RICHMOND RESEARCH CENTER MASTER PLAN **Environmental Impact Report**

EXISTING OPPORTUNITIES AND CONSTRAINTS REPORT

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PREPARED FOR THE
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Chapter II
EXECUTIVE SUMMARY:
LAND USE AND DESIGN IMPLICATIONS

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This chapter summarizes the major findings of the Richmond Research Center Master Plan Existing Opportunities and Constraints Report. It includes a brief synopsis of those areas of the site that could affect the physical design of the project, and an overview of the environmental findings discussed in this report.

A. Factors Affecting Master Plan Design

The following findings of the existing opportunities and constraints have the potential to directly influence the physical design of the Richmond Research Center. Each of these factors should be considered in developing the Master Plan, and in environmental evaluation of the project.

1. Grasslands and Wetlands

The native Coastal Terrace Prairie vegetation found at the Richmond Research Center is considered a significant resource. The general location of these grasslands is shown in Figure 8. The most significant areas are those which have 50 to 100 percent native grassland species. The Coastal Terrace Prairie grasslands at Richmond Research Center are scientifically and ecologically invaluable, since they constitute one of the last remaining examples of this ecosystem that was once prevalent on the shores of San Francisco Bay. This vegetation type is also virtually impossible to recreate. Although there is increasing reliance on transplantation and translocation of rare plants and plant associations to restore historic grasslands, these types of schemes do not recreate the function of the ecosystems in which target plants are found. In California, a prairie grassland has never been created on a new site.

Wetlands also exist among the Coastal Terrace Prairie grasslands found on the northwestern portions of the site. Native grasslands species cover up to 100 percent in the wetlands areas. These plant species are also wetland indicators. California oatgrass (*Danthonia californica*), Italian ryegrass (*Lolium*

multiflorum), and English plantain (*Plantago lanceolata*) are the dominant plants in these wetland and grassland areas.

2. Eucalyptus Groves

The eucalyptus trees are primarily concentrated in a large L-shaped stand located north of Lark Drive. Other small linear clumps are dispersed around the Research Center. Although non-natural and generally of little habitat value in comparison to natural woodlands, this stand does provide roosting and nesting sites for raptors and over-wintering habitat for the monarch butterfly. The habitat quality of the grove is increased by its close proximity to the large grassland found at the site. This grove has been an over-wintering site for the monarch butterfly since the mid-1960s, in addition to providing foraging and roosting opportunities for the butterfly.

The large expanses of eucalyptus trees that surround the site create a very strong visual envelope for the majority of the buildings which exist at the Richmond Research Center. The only buildings which lie outside of this visual edge are the Northern Regional Library Facility and the relatively new EPA Laboratory building. The eucalyptus groves, in combination with an expanse of Monterey Pines along the northern edge of the property, create a barrier to views in and out of the site along the western, northern, and eastern edges of current development of the site.

3. Transportation and Circulation

The Richmond Research Center, as described in the existing Administrative Draft Master Plan, is anticipated to generate approximately 11,700 vehicle trips on an average weekday, applying standardized rates to the Master Plan land uses. Peak hour vehicle trips generated by the project are estimated at 1,700 in the AM peak hour and 1,600 in the PM peak. It is anticipated that these additional trips would cause significant impacts at numerous locations, including I-80, I-580/Regatta Boulevard on- and off-ramps, Cutting Boulevard, Cutting Boulevard/Carlson Boulevard intersection, 31st Street/Cutting Boulevard intersection, Marina Bay Parkway/Regatta Boulevard intersection, Regatta Boulevard, and Meade Street. With the existing site access, the anticipated additional trips could necessitate an additional travel lane in each direction on Meade Street.

Based on these initial estimates, the proposed Richmond Research Center project would require improved site access. Specifically, a new access location on the western edge of the site would reduce some of the potential impacts on area roadways. This additional site access would provide necessary access to

the west and to central Richmond, enhance on-site circulation and emergency vehicle access, and allow for improved utilization of alternative travel modes.

In general, mitigation of project transportation impacts is likely to also require greater utilization of transit and HOV facilities for travel to the site. Refinement of the intended uses and functions on the site may also allow reduction in the trip generation estimates, thereby reducing the assumed impact.

4. Historic Areas

The surviving California Cap buildings are the major historic feature of the site. The Cal Cap Company occupied the site prior to 1945. These buildings are located primarily clustered along Lark Drive. The original road pattern defines large square or rectangular spaces, closed to the north and more open to the south, which are aesthetically pleasing. The building pattern is of scattered, low-scale buildings. These features could be considered significant under the California Environmental Quality Act and the National Register, depending on the historical significance of the operations at the California Cap Company. Research on this subject is currently underway. If the buildings and their surroundings are significant, they would need to be preserved or documented prior to demolition under the Master Plan.

5. Visual Accessibility

The southern end of the site is the area most effectively viewed both from the Bay Trail and the housing of the Marina Bay development. Buildings are generally not visible, with the exception of the EPA building, which stands out as a visual landmark. Future development should be sensitive to the visual envelope created by the eucalyptus trees and the current coastal shoreline.

B. Other Environmental Findings

The following points represent the significant findings beyond those discussed above. These findings will be incorporated into the Existing Settings section of the subsequent Environmental Impact Report on the Richmond Research Center Master Plan.

1. Land Use and Public Policy

- *Building Heights and Density.* Generally, the Richmond Research Center Master Plan as it is currently envisioned would not be consistent with the development standards of the City of

Richmond related to building height and density. Under City regulations, buildings on the site could reach heights up to 75 feet, or six stories, and overall development area densities could reach up to 2.0 FAR. However, the City's requirements are advisory due to the University's exemption from City's jurisdictions.

2. Hydrology and Water Quality

- *Groundwater*. A small pool of standing water in the southeastern corner of the marsh has been isolated from adjacent tidal creeks and flow is extremely limited. Surface water in this southeastern corner had a very low pH and sulfate contents twice that of other areas surveyed. Ground water contamination and lack of tidal flushing could be the cause of the high acidity detected in this isolated pool.
- *Project Development*. The City of Richmond must implement a municipal stormwater management plan that includes permitting and review of new developments. Treatment control measures required of new developments to remove pollutants from stormwater prior to discharge may include facilities such as wet ponds, detention/retention basins, swales, and stormwater treatment wetlands.

3. Noise

- *Existing Noise Levels*. Noise levels on the site are relatively low. This is primarily due to the fact that the nearest major noise source, Interstate 580, does not contribute significantly to the noise levels at the Richmond Research Center due to its location. In addition, noise levels measured at the Marina Bay apartments were very constant and also quite low.

4. Visual Quality

- *Development Core*. Current buildings are clustered in an existing development core on the northeast portion of the site. New development could effectively continue this pattern by clustering the majority of building intensity in this location.

5. Cultural Resources

- *Existing Resources.* No prehistoric archaeological resources have been recorded within the Research Center boundary. In addition, a previous systematic field inventory of the entire property located no surface indications of prehistoric or historic archaeological resources.

Chapter V
BIOLOGICAL RESOURCES

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The existing biological conditions at Richmond Research Center were assessed during several field visits in October and November 1993. In addition, documents on the natural vegetation and wildlife at the Research Center were reviewed, including written material on the flowering plants by J.A. Powell on the site, the California Department of Fish and Game (CDFG) Natural Diversity Database (NDDB) for the Richmond Quad, previous environmental documentation for the site, and historic aerial photographs of the site. Experts on the wildlife and vegetative communities found at the Research Center were also consulted during the development of this chapter.

A. Background

The Richmond Research Center soil belongs to the Clear Lake Series of the Clear Lake-Cropley association,[1] as shown in Figure 7. It is poorly drained clay soil that often forms a perched water table in the winter rainy season. There are three different soil types, including Clear Lake clay, Reyes silty clay, and Urban land. Clear Lake clay soils cover the northern half of the Research Center and are described as poorly drained with very slow runoff. Reyes silty clay soils are located in tidal marsh areas and are also described as poorly drained. Urban land is located between Clear Lake clay and Reyes silty clay. Urban land consists of fill that has been placed over native soils and along the bay shoreline. According to the Contra Costa County Hydric Soils List, only Reyes silty clay is hydric; Clear Lake clay is not hydric but may have hydric soil inclusions. During the winter, water often stands for periods of a week or longer in wet swales.

Historically, this soil supported dryland small grain and volunteer oat hay. Generally, the area is uplands that drain to the southwest. The site has a less than one percent slope and represents an alluvium deposit close to the bay

[1] Soil Conservation Service. 1977. Soil Survey of Contra Costa County, CA. USDA, SCS, and U.C. Agricultural Experiment Station.

shore. The grassland area west of the eucalyptus grove is at the original elevation, which is approximately 10 feet above mean high tide. The historical bay shore is approximately where a chain link fence currently exists, although some fill occurs north of the chain link fence. The old shore escarpment has been covered with broken cement rip-rap and soil fill.

B. Vegetation and Land Use History

For purposes of discussing the site's biological history, Richmond Research Center can be divided into three discrete land areas: (1) the area east of the eucalyptus grove, (2) the area west of the eucalyptus grove, and (3) created land generally south of the existing chain link fence.

1. East of the Eucalyptus Grove

The area east of the Eucalyptus Grove has a long history of industrial use and has been thoroughly disturbed since the turn of the century.

2. West of the Eucalyptus Grove

This area was once the 77-acre Leviston Estate, and was not subdivided until after 1910. There is no evidence that indicates whether or not the Leviston Estate was cultivated before 1910. It is possible that Leviston Estates was a development company. In addition, there is no evidence that a home or ranch occupied the property. Given the size of the estate and the availability of fresh water, the land was probably used for grazing livestock and harvesting volunteer oat hay.

Sometime around 1910, a road subdivision was built on the Leviston Estate. Graded dirt roads with redwood curbs and a complete sidewalk system was built.

A 1939 aerial photograph shows the Leviston parcel as part of larger open space that extended to the north and west. A small settlement existed in the center of this open space, part of which was located adjacent to the Leviston parcel. Despite the old road beds and sidewalks during this period, the study area was likely being grazed by livestock and may have been only a portion of a larger grazed unit. The darker color of the grassland of the eastern half of the Leviston parcel and indication of excavated pipe lines observed in historic aerial photographs indicates that this area may have been irrigated.

A 1946 aerial photograph indicates that grazing or agriculture pursuits on this property were abandoned by this time. Disturbances of the area may have altered the drainage but was not extensive enough to kill all the native perennial bulbs, forbs, and grasses of the area. None of the historic photographs show any indication of row crops or uniform cultivation.

3. Fill Land

This area represents new land fill and is generally located south of the existing chain link fence. The largest open space in this area is the central rounded peninsula south of the existing chain link fence close to the shore, although some fill is located north of the chain link fence.

C. Habitat Types

Nine habitat types were identified at the Richmond Research Center, including two native habitat types which historically occurred in the area (Northern Coastal Salt Marsh and Coastal Terrace Prairie). Native habitat types were labelled according to Holland's classification of natural communities in California.[2] However, much of the land at the Research Center has been significantly altered and currently supports vegetative communities dominated by non-native plants. These were labelled according to the dominant or co-dominant species. Although non-native, some of these communities provide valuable habitat for wildlife. The habitat types listed below are described in the following pages and shown in Figure 8.

- Coastal Terrace Prairie
- Disturbed/Closely Mowed Grassland
- Coyote Brush and Non-Native Grasses and Forbs
- Northern Coastal Salt Marsh
- Eucalyptus Grove
- Toyon and Firethorn
- Ornamental Landscaping
- Disturbed Bare Ground

[2] Holland, R.F. 1986. *Preliminary Descriptions of the Terrestrial Natural Communities of California.* Prepared for the Nongame-Heritage Program, California Department of Fish and Game, Sacramento, CA.

1. Coastal Terrace Prairie

Approximately fifteen acres of a coastal terrace prairie community occurs in two sections on the northern and southern ends of the Leviston parcel, as shown in Figure 8. Species of vegetation found in the Coastal Terrace Prairie are listed in Table 2. The coastal terrace prairie community once covered many of the terrace uplands around San Francisco Bay. Grazing, introduction of non-native annual grasses, and conversion to agriculture have diminished the extent of this community to 0.01 percent of its original area, thereby indicating that this native prairie is a significant resource.

a. Coastal Terrace Prairie Background. Coastal Terrace Prairie by definition is a mesic grassland. Annual rainfall is generally between 25 and 60 inches per year. The Coastal Terrace Prairie exists within the coastal fog belt where summer evapotranspiration rates are low. Coastal Terrace Prairie exists in California intermittently along the coast from the Oregon border to San Simeon in San Luis Obispo County.[3] The largest expanses of this vegetation type once existed on clay loam soils in west Marin County, the central East Bay lowlands, the coastal lowlands of Monterey Bay, and the coastal lowlands in the vicinity of San Simeon below Hearst Ranch.

Only a few remnant stands of Coastal Terrace Prairie remain in the greater East Bay area. These stands include isolated patches in Point Pinole Regional Park, at the study site at Richmond Research Center, on isolated hillsides on the Potrero Hills (Point Richmond), on grazed grasslands in the Wildcat Canyon watershed in Wildcat Canyon Regional Park, and on the East Bay Municipal District lands above San Pablo Reservoir.[4] Most of these stands are on well-drained, upland soils on Los Osos-Millsholm-Los Gatos and Gilroy-Vallecitos soil associations. The grassland open space at the Research Center is unique and represents the only Coastal Terrace Prairie in lowland clay soils in the greater East Bay area.

It is possible that the Coastal Terrace Prairie at Richmond Research Center is missing certain typical plant components. For example, Coastal Terrace Prairie habitat on more well-drained soils of upland sites on the nearby Potrero Hills has a rich assortment of native grasses and perennial broadleaf plants,

[3] Heady, H., T.C. Foin, M.M. Hektner, D.W. Taylor, M.G. Barbour, and W.J. Barry. 1977. Coastal prairie and northern coastal scrub, Terrestrial Vegetation of California. M.G. Barbour and J. Major, (eds). John Wiley & Sons, New York.

[4] Edwards, S. 1992. Observations on the prehistory and ecology of grazing in California. Tremontia 20(1):3-11.

Table 2
PLANT SPECIES IDENTIFIED IN LATE AUTUMN*
(I=introduced species, N=native species)

Coastal Terrace Prairie	
Aira elegantissima (I)	elegant European hairgrass
Aster spp. (N)	aster
Avena fatua (I)	wild oat
Bellardia trixago (I)	bellardia
Brassica nigra (I)	black mustard
Bromus hordeaceus (I) (formerly *B. mollis*)	soft chess
Carduus pycnocephalus (I)	Italian thistle
Carex tumulicola (N)	foothill sedge
Cyperus sp.	umbrella sedge
Danthonia californica (N)	California oatgrass
Dipsacus fullonum (I)	wild teasel
Epilobium sp.	willow herb
Eschscholzia californica (N)	California poppy
Grindelia hirsutula var. *hirsutula* (N)	gumplant
Hordeum brachyantherum (N)	meadow barley
Juncus phaeocephalus (N)	rush
Juncus occidentalus (N)	rush
Elymus glaucus (N)	blue wildrye
Elymus trachycaulus (N)	slender wheatgrass
Lolium multiflorum (I)	Italian ryegrass
Lupinus variicolor (N)	lupine
Nassella pulchra (N) (formerly *Stipa pulchra*)	purple needle grass
Phalaris aquatica (I)	Harding grass
Picris echiodes (I)	prickly ox-tongue
Plantago lanceolata (I)	English plantain
Sisyrnchium bellum (N)	blue-eyed grass
Spiranthes sp.	ladies tresses
Wyethia angustifolia (N)	mule ear
Swale Area of Coastal Terrace Prairie	
Cyperus sp.	umbrella sedge
Danthonia californica (N)	California oatgrass
Dipsacus fullonum (I)	wild teasel

Coastal Terrace Prairie	
Hordeum brachyantherum (N)	meadow barley
Juncus phaeocephalus var. *paniculatus* (N)	rush
Juncus occidentalus	rush
Lolium multiflorum (I)	Italian ryegrass
Picris echiodes (I)	prickly ox-tongue
Plantago lanceolata (I)	English plantain
Rumex crispus (I)	curly dock
Northern Coastal Salt Marsh	
Atriplex patula (N)	saltbush
Carduus pycnocephalus (I)	Italian thistle
Distichlis spicata (N)	saltgrass
Frankenia salina (N) (formerly *F. grandifolia*)	alkali heath
Grindelia humilis (N)	gumplant
Jaumea carnosa (N)	jaumea
Limonium californicum (I)	western marsh rosemary
Mesembryanthemum nodiflorum (I)	crystalline iceplant
Salicornia virginica (N)	pickleweed
Scirpus robustus (N)	bulrush
Spartina foliosa (N)	cord grass
Coyote Brush and Non-Native Grasses and Forbes	
Artemesia sp. (N)	sagebrush
Avena fatua (I)	wild oat
Baccharis pilularis (N)	coyote brush
Brassica nigra (I)	black mustard
Cortaderia jubata (I)	pampas grass
Heteromeles arbutifolia (N)	toyon
Lolium multiflorum (I)	Italian ryegrass
Nassella pulchra (N) (formerly Stipa pulchra)	purple needle grass
Phalaris aquatica (I)	Harding grass
Rubus discolor (I)	Himalayan blackberry
Toxicodendron diversilobium (N)	poison oak

* Since field visits were made in late autumn, these lists do not represent a complete list of the vegetation in these habitat type areas.

including junegrass (*Koeleria macrantha*), California Melic (*Melica californica*), red fescue (*Festuca rubra*), squaw root (*Perideridia kelloggii*), acaena (*Acaena californica*), and blue dicks (*Dichelostemma capitatum*) etc. However, many of these plants are not found on the clayey lowland soils and may not have been on the site originally. A good spring and summer survey will likely add more native prairie plants to the plant palette.

b. Types of Coastal Terrace Prairie. The Coastal Terrace Prairie on the site can be divided into two types:

(1) Disturbed Coastal Terrace Prairie. This vegetation type has between 10 to 50 percent cover of native prairie plant species mixed with exotic weeds and grasses depending on the site, moisture regime, or recent mowing frequency. Overall, vegetative cover ranges from 85 to 100 percent. The ground is irregular with local areas showing signs of vernal standing water. The low permeability of the clay subsoil results in ponding and seasonal soil saturation in local swales and depressions. Subtle shifts in vegetative composition reflect these differences in microtopography and hydrology. Existing deposited soil mounds have many native perennial grasses and forbs growing on them.

The most common native prairie plants found in the disturbed Coastal Terrace Prairie include California oatgrass, purple needlegrass, squirreltail (*Elymus multisetus*), gumplant (*Grindelia hirsutula*), foothill sedge, western rush, slender rush, and coast aster (*Aster chilensis*). Occasional robust canary grass, coyote bush, and toyon (*Heteromeles arbutifolia*) plants are found scattered in this vegetation type.

Research plots to study the effects of rodent herbivore on this plant community were established in the northern section of Coastal Terrace Prairie, between the eastern edge of this parcel and the main eucalyptus grove. These areas are markedly weedier than the rest of the prairie. Tall weedy annuals such as teasal, prickly oxtongue, wild lettuce (*Lactuca serriola*), and the native coast tarweed *Madia sativa* occur in this area. Exotics, such as fennel, Italian thistle, and black mustard, mix with purple needlegrass and California oatgrass, cover up to 50 percent of the area in the abandoned enclosures.

The dominance of taller weedy vegetation in the disturbed Coastal Terrace Prairie may be a function of infrequent mowing or an absence of mowing. It is also known that some of the enclosures were purposely overgrazed by rodents

in some of the experiments.[5] The area of these enclosures, known as the Lidicker enclosures, is shown on Figure 8. Until recently, the areas inside the Lidicker enclosures never had any mechanical mowing. As a result, the two most southern plots have a high percentage of annual weeds. The experiments conducted inside the individual enclosures may have had a long-term effect on the native perennial vegetation.

It is not known if the grassland outside the enclosures was mowed or how frequently it may have been mowed. Invading shrubs and the large size of grasses, including the Harding grass plants on the perimeter, indicate that the area was not mowed often and certainly never on a reliable annual basis.

This area is not as valuable as the Undisturbed Coastal Terrace Prairie (described below), since it contains exotic weeds and grasses. However, native prairie plant species are present, so the areas would qualify as sensitive habitat areas. More importantly, it may be possible to restore these areas to become healthier coastal prairies, since many natives are already in them and undisturbed Coastal Terrace Prairie is located nearby.

(2) Undisturbed Coastal Terrace Prairie. In some areas the native vegetation constitutes up to 100 percent of the vegetation cover. These areas are the most significant areas of Coastal Terrace Prairie on the site.

These areas tend to occur in the same areas wetlands are located, as discussed in Section E and shown in Figure 8. In addition to the native plants mentioned previously, pure stands of blue wildrye (*Elymus glaucus*), muleears (*Wyethia angustifolia* and iris-leaved rush occur in the wetlands area. Other native prairie plants include meadow barley (*Hordeum brachyantherum*), hayfield tarweed (*Hemizonia conjesta*), buttercup (*Ranunculus californica*), blue-eyed grass (*Sisyrinchium bellum*), morning glory (*Calystegia occidentalis* sun cup (*Camissonia ovata*), blackberry (*Rubus procerus*), and lady tresses (*Sprianthes* sp.) The lady tresses is a significant find and normally grows in undisturbed native perennial grasslands.

The proximity of this northern section of Coastal Terrace Prairie to the main eucalyptus grove adds to its overall habitat value.

c. Mitigation for Impacts to Coastal Terrace Prairie. In order to achieve compliance with the California Environmental Quality Act, there is increasing

[5] Bartolome, J. Personal Communication. U.C. Berkeley Forestry Department, Professor of Range Management.

reliance on transplantation and translocation of rare plants and plant associations. These types of schemes do not recreate the function of the ecosystems in which target plants are found.[6] One of the most obvious plant community resources, the soil horizon, is rarely considered in the mitigation process. Soil profiles that took millions of years to evolve cannot be recreated on an adjacent disturbed site. In addition, above-ground prairie vegetation cannot exist on a new site without the below-ground structure and biological relationships that are associated with the soil profile.

Grassland prairie restoration in California is a new discipline.[7] While it is true that native prairie plants are found on disturbed mounds at the study site, these specific sites are not high quality prairie. Today virtually all prairie restoration projects are concerned with enhancing existing sites by killing noxious weeds or managing ecosystem processes such as fire, grazing, and rest.[8] In California, a prairie grassland has never been created on a new site. The life cycles, germination requirements, and management processes of native prairie plants is poorly understood.

In conclusion, the remnant coastal prairie grassland at Richmond Research Center, specifically that which contains 50 to 100 percent native vegetation, is invaluable scientifically and ecologically, and virtually impossible to recreate.

2. Disturbed/Closely Mowed Grassland

Most open, grassy areas at the Research Center support California oatgrass maintained at 3 to 5 inches in height by regular mowing. These area are shown in Figure 8 California oatgrass is highly tolerant of cutting. However, the oatgrass growing in these repeatedly mowed areas appears stunted. Bunch sizes are significantly smaller and vegetation cover ranges from 10 to 40 percent lower than that of the Leviston parcel.

[6] Skinner, M. 1993. Reintroduction of rare plants. In Bulletin of the California Native Plant Society. 23(3). July, August, September 1993.

[7] Amme, D. and B. Pitschel. 1989. Restoration and management of California's grassland habitats. Proceedings of the First Annual Meeting of the Society for Ecological Restoration. 11 pp.

[8] Amme, D. 1992. Grassland restoration in California. *Grasslands*, the newsletter of the California Native Grass Association. 8 pp.

3. Non-Native Grasses and Forbs

Areas which have been subjected to significant disturbance support non-native annual grasses and opportunist herbs. These areas are shown in Figure 8. For example, land north of the coastal terrace prairie in the Leviston parcel has been regraded. The open soil was colonized by invasive exotic plants, including Harding grass, Italian thistle, wild teasel, fennel, and wild oats. Similarly, the dominant plant species directly surrounding the waste water treatment ponds include Italian ryegrass, bristly ox tongue, and English plantain.

4. Coyote Brush and Non-Native Grasses and Forbs

Approximately three acres of coyote brush and non-native grass and forb community occupy upland areas where soil has been disturbed and/or covered with fill, as shown in 4. This community interfaces with Inner Hoffman Marsh and the coastal terrace prairie adjacent to the EPA building. This community type occurs above mean high water (6 feet NGVD)[9] and includes plants characteristic of the *northern coyote brush scrub*. Native species, such as coyote brush, sagebrush, poison oak, and needle grass occupy up to 30 percent of this area. Closer to the shore among old soil piles and coyote bush, smaller isolated pockets of native slender wheatgrass (*Elymus trachycaulus*) and California brome (*Bromus carinatus*) exist. The presence of the slender wheatgrass is a significant botanical discovery. Lowland ecotypes of slender wheatgrass are very rare. In the greater Bay Area, slender wheatgrass is found only in the Berkeley/Oakland Hills on clayey serpentinite soils.

In addition, several trees and shrubs of toyon, eucalyptus, and Himalayan blackberry intermix with the above species. Aggressive exotic species, such as Harding grass, pampasgrass, fennel, and Italian thistle reflect the history of disturbance in this area, as shown in Table 2.

An area of approximately two acres in Inner Hoffman Marsh is comprised of fill colonized by the coyote brush community. The relatively steep sides of this block of fill narrows the transition zone between the upland area and the saltmarsh plain. This zone is occupied by gumplant and sea lavender. A strip of fill paralleling the former railroad tracks along the southern edge of the marsh also supports a coyote brush community, and includes coyote brush,

[9] NGVD refers to the National Geodetic vertical datum, the standard fixed elevation datum used in the United States. It was established in 1929, and corresponds approximately with mean sea level. Along the Richmond Research Center shoreline, NGVD is equivalent to +2.8 feet above mean lower low water (MLLW), the datum used for regional tide tables and most sea floor mapping.

eucalyptus, toyon, and wheatgrass. Iceplant and pampasgrass have grown over large chunks of cement and other debris along the northern rim of Hoffman Marsh. These areas offer little habitat value and provide a stronghold from which these exotic species can invade the marsh.

The coyote brush community crosses over the fence boundary on the northern side of Hoffman Marsh into the land southwest of the EPA building. This area of coyote brush community overlaps with the coastal terrace prairie west of the EPA building. Coyote brush, purple needle grass, mule ear, and non-native grasses from the brush scrub community have colonized piles of fill disposed along road to the EPA building. Patches of Harding grass, an aggressive exotic, are also interspersed throughout this area.

5. Northern Coastal Salt Marsh

A coastal salt marsh, Inner Hoffman Marsh, occupies approximately 6.3 acres along the southern boundary of the University property, as shown on Figure 8. Several tidal creeks extend into the southwestern and central areas of the marsh from a deep tidal channel, Meeker Creek, on the western side of Inner Hoffman Marsh. The western portion of Inner Hoffman Marsh is below mean high water (2.5 feet NGVD) and receives regular tidal action. Spring high tides flush most of the western and central marsh plain. A concentration of brackish species in the northeastern corner of the marsh suggests that fresh water flows into this area; however, no culverts or drainage ditches were apparent during November 1993 field visits.

Inner Hoffman Marsh is separated from similar habitat and associated mudflats to its south by a railroad embankment. During the first twenty years of this century, plans to develop a Richmond Marina at the Richmond Research Center site were partially executed. Breakwaters were laid parallel to the former shoreline before the marina project was abandoned. Vegetation colonized sediments deposited in the quiet shallows of these breakwaters, extending the coastal marsh into the Bay and forming the outer portions of Hoffman Marsh. A network of natural tidal channels began forming in these marshes. In the 1950's, however, a railroad line was constructed that cut the developing marsh plain into the Outer and Inner Hoffman Marsh, making Meeker Creek the only source of tidal flow to the inner marsh.

The northern portion of Inner Hoffman Marsh could be what was once part of the original, pre-settlement marsh land that rimmed the San Francisco Bay.[10] Original bay fringe salt marsh is relatively rare; less than 30 percent of the historic extent of these systems remains intact.

Today, Outer Hoffman Marsh as exposed to more tidal action than Inner Hoffman Marsh. Most of Outer Hoffman Marsh is below MHW (2.5 feet NGVD) and supports a rich cordgrass (*Spartina foliosa*) community. In contrast, tidal flow to Inner Hoffman Marsh is restricted to water introduced through Meeker Creek. The limited tidal action and higher elevation of the marsh plain in Inner Hoffman Marsh is reflected in the vegetation.

The vegetation of Inner Hoffman Marsh, as shown in Table 2, is typical of that found in the upper zones of salt marshes in the Bay Area and halophytic plant species are distributed according to the degree of tidal inundation. Open water and mud flats grade into dense beds of cordgrass (*Spartina foliosa*) in areas below mean high water (2.5 feet NGVD) that border Meeker Creek and the smaller tidal creeks. Pickleweed (*Salicornia virginica*) dominates the vegetative cover of the marsh plain, between approximately 2.5 and 5.5 feet NGVD. These areas are flushed with each tide, but are not constantly inundated. Beds of salt grass (*Distichlis spicata*) intermix with pickleweed in slightly raised areas of the marsh plain. Sea lavender (*Limonium californicum*), gum plant (*Grindelia humilis*), saltgrass, and pickleweed form a narrow transition zone between the upper salt marsh and associated upland.

A robust stand of alkali bulrush growing near the gate to Inner Hoffman Marsh at the northeastern corner indicates that freshwater flows into the marsh from the uplands to the north. In addition, freshwater riparian species, including willows and a small birch tree, grow in a depression just northeast of the fence-corner, and add further credence to the contention that freshwater flows into this corner of the marsh. Overflow from the adjacent experimental ponds and/or surface drainage from the surrounding area are the most likely sources of freshwater.

[10] Murry, M.A., and A.J. Horne. 1979. Studies on Hoffman Salt Marsh; Richmond, California. Initial Studies on the Inner Marsh and Its Acid Pollution. Sanitary Engineering Research Laboratory, University of California at Berkeley.

6. Eucalyptus Grove

Several large stands of mature eucalyptus grow at the Research Center. The most extensive stand covers approximately 7.5 acres, and runs along a north-south line through the center of the Research Center, as shown in Figure 8. The canopy exceeds 80 feet in height and effectively blocks sunlight from reaching the forest floor. Eucalyptus litter is rich in oils and resins which resist decomposition and preclude the growth of other plants. A few sparse patches of annual grasses grow under openings in the canopy; otherwise groundcover under the eucalyptus grove is nearly non-existent. Several other patches of mature eucalyptus were planted throughout the Research Center. Several individuals of Monterey pine (*Pinus radiata*) grow with the eucalyptus along Robin Drive. These tree groves create an impressive visual feature, as well as providing habitat for raptors and butterflies, as discussed below.

7. Toyon and Firethorn

Firethorn (*Pyracantha angustifolia*) is a common garden escape and toyon (*Heteromeles arbutifolia*) is a native tree which occurs as an understory component in mixed evergreen and pine/oak forests. Both produce bright red-orange berries in the fall, and are frequently planted as decorative trees. Individuals and small clusters of these fruit-bearing trees occur throughout the Research Center and offer an important wildlife food source.

8. Ornamental Landscaping

Ornamental landscaping has been planted directly adjacent to many of the buildings and along roadsides and boundaries at the Research Center, as shown in Figure 8. Well watered and fertilized lawns, ornamental shrubs, and garden flowers decorate the vicinity of the new EPA building and many of the structures along Robin Drive, Meade Drive, Egret Way and Lark Drive. Plants commonly used include periwinkle, English ivy, cypress, redwood, fruit trees, and garden flowers.

9. Disturbed Bare Ground

Several areas in the Leviston parcel have recently been regraded or overlain with fill, as shown in Figure 8. Currently devoid of vegetation, these areas will presumably be reseeded by hand or allowed to reseed naturally during the next growing season. The ground south of the Fog Building appears to have been covered recently with clay subsoil from another location, and a loamy surface soil should be added before the area is allowed to seed in. The slope directly south of the new EPA building was regraded this summer.

D. Wildlife

The 152-acre Richmond Research Center is comprised of a diverse assemblage of biological communities that offer a variety of habitat for wildlife, primarily in the undeveloped western, southern and northern portions.

1. Wildlife by Habitat Type

Although relatively small, highly fragmented and isolated from adjoining habitat in the vicinity, Richmond Research Center does provide significant potential wildlife habitat. The habitat types and associated wildlife discussed below include eucalyptus grove, coastal terrace prairie, non-native grassland, northern coastal salt marsh, coyote brush, non-native grasses and forbs, and ornamental landscape.

a. Northern Coastal Salt Marsh and Coyote Brush. Located on the southern most portion of the Richmond Research Center is a coastal tidal salt marsh separated by a railroad right-of-way and levee into inboard and outboard sections, as shown in Figure 3 and discussed previously. The outboard marsh consists of a coastal tidal salt marsh and a large expanse of mud flat exposed during low tides. The inboard salt marsh (Inner Hoffman Marsh) is connected to the bay by a small branch that splits off Meeker Creek. This small marsh is dominated by cordgrass, pickleweed and saltgrass. The southwestern corner of this small marsh has a series a tidally influenced slow draining ponds. The avian species that utilize tidal salt marsh are predominately shorebirds, rails and herons. Localized and migratory populations of shorebirds forage on the exposed mud flats and seek refuge on the salt marsh vegetation during high tides. The open water on the exterior portions of the Research Center provide foraging opportunities for white pelican, California brown pelican, California least tern and double-crested cormorant. Although the main and interior channels of the inner marsh provide suitable habitat, California clapper rails and black rails have not been recorded as occurring at the Research Center.[11] Great blue herons, snowy egrets and great egrets forage along the open water of the main channel, interior marsh and levees. Raptors such as the northern harrier hunt for prey items in the open areas of the interior and exterior salt marsh.

An upland levee along the southern and western edge of the tidal marsh supports the coyote brush and non-native grasses and forbs habitat type. This

[11] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

upland habitat forms a transition zone between the non-native grasslands inside the perimeter fence and the small tidal salt marsh. The coyote brush and non-native grasses and forbs habitat also adjoins Meeker Creek along the edge of the Research Center site. The tall grasses and shrubs on this upland provide foraging and breeding opportunities for birds, reptiles, insects and mammals. The high marsh zone with mixed halophytes along the small salt marsh and main channel provides high-water refuge for special status species that potentially inhabit the marsh plain and provide a valuable transitional habitat. San Pablo song sparrows have established breeding territories within the coyote brush upland and salt marsh yellowthroat utilize this upland ecotone during the winter non-breeding season. Special status small mammal species that may potentially occur in the salt marsh and its bordering upland habitat include the salt marsh vagrant shrew and the salt marsh harvest mouse. The San Pablo vole may occur in the transition zone adjoining the small salt marsh. Introduced species that may potentially utilize the transitional uplands and levees are the Virginia opossum, house mouse, roof rat and the red fox.

b. Coastal Terrace Prairie. The coastal terrace prairie represents the largest habitat type on the site. Once abundant, this native perennial dominated grassland has declined due to agriculture and development. In addition to having up to 100 percent native prairie plant cover, large portions of this grassland type are classified as seasonal wetlands under Clean Water Act definitions. Dispersed on the site are also patches of mowed coastal terrace prairie. Coastal terrace prairie functions primarily as a foraging and breeding area for grassland dependent avifauna, small mammals, insects and reptiles. Raptors associated with the eucalyptus grove forage in this grassland habitat, as described below. A total of 41 other avian species utilize the grasslands of Richmond Research Center. These species are described in the Biology Appendix. An abundance of mammals and reptiles inhabit the perennial grasses of the coastal terrace prairie including the California vole, valley pocket gopher, California ground squirrel, black-tailed jackrabbit, striped skunk, raccoon, common garter snake, western terrestrial garter snake, gopher snake, racer and western fence lizard. Common introduced generalist species that may utilize this habitat include the Virginia opossum, house mouse, roof rat and red fox. The plant community of the coastal terrace prairie supports unique populations of insects, in particular moths and butterflies. Approximately 70 species of moths and butterflies were identified at the Research Center. This represents about 40 percent of a potential resident fauna. Although a 48 percent of observed species were generalist feeders,

potentially a large number may rely on plants associated with the coastal terrace prairie.[12]

c. Eucalyptus Grove. The eucalyptus trees are primarily concentrated in a large L-shaped stand located north of Lark Drive. Other small linear clumps are dispersed around the station. The western most portion of the site is devoid of eucalyptus trees. The trees are spaced in a grid fashion approximately ten feet from one another. The large amount of tree litter created by this type of grove alters the soil acidity and increases the level of duff which inhibits the growth of other tree species and minimizes understory vegetation. Although non-natural and generally of little habitat value in comparison to natural woodlands, this stand does provide roosting and nesting sites for raptors and over-wintering habitat for the monarch butterfly. The habitat quality of the grove is increased by its close proximity to the largest contiguous parcel of grassland found at the Research Center. Common bird species that use the grove and its smaller satellites as nesting habitat are primarily raptors and passerines. Red-tailed hawks, great horned owls and black-shouldered hawks have nested in the main grove. These species are listed in the Biology Appendix. Foraging opportunities for insectivorous and nectar feeding birds are provided by the eucalyptus grove. The main grove is used by monarch butterflies as a staging ground during their annual migration and is considered over-wintering habitat.[13]

d. Non-Native Grasses and Forbs. Non-native grassland occurs on the most disturbed habitat at the Richmond Research Center and wildlife use of this habitat is limited. Concentrations of small mammals and grassland nesting bird species are reduced by mowing activities. Lack of prey items and vegetative cover curtails the extent of foraging and breeding by avian, reptile, insect and small mammal species. Despite its low habitat quality in comparison to the coastal terrace prairie, wildlife species do utilize the non-native grasslands on the Richmond Research Center. These species are listed in the Biology Appendix.

e. Ornamental Landscape, Toyon, and Firethorn. The ornamental landscape represents an assemblage of intensely managed plant species primarily concentrated around the existing buildings and structures of the Richmond Research Center. These areas provide limited wildlife habitat due

[12] Powell, J.A. 1992. Richmond Field Station Lepidoptera. Department of Entomological Sciences, University of California, Berkeley.

[13] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

to their close proximity to human disturbance. In the northeastern corner of the site is a stand of Monterey pine that may offer nesting and foraging opportunities for avian species. Limited foraging opportunities exist in the toyon and firethorn tickets.

2. Sensitive Wildlife Species

The Richmond Research Center is within the historic geographic distribution of several sensitive species protected under federal and State law, as shown in Table 3. The majority of these species are closely associated with the coastal tidal salt marsh habitat. Other sensitive species may use the eucalyptus grove and coastal terrace prairie. Prior to development in these three habitat areas, site-specific surveys should be completed to determine if the following sensitive species exist. If evidence of such species is found, appropriate mitigation should be developed. These measures could include the provision of appropriate buffer areas, landscaping of buffer areas with native vegetation, the provision of shield lights to reduce off-site glare, and restrictuve entry into these habitat areas. If development is proposed in an area where sensitive species exist, appropriate mitigation may not be possible, and the proposed development could cause a significant impact. The sensitive species considered likely to occur on the site or in the immediate vicinity are discussed below in the order of federal and State protective status.

a. California Clapper Rail (*Rallus longirostris obsoletus*). The California clapper rail (CCR) is found only in salt to mildly brackish marshes of the San Francisco Bay area. The primary plant community this species is associated with is tall emergent vegetation, especially cordgrass with a mixture of pickleweed, gum plant, and other halophytes. A possible relationship exists between the distribution and abundance of CCR and the age dependent characteristics of marshlands, such as elevation, plant community structure and prey density.[14] During high tides and storms, CCR are forced out of their preferred habitat into adjacent high marsh and upland borders. Vegetative high marsh and uplands are essential to the survival of CCR because they provide cover from predators during high-water events. The coastal salt marsh at the Richmond Research Center provides suitable refuge, foraging and breeding habitat for this species. The nearest observation is from the remnant

[14] Evens, J.G., and J.N. Collins. 1992. Distribution, abundance and habitat affinities of the California Clapper Rail (*Rallus longirostris obsoletus*) in the northern reaches of the San Francisco Estuary during the 1992 breeding season. California Dept. of Fish & Game, Yountville, CA.

Table 3
SENSITIVE SPECIES THAT OCCUR OR POTENTIALLY OCCUR AT THE RICHMOND RESEARCH CENTER

Common Name	Scientific Name	Status	Habitat
*California clapper rail	*Rallus longirostris obsoletus*	FE/SE	Coastal salt marsh
*Salt marsh harvest mouse	*Reithrodontomys raviventris halicoetes*	FE/SE	Coastal salt marsh
*Black rail	*Laterallus jamaicensis coturniculus*	C2/ST	Coastal salt marsh
*Salt marsh vagrant shrew	*Sorex vagrans halicoetes*	C1/SC	Coastal salt marsh
*Salt marsh yellowthroat	*Geothlypis trichas sinuosa*	C2	Coastal salt marsh
San Pablo song sparrow	*Melospiza melodia samuelis*	C2	Coastal salt marsh Coyote brush
*San Pablo vole	*Microtus californicus sanpabloensis*	C2	Coastal salt marsh Coyote brush
Loggerhead shrike	*Lanius ludovicianus*	C2	Coastal salt marsh Coyote brush Coastal Terrace Prairie Non-native grasses
Black-shouldered kite	*Elanus caeruleus*	CFP	Eucalyptus grove Coyote brush Coastal Terrace Prairie Non-native grasses
Northern harrier	*Circus cyaneus*	SC	Eucalyptus grove Coyote brush Coastal Terrace Prairie Non-native grasses
*Long-billed curlew	*Numenius madagascariensis*	SC	Coastal salt marsh Coastal mud flats
Monarch butterfly	*Danaus plexippus*	SR	Eucalyptus grove Coastal terrace

STATUS:
FE - Federally listed as endangered
ST - State listed as threatened
C1 - Federal candidate for listing, Category 1
CFP - California fully protected
C2 - Federal candidate for listing, Category 2
SC - State Species of Special Concern
SE - State listed as endangered
SR - State Special Resources.
* Species that could occur on the site, but has not been seen there.

marshes east of Point Isabel, less then a mile from the Research Center.[15] If development is planned in the vicinity of the Northern Coastal Salt Marsh, site-specific suveys, such as call counts and nest surveys, should be completed during the breeding season (April-September).

b. Salt Marsh Harvest Mouse (*Reithrodontomys raviventris halicoetes*). The primary habitat requirement for the salt marsh harvest mouse (SMHM) is dense pickleweed. An important secondary habitat requirement is the presence of vegetated high marsh and upland areas that provide refuge from high tides and storms. The coastal salt marsh and the bordering upland area at Richmond Research Center offers this species suitable habitat. The nearest known occurrence for this species to the Research Center is approximately 4 miles to the northwest at San Pablo Creek marsh. Since no development is expected in the wetlands and salt marsh areas of the site, no impacts to this species are expected.

c. Black Rail (*Laterallus jamaicensis coturniculus*). More then 90 percent of the black rails found in the Bay Area live in the northern reaches of the San Francisco estuary, where they occur almost exclusively in marshlands with unrestricted tidal influence.[16] The primary breeding habitat for this species is pickleweed dominated salt marsh. During high-water tides and storms, black rails seek refuge on high marsh uplands adjacent to their preferred marsh habitat. Dense clumps of tall vegetative cover are essential to prevent predation on the rails during these periods of vulnerability. Suitable habitat for this species is currently present within the coastal salt marsh and adjoining upland habitat at the Research Center. If development is planned in the vicinity of the Northern Coastal Salt Marsh, site-specific surveys should be completed.

d. Salt Marsh Vagrant Shrew (*Sorex vagrans halicoetes*). The salt marsh vagrant shrew inhabits tidally influenced salt marsh with a dense, low-lying cover of pickleweed, cordgrass and gumplant. Driftwood and other litter at the upper limits of the marsh provides nesting and foraging sites. In addition, adjacent upland habitat provides refuge for the shrew during periods of high water. The coastal salt marsh coupled with the upland border offer suitable habitat for this species at Richmond Research Center. The closest observation for this species is approximately 4 miles to the northwest of the Research

[15] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

[16] Evens, J.G., G.W. Page, S.A. Laymon, and R.W. Stallcup. (In press). Distribution, relative abundance and status of the California Black Rail in Western North America. PRBO, CA.

Center at the San Pablo Creek salt marsh. Since no development is expected in the wetlands and salt marsh areas of the site, no impacts to this species or its habitat are expected.

e. Salt Marsh Yellowthroat (*Geothlypis trichas sinuosa*). The salt marsh yellowthroat has occurred at the Research Center during the non-breeding season. During a detailed survey by Hobson et al. in 1985 no nesting salt marsh yellowthroat were found in Contra Costa County. Because no development is expected in the wetlands and salt marsh areas of the site, no impact to this species or its habitat is expected.

f. San Pablo Song Sparrow (*Melospiza melodia samuelis*). The San Pablo song sparrow is predominately associated with emergent vegetation of regularly flooded tidal salt marsh. The primary habitat type is found in low to high marsh. Habitat loss and fragmentation has reduced numbers of these species in the southern portion of its range. Observations of breeding individuals were made in the vicinity of gate 5 and 6 at the Research Center's western boundary fence in 1991.[17] On the Richmond Research Center suitable habitat exists in the coastal salt marsh and accompanying upland habitat. If development is planned in the vicinity of the Northern Coastal Salt Marsh or the Coastal Terrace Prairie Habitats, site-specific surveys, such as call counts and nest surveys, should be completed during the breeding season (March-September).

g. San Pablo Vole (*Microtus californicus sanpabloensis*). The San Pablo vole is generally associated with grasslands in the close vicinity of salt marsh habitat. This subspecies is known to exist in the salt marshes on the south shore of San Pablo Bay. The nearest record for this species is approximately 4 miles to the northwest of the Research Center.[18] If development is planned in the vicinity of the Northern Coastal Salt Marsh or the Coastal Terrace Prairie Habitats, site-specific surveys should be completed.

h. Loggerhead Shrike (*Lanius ludovicianus*). The loggerhead shrike has a preference for a landscape dominated by open country with interspersed patches of scrub or wooded habitat. The diet of this species includes a variety of insects, small birds, mammals, reptiles and amphibians. Sightings at the Research Center include both the grassland and salt marsh/transitional zone

[17] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

[18] Environmental Collaborative. 1989. Administrative draft report, biotic resources assessment. Appendix B. University of California, Berkeley, Richmond Field Station. Point Richmond, CA. Prepared for: Wallace, Roberts & Todd, San Francisco, CA.

habitat types, as listed in the Biology Appendix. If development is planned in the vicinity of the Northern Coastal Salt Marsh of the Coastal Terrace Prairie, site-specific surveys should be completed.

i. Black-shouldered Kite (*Elanus caeruleus*). Black-shouldered kites nest in trees within open woodlands that are situated near water and open grasslands. The coastal prairie and mowed ruderal grasslands located on the Richmond Research Center offer foraging habitat for this species. A pair of kites nested in the main eucalyptus grove between 1985 and 1989.[19] Prior to development in the existing eucalyptus habitats, site-specific breeding site and nest surveys should be completed.

j. Northern Harrier (*Circus cyaneus*). The northern harrier constructs grasslined nests in dense vegetation in close proximity to the ground. This has made this species sensitive to disturbance from predators and agricultural practices. Due to the proximity of the highway and research buildings the site constitutes less then adequate nesting habitat for the northern harrier, but the coastal prairie and the mowed ruderal grassland provide suitable foraging habitat. This species has been seen at the Research Center throughout the year. However, suitable breeding habitat is minimal at the Richmond Research Center, therefore no significant impacts from future development are expected.

k. Long-billed Curlew (*Numenius madagascariensis*). The only suitable habitat for the long-billed curlew on the site is the peripheral mud flats of the outer coastal salt marsh. Though this species has not been observed at the site, it could occur in the wetland areas. Because no development is expected in these areas, no impacts are anticipated.

l. Monarch Butterfly (*Danaus plexippus*). The monarch butterfly adult life cycle incorporates a southward migration from its northern breeding grounds to warmer over-wintering areas on the coast. Along the migration route, particular staging grounds have been identified as necessary to the continued survival of this species. Under California law (1988 Statutes Chapter 540), the monarch butterfly over-wintering colonies are recognized as "special resources" in California. The International Union for the Conservation of Nature and Natural Resources has determined that the protection of the over-wintering colonies is a top priority and should be considered a "threatened phenomenon". The California Department of Fish and Game has been charged with delineating wintering colonies and establishing management plans to maintain

[19] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

the viability of this population. On the Richmond Research Center a staging area exists in the main eucalyptus grove, as shown in Figure 8. This grove has been an over-wintering site since the mid-1960's and provides foraging and roosting opportunities for the monarch butterfly.[20] Development which would remove any of the existing habitat area or trees surrounding this area could impact the viability of the Monarch Butterfly.

E. Wetlands

This section describes the presence of wetlands and waters of the U.S. subject to federal jurisdiction under Section 404 (Clean Water Act) and Section 10 (Rivers and Harbors Act) at the Richmond Research Center. As stated in the federal regulations, wetlands are defined as:

> *Those areas that are inundated or saturated by surface or ground waters at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.*
> (EPA, 40 CFR 230.3 and CE, 33 CFR 328.3)

During November of 1993 potential jurisdictional wetlands were identified based on the presence or absence of wetland indicators used by the Corps of Engineers in making a jurisdictional determination. The three criteria used to delineate wetlands as stated in the *Corps of Engineers Wetlands Delineation Manual* (1987) are the presence of (1) hydrophytic vegetation, (2) hydric soil, and (3) wetland hydrology. According to the *Corps Manual*:[21]

> *....Evidence of a minimum of one positive wetland indicator from each parameter (hydrology, soil, and vegetation) must be found in order to make a positive wetland delineation.*

In addition, those portions of the Study Area subject to jurisdiction under Section 10 of the Rivers and Harbors Act of 1899 were also identified. As stated in the federal regulations:

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[20] Draft Environmental Impact Report. 1991. Proposed U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station.

[21] Army Corps of Engineers. 1987. Corps of Engineers Wetlands Delineation Manual, Department of the Army, Waterways Experiment Station, Corps of Engineers, P.O. B31, Vicksburg, Mississippi 39180-0631.

Section 10 prohibits the unauthorized obstruction or alteration of any navigable water of the United States.

Section 10 affects all navigable waters including navigable tidal waters. The shoreward limit of jurisdiction in tidal waters extends to the line on the shore reached by the plane of the mean (average) high water (33 CFR 329.12). Section 10 jurisdiction also applies to areas behind levees that are "navigable by law" determined by past use (33 CFR 329.9).

1. Background

The National Wetlands Inventory map (Richmond Quadrangle) shows areas of estuarine tidal marsh and mudflat and one excavated pond within the Study Area. The National Wetland Inventory maps are prepared from high altitude photography (1:24,000 scale) and are not suitable for accurate jurisdictional wetland delineation. However they can be used to corroborate findings in this study.

A wetland delineation was previously conducted at the Richmond Research Center in September 1989. However, the delineation was conducted during a period of drought years and using delineation methods described in the *Federal Manual for Identifying and Delineating Jurisdictional Wetlands* (1989). Use of this manual has been rescinded. Due to these reasons an updated wetland delineation was necessary.

a. Methodology. The routine method for wetland delineation as described in the *Corps Manual* (1987) was used to identify areas potentially subject to U.S. Corps of Engineers jurisdiction within the Richmond Research Center property. The study area is defined as the area within the Research Center property that is included on the topographic maps. Prior to the site visit, the U.S. Soil Conservation Service, Contra Costa County Soil Survey and the U.S. Fish and Wildlife Service Wetland Inventory Map were reviewed.[22] [23] Field studies conducted in November 1993 included examination of the soils, hydrology and vegetation in the study area boundary. Section 10 waters were determined based on location of mean high water (MHW) tidal datum.

[22] U.S. Soil Conservation Service. 1977. Soil survey of Contra Costa County, California, U.S.D.A. Soil Conservation Service.

[23] U.S. Fish and Wildlife Service. 1985. National Wetland Inventory Map, Richmond Quadrangle. U.S. Fish and Wildlife Service, Portland, OR.

The Corps provides standard forms on which soil, hydrology, and vegetation data can be recorded and normally requires that these forms be completed for wetland delineations. Once an area was found to meet the criteria for jurisdictional wetlands, its location and extent was recorded on an aerial photograph and topographic maps. Wetland acreage was measured on the topographic maps using a digital planimeter (Lietz Planix 7). The soil, hydrology, and vegetation criteria used to make a wetland determination are summarized below.

b. Soil Criterion. Soils formed under wetland (anaerobic) conditions have a characteristic low chroma, designated 0, 1, or 2, used to identify them as hydric soils. Chroma designations are determined by comparing a soil sample with a standard soil color chart.[24] Soils with a chroma of 0 or 1 are considered hydric; soils with a chroma of 2 must also have mottles to be considered hydric. The soil types found at the Richmond Research Center are shown on Figure 7.

c. Hydrology Criterion. The jurisdictional wetland hydrology criterion in a non-tidal area is satisfied if the area is inundated or saturated for a period sufficient to create anoxic soil conditions during the growing season, usually a week or more. Evidence of wetland hydrology can include direct evidence, such as visible inundation or saturation, or indirect indicators, such as oxidized root channels, algal mats, surface sediment deposits and drift lines.

d. Vegetation Criterion. Plant species identified on the project site were assigned a wetland status according to the U.S. Fish and Wildlife Service[25] list of plant species that occur in wetlands. This wetland classification system is based on the expected frequency occurrence in wetlands as shown in Table 4.

Plants with OBL, FACW, and FAC classifications are considered wetland plants in the *Corps Manual* (1987) methodology. If 50 percent or more of the dominant plants (dominant is $\geq$20 percent of the cover) are wetland plants, the area is considered to have met the wetland vegetation criterion.

e. Tidal Wetlands. According to Section 404 of the Clean Water Act, Corps jurisdiction extends to the high tide line in tidal waters (33 CFR 328.4). The high tide line in the Study Area (Richmond Inner Harbor) has been determined to be +6.2 feet NGVD by Philip Williams and Associates using

[24] Munsell Soil Color Charts. 1975. Kollmorgen Corporation, Baltimore.

[25] Reed, P.B., Jr. 1988. National list of plant species that occur in wetlands: California (Region 0). U.S.Fish and Wildlife Service Biological Report 88 (26.10).

Table 4
VEGETATION CRITERION

Vegetation Criterion		Occurrence Frequency
OBL	Always found in wetlands	>99%
FACW	Usually found in wetlands	67-99%
FAC	Equal in wetland or non-wetlands	34-66%
FACU	Usually found in non-wetlands	1-33%
UPL	Not found in local wetlands	<1%
NL	Not listed (upland)	

tidal data published by NOAA. Areas below the high tide line are considered potential jurisdictional wetlands and waters of the United States.

f. Section 10 Waters. Section 10 of the Rivers and Harbors Act (1899) applies to tidal areas below mean high water (MHW), and includes tidal areas currently subject to tidal influence as well as historic tidal areas below MHW. MHW at the Richmond Research Center was determined to be +2.50 feet, NGVD by Philip Williams and Associates using tidal data published by NOAA for Point San Pedro, the nearest point for which data is available.

2. Wetland Delineation Results

Areas in the Richmond Research Center which met the three mandatory criteria for delineating jurisdictional wetlands included tidal marshes, areas in open fields north of Lark Drive and west of the New EPA Building, and drainage ditches. Tidal channels qualify as potential jurisdictional waters of the U.S. These areas are shown in Figure 9.

A list of plants identified during the routine delineation study are given with their wetland classification in the Biology Appendix.

a. Site A, Open Field. Site A, as shown in Figure 9, is an open field north of Lark Drive and is relatively level with a gentle slope southward. Apparently the field was to be subdivided in the early 1900s.[26] The street layout of the subdivision is still visible in aerial photographs and on the ground, including old concrete sidewalks and curbs. The field has not been maintained or moved in

[26] Kevin Hufferd, U.C. Berkeley, personal communication.

the recent past; however, portions of the field have been used for small mammal population studies and other experiments.[27] Several areas and drainage ditches on the site (maps attached) meet the three jurisdictional criteria and, therefore, are considered potential jurisdictional wetlands.

(1) Soil. Native soils in Site A appear to cover most of the site with some areas of fill that run parallel to the "fog building" and the former "streets" and several scattered dirt piles. The native soil profile consists of 0 to 12 inches of a loamy soil overlying heavy clay. The soil color notation of both horizons is 10YR 3/1. This color notation is consistent with Clear Lake clay soils and was generally found across the entire field, including areas with no positive wetland hydrological indicators or wetland vegetation. Therefore, low chroma was not necessarily considered a wetland characteristic and greater reliance was placed on wetland hydrology and wetland vegetation as indicators of wetland characteristics during the routine delineation.

(2) Hydrology. Wetland hydrology indicators were not well defined on the site. Indicators of surface inundation, such as algal mats or sediment deposits, were infrequent either because (a) development was not widespread or (b) they were destroyed by small mammal activity. Occasional algal mats, vegetation mats, and water marks were found, however, and used in the routine delineation process to determine the wetland-upland boundary.

Near surface ground water table data collected during a 1989-1990 piezometer study was also used to corroborate current conditions.[28] The piezometer study results indicated the site has a perched ground water table in the upper 12 inches during the winter and spring. A sustained (one week or longer) ground water level within 12 inches of the surface was observed in three of four piezometer stations during the study. These three piezometer stations (1, 3, and 4) are located within the area where positive wetland hydrology indicators and wetland vegetation was discovered. The locations of the piezometer stations are shown in Figure 9.

[27] Lidicker, W.A. 1973. Regulation of numbers in an island population of the California vole, a problem in community dynamics. Ecol. Monog. 43, 271-302.

[28] Wetlands Research Associates, Inc. (WRA) 1990. U.C. Richmond Groundwater Study, prepared for University of California, Berkeley. Wetlands Research Associates, Inc., San Rafael, CA.

(3) Vegetation. Wetland plant species were the dominant vegetation in areas with positive hydrological indicators. California oatgrass (*Danthonia californica*), a FACW classified plant, and Italian ryegrass (*Lolium multiflorum*), and English plantain (*Plantago lanceolata*), both FAC classified plants, were dominant plants; subdominant plants included coyote thistle (*Eryngium armatum*), brown-head rush (*Juncus phaeocephalus* var. *paniculatus*), and slender rush (*Juncus tenious* var. *congestus*a), all FACW classified plants, and ox tongue (*Picris echioides*), a FAC classified plant. Vegetation in adjacent areas lacking positive hydrological indicators included non-listed species, such as purple needle grass (*Nassella pulchra*), wild oat (*Avena fatua*), and Italian thistle (*Carduus pycnocephalus*), and FACU classified plants, such as soft chess (*Bromus hordeaceus*) and blue wildrye (*Leymus glaucus*).

b. Site B, Open Field. Site B is an open field that is relatively level and has a gentle slope southward. The field has not been maintained or mowed; however, there has been recent site disturbance including placement of fill material at the northern end. The Meeker ditch, which is concrete lined, runs along the west boundary and a dirt lined drainage ditch (approximately 2-feet wide) runs along the east boundary.

(1) Soil. Native soils cover most of the site but are interspersed with areas of fill, including a mound (approximately 1-foot tall and 10-feet wide) that runs parallel to Meeker ditch, several scattered dirt piles, and newly placed fill at the northern end. The native soil profile consists of 0 to 12 inches of a loamy soil overlying heavy clay. The soil color notation of both horizons is 10YR 3/1. This color notation is consistent with Clear Lake clay soils and was generally found across the entire field, including areas with no positive wetland hydrological indicators or wetland vegetation. Therefore, low chroma was not necessarily considered a wetland characteristic and greater reliance was placed on wetland hydrology and wetland vegetation as indicators of wetland characteristics during the routine delineation.

(2) Hydrology. Wetland hydrology indicators were not well defined on the site. Indicators of surface inundation, such as algal mats or sediment deposits, were infrequent either because they never developed or because they were destroyed by small mammal activity. Occasional algal mats and vegetation mats were found and used in the wetland-upland boundary determination.

(3) Vegetation. Wetland plant species were the dominant vegetation in areas with positive hydrological indicators. California oatgrass (*Danthonia californica*), a FACW classified plant, and Italian ryegrass (*Lolium multiflorum*), a FAC classified plant, were dominant plants; subdominant plants

included loosestrife (*Lythrum hyssopifolium*), meadow barley (*Hordeum brahcyantherum*), both FACW classified plants, and Harding grass (*Phalaris aquatica*), a FAC classified plant. Vegetation in adjacent areas lacking positive hydrological indicators included non-listed species, such as wild oat (*Avena fatua*), Italian thistle (*Carduus pycnocephalus*), and black mustard (*Brassica nigra*), and FACU classified plants, such as soft chess (*Bromus hordeaceus*).

c. Site C. Willow Thicket. Site C is a depression located at the southeastern corner near an experimental sewage treatment facility. Although the treatment facility was constructed as a contained system, there may be undetected leakage from the system into the depression and/or a high ground water table.

(1) Soil. Substrate in the depression appeared to be fill material with high organic content.

(2) Hydrology. There was several inches of water in the depression during the field studies conducted in November prior to significant rainfall, indicating inundation is persistent through most of the year.

(3) Vegetation. Dominant vegetation in the depression was arroyo willow (*Salix laseolepis*), an OBL classified plant. Other plants included paper birch (*Betula occidentalis*), a FACW classified plant, and pampas grass (*Cortederia* sp.).

d. Research Center Drainage Ditches. Most drainage ditches on the field station have sufficient slope to drain water quickly. These drains do not meet the wetland hydrology criterion and are not considered jurisdictional wetlands. Drainage ditches that meet the three wetland criteria are located near Egret Way and at the end of Crow Drive.

(1) Soils. The soils in drainage ditches are clay with a soil color notation of 10 YR 3/1. This is consistent with Clear Lake clay soils.

(2) Hydrology. Positive wetland hydrology indicators in the ditches include algal mats and sediment deposits.

(3) Vegetation. Wetland plants are dominant in the drainage ditches and include paspalum (*Paspalum distichum*), an OBL plant, California loosestrife (*Lythrum californicum*) and umbrella sedge (*Cyperus eragrostis*), both FACW plants, and Italian ryegrass (*Lolium multiflorum*), a FAC plant. Not-listed plants, such as black mustard (*Brassica nigra*) and wild oat (*Avena*

fatua) were dominant in areas above the ditches where positive wetland hydrology indicators were not found.

e. Tidal Salt Marsh. Tidal salt marsh is located at the southern end of the Research Center. Section 404 jurisdiction extends to the high tide line (+6.2 feet NGVD) and to areas above this line where the three wetland criteria are met. A survey of the shoreline, however, indicated there are no areas adjacent to the salt marsh and above the +6.2 foot contour that met wetland criteria.

3. Potential Corps of Engineers Jurisdiction

a. Potential Section 404 Jurisdiction Wetlands and Waters of the U.S.

(1) Section 404 Wetlands. Wetlands are specifically defined within the Corps of Engineers regulations (Section 328.3) and the Corps of Engineers has issued guidance on their delineation. Three elements need to be present for an area to be defined as a wetland, notably hydrophytic vegetation, saturated soils, and groundwater or surface flooding. Generally, wetlands border other water bodies such as oceans, lakes, rivers, and streams.

Potential jurisdictional wetlands in the Richmond Research Center area were determined during routine delineation field studies. Examination of soils, wetland hydrology, and wetland vegetation were conducted and wetland-upland boundaries determined in the field. Wetland-upland boundaries were then drawn on a recent (1989) color aerial photograph (approximate scale: 1 inch = 150 feet) of the site and later transferred to topographic maps. The extent of potential jurisdictional wetlands was determined from the topographic maps using a digital planimeter (Lietz Planix 7).

Potential jurisdictional wetlands in tidal and non-tidal areas are shown in Figure 9. The estimated area covered by these potential wetland areas is 8.47 acres. The amount of area by site is given in Table 5.

(2) Section 404 Waters. Meeker ditch is located along the western border of the site. A discrepancy on base maps does not clearly indicate whether the ditch lies within or outside the Richmond Research Center property. If it is determined to be part of the property, it should be considered potential jurisdictional waters of the U.S. since it drains directly into San Francisco Bay. The concrete lined ditch is generally unvegetated, but cattail (*Typha* sp.) and monkey flower (*Mimulus guttatus*) and other plants were observed in several areas along the ditch where sediments have collected. The area of waters of the U.S. in Meeker ditch (within the concrete channel) is approximately 0.11 acres.

Table 5
POTENTIAL JURISDICTIONAL WETLANDS,
WATERS OF THE U.S. AND NAVIGABLE WATERS OF THE U.S.

Map Location	Potential Wetlands (Acres)	Potential Waters of the U.S. (Acres)	Potential Section 10 Navigable Waters (Acres)
Site 1	2.55	0	0
Site 2	0.08	0	0
Site 3	0.04	0	0
Ditches	0.11	0	0
Tidal Marsh	5.69	0.66	0.66
Total	8.47	0.66	0.66

Tidal waters and mudflats at the southern end of the site are also considered potential Section 404 jurisdictional waters of the U.S. Areas below the MHW mark have dual jurisdiction under Section 10. There are approximately 0.66 acres of tidal waters of the U.S.

b. Potential Section 10 Jurisdictional Waters of the U.S. Corps of Engineers Section 10 jurisdiction includes tidal areas below MHW, as well as historic tidal areas that were below MHW. MHW at the Research Center is +2.5-feet NGVD at Point San Pedro. The estimated area of existing potential Section 10 jurisdiction is 0.66 acres.

c. Comparison with Previous Delineations. Maps showing the location and extent of potential jurisdictional wetlands in the 1989 Jones and Stokes report generally agree with findings in this study.[29] The discrepancies are the result of: (a) differences in map scale; (b) changes in site conditions; and (c) inaccurate delineation of wetlands.

The scale of the map of potential jurisdictional wetlands in the Jones and Stokes report was 1 inch = 300 feet and was further reduced to approximately 1 inch = 430 feet. Greater detail and accuracy can be obtained and shown using larger scale aerial photographs and topographic maps. In this study, both

[29] Jones and Stokes. 1989. Wetland delineation of potential sites for EPA Laboratory. Prepared for University of California, Berkeley. Jones and Stokes Associates, Inc., Sacramento, CA.

the aerial photograph (approximate scale: 1 inch = 150 feet) and the topographic maps (scale: 1 inch = 100 feet) allowed greater mapping accuracy.

Changes in site conditions can be man-made (due to mechanical disturbance) or natural (due to climate changes). Only a portion of the area designated as potential wetland number 4 in the Jones and Stokes report now exists. It appears that some activity in this area between 1989 and the present may have altered site conditions. A potential wetland area delineated west of the new EPA building in this study was not shown on the Jones and Stokes map. This area may not have met the wetland criteria in 1989 due to drought conditions. Near normal rainfall has created the necessary conditions which allows this area to be considered a potential jurisdictional wetland.

The potential wetland designated number 7 on the Jones and Stokes map appears to have been misplaced. This area was thoroughly searched and no wetland indicators were found. However, an area of similar size to the south along Lark Drive was delineated as potential jurisdictional wetlands in this study.

Chapter VI
HYDROLOGY AND WATER QUALITY

■ ■ ■

This section presents the existing hydrologic conditions of the Richmond Research Center site which may influence its potential development, or may be affected by proposed development. They include local drainage issues, tidal influence, and water quality concerns.

A. Site Characteristics

The Richmond Research Center site totals approximately 152 acres, of which 104 acres are upland and 48 acres are tidal wetland below the 6-foot contour[1]. The upland is located on a relatively flat coastal plain on the eastern shore of San Francisco Bay. Elevations on the upland site range from approximately 30 feet above the National Geodetic Vertical datum (NGVD) on the north to approximately 9 feet at the upland edge to the south. The edge is protected by a rubble rip rap barrier. The tidal area is divided into an "inner" and "outer" marsh by a railroad embankment which now is part of the East Bay Shoreline Trail system. Below the riprap the inner marsh slopes from high marsh elevations of approximately 3.5 feet, to 2.5 feet at the railroad embankment. The outer marsh elevations range from approximately 2 feet to subtidal elevations.

B. Drainage and Runoff

Hydrologic characteristics of the site indicate moderate to high runoff rates. The soils on the majority of the site are mapped as Clear Lake clay, with the remaining portion of the site mapped as urban lands.[2] A soils map is included in Chapter 5, Biology. Clear Lake clay has very low infiltration rates and

[1] University of California, Berkeley. 1993. "Richmond Research Center Master Plan Administrative Draft". Physical and Environmental Planning Office. Berkeley, CA.

[2] USDA Soil Conservation Service. 1977. *Soil Survey of Contra Costa County, California.*

therefore high runoff rates. The soil has been described as interbedded layers of alluvial sand, gravel, and clay on top of bedrock.[3] Impervious surface on the site consists of numerous small buildings and several narrow roadways. The exact percent of impervious surface has not been established. While infiltration is low and rainfall runoff generated on site would appear high, the rate of runoff leaving the site is reduced by the long overland flow distances which increases the time of concentration, and undulating topography which creates significant surface depression storage on the site.

Surface drainage is by overland flow and two stormdrain lines, as shown in Figure 10. Drainage to the west is by overland flow to Meeker Ditch. Meeker Ditch is a concrete trapezoidal channel which extends along the western boundary of the site at Regatta Boulevard (32nd Street) to Highway 580. Its drainage area, design capacity, and other hydrologic features are not currently available.[4] Overland flow to the southwest is conveyed in an open channel along Avocet Way directly to the inner marsh. A 24-inch storm drain line, formerly a sanitary sewer overflow line, flows southerly along the westerly side of Avocet Way and discharges into Meeker Slough. The portion of this storm drain which flows under the EPA regional laboratory was replaced during construction of that facility. A portion of the overland flow from the north of Crow Way is intercepted by two catch basins and directed to this stormdrain. Drainage from the east is captured by a series of catch basins along Egret Rd. which connect to an 18-inch by 24-inch oval stormdrain which flows to the inner marsh.

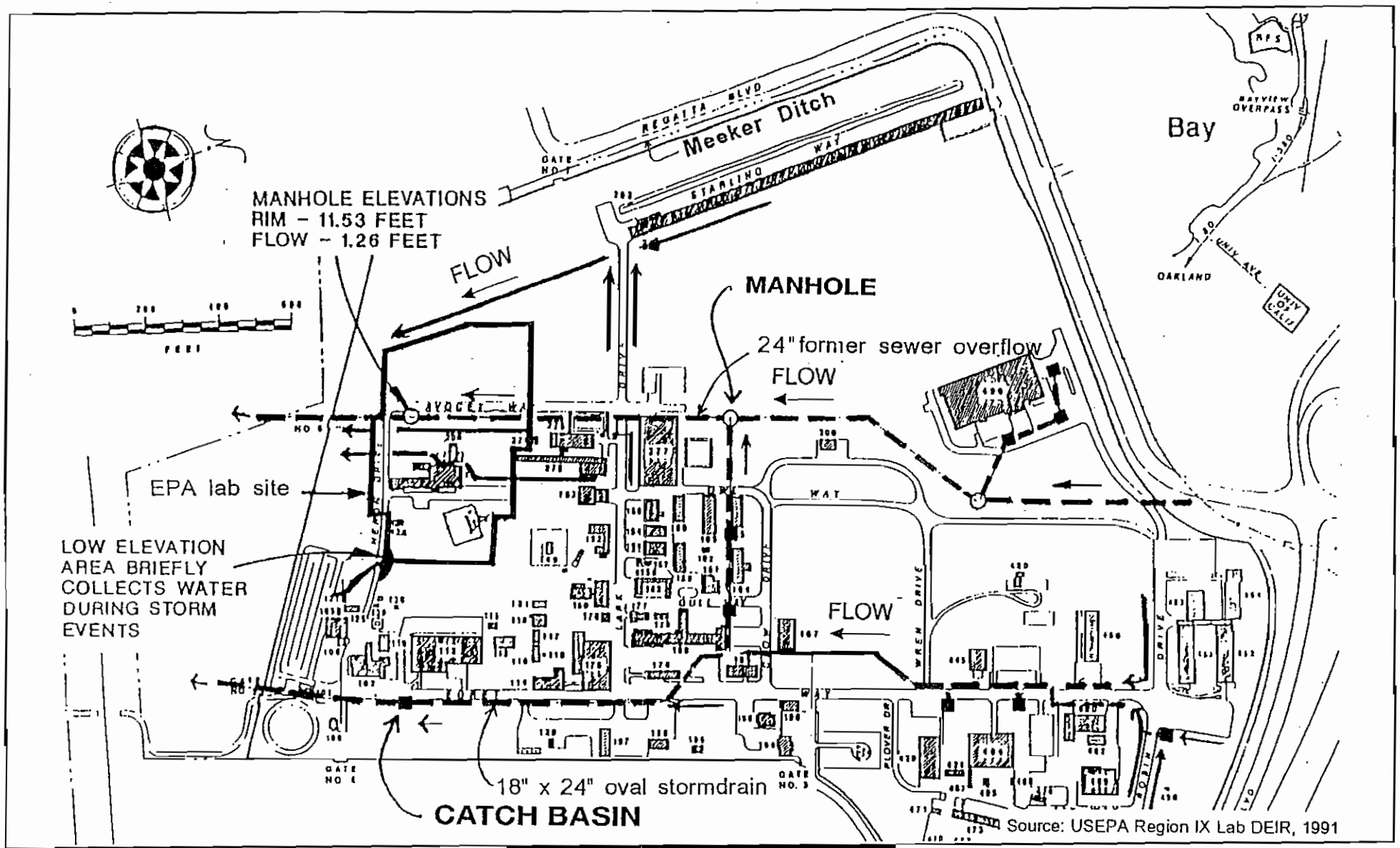
C. Tidal Area

The natural shoreline of the site is in a high wave energy environment which prevented the formation of tidal salt marsh. The existing marsh formed in the lee of a breakwater which was constructed prior to 1947.[5] The marsh was divided into an inner marsh and outer marsh by a railroad embankment fill constructed between 1947 and 1969. The railroad right-of-way is now part of the East Bay Shoreline Trail system. An area of fill of approximately 2.5 to 3.5 acres was placed along the northern edge of the marsh between 1947 and 1969. A linear fill area of approximately 1 acre was placed in the inner marsh between 1947 and 1969, replacing a previous linear fill area visible in 1947

[3] Richmond Research Center Master Plan, Administrative Draft.

[4] Ajit Sarkar, City of Richmond Public Works, Personal Communication

[5] Abbe, T. 1992. "Wave Energy and Wetland Evolution, Richmond, CA".



Underground Culvert

Open Ditch

Richmond Research Center
ENVIRONMENTAL IMPACT REPORT

FIGURE 10

Storm Drains

BRADY AND ASSOCIATES, INC.
PLANNERS AND LANDSCAPE ARCHITECTS

aerial photographs. The westerly portion of the marsh has a well defined slough channel system and appears to receive adequate tidal circulation. The eastern portion of the marsh does not have a well defined drainage system and circulation is hampered. There is a small impoundment on the southeast corner of the inner marsh which is connected to the main marsh by a 12-inch culvert. The circulation in this impoundment is poor and the culvert is in poor condition.

The Bay Conservation and Development Commission (BCDC) has jurisdiction over development activities below the 6-foot contour. Only the tidal marsh area is below this elevation. BCDC does not have jurisdiction over the existing fill areas as they predate the Commission's mandate (personal communication, Joe LeClare, BCDC).

D. Flood Hazards

The south side of Heron Drive would be in the 100-year floodplain indicated on the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), 1979.[6] However, the current elevation of Heron Drive is above tidal flood elevation as indicated below. Heron Drive was evidently constructed after 1977 on fill placed along the shoreline and protected by the rip rap barrier described above.

1. Tidal Flooding

The 100-year tide elevation for the South Richmond Shoreline area was revised upward from 6.0 feet to 6.3 feet in 1983 based on a study by the U.S. Army Corps of Engineers (COE).[7] The upland portions of the site are above this elevation and not subject to tidal flooding.

2. Surface Run-off Flooding

Flooding from surface water runoff is a result of a combination of high tides and stormwater runoff. Meeker Ditch is tidally influenced, so any drainage facility connected to it would be hampered by high tides. The culvert outlets

[6] University of California, Berkeley, Physical and Environmental Planning Group. 1991. "U.S. Environmental Protection Agency, Region IX Laboratory at the University of California's Richmond Field Station, Draft Environmental Impact Report". Berkeley, CA.

[7] U.S. Army Corps of Engineers. 1984. "San Francisco Bay Tidal Stage vs. Frequency Study". San Francisco, CA.

are at elevation 3.5 feet NGVD, below the highest tide elevations. Flooding of the site occurred in 1983 when a high tide of approximately 7 feet coincided with a 65-year storm and tidal water backed up into the storm drains. Ponded storm water runoff was able to drain when the tide receded.

E. Water Quality

The quality of stormwater runoff from the site is not currently monitored or regulated. However, regulations currently in effect will be applied to the Richmond Research Center Site when development plans are proposed. These stormwater regulations are described below. In addition, there may be some groundwater quality concerns.

1. Ground Water Quality

Historically, the Research Center site and surrounding areas have been subjected to industrial use and other disturbances which have affected the hydrology and soil quality of the area. From the mid-1800s through the end of WWII, factories produced ammunition on the Richmond Research Center site. Although production ended after the war, thorough studies of the soil and ground water have not been conducted to ascertain whether or not permanent, significant contamination occurred. An analysis of acidity and sulfate concentrations in the marsh was completed in 1979 and indicates that contamination from polluted ground water, draining into the marsh, could be an issue of concern. Production of sulfuric acid and other commercial chemicals by the adjacent Stauffer Chemical Company (now Zeneca) could be the source of ground contamination.

Tidal circulation is restricted along the eastern border and in the northeastern corner of Inner Hoffman Marsh. A small pool of standing water in the southeastern corner of the marsh has been isolated from adjacent tidal creeks by a small road, known as Road 294, built in the 1970s. Although a culvert below the road allows high tide waters to reach this pool, flow is extremely limited. Vegetation around the small pool is sparse and concentrated above the high tide line (6 feet NGVD). Surface water in this southeastern corner had a very low pH (2.7) and sulfate contents twice that of other areas surveyed.[8] Although further studies should be performed, these results

[8] Murry, M.A., and A.J. Horne. 1979. Studies on Hoffman Salt Marsh; Richmond, California. Initial Studies on the Inner Marsh and Its Acid Pollution. Sanitary Engineering Research Laboratory, University of California at Berkeley.

indicate that ground water contamination and lack of tidal flushing in this area could be the cause of the high acidity detected in this isolated pool.

2. NPDES Permit

Storm runoff from urban areas contains a variety of pollutants, including metals, nitrates and phosphates, oil and grease, bacteria and viruses, toxic organics, and pesticides.[9,10] The discharge of stormwater runoff is regulated under the National Permitted Discharge Elimination System (NPDES), as mandated by the 1987 amendments to the Clean Water Act. In California, this program is administered by the State through the Regional Water Quality Control Boards. The State currently requires NPDES discharge permits for industrial activities and construction activities covering more than 5 acres.

The City of Richmond is also required by the State to obtain a municipal NPDES stormwater discharge permit. Under this permit, which is being developed in conjunction with a county-wide program, the City of Richmond must implement a municipal stormwater management plan that includes permitting and review of new developments.

The University of California is required to comply with the Clean Water Act and the NPDES system, but they are not specifically required to follow the City of Richmond's permitting process. However, if the University chooses not to follow Richmond's requirements as established by the City's municipal NPDES permit, the Regional Water Quality Control Board could require independent permitting for the University. In addition, if the University is not cooperative with the City, those actions could be seen as regulatory and enforcement problems by the Regional Water Quality Control Board.[11]

Both the State NPDES and City permitting programs are relatively non-specific regarding the types of Best Management Practices (BMP) that are required. The general approach is to have applicants design and submit stormwater management plans for review on a case-by-case basis by the permitting

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[9] The U.S. Environmental Protection Agency (EPA). 1983. Final Report of the Nationwide Urban Runoff Program, Water Planning Division. December.

[10] Woodward-Clyde Consultants. 1991. Alameda County Urban Runoff Clean Water Program, Loads Assessment Report. Prepared for the Alameda County Flood Control and Water Conservation District. October.

[11] Tom Mumley. Regional Water Quality Control Board.

agencies. Recommended BMPs are summarized in the State BMP manuals,[12] and include both source and treatment control measures. Source control measures focus on reducing the use and buildup of pollutants within the watershed, and include public education programs, household hazardous waste disposal, land use planning, street and storm drain maintenance, and erosion control. Treatment control measures remove pollutants from stormwater prior to discharge, and involve facilities such as wet ponds, detention/retention basins, swales, and stormwater treatment wetlands.

[12] Stormwater Quality Task Force. 1993. California Stormwater Best Management Practices Handbooks. March.

APPENDIX: BIOLOGICAL RESOURCES

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Plants identified during the routine delineation study at the Richmond Field Station, UC Berkeley. Wetland classification (Reed 1988) is based on U.S. Fish and Wildlife Service National List of Plant Species That Occur in Wetlands: California (Region 0). An (I) indicates introduced species; (N) indicates California native species.

Species	Common Name	Wetland Status
Aira elegantissima (I)	elegant european hairgrass	NL
Aster spp. (N)	aster	
Atriplex patula (N)	saltbush	FACW
Avena fatua (I)	wild oat	NL
Bellardia trixago (I)	bellardia	NL
Brassica nigra (I)	black mustard	NL
Bromus hordeaceus (I) (formerly B. mollis)	soft chess	FACU
Carduus pycnocephalus (I)	Italian thistle	NL
Carex tumulicola (N)	foothill sedge	NL
Cyperus eragrostis	umbrella sedge	FACW
Danthonia californica (N)	California oatgrass	FACW
Dipsacus fullonum (I)	wild teasel	NL
Distichlis spicata (N)	saltgrass	FACW
Epilobium sp.	willow herb	
Eschscholzia californica (N)	California poppy	NL
Frankenia salina (N) (formerly F. grandifolia)	alkali heath	FACW
Grindelia hirsutula var. hirsutula (N)	gumplant	NL
Grindelia stricta var. angustifolia (N) (formerly G. humilis)	marsh gumplant	FACW
Hordeum brachyantherum (N)	meadow barley	FACW
Jaumea carnosa (N)	jaumea	
Limonium californicum (I)	western marsh rosemary	FACW
Juncus phaeocephalus var. paniculatus (N)	rush	FACW
Juncus occidentalus (N)	rush	FACW
Elymus glaucus (N)	blue wildrye	NL
Lolium multiflorum (I)	Italian ryegrass	FAC
Lupinus variicolor (N)	lupine	NL
Nassella pulchra (N) (formerly Stipa pulchra)	purple needle grass	NL
Phalaris aquatica (I)	Harding grass	FAC
Picris echiodes (I)	prickly ox-tongue	FAC
Plantago lanceolata (I)	English plantain	FAC
Rumex crispus (I)	curly dock	FAC
Salicornia virginica (N)	pickleweed	OBL
Scirpus robustus (N)	bulrush	OBL

Species	Common Name	Wetland Status
Sisrynchium bellum (N)	blue-eyed grass	FAC
Spartina foliosa (N)	cord grass	OBL
Spiranthes sp.	ladies tresses	
Wyethia angustifolia (N)	mule ear	FACU

BIRDS RECORDED AT THE DC RICHMOND FIELD STATION
Based on documented observations, January 1987-April 1989

Loon (species)
Western Grebe
Clark's Grebe
Brown Pelican
White Pelican
Double-crested Cormorant
Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night Heron
Green-backed Heron
Canada Goose
Mallard
Gadwall
Green-winged Teal
Cinnamon Teal
American Wigeon
Eurasian Wigeon
Ruddy Duck
Canvasback
Lesser Scaup
Greater Scaup
Surf Scoter
White-winged Scoter
Barrow's Goldeneye
Common Goldeneye
Bufflehead
Red-breasted Merganser
American Coot
Killdeer
Black-bellied Plover
Semi-palmated Plover
Long-billed Curlew
Whimbrel
Marbled Godvit
Willet
Greater Yellowlegs
Dowitcher (species)
Black Turnstone
Dunlin
American Avocet
Western Sandpiper
Least Sandpiper
Sanderling
Bonaparte's Gull
California Gull
Glaucous-winged Gull
Western Gull
Forster's Tern
Caspian Tern
Turkey Vulture
Osprey
Black-shouldered Kite
Northern Harrier
Cooper's Hawk
Sharp-shinned Hawk
Red-tailed Hawk
American Kestrel
California Quail
Ring-necked Pheasant
Rock Dove
Mourning Dove
Red-crowned Parrot
Great-horned Owl
Anna's Hummingbird
Allen's Hummingbird
Belted Kingfisher
Northern Flicker
Red-breasted Sapsucker
Williamson's Sapsucker
Western Wood Pewee
Black Phoebe
Says Phoebe
Willow Flycatcher
Western Flycatcher
Northern Rough-winged Swallow
Barn Swallow
Scrub Jay
Common Raven
American Crow
Chestnut-backed Chickadee
Bushtit
Ruby-crowned Kinglet
Hermit Thrush
American Robin
Loggerhead Shrike
Northern Mockingbird
Water Pipit
Cedar Waxwing
European Starling
Yellow-rumped Warbler
Wilson's Warbler
Common Yellowthroat
Brown Towhee
Savannah Sparrow
Song Sparrow
Golden-crowned Sparrow
White-crowned Sparrow
Fox Sparrow
Lincoln's Sparrow
Dark-eyed Junco
Red-winged Blackbird
Brewer's Blackbird
Brown-headed Cowbird
Western Meadowlark
House Finch
Pine Siskin
American Goldfinch
Lesser Goldfinch
House Sparrow

*Includes 'accidentals'

Prepared by Kay Loughman, KRLF, 400 RFS, May 3, 1989

SHOREBIRDS, WATERFOWL, AND SEABIRDS RECORDED AT THE UC RICHMOND FIELD STATION
Based on documented observations, January 1987-April 1989*

Loon (species)
Western Grebe
Clark's Grebe
Brown Pelican
White Pelican
Double-crested Cormorant
Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night Heron
Green-backed Heron
Canada Goose
Mallard
Gadwall
Green-winged Teal
Cinnamon Teal
American Wigeon
Eurasian Wigeon
Ruddy Duck
Canvasback
Lesser Scaup
Greater Scaup
Surf Scoter
White-winged Scoter
Barrow's Goldeneye
Common Goldeneye
Bufflehead
Red-breasted Merganser
American Coot
Killdeer
Black-bellied Plover
Semi-palmated Plover
Long-billed Curlew
Whimbrel
Marbled Godwit
Willet
Greater Yellowlegs
Dowitcher (species)
Black Turnstone
Dunlin
American Avocet
Western Sandpiper
Least Sandpiper
Sanderling
Bonaparte's Gull
California Gull
Glaucous-winged Gull
Western Gull
Forster's Tern
Caspian Tern
Osprey
Belted Kingfisher

*NOTE: Since I have had regular access to the shoreline only since January 1989, all sightings are included.

Prepared by Kay Loughman, NRLF, 400 RFS, May 3, 1989

BIRDS RECORDED IN THE SALT MARSH AT THE DC RICHMOND FIELD STATION
Based on documented observations, January 1987-April 1989*

+ = also recorded in grasslands
n = nests seen at RFS

+ Great Blue Heron
Great Egret
Snowy Egret
Black-crowned Night Heron
Green-backed Heron
Canada Goose
+ Mallard (n)
+ Killdeer (n)
Semi-Palmated Plover
Long-billed Curlew
Whimbrel
Marbled Godwit
Willet
Greater Yellowlegs
+ Turkey Vulture
Osprey
+ Black-shouldered Kite (n)
+ Northern Harrier
+ Sharp-shinned Hawk
+ Red-tailed Hawk (n)
+ American Kestrel
+ Rock Dove
+ Mourning Dove (n)
+ Great-horned Owl (n)
+ Anna's Hummingbird
Belted Kingfisher
+ Northern Flicker
+ Black Phoebe
+ Says Phoebe
+ Western Flycatcher
Willow Flycatcher
+ Northern Rough-winged Swallow
+ Barn Swallow
Common Raven
+ American Crow
+ Bushtit (n)
+ Loggerhead Shrike
+ Northern Mockingbird
+ Water Pipit
+ European Starling (n)
+ Yellow-rumped Warbler
+ Common Yellowthroat
+ Savannah Sparrow
+ Song Sparrow (n)
+ Golden-crowned Sparrow
+ White-crowned Sparrow
+ Red-winged Blackbird
+ Western Meadowlark
+ House Finch
+ American Goldfinch
+ Lesser Goldfinch

*NOTE: Since I have had regular access to the salt marsh only since January 1989, all sightings are included.

Prepared by Kay Loughman, NRLF, 400 RFS, May 3, 1989

BIRDS RECORDED IN THE GRASSLANDS AT THE UC RICHMOND FIELD STATION
Based on documented observations, January 1987-March 1989

Legend: r = resident at RFS; n = nests seen at RFS ; + = also recorded in salt marsh
Sp = Spring; Su = Summer; F = Fall; W = Winter

	Species	Sp	Su	F	W
+	Great Blue Heron			X	X
+	Mallard (r) (n)	X	X	X	X
+	Killdeer (r)	X	X	X	X
+	Turkey Vulture (r)	X	X	X	X
+	Black Shouldered Kite (n)	X		X	X
+	Northern Harrier	X	X	X	X
	Cooper's Hawk				X
+	Sharp-shinned Hawk				X
+	Red-tailed Hawk (r) (n)	X	X	X	X
+	American Kestrel (r)	X	X	X	X
	California Quail	X			X
	Ring-necked Pheasant	X			
+	Rock Dove (r)	X	X	X	X
+	Mourning Dove (r) (n)	X	X	X	X
+	Great-horned Owl (r?) (n)	X	X		
+	Anna's Hummingbird (r)	X	X	X	X
	Allen's Hummingbird	X	X		
+	Northern Flicker			X	X
+	Black Phoebe (r)	X	X	X	X
+	Says Phoebe			X	X
+	Western Flycatcher			X	
+	Northern Rough-winged Swallow		X		
+	Barn Swallow	X	X		
+	American Crow (r)	X	X	X	X
+	Bushtit (r) (n)	X	X	X	X
	Hermit Thrush	X		X	X
	American Robin (r) (n)	X	X	X	X
+	Loggerhead Shrike	X		X	X
+	Northern Mockingbird (r)	X	X	X	X
+	Water Pipit				X
+	European Starling (r) (n)	X	X	X	X
+	Yellow-rumped Warbler			X	X
+	Common Yellowthroat				X
	Brown Towhee (r)	X	X	X	X
+	Savannah Sparrow			X	X
+	Song Sparrow (r) (n)	X	X	X	X
+	Golden-crowned Sparrow			X	X
+	White-crowned Sparrow			X	X
	Lincoln's Sparrow			X	X
+	Red-winged Blackbird (r)	X	X	X	X
	Brewer's Blackbird	X			
	Brown-headed Cowbird	X			
+	Western Meadowlark			X	X
+	House Finch (r)	X	X	X	X
+	American Goldfinch	X	X	X	X
+	Lesser Goldfinch		X		
	House Sparrow	X	X		

NOTE: Species observed fewer than four times in any year are considered 'accidentals,' and are not included in this list.

Prepared by Kay Loughman, WRLF, 400 RFS, April 13, 1989

MAMMALS RECORDED AT UC RICHMOND FIELD STATION
January - May 1989

(Identifications by Joyce Gutstein, SEEHRL, and Wm. Lidicker, Dept. of Zoology)

Microtis californicus - California vole
Mus musculus - house mouse (I)
Rattus rattus - roof rat (prob. iden.) (I)
Thomomys bottae - valley pocket gopher
Spermophilus beecheyi - California ground squirrel
Lepus californicus - black-tailed jackrabbit

Mephitis mephitis - striped skunk
Procyon lotor - raccoon
Vulpes fulva - red fox (probable identification) (I)
Mustela frenata - long-tailed weasel (possible sighting)

Didelphis virginiana - Virgina opposum (I)

possibles: As stated by Wm. Lidicker, Dept. of Zoology, UCB

Sorex vagrans halicoetes - vagrant shrew
Scapanus latimanus - broad-footed mole
Rheithrodontomys megalotis - western harvest mouse
Rheithrodontomys raviventris raviventris - salt marsh harvest mouse (endangered)
Eptesicus fuscus -big-brown bat
Lasiurus cinereus - hoary bat
Myotis californicus
Myotis yumanensis
Myotis volans
Myotis thysanodes
Myotis evotis
Lasionycteris noctivagans
Lasiurus borealis
Plecotus townsendii
Tadarida brasiliensis

Reptiles and Amphibians of the Richmond Field Station

REPTILES

Thamnophis elegans (western terrestrial garter snake) - Uncommon

Thamnophis sirtalis (common garter snake) - Uncommon

Pituophis melanoleucus (gopher snake) - Common

Coluber constrictor (racer) - Moderately common

Diadophis punctatus (western ring-necked snake) - Probably occurs; known from Point Pinole.

Sceloporus occidentalis (western fence lizard) - Moderately common.

Elgaria multicarinata (southern alligator lizard) - Possibly present; known from Point Pinole.

Elgaria coerulea (northern alligator lizard) - Not recorded from the Station, but known from nearby Brooks Island.

AMPHIBIANS

Hyla regilla (Pacific treefrog) - Common

Batrachoseps attenuatus (slender salamander) - Uncommon; usually found near edges of saltmarsh.

This list includes 10 species, only 7 of which are definitely known to be present at the Richmond Field Station.

compiled by
W. Z. Lidicker, Jr.
in consultation with
H. W. Greene

April, 1989

BERKELEY: ENTOMOLOGY AND PARASITOLOGY

24 August 1992

TO: Provost J. Cerny
Chair RFS Planning Committee
Office of the Provost for Research
Graduate Division
Sproul Hall

RECD GRADUATE DIVISION
Date: 8-25-92

FROM J. A. Powell

Bill Lidicker suggested that I send you a copy of the enclosed survey of Lepidoptera (moths and butterflies) species at the Richmond Field Station.

This cursory survey is based on several brief visits during February- June. It enumerates about 70 species, which I estimate to be about 40% of a potential resident fauna. I was surprised to find five or six species that we had not known to occur in the East Bay previously, which suggests that the remnant coastal prairie and salt marsh area ought to be preserved for further study.

The proximity and ownership status enable realistic visits to RFS during a lab session; such sites are virtually lacking for courses in organismal biology.

cc: W. Lidicker, Jr.

RICHMOND FIELD STATION LEPIDOPTERA

Jerry A. Powell
Dept. Entomological Sciences, University of California, Berkeley

Revised August, 1992.

The following list records about 70 species, members of 24 families, of moths and butterflies that were observed at the University of California, Richmond Field Station (RFS), Contra Costa Co., CA, February to June, 1992. Observations were made during 12 daytime visits of 1.5-2.5 hrs each, by J. A. Powell or Y.-F. Hsu. Larvae, leaf mines, or galls were recorded for 31 species (44%), adults only for the remainder.

Based on the number of butterfly speoies observed, 17 (13 probably resident, mostly feeding on weedy plants), I estimate that 160-200 species of moths inhabit RFS. A thorough inventory would depend in large part on nocturnal sampling by ultraviolet lights, through all seasons over a several year period. Such a census in a site the size and configuration of RFS, however, would include an unknowable number of vagrant species, attracted to the lights from outside the Station.

Larval hostplant relationships.-- Among 66 species thought to be resident at RFS, larvae or larval mines of 31 (48%) were discovered; larval foods of 29 others can be extrapolated with confidence, based on knowledge from other populations; likely hostplant associations were observed at RFS for 3 of the remaining 6. Hence, larval foods of 91% are accounted for, 95% including those projected from adult-plant associations.

While obviously not completely inventoried, this appears to be a relatively depauperate lepidopterous fauna, considering the known flora (100+ plant species). This phenomenon could be predicted from the architecture of the plant community and the disproportionate representation of exotic plants. In general, trees support the largest numbers of phytophagous insects, followed by shrubs, larger forbs, and annual herbs and monocots with the fewest. For example, at the Antioch National Wildlife Refuge in eastern Contra Costa County, there are 110 native plant species in the perturbed community, and these harbor 35 species of butterflies and at least 134 species of smaller moths (microlepidoptera), contrasted with 17 and 34, respectively, known at RFS. At Antioch, about half the microlepidoptera feed on 7 species of woody plants, only four of which have generic counterparts at RFS, and oaks and willows support 31% of the small moths. At RFS, only Baccharis fills a dominant role of the woody superstructure, harboring 8 species (12.5% of the resident Lepidoptera). At least 32 of the resident species (48%) are generalist feeders and/or depend upon weedy plants at this site, or are detritivores.

Rare and biologically significant species.-- At least six species of smaller moths are noteworthy, their populations representing new records for the East Bay area and/or providing potentially new larval hostplant associations.

1. Coleophora species.
We reared this moth from case-bearing larvae on Aster. I have not seen the species previously. Specimens will be sent to J.-F. Landry at Ottawa, who is currently studying the group.

2. Heliodines species near sexpunctella Walsingham.
This is the first known occurrence of Heliodines in the East Bay area. The taxonomic status is under study by Y.-F. Hsu; the larval biology is unknown.

3. Eucosma conspiciendana (Walsingham)
This species has been taken at lights in the East Bay (Orinda), but adults taken in close association with Aster at RFS provide the first clue to the larval biology. I hope the south field of the coastal prairie can be preserved so that the colony can be studied next season.

4. Phaneta corculana (Zeller)
This species was described originally from Vancouver Island and has remained poorly known. It has been recorded in more boreal parts of California but not in low coastal areas previously. Adults were associated with Wyethia, which provides the first suggestion of its larval biology.

5. Phaneta minimana (Heinrich)
One adult of this tiny tortricid was taken from Artemisia californica, which presumably was planted on the railroad bed bordering the salt marsh, a hostplant association that has been recorded for minimana elsewhere. This species was described from San Diego originally and has not previously been recorded north of Monterey County.

6. Anatralata versicolor (Warren)
This diurnal moth has a wide range in the mountains, from British Columbia to the Sierra Nevada, mostly at higher elevations. We have two recent records in serpentine grasslands in Alameda and San Mateo counties, and now in coastal prairie at RFS, perhaps a relict of once more extensive occurrence at low elevations. The adults were taken in close association with Wyethia, the first indication of a hostplant relationship for this or related genera.

LIST OF THE OBSERVED LEPIDOPTERA

(Abbreviations: e=exotic species, n=native; r=resident, v=vagrant; ad=adult observed, la=larvae or larval mines, galls observed; II-VI, February to June. Larval collections designated by lot numbers, e.g. 92B7= collection 7 in February, 1992. *=association with exotic or weedy larval hostplant.

NEPTICULIDAE

Stigmella heteromelis Wilkinson & Scoble — n, r
ad: la: mines Heteromeles arbutifolia (abandoned II, 92B..)

HELIOZELIDAE

Coptodisca saliciella (Clemens) — n, r
ad: VII, diurnal; la: leaf miner on Salix lasiolepis (92F10)

TINEIDAE

Amydria sp. — n, r
ad: IV la: detritivore, likely in mammal burrow

GRACILLARIIDAE

Cremastobombycia sp. 1 — n, r
ad: III la: leaf mines on Grindelia humilis, II, III, VI (92B7, 92C10, 92F14)

Cremastobombycia sp. 2 — n, r
ad: IV la: mines leaves of Baccharis pilularis, III, VI (92C8.1, 92F13)

Marmara sp. — n, r*
ad: la: mines stems of Rubus (abandoned II, 92B)

BUCCULATRICIDAE

Bucculatrix variabilis Braun — n, r
ad: IV, nocturnal la: mines first, then feeds externally, on Baccharis pilularis, II (92B4, 92D44).

Bucculatrix sp. — n, r
ad: VI la: likely a skeletonizer on Artemisia californica

BLASTOBASIDAE

Hypatopa sp. — n, r
ad: IV, V la: feeds in dry seed of Rumex, II (92B2)

COLEOPHORIDAE

Batrachedra salicipomonella Clemens — n, r
ad: VI, VII, nocturnal; la: in Salix leaf galls caused by the sawfly, Pontania californica (Tenthredinidae), IV, VI (92D60, 92F12).

Coleophora baccharella Landry ms — n, r
ad: VIII; la: case bearer on Baccharis pilularis, II, III, IV, VI (92B4.1, 92C80, 92D43, 92D61, 92F13)

Coleophora sp. 2 — n, r
ad: IV; la: case bearer on Aster, III (92C5)

GELECHIIDAE

Aristotelia argentifera Busck n, r
ad: V, nocturnal; la: tip webber on Baccharis pilularis (92D43).

Chionodes ochreistrigella (Chambers) n, r*
ad: V,VI, VII, nocturnal; la: external feeder on Rumex crispus, IV, VI (92D65, 92F7).

Chionodes sp.? n, r
ad: VI la: unknown

Gnorimoschema baccharisella Busck n, r
ad: la: stem gall maker on Baccharis pilularis, abandoned II, immature III (92B3), V (92E236).

Gnorimoschema ?subterranea Busck n, r
ad: la: stem gall maker on Aster, III, IV, V (92C6, 92E236)

unplaced sp. 1 n, r
ad: la: leaf tier on Grindelia humilis, III (92C9, 92C25)

Scrobipalpula psiliella complex n, r
ad: IV, nocturnal; la: tip borer in Gnaphalium, III (92C11).

PLUTELLIDAE

Plutella xylostella (L.) e, r*
ad: VI la: external feeder on Lepidium & other weedy crucifers

HELIODINIDAE

Heliodines sp. n, r?
ad: IV, diurnal; la: unknown

SESIIDAE

Synanthedon bibionipennis (Boisduval) n, r*
ad: V,VI, diurnal wasp mimic; la: stem borer in Rubus

TORTRICIDAE

Epiblema strenuana (Walker) coastal strand race n, r
ad: III, VI la: stem borer in Ambrosia chamissonis (92F15)

Epinotia columbia (Kearfott) n, r
ad: IV, V, nocturnal; la: tip tier on Salix lasiolepis, III (92C26).

Epinotia infuscana (Walsingham) n, r
ad: IV; la: stem borer in Lupinus arboreus, III (92C23)

Eucosma conspiciendana Heinrich n, r
ad: V, assoc. Aster la: probably a root borer in Aster

Phaneta corculana (Zeller) n, r
ad: IV, assoc. Wyethia; la: stem borer

Phaneta minimana (Heinrich) n, r
ad: VI la: possibly twig borer in Artemisia californica

Acleris hastiana (L.)
ad: VII la: leaf tier on Salix lasiolepis, VI (92F11)

Argyrotaenia citrana (Fernald) n, r
ad: II, III, IV, assoc. Baccharis, multivoltine, nocturnal
la: general feeder

Clepsis peritana (Clemens) n, r
ad: IV, multivoltine, nocturnal la: general feeder,

especially on low herbs

Platynota stultana (Walsingham) e, r
ad: III, IV, V, VI, multivoltine, nocturnal; la: general feeder, found on Wyethia at RFS (92E237).

CRAMBIDAE

Anatralata versicolor (Warren) n, r
ad: IV, diurnal, assoc. Wyethia; la: unknown

Dicymolomia metaliferalis (Packard) n, r
ad: V, VI, nocturnal; la: scavenger, case-bearer

Diastictis fracturalis (Zeller) n, r
ad: IV; la: in terminals of Gnaphalium

Hellula rogatalis (Hulst) e, r*
ad: VI la: leaf miner first, then external feeder on Lepidium

Pyrausta subsequalis (Guenee) n, r*
ad: II, III, IV, V la: stem borer of Asteraceae

Udea profundalis (Packard) n, r*
ad: III, IV, VI la: leaf tier, general feeder on herbs

Uresiphita reversalis (Guenee) e, r*
ad: II, III, VI, nocturnal but flies readily during the day upon disturbance; la: colorful, exposed caterpillar on Cytisus monspessulanus (92F16) and Lupinus, at RFS on L. arboreus (92B8)

PYRALIDAE

Phycitodes mucidellum (Ragonot) n, r
ad: V la: feeds in flower heads of Asteraceae

PTEROPHORIDAE

Emmelina monodactyla (L.) e, r*
ad: V la: external feeder on Convolvulus arvensis, IV, V (92D108, 92E43)

Oidaematophorus grandis (Fish) n, r
ad: VII, VIII, nocturnal; la: stem borer in Baccharis pilularis, III- VI (92C7, 92F8)

Platyptilia williamsi Lange n, r
ad: III la: on Gnaphalium, II (92B10)

GEOMETRIDAE

Elpiste marcescaria (Guenee) n, r
ad: III, IV, VI la: external feeding inchworm on Baccharis pilularis

Perizoma custodiata (Guenee) n, r
ad: III, IV, VI la: external feeder on Salicornia?

Synaxis truxaliata complex n, r
ad: VI, nocturnal; la: stick mimic inchworm on Baccharis pilularis

ARCTIIDAE

Estigmene acrea (Drury) n, r*
ad: nocturnal la: general feeder, found at RFS on Melilotus indica, V (92E238).

NOCTUIDAE

Autographa californica (Speyer) n, r*
ad: III, V la: cutworm, general feeder, on Melilotus indica at RFS, IV (92D62).

Caenurgina erechtea (Cramer) n, r
ad: IV la: reported on grasses and other herbs

Leucania oregona Smith n, r
ad: V, nocturnal la: reported on grasses

Spodoptera exigua (Hubner) e, r*
ad: V, nocturnal; la: general feeding cutworm, at RFS found on an unidentified monocot, IV (92D66).

Undetermined species n?, r
ad: la: in terminal of Grindelia humilis, IV (92D64).

HESPERIIDAE

Hylephila phyleus (Drury) e, r*
ad: IV la: lawn grass

Paratrytone melane (Edwards) n, r
ad: IV la: Poaceae

Polites sabuleti (Boisduval) n, r
ad: IV, V la: Poaceae (native, weedy)

Pyrgus communis (Grote) n, r*
ad: IV la: leaf tier on Malva (weedy)

PAPILIONIDAE

Battus philenor (L.) n, v
ad: IV ; la: on Aristolochia

Papilio zelicaon Lucas e, r*
ad: III, V, VI la: external feeder on Foeniculum vulgare, IV (92D..)

PIERIDAE

Pieris rapae (L.) e, r*
ad: II, III, IV, V, VI la: external feeder on weedy Brassicaceae

Colias eurytheme Boisduval n, v
ad: III, IV, V la: on Fabaceae

Euchloe ausonides (Lucas) n, r*
ad: IV, oviposition on Brassica; la: exposed, on Brassica inflorescence

LYCAENIDAE

Lycaena xanthoides (Boisduval) n, r*
ad: V, VI la: external feeder on Rumex leaves

Strymon melinus Hubner n, r*
ad: VI la: general feeder on buds and flowers

NYMPHALIDAE

Danaus plexippus (L.) n, r
ad: overwintering aggregations in Eucalyptus, II, occasional

individuals III, IV; la: external feeder on Asclepias (winter resident but not breeding at RSF)

Junonia coenia (Hubner)
ad: II, IV, V, VI la: on Plantago n, r*

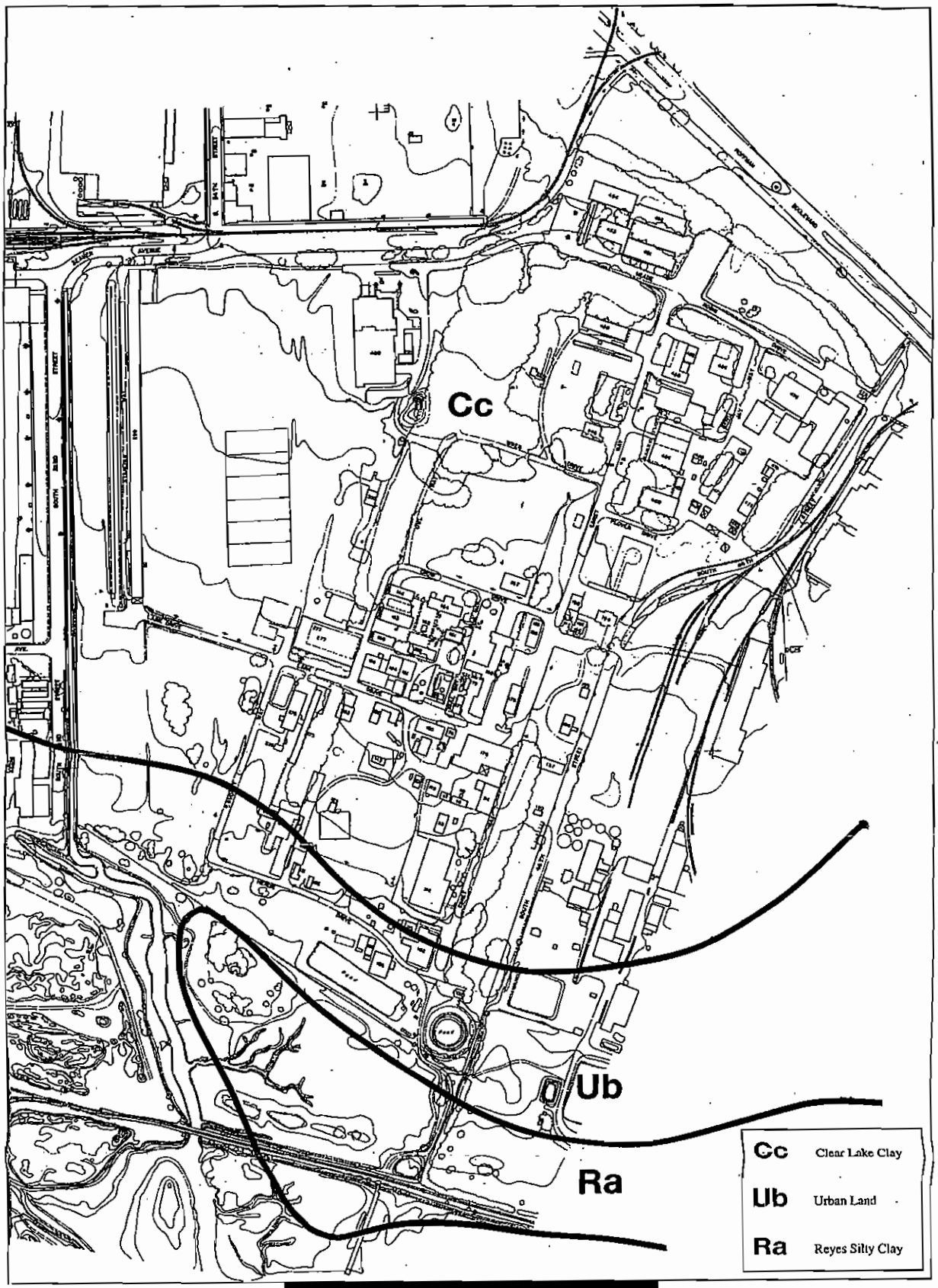
Vanessa annabella Field
ad: III la: leaf tier on Malva n, r*

Vanessa atalanta (L.)
ad: II la: on Urtica and weedy Parietaria n, v

Vanessa cardui (L.)
ad: IV, V, VI, migrant la: generalist n, v

SATYRIDAE

Coenonympha california Westwood
ad: IV, VI ; la: on Poaceae n, r



Richmond Research Center
ENVIRONMENTAL IMPACT REPORT

FIGURE 7
Soils Map

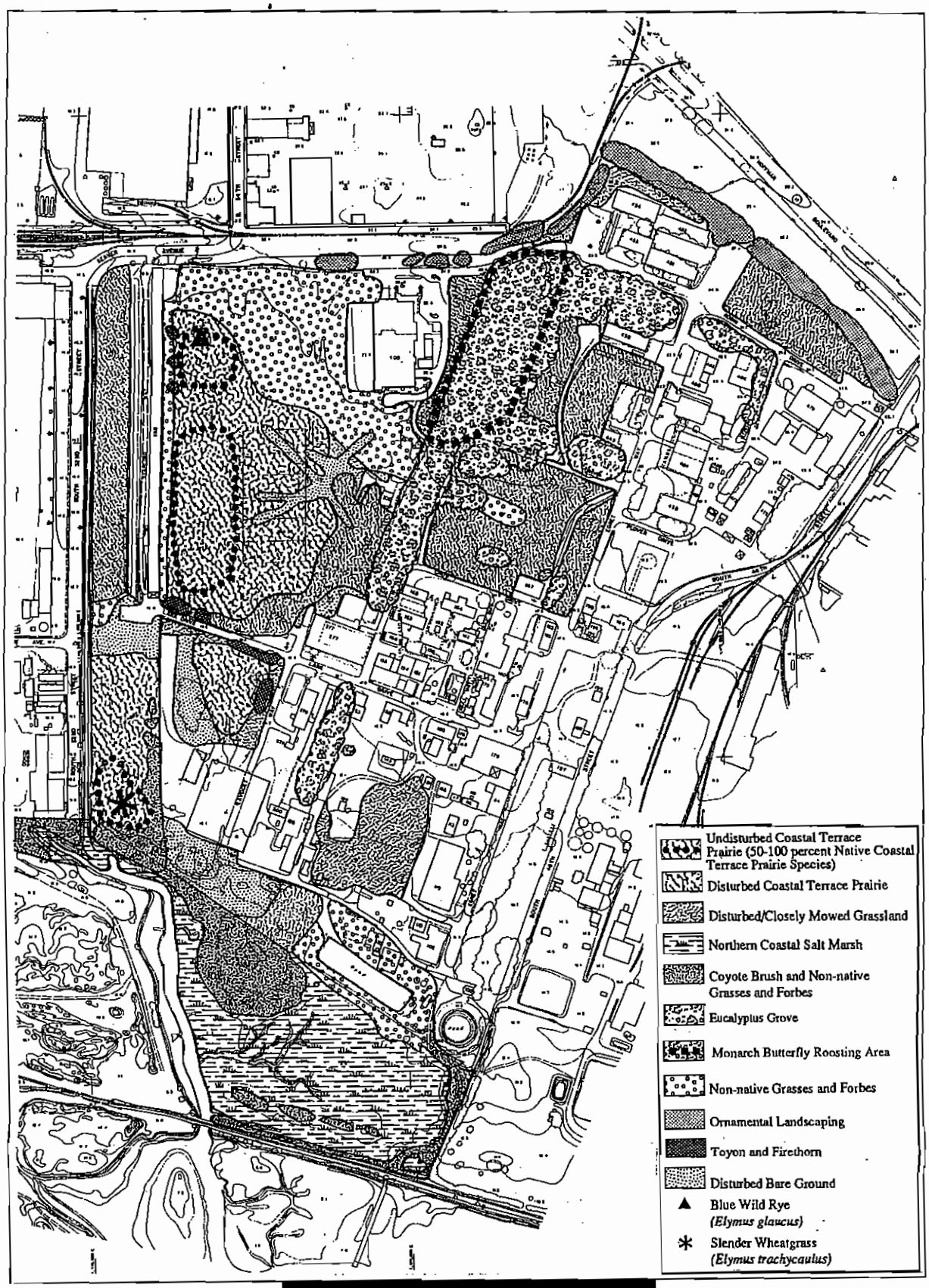


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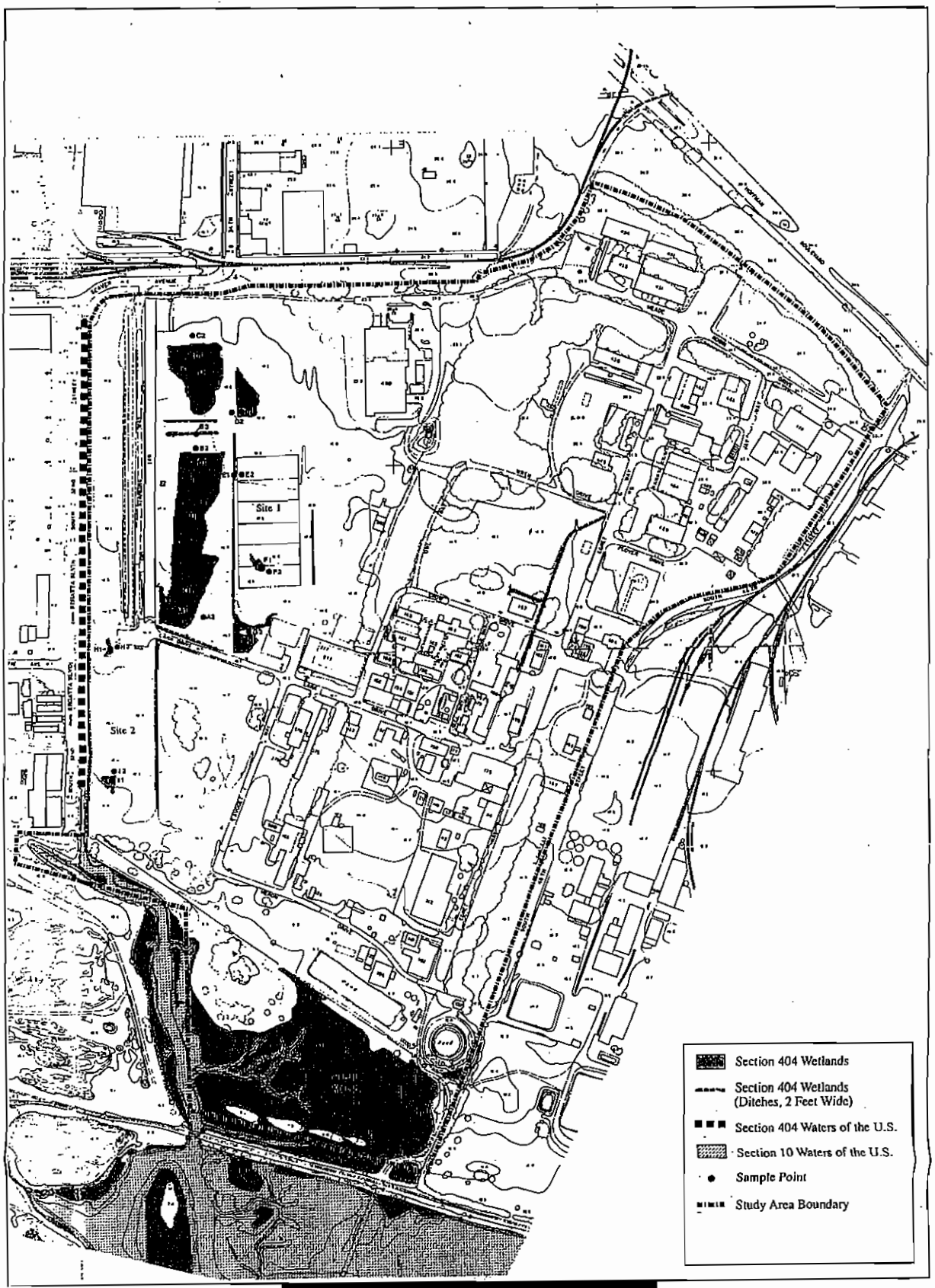
FIGURE 8
Habitat Areas



Richmond Research Center
ENVIRONMENTAL IMPACT REPORT

FIGURE 9
Wetlands: Potential Section 404 and Section 10 Jurisdiction

BRADY AND ASSOCIATES, INC.
PLANNERS AND LANDSCAPE ARCHITECTS