of alluvial fans deposited on top of the west-facing bedrock surface.[13]

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[9] U.S. Environmental Protection Agency (USEPA), October 1995. *The Probability of Sea Level Rise*, EPA 230-R-95-008.

[10] Bay Conservation and Development Commission (BCDC), December 1987. *Sea Level Rise: Predictions and Implications for San Francisco Bay*.

[11] US EPA, 1983. *Can We Delay Greenhouse Warming?*, authors: Seidel, S., and Keyes, D.

[12] US EPA, October 1995. *The Probability of Sea Level Rise*, EPA 230-R-95-008.

[13] Figuers, S., 1998. Groundwater Study and Water Supply History of the East Bay Plain, Alameda and Contra Costa Counties.

Depths to groundwater range from near the surface at the waterfront to greater than 30 feet below the ground surface in the Berkeley Hills.[14]

[14] Alameda County Flood Control and Water Conservation District, June 1988. Geohydrology and groundwater- Quality Overview, East Bay Plain Area, Alameda County, California, 205(j) report.

Historic groundwater usage within the City limits has been minimal. Most of the usable groundwater resources were found in tunnels and springs in the hills east of the UC Berkeley campus, although these resources proved unsustainable at high pumping rates.[15]

b0 Water Quality. The quality of surface and groundwater in the City is affected by land uses within the watersheds and the composition of the underlying geologic materials. Drainage from the City and upstream areas contribute to the overall quality of water in the Bay.

Water quality in surface and groundwater bodies is regulated by the State and Regional Water Quality Control Boards (RWQCB). The project site is under the jurisdiction of the San Francisco Bay RWQCB, which is responsible for implementation of State and Federal water quality protection laws and guidelines in the Bay Area. The RWQCB implements the Water Quality Control Plan (Basin Plan),[16] a master policy document for managing water quality issues in the region. The Basin Plan establishes beneficial water uses for waterways, groundwater, and water bodies within the region.[17] The only beneficial uses for Berkeley surface waters designated in the Basin Plan are for the Aquatic Park Lagoon, and include: fish migration, contact and non-contact water recreation, and wildlife habitat for fish spawning. Beneficial uses of the East Bay Plain groundwater basin include municipal and domestic water supply, industrial process water supply, industrial service water supply, and agricultural water supply.

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[15] Figuers, S., 1998. Groundwater Study and Water Supply History of the East Bay Plain, Alameda and Contra Costa Counties.

[16] San Francisco Bay Regional Water Quality Control Board, June 1995. *Water Quality Control Plan*.

[17] RWQCB, 1995. *Basin Plan*: AState policy for water quality control in California is directed toward achieving the highest water quality consistent with maximum benefit to the people of the state. Aquatic ecosystems and underground aquifers provide many different benefits to the people of the state. The beneficial uses...define the resources, services, and qualities of these aquatic systems that are the ultimate goals of protecting and achieving high water quality. The Regional Board is charged with protecting all these uses from pollution and nuisance that may occur as a result of waste discharges in the region.@

In a national effort to improve water quality, the Clean Water Act, as amended in 1987, requires the EPA to mandate the implementation of storm water control measures and the issuance of permits under the National Pollutant Discharge and Elimination System (NPDES). In 1986, in anticipation of these federal regulations, the RWQCB required local agencies along the East Bay shoreline to evaluate existing nonpoint source run-off (e.g., storm water), and to identify specific problems and control strategies. The City of Berkeley joined the Alameda Countywide Clean Water Program (Clean Water Program), a consortium of Alameda County and municipal agencies formed to address nonpoint source pollutant issues in the region. The RWQCB issued a NPDES permit to the Clean Water Program's 17 participating agencies that discharge into San Francisco Bay. The NPDES program addresses both point source (e.g., wastewater treatment plants) and non-point source (e.g., storm water runoff) forms of water discharge. The Clean Water Program coordinates its activities with other pollution prevention programs, such as wastewater treatment plants, hazardous waste disposal, and wastewater recycling.[18]

c0 Draft General Plan Policies. Policies included in the *Draft General Plan* that pertain to hydrology and water quality include:

- *Policy H-15*. Encourage construction of new medium and high density housing on major transit corridors and in the Downtown consistent with the scale, character, and zoning of these areas.
- *Policy H-18*. Maintain sufficient land zoned for high and medium density residential development to allow sufficient new construction to meet Berkeley's fair share of regional housing needs.
- *Policy H-31*. Urge the University of California to provide housing for at least 25% of its students at affordable prices and expand housing opportunities for students and staff.
- *Policy EM-23*. Take action to improve water quality in San Francisco Bay.

  Actions:

  A. Work with the East Bay Municipal District to ensure that wastewater discharges comply with the requirements of EBMUD=s Wastewater Control Ordinance No. 311 to manage wastewater treatment discharges to protect San Francisco Bay.
  B. To minimize storm sewer pollution of the San Francisco Bay, maintain an effective street sweeping and cleaning program.
  C. Identify and eliminate cross connections between the sanitary sewer and storm sewer system.

[18] Alameda Countywide Clean Water Program, 1999. Website <http://www.co.alameda.ca.us/pwa/water.html>.

- *Policy EM-24.* Protect and improve water quality by improving the citywide sewer system.

  Actions:

  A. Adequately fund sewer system improvements necessary to maintain water quality in natural areas and reduce public health hazards.
  B. Identify and eliminate illegal roof leader and other illegal connections to the sewer system.
  C. Establish a program for the identification and remediation of faulty laterals on private property. Consider requiring inspection and repair prior as a condition of property transfer.
  D. Identify alternative funding sources for essential infrastructure improvements such as grants, public private partnerships, and special benefit districts.
  E. Ensure that new development pays its fair share of improvements to the storm drainage system necessary to accommodate increased flows from the development.
  F. Coordinate storm sewer improvements with creek restoration projects

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

- *Policy EM-28.* Restore a healthy freshwater supply to creeks and the bay by eliminating conditions that pollute rainwater and by reducing impervious surfaces and encouraging swales, cisterns and other devices that increase infiltration of water and replenishment of underground water supplies that nourish creeks.

- *Policy EM-29.* Increase public awareness of the value of promoting healthy watersheds and aquifers and work in cooperation with adjoining jurisdictions to jointly undertake watershed and creek restoration projects.

- *Policy S-27.* Reduce existing flood hazards in Berkeley.

- *Policy S-28.* Use development review to ensure that new development does not contribute to an increase in flood potential.

- *Policy S-29.* Reduce the cost of flood insurance to property owners in the city.

2 Impacts and Mitigation Measures

a0 Criteria of Significance. Implementation of the *Draft General Plan* would have a significant effect on hydrology and water quality if it would:

- Violate any water quality standards or waste discharge standards set by the RWQCB or otherwise substantially degrade surface or groundwater quality;

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that the local groundwater table would be lowered;
- Substantially reduce the amount or quality of water otherwise available for public water supplies;
- Substantially alter an existing drainage such that substantial erosion, siltation, or flooding would occur in the City or property in adjacent municipalities;
- Create or substantially contribute to runoff water which would exceed the capacity of existing or planned storm water drainage systems or create an increase in calculated peak flood discharges;
- Substantially alter a natural water course;
- Place housing or other structures within a 100-year flood hazard zone, as defined by FEMA; or
- Expose people or property to a significant risk of loss, injury or death from flooding, including flooding by seiche inundation, dam or reservoir failure, tsunami or mud flows.

b. Impacts and Mitigation Measures. This section outlines potential hydrology and water quality impacts and suggests mitigation measures. Less-than-significant impacts to hydrology and water quality are listed first, followed by significant impacts.

(1 Less-than-Significant Hydrology and Water Quality Impacts. One less-than-significant physical hydrology and water quality impact is identified below.

Implementation of the polices listed above related to hydrology and water quality would not contribute to depletion of groundwater supplies or reduce the amount or quality of water available for public water supplies. The proposed policies of the *Draft General Plan* do not propose development that would substantially alter a natural watercourse. The proposed policies of the *Draft General Plan* would not contribute to violation of any water quality standards or substantial degradation of surface or ground water quality. As noted in the Setting section above, the City of Berkeley has a NPDES permit to discharge water into the San Francisco Bay. However, this discharge of storm water and wastewater would not have a significant impact on water quality in the Bay.

Impact HYD-1: Construction of new medium- and high-density housing (*Policies H-15 and H-18*) and additional student housing at UC Berkeley (*Policy H-31*), could result in localized flooding problems by increasing impervious surfaces. (LTS)

New housing construction would likely result in a small net increase in impervious

surfaces, which would increase runoff volumes and velocities.[19] When storm water runoff volumes and velocities are increased, existing storm drainage components that are at or near capacity may be inadequate to convey the additional runoff during peak events, causing localized ponding and flooding. However, existing City programs for project design and approval require drainage plans (including hydraulic calculations quantifying potential increases in runoff volumes associated with particular projects) prior to project approval. Therefore, existing City programs would adequately mitigate this potential impact. Additionally, because the City of Berkeley is generally built out, most new construction would be redevelopment or development of a paved site (e.g., a parking lot). Therefore, no substantial net increase in impervious surfaces would result.

Mitigation Measure HYD-1: None required. (LTS)

(2 Significant Hydrology Impacts and Mitigation Measures. One potentially significant impact to hydrology and water quality would occur with implementation of the *Draft General Plan*.

Impact HYD-2: Removing culverts and underground pipes that convey storm water to restore creeks to natural conditions, as described in *Policy EM-27*, may result in increased flooding and erosion hazards. (PS)

In the event that creek daylighting projects were to be poorly designed, implemented or maintained, they could result in creation of new flooding hazards because natural channels do not convey runoff as efficiently as pipes. In addition, erosion hazards from channel incision or downcutting could cause bank failures and undercutting of adjacent lands. Debris, if allowed to accumulate in these creek segments, could restrict flow or cause more turbulent flows, also resulting in flooding and erosion hazards. Implementation of policies *S-27, S-28,* and *S-29* would reduce the potential for flooding by continuing programs that maintain storm drains, using development review to ensure that new development does not contribute to an increase in flood potential and reducing the cost of flood insurance. Implementation of the following mitigation measure also would reduce this impact to a less-than-significant level.

Mitigation Measure HYD-2: The Department of Public Works staff or qualified consultant retained by the City shall review and approve the hydraulic design and proposed maintenance program of creek restoration projects that include

[19] An increase in impervious surface (i.e. roads, parking lots, buildings) reduces the amount of exposed soil and therefore the amount of rainfall that can infiltrate into the subsurface. While the majority of precipitation infiltrates into the subsurface of undeveloped or vegetated land, impervious surfaces yield nearly all rainfall as runoff.

significant alterations to the storm water conveyance system prior to final City approval. (LTS)