Oakland Alameda Access Project

Aquatic Resources Delineation Report

Caltrans District 04
Alameda County, California
EA 04-0G360
04-ALA-260 PM R0.78/R1.90
04-ALA-880 PM 30.47/31.61

March 2020

Prepared for:

ALAMEDA County Transportation Commission

Caltrans

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EXECUTIVE SUMMARY

The proposed Project (Project), the Oakland Alameda Access Project, is located in the cities of Oakland and Alameda in Alameda County, California. The Project would improve access along (I-880), the Posey and Webster Tubes, downtown Oakland, and the City of Alameda. The Project would improve access to northbound (NB) and southbound I-880 from the Posey Tube via a right-turn-only lane from the Posey Tube to 5th Street and a new horseshoe connector at Jackson Street below the I-880 viaduct that would connect to the existing NB I-880/Jackson Street on-ramp. The Project would also reconstruct and shift the existing westbound Interstate 980/Jackson Street off-ramp to the south.

The proposed Project is located in the Oakland West United States Geological Survey (USGS) 7.5 Minute quadrangle in the cities of Oakland and Alameda in Alameda County. The Project location is found in the Mount Diablo Meridian: Section 2, Township 2S, Range 4W.

As part of the environmental analysis, biological study areas (BSA) were established in Oakland and Alameda. The BSA encompasses the Project limits and a 100-foot buffer zone in order to determine potential indirect impacts that may be caused by construction. The BSA does not extend across the Oakland Estuary, because all work in that area would be contained within underground tunnels.

The purpose of this Aquatic Resources Delineation Report is to identify potential jurisdictional wetlands and “Other Waters of the U.S.” (OWUS) with the BSAs that could be regulated by the United States Army of Corps of Engineers (USACE) pursuant to Section 404 of the Clean Water Act (CWA). Wetlands were delineated using the 1987 USACE Delineation Manual and the 2008 Arid West Regional Supplement, routine approach method for areas greater than 5 acres.

Site visits were conducted in January 2016, March 2018, and September 2019 to locate and delineate potential wetlands and OWUS within the BSAs. Referenced materials were reviewed on February 19, 2020 to determine whether Waters of the U.S. (WOUS) including wetlands and OWUS are included in the BSA.

No wetlands were identified within the Oakland BSA, and two saline emergent wetlands were delineated just beyond the northeast boundary of the Alameda BSA. Lake Merritt Channel is a potentially jurisdictional OWUS in the Oakland BSA. However, the only construction activities that would occur near Lake Merritt Channel is roadway striping along the aerial I-880 structure, and no construction activities will take place in the channel. For these reasons, Lake Merritt Channel was not delineated for this report. The following table summarizes the geometry of the two saline emergent wetlands delineated near the Alameda BSA.

Based on aquatic resources searches conducted on February 19, 2020, no WOUS or other waters were observed in the BSA. Therefore, no wetlands, WOUS, or OWUS will be impacted by the Project.

Mapped Saline Emergent Wetlands

Aquatic Feature	Area (acres)	Area (square feet)	Length (linear feet)
Wetland A	0.014	607	47
Wetland B	0.06	2,716	335
Total	**0.074**	**3,323**	**382**

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Acronyms

BSA	Biological Study Area
Caltrans	California Department of Transportation
CWA	Clean Water Act
FAC	Facultative
FACU	Facultative Upland
FACW	Facultative Wetland
FEMA	Federal Emergency Management Agency
GPS	Global Positioning System
I-	Interstate
NB	Northbound
OBL	Obligate
OHWM	Ordinary High-Water Mark
OWUS	Other Waters of the United States
Project	Oakland Alameda Access Project
RPW	Relatively Permanent Water
SB	Southbound
SR	State Route
UPL/NL	Upland or Not Listed
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WB	Westbound
WOUS	Waters of the U.S.

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1.0 GENERAL DESCRIPTION

This Aquatic Resources Delineation Report (ARDR) was prepared to describe the methods used and results of the surveys performed in order to identify potential jurisdictional waters and wetlands regulated by the United States Army of Corps of Engineers (USACE) and Regional Water Quality Control Board (RWQCB) pursuant to Section 404 (waters and "Other Waters of the United States" [OWUS]) and Section 401 of the Clean Water Act (CWA).

The proposed Project (Project), the Oakland Alameda Access Project (OAAP), is located in the cities of Oakland and Alameda in Alameda County, California. The project proposes to improve access along I-880 and in and around the Tubes, downtown Oakland, and the City of Alameda. Within the approximately 1-mile-long project, I-880 (PM ALA 30.47 to PM 31.61) and SR-260 (PM ALA R0.78 to R1.90) are major transportation corridors. Also, the I-880 freeway viaduct is a physical barrier, limiting bicycle and pedestrian connectivity between downtown Oakland and Chinatown to the north and the Jack London District and Oakland Estuary to the south. Existing local street patterns across I-880 are intertwined with on- and off-ramps and the Tubes connecting Oakland and Alameda affecting the cross-freeway circulation of motorists, bicyclists, and pedestrians.

Figure 1 shows the project footprint. See Figure 1a and Figure 2 for the Project areas within Oakland and Figure 3 for the Project areas within Alameda. All report figures are provided in Appendix A.

1.1 Purpose and Need

The purpose of the Project is to:

- Improve multimodal safety and reduce conflicts between regional and local traffic;
- Enhance bicycle and pedestrian accessibility and connectivity within the project study area;
- Improve mobility and accessibility between I-880, SR-260 (Tubes), City of Oakland downtown neighborhoods, and City of Alameda;
- Reduce freeway-bound regional traffic and congestion on local roadways and in area neighborhoods.

Access between the freeway and the roadway networks between I-880 and the Tubes is limited and indirect, and access to/from the cities of Oakland and Alameda is circuitous. Existing access to I-880 from Alameda and the Jack London District requires loops through several local streets and intersections, routing vehicles through the downtown Oakland Chinatown neighborhood, which has the following operational impacts on local streets:

- Streets in and around the downtown Oakland Chinatown area have a high volume of pedestrian activity and experience substantial vehicle-pedestrian conflicts, and the I-880 viaduct limits bicycle and pedestrian connectivity between downtown Oakland and the Jack London District.

- SB I-880 traffic heading to Alameda must exit at the Broadway/Alameda off-ramp, then travel south along 5th Street for more than a mile — through nine signalized and unsignalized intersections — before reaching the Webster Tube at 5th Street/Broadway.
- WB I-980 traffic heading to Alameda must exit at the Jackson Street off-ramp and circle back through Chinatown through seven signalized and unsignalized intersections to reach the Webster Tube.
- NB I-880 traffic heading to Alameda must exit at the Broadway off-ramp and form a queue on Broadway between 5th and 6th streets, which backs up onto the ramp. Alternatively, drivers may loop through Chinatown to access the Webster Tube.

1.1.1 No-Build Alternative

Under the No-Build Alternative, there would be no improvements to bicycle or pedestrian connectivity or safety. Freeway traffic to/from the cities of Oakland and Alameda would continue to use city streets through Oakland and Chinatown, which are areas with a high volume of pedestrian activity. Vehicle-pedestrian or -bicycle conflicts from traffic traveling through city streets would continue. The I-880 viaduct would continue to impede connectivity between downtown Oakland and the Jack London District, and access would not be improved for bicycles and pedestrians traveling between Oakland and Alameda.

1.1.2 Build Alternative

Under the Build Alternative, Caltrans and ACTC propose to remove and modify the existing freeway ramps and to modify the Posey Tube exit in Oakland. The Build Alternative would improve access to NB and SB I-880 from the Posey Tube via a right turn-only lane from the Posey Tube to 5th Street and a new horseshoe connector at Jackson Street below the I-880 viaduct that would connect to the existing NB I-880/Jackson Street on ramp. The existing WB I-980/Jackson Street off ramp would be reconstructed and shifted to the south.

The Webster Tube entrance at 5th Street and Broadway would be shifted to the east to create more space for trucks to make the turn from Broadway into the Webster Tube. A bulb-out would be constructed to extend the sidewalk, reducing the crossing distance and allowing improved visibility of pedestrians on the southeast corner.

The NB I-880/Broadway off-ramp would be removed and the NB I-880/Oak Street off-ramp to 6th Street would be widened. The NB I-880/Oak Street intersection would become the main NB I-880 off-ramp to downtown Oakland and to Alameda. 6th Street would become a one-way through street from Oak Street to Harrison Street and a two-way street from Harrison Street to Broadway.

The proposed project would include the addition of a Class IV two-way cycle track on 6th Street between Oak and Washington streets and on Oak Street between 3rd and 9th streets Bicycle and pedestrian improvements would be constructed at the Tubes' approaches in Oakland and Alameda, and the Webster Tube westside walkway would be opened to pedestrians. This would improve connectivity to existing and future planned bicycle paths in the City of Oakland and implement various "complete streets" improvements to create additional opportunities for nonmotorized vehicles and pedestrians to cross under I-880 between downtown Oakland, the Jack London District, and Alameda.

Additional details on the Build Alternative improvements:

1. **Construction of a new horseshoe connector under I-880 at Jackson Street.**

   Vehicles exiting the Posey Tube would have direct access to NB I-880 via the proposed horseshoe connector. Vehicles heading to NB and SB I-880 would use the right-turn-only lane at the Posey Tube exit to turn onto eastbound 5th Street. Access to a new horseshoe connector would be provided from the left side of 5th Street and would loop below the I-880 viaduct to connect to the existing NB I-880/Jackson Street on-ramp. Traffic heading to SB I-880 would continue eastbound on 5th Street to the SB I-880/Oak Street on-ramp. Figure 1a shows the new horseshoe connector under I-880 at Jackson Street.

   Construction of the new right-turn-only lane onto 5th Street would require new retaining walls along the right side of the Posey Tube exit replacing the historic Posey Tube wall. The horseshoe connector would provide a direct route between the Posey Tube and NB I-880/ EB I-980 and SB I-880, substantially improving connectivity and minimizing the need for freeway-bound vehicles to travel through Chinatown to access the ramps. This configuration would also reduce intersection and bicycle-pedestrian conflicts.

   Posey Tube traffic heading to Chinatown and downtown Oakland would remain in the left lane and continue onto Harrison Street or turn left onto 6th Street to reach downtown via Broadway. A new left-turn pocket to accommodate the turn onto 6th Street would be constructed requiring removal of a section of the historic Posey Tube western exit wall.

2. **Reconstruction of the existing WB I-980/Jackson Street off-ramp.**

   To provide space for unimpeded movement from the Posey Tube to the new horseshoe connector, the WB I-980/Jackson Street off-ramp would be realigned to the south. Figure 1a shows the relocated Jackson Street off-ramp. The realigned off-ramp would touch down at-grade on 5th Street at the Alice Street intersection. Off-ramp and 5th Street traffic would continue to be separated by a landscaped median past the condominium building at 428 Alice Street. 5th Street would be converted to a two-way street to accommodate condominium residents allowing vehicles to turn left or right onto 5th Street.

3. **Removal of the existing NB I-880/Broadway off-ramp viaduct structure including the bridge deck and supporting columns.**

   Removing the NB I-880/Broadway off-ramp structure would provide the space for complete street improvements on 6th Street. It would also restore an element of the City of Oakland's street grid system by providing a continuous 6th Street between Oak Street and Broadway. Figure 1a shows where the existing NB I-880/Broadway off-ramp would be removed. This would provide for a more efficient street network, and it would allow traffic to be more evenly distributed on Oakland city streets. Also, it would improve traffic operations at the Broadway/6th Street and Broadway/5th Street intersections by eliminating the stream of traffic exiting the Broadway off-ramp and heading to the Webster Tube entrance. Instead, this traffic would use 6th Street and turn left at Webster Street to access the Webster Tube.

4. **Widening of the NB I-880/Oak Street off-ramp.**

The existing Oak Street off-ramp would be widened from a one- to a two-lane exit by restriping the NB I-880 mainline and reconfiguring the ramp terminus. Figure 2 shows the proposed widening at the NB I-880/Oak Street off-ramp and restriping on NB I-880. At the Oak Street intersection, the ramp would be further widened from one left-turn-only pocket lane, one through and left-turn lane, and one through and right-turn lane to provide one left-turn-only (SB) pocket lane, one through westbound (WB) lane, one through (WB) and right-turn (NB) lane, and one right-turn-only (NB) lane. Two new retaining walls would be constructed along the widened ramp's new edge of the shoulder. In advance of the Oak Street exit, NB I-880 would be restriped from four to five lanes, including a standard 1,400-foot-long auxiliary lane to accommodate the additional traffic resulting from the Broadway off-ramp removal.

5. **Modification of 5th Street/Broadway access to the Webster Tube.**

The 5th Street/Broadway entrance to the Webster Tube would be moved slightly east (refer to Figure 1a Also, the 5th Street crosswalk on the east side of Broadway would be shifted east and considerably shortened, and the signal phasing would be modified to include a pedestrian-led signal phase for eastbound pedestrian traffic. This would improve safety by giving pedestrians priority over turning traffic. Also, this would improve truck access to the Webster Tube and minimize conflicts with other vehicular traffic.

6. **Construction of a new through 6th Street connecting Oak Street to Broadway.**

Improvements to 6th Street would be accomplished by turning the street into a one-way street in the westbound direction from Oak Street to Harrison Street and a two-way street from Harrison Street to Broadway (refer to Figure 1a). The lanes would be a minimum of 11 feet wide. There would be a minimum of two through lanes with additional turn pockets at intersections in the westbound direction. There would be one lane in the eastbound direction from Harrison Street to Broadway.

A new sidewalk would be constructed along the south side between Broadway and Oak Street. Segments of the existing sidewalk along the north side between Oak Street and Broadway would be reconstructed to a minimum of 10 feet wide between Harrison and Alice streets to provide continuity for pedestrians. A continuous Class IV two-way cycle track would also be provided between Oak and Washington streets. Parking spaces would be provided along portions of this roadway.

7. Construction of a two-way bicycle/pedestrian path and walkway from Webster Street in Alameda to 6th Street in Oakland through the Posey Tube and from 4th Street in Oakland through the Webster Tube to Mariner Square Loop in Alameda.

The path would begin at Webster Street and Constitution Way in Alameda, would continue through the Posey Tube on the existing eastside walkway, and would exit the Tube via a new ramp with a hairpin turn at 5th Street. Figure 3 shows the proposed bicycle and pedestrian improvements. The path in Alameda connecting to the Posey Tube would be realigned and widened. The path in Oakland would wrap around the back of the Portal building on 4th Street and continue onto Harrison Street. It would continue onto a Class I two-way bicycle/pedestrian path under I-880 just west of Harrison Street and connect to the Class IV two-way cycle track on 6th Street between Oak and Washington streets. The new bicycle and pedestrian ramp exit from the Posey Tube would require removal of the existing historic Posey Tube staircase to provide street level ADA-compliant access from the Tube.

The proposed project would improve access between Oakland and Alameda by opening the Webster Tube maintenance walkway to bicycle and pedestrian travel. The walkway would connect to the proposed path under I-880 at 4th Street (near the Posey Tube Portal building). It would continue onto 4th Street to Webster Street, and it would turn north through the existing parking lot on the west side of the Webster Tube entrance before making a hairpin turn to connect to the westside walkway inside the Tube.

On the Alameda side, the walkway would connect to existing bicycle and pedestrian facilities at Mariner Square Loop and Willie Stargell Avenue. The existing sidewalk within Neptune Park would be widened to match the proposed sidewalk to the north. Improvements inside the Tube would include widening the existing walkway, upgrading the existing railings, and relocating call boxes and fire extinguishers.

8. Modification of 5th, 7th, Madison, Jackson, Harrison, Webster, Oak, and Franklin streets.

The street modifications (refer to Figure 1a) would include replacing the dual right turns at the 7th Street/Harrison Street intersection with a single right-turn-only lane and removing the free right turn (where the island allows cars to turn right without stopping) at the 7th Street/ Jackson Street intersection. These would no longer be needed because Alameda traffic bound for NB/SB I-880 would be better served by the right turns from the Posey Tube to 5th Street. With the removal of the free right turns, vehicles would observe the traffic signal before turning right. With the curb extension proposed at this location, the pedestrian crossing distance would be shortened, which would decrease vehicle-pedestrian conflicts. In addition, a PHB beacon would be installed on 7th Street across the street from the Chinese Garden Park. There would also be restrictive right-turn movements to reduce bicycle and vehicle conflicts at the 5th/Broadway, 6th/Webster, 6th/Harrison, 6th/Jackson, 6th/Madison, 5th/Jackson, 8th/Oak, and 7th/Oak intersections.

A continuous sidewalk would be installed along the perimeter of Chinese Garden Park. Additional improvements, including landscaping modifications, could occur adjacent to the southern boundary of the park and would be coordinated through the City of Oakland.

Jackson Street between 5th and 6th streets would be converted from two- to one-way travel lanes in the northbound direction, and it would provide an emergency-only access lane.

Retaining Walls and Excavation

The proposed improvements would include construction of several new retaining walls along the NB I-880 Jackson Street on-ramp, WB I-980 Jackson Street off-ramp, NB I-880 Oak Street off-ramp, and new horseshoe connector. Retaining wall construction would minimize the need for right-of-way (ROW) acquisition. Table 1 lists the retaining walls needed for the proposed project including their locations and approximate dimensions. Table 2 lists the excavation depths of other proposed project features.

Table 1. Retaining Wall Locations and Dimensions (Oakland)

Wall Number	Location	Approx. Length (feet)	Height (feet)	Anticipated Excavation Depth (feet)
1	Supporting Harrison Street as Posey Tube right lane runs onto 5th Street	215	8-12	36
2	Supporting existing fill in front of the existing abutment at Harrison Street	65	8-30	13
3	Supporting the I-880 mainline	410	24-32	28
4	Supporting the Jackson Street abutment	145	17	2
4A	Supporting the Jackson Street abutment	60	10	20
4B	Supporting the Jackson Street abutment	60	14	20
5	Supporting cut slope south of 6th Street and parallel to existing NB I-880 Broadway off-ramp	510	4-22	44
6	Supporting Posey Tube bicycle/pedestrian switchback on the exit's east side	105	10	32
7	Supporting along the NB I-880 Oak Street off-ramp to accommodate an additional left-turn pocket	215	4-10	6
8R	Supporting reconstruction of the WB I-980 Jackson Street off-ramp (north wall)	230	24	32
8L	Supporting reconstruction of the WB I-980 Jackson Street off-ramp (south wall)	225	22	6

9	Supporting additional left-turn pocket for traffic from the Posey Tube at Harrison Street and 6th Street intersection	95	8	12
10	Supporting NB I-880 Oak Street off-ramp widening	399	12	4

Table 2. Excavation Depths

Feature	Description	Excavation Depth (feet)
OAKLAND		
Bike Path	Assumed pavement depth = 0.5’ PCC, 0.5’ CL 2 aggregate base (AB)	1
Roadway	Assumed pavement depth =0.75’ hot mix asphalt (HMA) (type A), 0.75’ class 2 AB, 1’ class 2 aggregate subbase (AS)	2.5
WB I-980 Jackson Street Off-ramp	New bents (columns) and an abutment	50
ALAMEDA		
Bike Path	Assumed pavement depth = 0.5’ PCC, 0.5’ class 2 AB	1
Roadway	Assumed pavement depth =0.75’ HMA (type A), 0.75’ class 2 AB, 1’ class 2 AS	2.5
Overhead Sign Foundation	Truss single-post Type V with assumed span length = 32’	20

Property Acquisitions

The proposed project would require the transfer of ROW from the following public entities: City of Oakland and City of Alameda. It would also require a permanent maintenance easement from Laney College to maintain a retaining wall for the Oak Street off-ramp. The Build Alternative would not result in the displacement of any residences or businesses.

Utilities

Existing Pacific Gas and Electric (PG&E) overhead distribution electric lines along 5th and Harrison streets would be relocated as part of the Build Alternative. Some of these overhead lines would be placed underground. Utility relocations may require trenching to a depth of approximately 6 feet. Positive location (potholing) would be performed to verify the location of mapped utilities. Table 3 lists proposed utility work for the Build Alternative.

Table 3. Proposed Utilities, Operational Elements, and Drainage Systems

Location	Type of Work	Utility/Service System	Size
Harrison Street from 4th to 5th streets	Relocate existing overhead utilities underground. Relocate fire hydrant.	*Pacific Gas & Electric (PG&E):* Electric *American Telephone and Telegraph Company (AT&T):* Telecom *East Bay Municipal Utility District (EBMUD*	Overhead lines (both) 6" water line
	Relocate fire hydrant.	*EBMUD:* Water	6" water line
5th Street from Harrison to Jackson streets	Protect existing underground utilities in place. Possible permanent relocation.	*EBMUD:* Water *City of Oakland:* Sewer and storm drain *PG&E:* Gas *AT&T:* Fiber optic	4", 6" water lines 8" sewer lines 21", 24" storm drain 2" gas lines
5th Street from Webster to Harrison streets	Protect existing underground utilities in place. Possible temporary relocation.	*EBMUD:* Water *City of Oakland:* Sewer and storm drain *PG&E:* Gas	4", 6" water lines 8" sewer lines 24" storm drain 1-1/4" gas lines
Posey Tube Walkway	Protect existing underground utilities in place. Possible permanent relocation.	*EBMUD:* Water *City of Oakland:* Sewer and storm drain *PG&E:* Gas *AT&T:* Fiber optic	10" water lines 8" sewer lines 24" storm drain 1-1/4", 2" gas lines
	Install new lines.	*Caltrans:* Street lighting and drainage	New – TBD
6th Street from Oak Street to Broadway	Install new lines.	*EBMUD:* Water *City of Oakland:* Sewer and storm drain *PG&E:* Gas	New – TBD Existing lines will be relocated if is determined they are in conflict.
	Protect in place.	*PG&E:* 115 kilovolt (kV) Electric	Unknown size
Jackson Street Horseshoe	Install new lines.	*Caltrans:* Street lighting and storm drains	New – TBD
Intersections	Modify traffic and bicycle signals.	*City of Oakland:* Traffic signals and lighting	N/A

3rd/Oak 5th/Broadway 5th/Jackson 5th/Oak 6th/Harrison 6th/Broadway 7th/Harrison 7th/Jackson 7th/Oak 8th/Oak 9th/Oak			
Intersections 6th/Jackson 6th/Webster 6th/Franklin 6th/Oak 7th/Alice	Install new traffic signals. Install a PHB at 7th/Alice.	*City of Oakland:* Traffic signals and lighting	N/A

Construction Schedule

Construction activities would last approximately 36 months. Construction is expected to begin in mid-2023. There would be two major stages with several phases in each. The first stage would include construction of the Jackson Street horseshoe and associated improvements on the southside of I-880 as well as the widening of the walkway in the Webster Tube. The second stage would include widening of the NB I-880/Oak Street off-ramp, removal of the Broadway NB I-880 off-ramp, and construct 6th Street improvements with associated elements on the northside of I-880.

Construction equipment would be staged in areas underneath I-880 that are owned by Caltrans and currently leased as parking lots. Construction activities would be completed during the day; however, nighttime work would be needed to minimize impacts to traffic, especially in the Webster Tube. Caltrans would continue to coordinate with the cities of Oakland and Alameda to develop and implement a Transportation Management Plan (TMP) and other measures to minimize construction impacts on the human and natural environment. As part of the TMP, a shuttle may be needed to transport bicyclists and pedestrians between Oakland and Alameda during construction.

The proposed project contains a number of standardized project measures which are employed on most, if not all, Caltrans projects. They were not developed in response to any specific environmental impacts resulting from the proposed project.

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2.0 LOCATION

The proposed Project is located in the Oakland West U.S. Geological Survey (USGS) 7.5 Minute quadrangle in the cities of Oakland and Alameda in the County of Alameda. The Project location is found in the Mount Diablo Meridian: Section 2, Township 2S, Region 4W.

The Oakland portion of the biological study area is 104.3 acres. The Alameda portion of the biological study area is 33.2acres.

To access the Oakland portion of the Project area from the north; take I-80 through Emeryville and northwest Oakland where it becomes I-880. The north end of the Project area is just before the point where I-980 merges onto I-880. The south end of the Project area is just south of the Lake Merritt Channel.

To access the Alameda portion of the Project area from the north; from I-880 (heading south) take the Broadway/Alameda exit. Turn right onto 5th Street. Take the I-880 South ramp but stay straight to go onto 5th Street. Merge onto Webster Street Tube. The Project area extends from the Webster Tube exit along Webster Street to Atlantic Avenue the north along Constitution Way and Mariner Square Drive to the Posey Tube.

To access the Oakland portion of Project area from the south; take Hwy I-880 to Oakland. The Project area begins on the I-880 corridor just south of the Lake Merritt Channel and ends just north of the point where I-980 merges onto I-880 in Oakland.

To access the Alameda portion of the Project area from the south; from I-880 take the Broadway exit toward downtown. Take the first right onto 7th Street. Turn right on Webster Street which funnels traffic into the Webster Street Tube.

To access the Oakland portion of the Project area from San Francisco; take the Bay Bridge east to Oakland and merge onto Hwy I-880 south. The north end of the Project area is just before the point where I-980 merges onto I-880. The south end of the Project area is just south of the Lake Merritt Channel.

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3.0 METHODS

This section describes the methods utilized to identify and delineate potential "Waters of the U.S."

3.1 Biological Study Area

Biological study areas (BSA) were established in Oakland and Alameda that encompassed the Project limits and surrounding areas that could be affected directly or indirectly by the Project. A BSA is defined as the area (land and water) that may be directly, indirectly, temporarily, or permanently impacted by construction and construction-related activities. The BSAs were used to define the limits of the aquatic resources delineation. Figure 4 depicts the Project BSAs.

3.2 Literature Review

Prior to conducting the field surveys, reference materials were reviewed. Soils data for Alameda County were downloaded from the Soil Conservation Service's *Soil Survey of Alameda County* (U.S. Department of Agriculture [USDA], 2017a), and the data was imported to ArcGIS. USGS topographic maps of the Oakland and Alameda quadrangles (USGS 2001), the *National Wetlands Inventory* (U.S. Fish and Wildlife Service 2019), and aerial images were reviewed to determine whether any waterbodies have been identified within the BSAs. For purposes of this study, a topographic map was used to characterize the actual on-the-ground large-scale details, using line contours to represent both natural and manmade quantitative features at the site. The geotechnical log of test borings was reviewed to verify the soil types that are found within the BSAs.

3.3 Delineation of Waters of the United States

WRECO biologist Jared Elia conducted initial aquatic resources surveys of the BSAs in January 2016. A jurisdictional wetland determination was conducted by WRECO biologists Gregory Wattley and Jared Elia on March 30, 2018. An additional site visit was conducted on September 16, 2019 by WRECO biologist Gregory Wattley, to search for potential jurisdictional aquatic resources within an expanded portion of the Oakland BSA. On February 19, 2020, WRECO biologist Gregory Wattley performed a desktop reconnaissance for the Oakland and Alameda BSAs using the *National Wetlands Inventory* (U.S. Fish and Wildlife Service, 2019) and Google Earth aerial images.

3.3.1 Wetlands

Wetlands were delineated using the US Army Corps of Engineers Wetlands Delineation Manual (USACE, 1987) and the Regional Supplement to the US Army Corps of Engineers Wetland Delineation Manual: Arid West Region (USACE, 2008), routine approach method for areas greater than 5 acres. The three parameters used to delineate wetlands in the BSAs were the presence of hydrophytic vegetation, wetland hydrology, and hydric soils. According to the USACE manual, there must be evidence of at least one positive wetland indicator from each parameter under typical or unproblematic situations.

Potential wetlands were visually inspected for the approximate location of the wetland-upland boundary. Paired sample points were used to verify the exact location of the wetland-upland boundary; each sample point was marked with a Trimble Model Geo7X sub-meter Global Positioning System (GPS) unit. Paired sample points consisted of two locations: one in a suspected wetland area and one in a suspected upland area, where the three wetland parameters are evaluated for presence or absence. If the wetland point displays indicators of each of the three wetland parameters and the upland point does not meet the three-parameter criteria, the wetland-upland boundary is located between the paired sample points. Additional sample points were utilized to verify the location of the wetland-upland boundary, as needed. After completing the pair sample points, the wetland-upland boundary was delineated with the same sub-meter GPS unit.

3.3.1.1 Vegetation

Hydrophytic vegetative communities were identified where more than 50 percent of the dominant species were OBL, FACW, or FAC (see Table 4) the prevalence index was calculated but was not needed because all wetland points passed the dominance test. The wetland indicator status of plants for Region 0 was obtained from the *Field Indicators of Hydric Soils in the United States: A Guide for Identifying and Delineating Hydric Soils* (USDA, 2017b).

Table 4. Definitions of Wetland Vegetation Indicator Status

Indicator Category	Indicator Symbol	Definition
Obligate Wetland Plants	OBL	Plants that occur almost always (estimated probability >99%) in wetlands under natural conditions, but which may also occur rarely (estimated probability <1%) in non-wetlands. Example: *Salicornia virginica L.*
Facultative Wetland Plants	FACW	Plants that occur usually (estimated probability >67% to 99%) in wetlands, but also occur (estimated probability 1% to 33%) in non-wetlands. Example*: Distichlis spicata; Grindelia camporum*
Facultative Plants	FAC	Plants with similar likelihood (estimated probability 33% to 67%) of occurring in both wetlands and non-wetlands. Examples: *Helminthotheca echioides; Rumex crispus*
Facultative Upland Plants	FACU	Plants that occur sometimes (estimated probability 1% to 33%) in wetlands, but also occur (estimated probability >67% to 99%) in non-wetlands. Examples: *Taraxacum officinale; Salsola australis*
Obligate Upland Plants	UPL	Plants that occur rarely (estimated probability <1%) in wetlands under natural conditions, but which also occur (estimated probability >99%) in non-wetlands in natural conditions. Example: *Vicia sativa; Eucalyptus sideroxylon*

Table Courtesy: U.S. Army Corps of Engineers. Plants were assigned a wetland indicator status according to the *Arid West 2016 Final Regional Wetland Plant List* (Lichvar 2016).

3.3.1.2 Hydrology

WRECO biologists surveyed the BSAs for primary and secondary indicators of wetland hydrology. Primary indicators of wetland hydrology that were surveyed included, but were not limited to, visible surface water, soil saturation, water marks, surface soil cracks, aquatic invertebrates, oxidized root channels, and salt surface crusts. Secondary indicators that were surveyed for included the presence of a shallow aquitard or existing drainage patterns. The presence or absence of the primary or secondary indicators described in the Arid West Region supplement was used to determine if sample points within the BSAs met the wetland hydrology criterion.

3.3.1.3 Soils

WRECO biologists evaluated soil conditions at each sample point. At each sample point, biologists excavated a 1- to 1.5-foot-deep hole. Soils removed from the hole were examined for indicators of hydric soil, including a hydrogen sulfide (rotten egg) odor, low chroma matrix color, presence of redox concentrations, gleyed or depleted matrix, and high organic matter content. Soil chroma and values were determined using a standard Munsell soil color chart (Gretag Macbeth, 2009). Hydric soils were determined to be present if the paired soil samples met any of the 23 indicators of hydric soil listed in the Arid West Region Supplement. Soils from each test pit were photographed.

3.3.2 Other Waters of the United States

Preliminary identification of potentially jurisdictional OWUS were noted in the field on Project layouts and aerial photography, and later digitized to ArcGIS format; and some features were surveyed using a Trimble Model Geo7X sub-meter GPS unit. The acreage and length of each feature was calculated using the ArcGIS program.

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4.0 ENVIRONMENTAL SETTING

This section provides more information on environmental factors that influence wetland formation and continuity.

4.1 Topography

The elevations of the BSAs range from approximately sea level to 35 feet. The flat portions of the BSAs near sea level were reclaimed from relic tidal marshlands (Sowers, 2014). Figure 5 shows a topographic map of the Project.

4.1.1 Oakland BSA

The Oakland BSA is located on the southern slope of the knoll that supports Downtown Oakland. The BSA also includes flatter sections as it approaches the east and west margins of the BSA (Sowers 2014). The elevation ranges from approximately 5 feet to 35 feet (USGS, 2001).

4.1.2 Alameda BSA

The Alameda BSA is located on Alameda Island. The main topographic feature is a ridgeline that runs down the middle of the island in a northwest-southeast direction (Schaaf and Wheeler, 2008). The Alameda BSA is located on the northern side of the ridgeline, where the terrain gently slopes toward Oakland Estuary. Elevations in this section range from sea level to approximately 10.6 feet (USGS, 2001).

4.2 Soils

Figure 6 in Appendix D shows the mapped soil units within the Project.

4.2.1 Oakland BSA

According to the *Soil Survey of Alameda County, California, Western Part* (USDA, 2017a), the following soil types are associated with the Oakland BSA:

Urban Land – This soil type consists of urban lands covered by buildings, roadways, parking lots, and other structures found in the Oakland and Alameda BSA. The soil in this area is made up of heterogeneous fill derived from various sources. A lot of areas in the BSA have been classified under this mapped soil designation; which consists of reclaimed land adjacent to the San Francisco Bay. According to the USDA, this soil type has not been assigned a Hydrologic Soil Group.

Urban Land – Baywood Complex – A majority of the Oakland BSA is mapped as containing Urban Land – Baywood complex soil. This soil type consists of a mixture of approximately 60% urban land, 35% Baywood sandy loam, and 5% of various other soil types. Elevations for this soil complex range between 10 to 60 ft. Slopes range from 0 to 8%, with a majority between 2 to 5%. Runoff is slow to medium, and permeability is rapid. The Hydrologic Soil Group is A. If left bare, wind erosion can become a hazard.

4.2.2 Alameda BSA

The majority of the Alameda BSA is also Urban Land-Baywood complex, and also contains the Urban Land soil type. In addition, the *Soil Survey of Alameda County, California, Western Part* (USDA, 2017a) indicates that the following soil type is associated with the Alameda BSA:

Xerorthents, Clayey **–** This soil type consists of clayey material used as fill for construction sites. These soils are typically dark brown to grayish brown in color. The texture is mainly heavy clay loam, but also includes some silty-clay and clays. The soil profile consists of up to 15% asphalt, concrete, sandstone, and glass debris. Permeability is slow to very-slow; also, runoff is very slow. The Hydrologic Soil Group is D.

4.3 Precipitation and Data Analysis

Both the Oakland and Alameda BSAs in Alameda County experience the same climate patterns. According to the Köeppen Climate Classification System, the BSAs experience a Mediterranean climate, characterized by hot, dry summers and mild, moist winters (George). Precipitation generally occurs between mid-October and mid-April. The average annual precipitation for Alameda County is 3.89 inches. A climate summary report obtained from the closest National Oceanic and Atmospheric Administration weather station (Western Regional Climate Center, 2015) with similar elevation and topography indicates the following:

Oakland International Airport (KOAK)

- Average annual rainfall for Oakland is 18.27 inches
- Average minimum and maximum temperatures are 41.4 and 73.5º F

Precipitation data for Alameda County were reviewed for the years between 1971 and 2018. The maximum average temperature reported was 61.6 ºF in January 2018; the lowest average temperatures for January, February and March, were 51.6 ºF, 54.8 ºF, and 56.6 ºF, respectively. The wettest month of the year in 2018 was January with an average rainfall of 4.14 in., and the driest month was March with an average of 3.47 inches. A climate summary report for the Project vicinity was obtained from the closest WETS weather Station: Oakland Metropolitan International Airport (USDA, 2018a) and is included in Appendix D. While winter storms are usually moderate for this time of year, winter precipitation in 2018 was above normal due consecutive rain events during January (USDA, 2018b).

4.4 Hydrology

The proposed Project lies on either side of Oakland Estuary, which is connected to San Francisco Bay. The National Wetland Inventory map shows the waterbodies in the Project area (Figure 7), which include Lake Merritt Channel, Oakland Estuary, and unnamed ponds.

4.4.1 Oakland BSA

Runoff within the Oakland BSA primarily collects along the roadway shoulders, conveys into underground storm drainage systems, and flows into Lake Merritt Channel and Oakland Estuary (Sowers, 2000; Schaaf and Wheeler, 2008).

Lake Merritt Channel connects Lake Merritt to Oakland Estuary. A pump station and tide gate regulate the tidal exchanges between Lake Merritt Channel and Oakland Estuary. During the summer, water levels within Lake Merritt Channel are kept high for recreational activities. In the winter, the water levels are kept low to accommodate storm flows. The tide gate and pump station that regulate these water levels are located upstream (north) of the BSA at the 7th Street crossing. Lake Merritt Channel, at I-880, is open to Oakland Estuary and subject to the ebb and flow of the tides.

4.4.2 Alameda BSA

As in the Oakland BSA, runoff within the Alameda BSA collects along the roadway shoulders, conveys into underground storm drainage systems, and flows towards Oakland Estuary (Sowers, 2000; Schaaf and Wheeler, 2008).

4.5 Land Use

4.5.1 Oakland BSA

The Oakland BSA is located entirely within an urban setting and is covered with impervious surfaces, buildings, freeways, city roadways and other urban development and infrastructure. The Oakland Inner Harbor, Oakland Estuary, and Estuary Park lie south of the BSA and I-880/I-980 corridor. The remainder of the area surrounding the Oakland BSA consists mainly of residential and commercial complexes. The inlet of Lake Merritt Channel is within the southern portion of the BSA.

4.5.2 Alameda BSA

The Alameda BSA is also in an urban setting and consists primarily of commercial developments and business complexes. Oakland Estuary is situated beyond the northern portion of the Alameda BSA.

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5.0 RESULTS

The results of the aquatic resource delineations for each BSA are detailed in this section. Jurisdictional delineation maps are provided in Appendix A. Appendix B contains Ordinary High-Water Mark (OHWM) and Wetland Determination Data Forms. Appendix C contains representative photographs of the BSA.

5.1 Potential Jurisdictional Wetlands

This section is organized by feature type and includes a discussion of potential wetlands and OWUS that would be subject to USACE jurisdiction under Section 404 of the CWA.

5.1.1 Oakland BSA

No wetlands were identified or delineated in the Oakland BSA.

5.1.2 Alameda BSA

Two wetlands were identified just beyond the northeastern boundary of the Alameda BSA. The wetlands are at located at 37.78826º latitude and -122.27599º longitude and are referred to as Wetland A and Wetland B (Figure 8 and Figure 9).

Wetland A and Wetland B were delineated to determine whether they crossed into the BSA. It was determined that these wetlands are outside of the BSA and no construction activities are planned for this area.

A total of six test pits were dug along three transects of a potential wetland immediately adjacent to the northeast portion of the Alameda BSA. Three of the test pits contained hydric soils (Nos. 2, 4, and 6); the other three test pits did not have hydric soils (Nos. 1, 3, and 5) (see mapped test pit locations on Figure 9). The length of each transect varied to include adequate land topography, vegetation, and aquatic features. Test pits were located in major vegetation communities that were defined by changes in elevation, hydrology, soil types, or human influences, such as roads, ditches, and agricultural practices.

The wetlands exhibited all three required characteristics of hydrology, hydrophytes, and hydric soils. Based on vegetation, hydric soils, hydrology, and topographic features, the upland/wetland boundary at this location had distinct areas of influence along the areas of open water, ditch banks, saline emergent wetland, and annual grassland communities. Because of its relatively small community size, areas inside the ditch banks below the OHWM were mapped as saline emergent wetland (which included open water and ditch combined), and areas outside the OHWM were mapped as annual grassland. There were distinct boundaries mapped between saline emergent wetland and annual grassland. Evidence of the distinct boundaries is shown in Appendix B. Details of the information collected during the site survey are provided in the following sections.

5.1.2.1 Vegetation Communities and Plant Species Identified

It has been reported this area of the Project was reclaimed from historic tidal marshlands (Sowers 2014) and was likely a salt marsh prior to commercial and urban development. The wetlands are located on a very flat portion of the Alameda BSA near sea level.

Vegetation Communities

Three plant community types were identified in the area of the wetlands: annual grassland, saline emergent wetland, and open water. These communities are described below.

Annual Grasslands

Annual grassland is the most prevalent plant community at this location. This community is dominated by native and non-native annual and perennial grasses and forbs. At the wetland locations, the dominant species include wild oats (*Avena fatua,* UPL), wild radish (*Raphanus sativus,* UPL), English plantain (*Plantago lanceolate,* FAC-), common dandelion (*Taraxacum officinale,* FACU), creeping buttercup (*Ranunculus repens,* FAC), and Russian thistle (*Salsola australis,* FACU). Test holes 1, 3, and 5 were dug in this community. None of the areas met the dominance test with over 50% OBL, FACW, or FAC vegetation, or the prevalence index test; therefore, this community is non-hydrophytic.

The wetland banks mainly consist of blow-wives (*Achyrachaena mollis*, FAC), spring vetch (*Vicia sativa,* UPL), curly dock (*Rumex crispus,* FAC), cutleaf plantain (*Plantago coronopus*, FAC), white stem filaree (*Erodium moschatum,* FACU), and sweet fennel (*Foeniculum vulgare,* FACU-). No test holes were dug in the bank.

Saline Emergent Wetland

Saline emergent wetland typically establishes along an elevation gradient between tidal zone area and adjacent upland areas. The distribution is dependent on surface elevation, soil and water salinity, and duration of tidal inundation (Jones & Stokes, 2001). In some areas, saline emergent wetland may also occur in some areas with minimal to no tidal influence where a combination of evapotranspiration with salt content of maritime airflow can influence levels of salinity (North State Resources, Inc. 2008). The dominant vegetation at the wetland locations include salt grass (*Distichlis spicata,* FACW) and common pickleweed (*Salicornia pacifica,* OBL).

Open Water

Open water found in the Alameda BSA is the product of drainage flows during high tide via a series of drainage culverts that connect the BSA to Oakland Estuary. Because the topography of the site is relatively flat, there is no downslope-gradient municipal infrastructure for water to flow into. As a result, there is often ponding around the mouths of inlet culvert structures, even during low tides. During the site visit, open water was observed at the mouth of three culverts at Wetland B (Appendix B; Photos 7, 8, and 9). Standing open water was also observed in Wetland A (Photos 1, 2, and 3). Low tide was observed during the site evaluation; however, there was open water/ponding (perennial flows) observed at three culvert inlets. Perennial flows observed were below the OHWM within the flow channels. Other hydrological indicators observed included water-stained leaves and sediment deposits within the OHWM. At the time of the field visit, the average depth within the open water channel was greater than 12 inches and no flowing water nor emergent vegetation were observed in the channel. Typically, flows in this open water community flow north from a large 45-inch storm drainage outfall (which connects the wetland area to the Alameda shoreline), through a culvert under the Marina Parkway road into the wetland location where it percolates into the soil.

Plant Species Identified

Table 5 indicates the plant species identified, common name of the plant, and wetland indicator status, as described in the methods section above. Plant species that were prevalent at the test pits are also noted.

Table 5. Plant Species List with U.S. Department of Agriculture Wetland Indicator Status

Scientific Name	Common Name	Indicator Status	Dominant Plant Found at Test Hole
Acacia sp.	Acacia sp.	FACU	
Achyrachaena mollis	Blow-wives	FAC	
Avena fatua	Wild oats	UPL	1, 3, 5
Contoneaster sp.	Contoneaster sp.	NL	
Cotula coronopifolia	Brass buttons	OBL	
Distichlis spicata	Saltgrass	FACW	2,4,6
Elymus canadensis	Canada wild ryegrass	FAC	5
Erodium moschatum	Whitestem filaree	FACU	
Eschscholzia californica	California poppy	NL	
Eucalyptus sideroxylon	Eucalyptus sp.	UPL	
Foeniculum vulgare	Sweet fennel	FACU-	1
Geranium californicum	California geranium	FAC	3
Grindelia camporum	Common gumplant	FACW	
Hedera helix	English ivy	FACU	
Helminthotheca echioides	Bristly ox-tongue	FAC	
Hordeum brachyantherum	Meadow barley	FACW	
Lactuca serriola	Prickly lettuce	FACU	
Malva nicaeensis	Bull mallow	UPL	
Medicago polymorpha	Bur clover	FACU	
Melilotus officinalis	Yellow sweetclover	FACU	
Ranunculus repens	Creeping buttercup	FAC	
Plantago coronopus	Cut leaf plantain	FAC	
Plantago lanceolata	English plantain	FAC-	
Raphanus sativus	Wild radish	UPL	
Rumex crispus	Curly dock	FAC	
Salicornia pacifica	Common pickleweed	OBL	2,4,6
Salsola australis	Russian thistle	FACU	
Sequoia sempervirens	Coast redwood	NL	
Silybum mariaum	Milk thistle	NL	
Taraxacum officinale	Common dandelion	FACU	
Verbascum thapsus	Common mullein	FACU	
Vicia sativa	Spring vetch	UPL	

5.1.2.2 Hydrology

The primary hydrological influence for this site is purported to be a large 45-inch concrete storm drainage outfall (see Photos 12 and 13 in Appendix B) located at the Barnhill Marina along the Alameda shoreline of Oakland Estuary. The Barnhill Marina is a private land and houseboat marina located directly north. Additionally, there is a series of storm drain systems that conveys runoffs underground into Oakland Estuary (Jim Barse, City of Alameda Public Works

Department, personal communication April 5, 2018). During high tides, water flows from Oakland Estuary, south through the large culvert and empties into the wetland area and other privately-owned adjacent sites. The main water body providing connectivity to the wetlands in the BSA is Oakland Estuary.

5.1.2.3 Soil

According to the *Soil Survey of Alameda County, California, Western Part* (USDA, 2017a), the soil type associated with the wetland area is Xerorthents, Clayey. This soil type consists of clayey material used as fill for construction sites. The soil is typically dark brown to grayish brown in color. The texture is mainly heavy clay loam, but also includes some silty-clay and clays. The soil profile consists of up to 15% asphalt, concrete, sandstone, and glass debris. Permeability is slow to very-slow; also, runoff is very slow. The Hydrologic Soil Group is D.

5.2 Other Waters of the U.S.

5.2.1 Oakland BSA

Lake Merritt Channel is a potentially jurisdictional OWUS. Lake Merritt Channel has been classified as "open water" (USDA, 2017a). The channel is within the Oakland BSA, but no construction activities will take place in the channel and therefore, the channel was not delineated for this report. No additional OWUS were identified within the Oakland BSA.

5.2.2 Alameda BSA

No OWUS were identified in the Alameda BSA.

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6.0 SUMMARY OF DELINEATED WETLANDS

Two wetlands were delineated just beyond the Alameda BSA (Wetlands A and B); they are both classified as saline emergent wetlands (Figure 8 and Figure 9). Wetland A is 0.014 acres (607 square feet) and is located to the north and just east of the BSA. Wetland B is 0.06 acres (2,716 square feet) and is located due south of Wetland A. Based on aquatic resources searches conducted on February 18, 2020, no additional WOUS (including wetlands) or other waters were observed in the amended BSA. Therefore, no wetlands, WOUS, or OWUS will be impacted by this Project. Table 4 summarizes the dimensions of the wetlands.

Table 4. Mapped Saline Emergent Wetlands near the Alameda BSA

Mapped Saline Emergent Wetlands

Aquatic Feature	Area (acres)	Area (square feet)	Length (linear feet)
Wetland A	0.014	607	47
Wetland B	0.06	2,716	335
Total	**0.074**	**3,323**	**382**

Wetland A is connected to Wetland B by a culvert underneath Marina Parkway Road. There are distinct upland/wetland boundaries for Wetland A. The wetland sits within a ditch and there is a distinct raised ditch bank located above the OHWM.

Wetland B also has a clear upland/wetland boundary marked by a distinct raised ditch bank. No flowing water was observed in Wetland B during the time of the delineation, as the site evaluation was performed during low tide (Photos 7, 8, and 9).

There is a significant nexus between the delineated wetlands (A and B) and Oakland Estuary and therefore, both wetlands are considered relatively permanent water (RPW). Wetlands, ditches, and creeks are considered RPW when they have flows year-round or continuously, or at least “seasonally” (e.g., typically three months or more in a given year).

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Appendix A Report Figures

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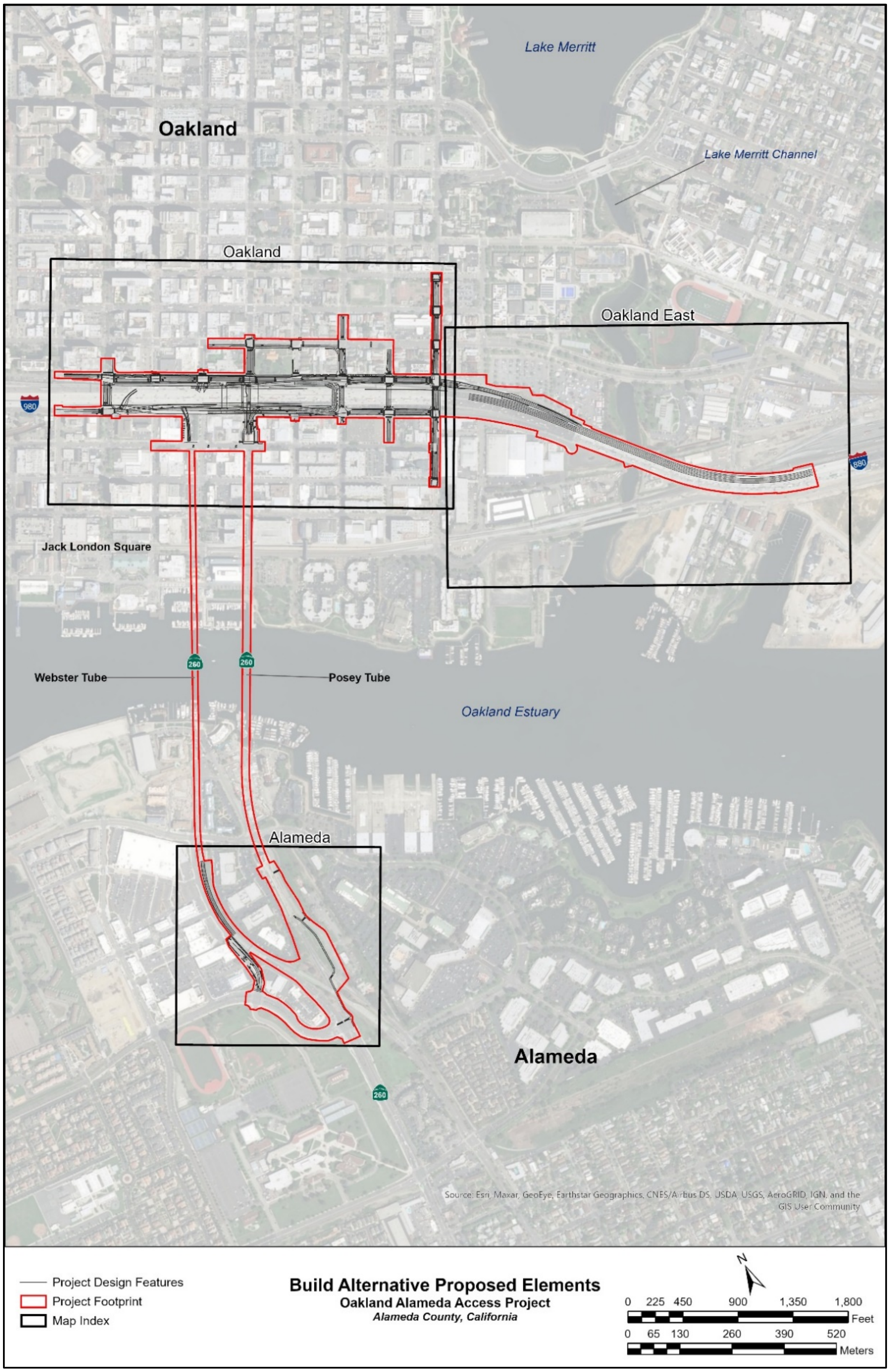

Figure 1. Project Map (City of Oakland, west of Oak Street)

Source: HNTB

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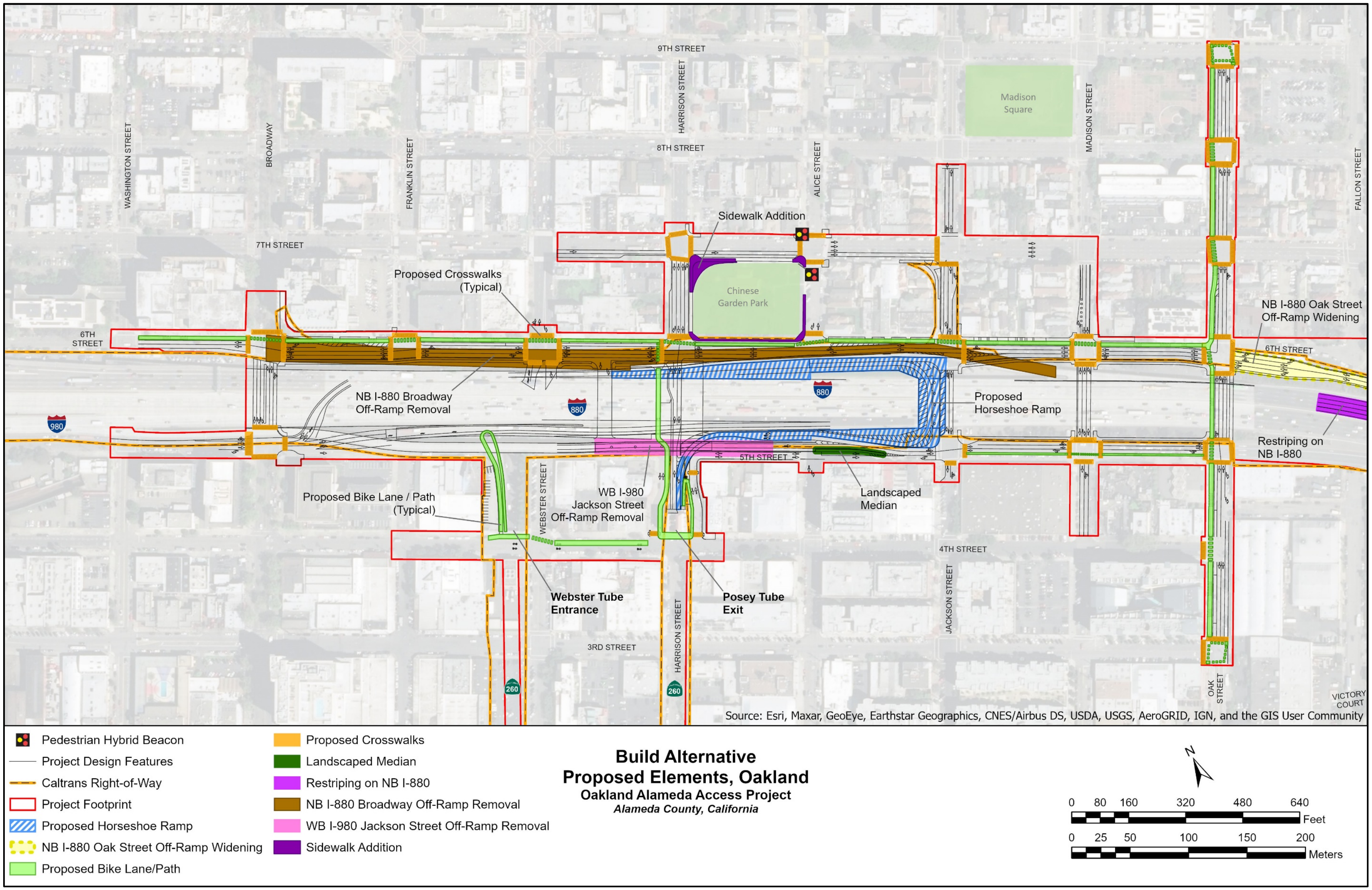

Figure 1a. Project Map (City of Oakland, west of Oak Street)

Source: HNTB

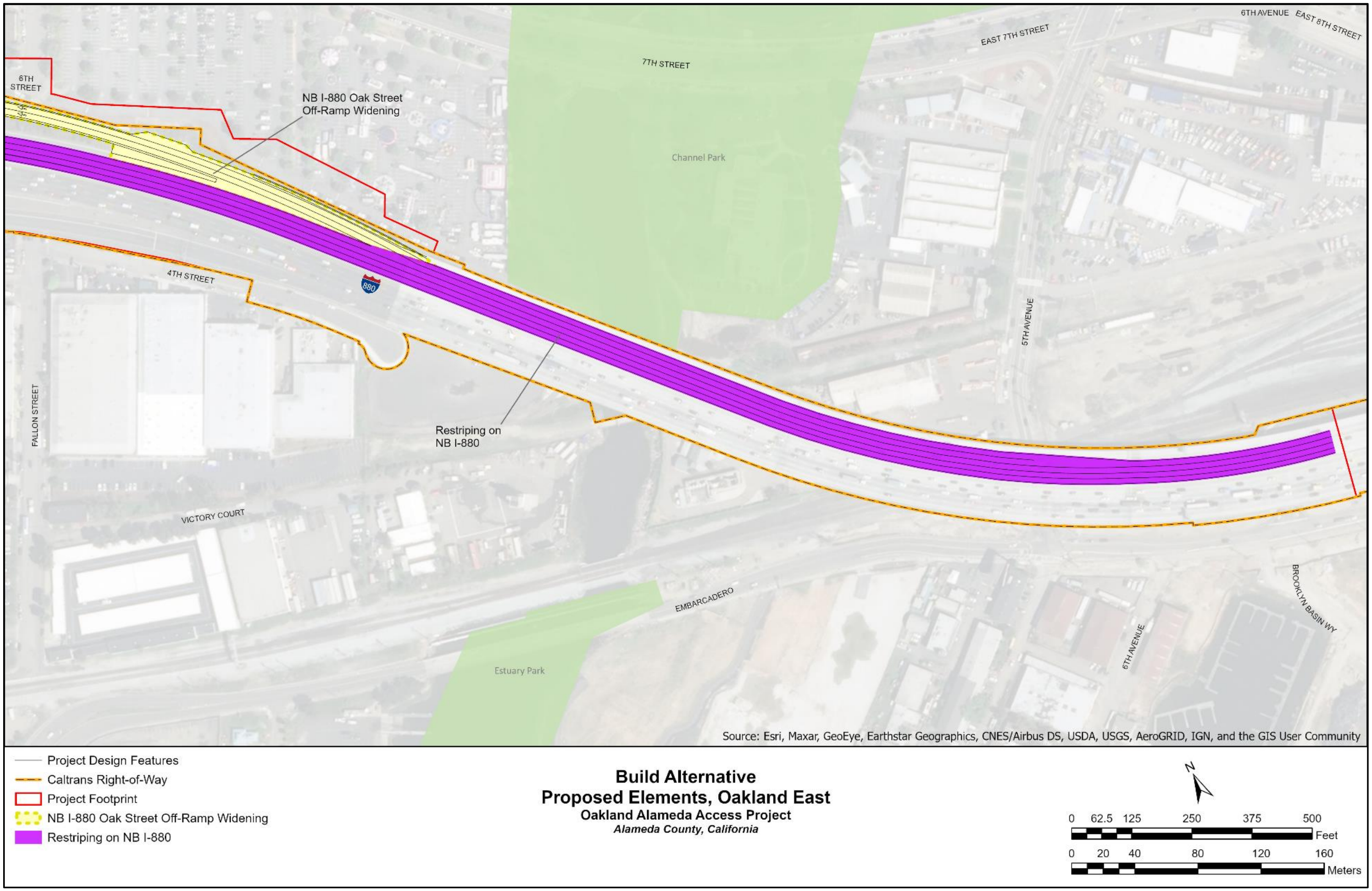

Figure 2. Project Map (City of Oakland, east of Oak Street)

Source: HNTB

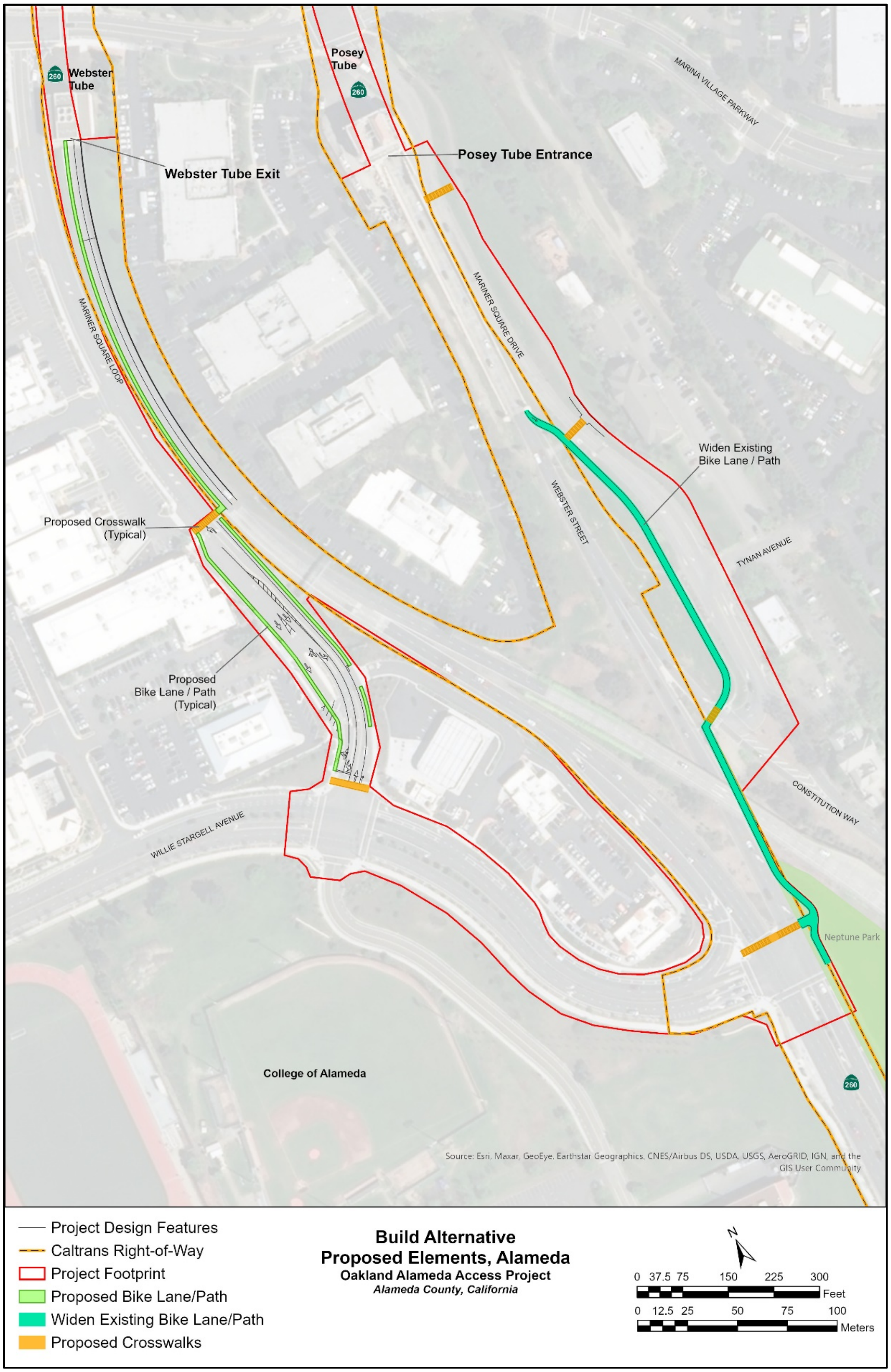

Figure 3. Project Map (City of Alameda)

Source: HNTB

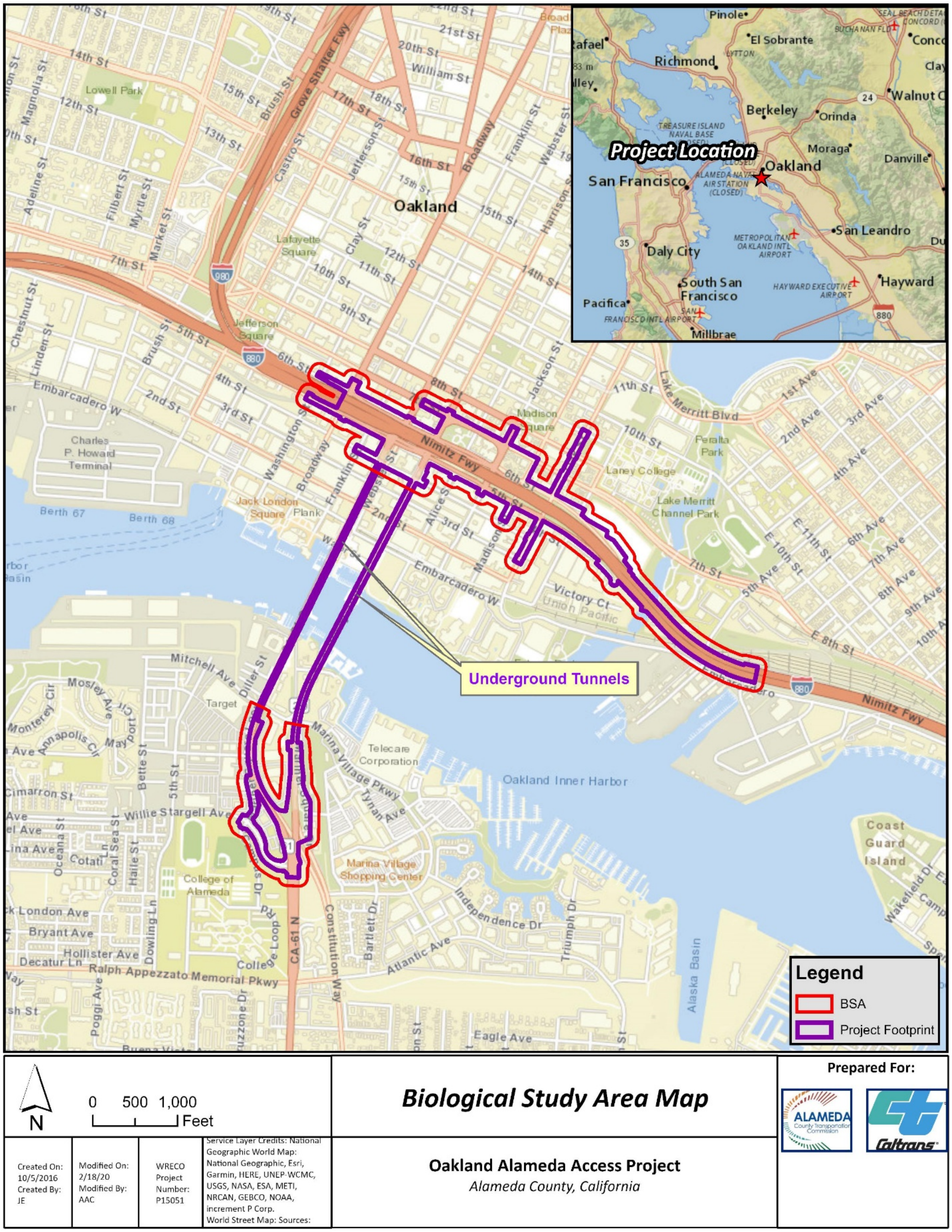

Figure 4. Map of Biological Study Areas

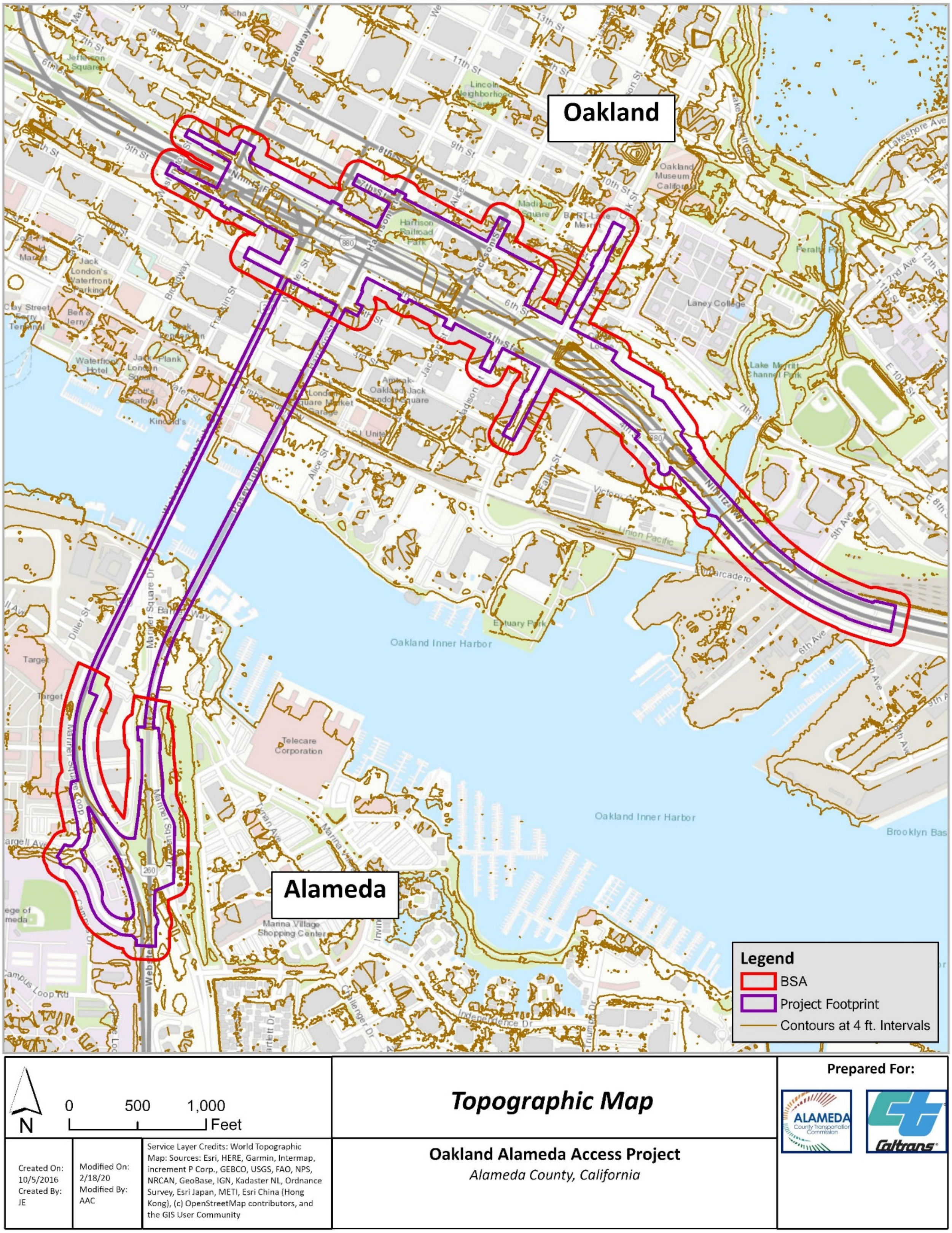

Figure 5. Topographic Map

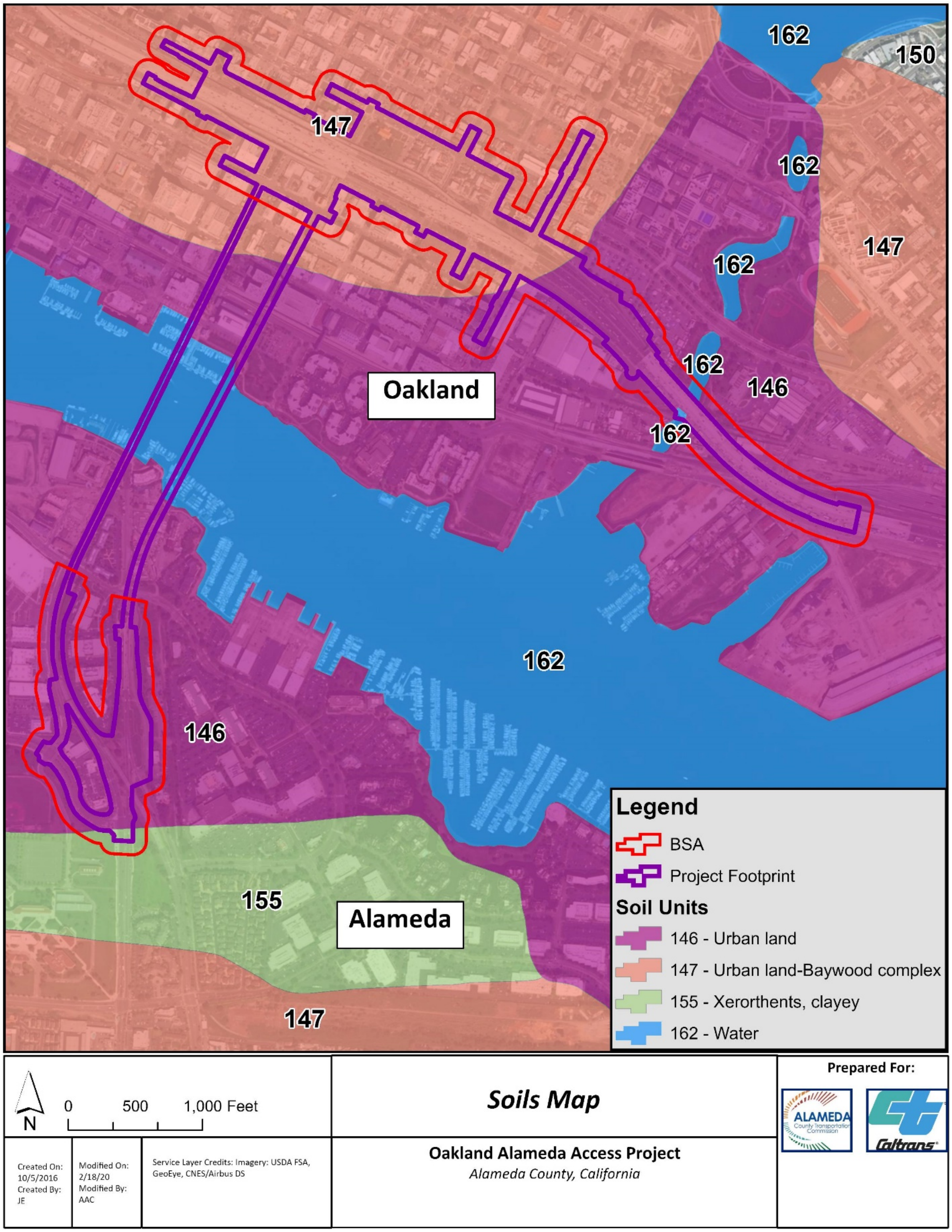

Figure 6. Soils Map

Source: https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

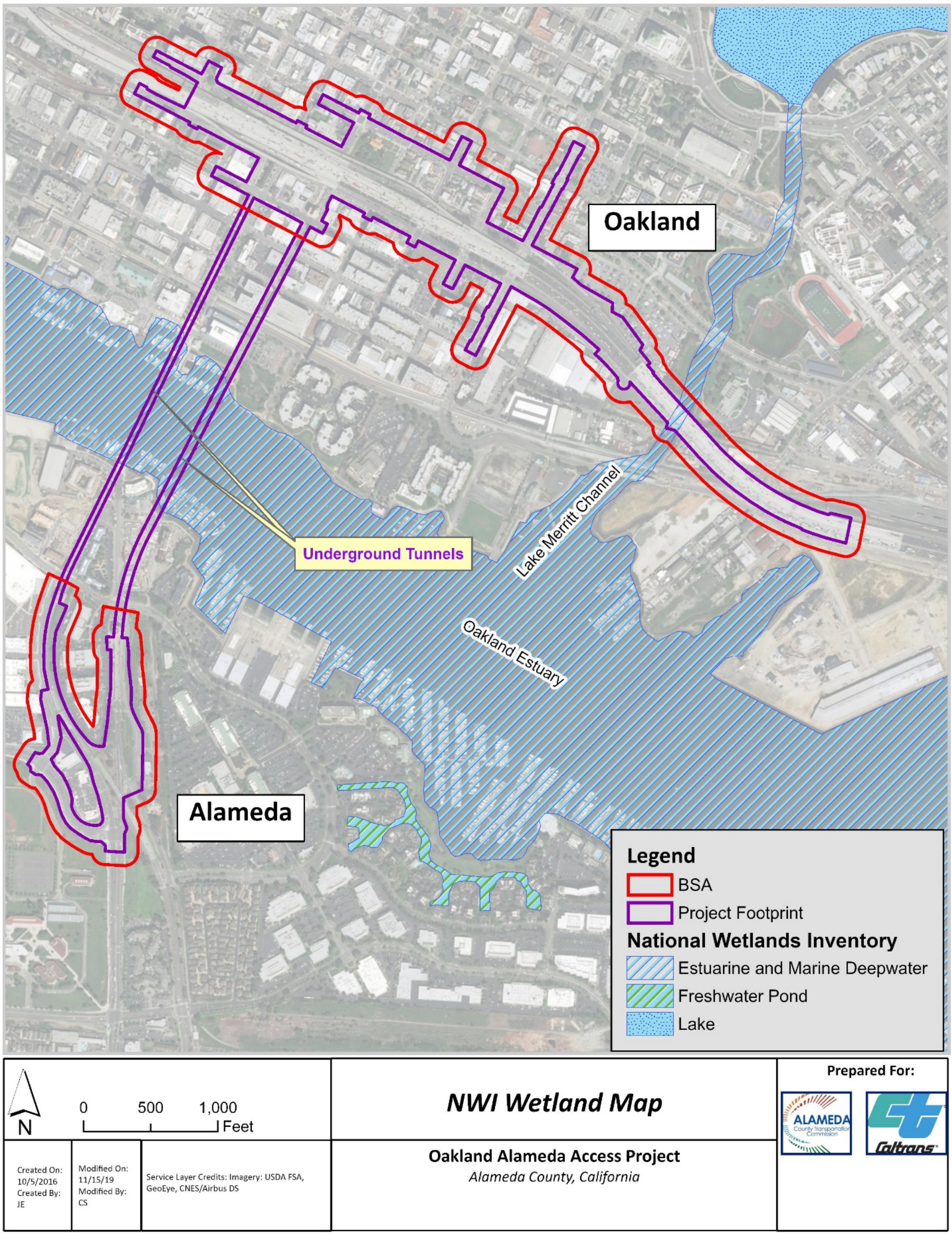

Figure 7. National Wetlands Inventory Map

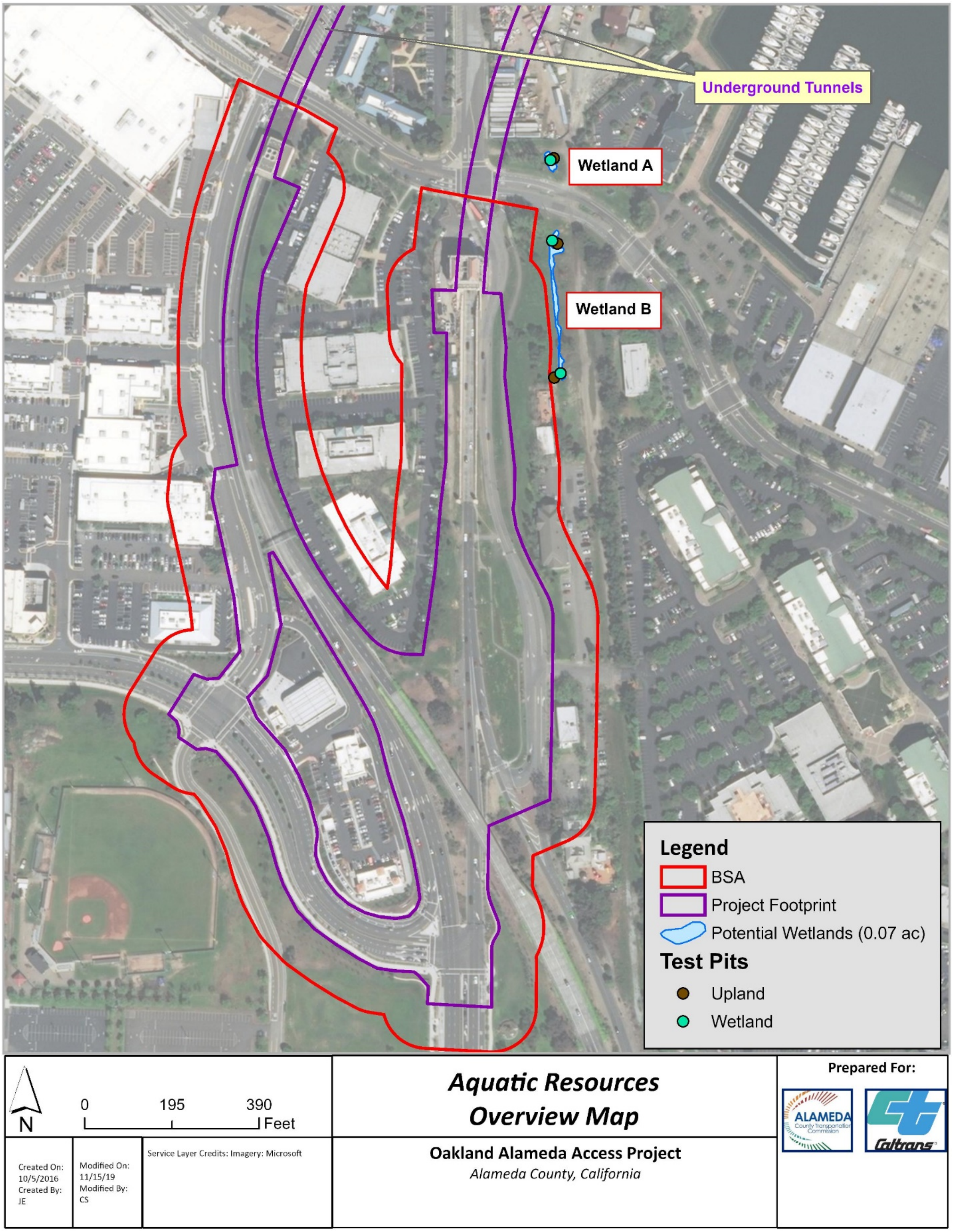

Figure 8. Overview of Delineated Aquatic Resources

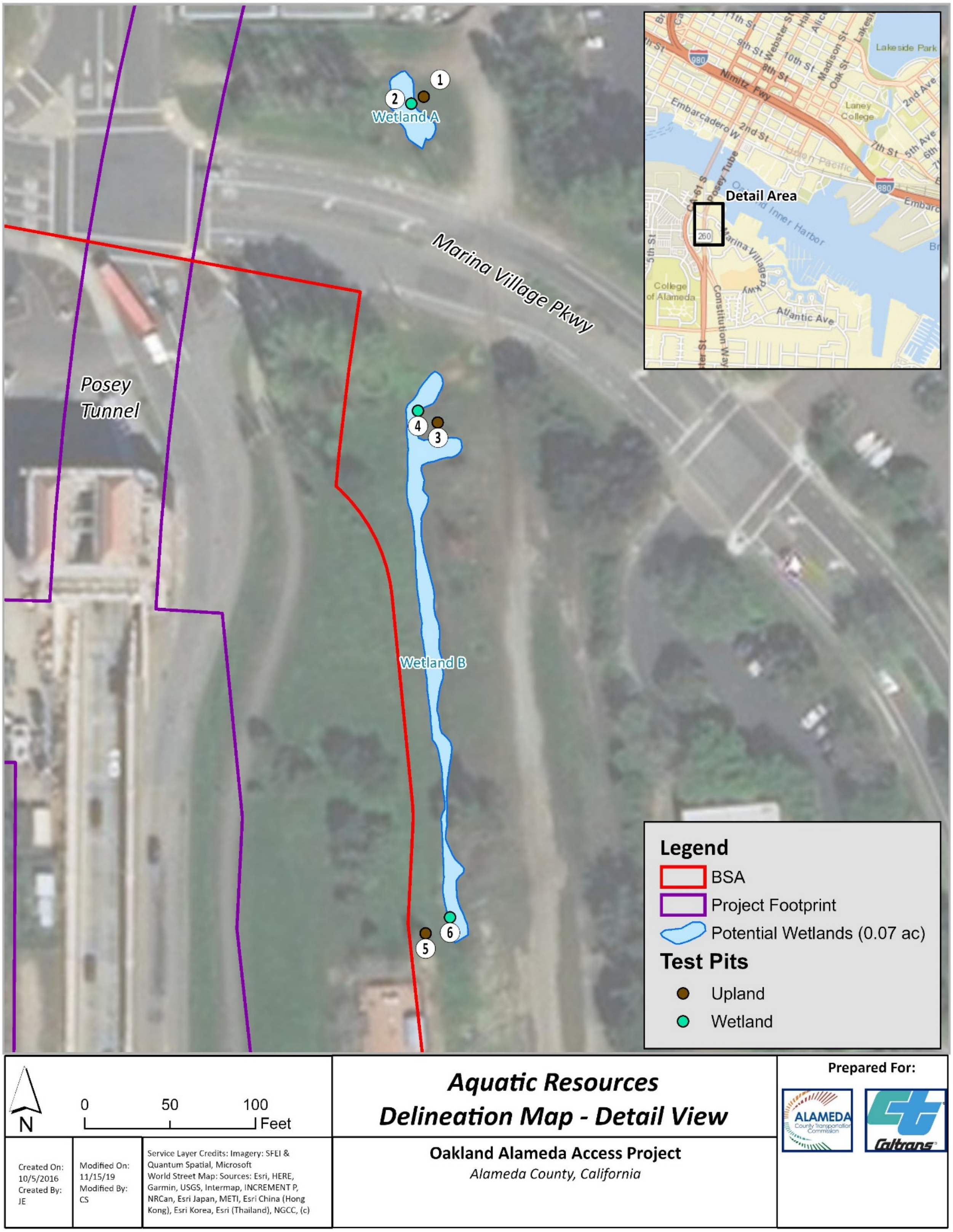

Figure 9. Aquatic Resources Delineation Map – Detail View

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Appendix B Wetland and OHWM Determination Data Forms

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WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland-Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18

Applicant/Owner: ACTC State: CA Sampling Point: #1

Investigator(s): Greg W.; Jared E. Section, Township, Range: S35; T1S; R4W

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%

Subregion (LRR): ___ Lat: 37.788261985 Long: -122.275995572 Datum: ___

Soil Map Unit Name: Xerorthents, Clayey NWI classification: ___

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

	Yes	No
Hydrophytic Vegetation Present?		✓
Hydric Soil Present?		✓
Wetland Hydrology Present?		✓

Is the Sampled Area within a Wetland? Yes ___ No ✓

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: ___)			
1. Foeniculum vulgare	20	X	FACU
2. Avena fatua	65	X	UPL
3. Raphanus sativus	2		UPL
4. Geranium californicum	3-5		FAC
5. Plantago lanceolata	7-10		FAC-
6. Achyrachaena mollis	1		FAC
7.			
8.			
= Total Cover	100		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ___ % Cover of Biotic Crust ___

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 0 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 0 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	0	x 2 =	0
FAC species	16	x 3 =	48
FACU species	20	x 4 =	80
UPL species	67	x 5 =	335
Column Totals:	103 (A)		463 (B)

Prevalence Index = B/A = 4.5

Hydrophytic Vegetation Indicators:

N Dominance Test is >50%

N Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks:

SOIL

Sampling Point: TH #1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
1-2	10YR 3/1	100	—	—	—		Cl lo.	organic matter layer
2-6	10YR 3/2	100	—	—	—		Cl lo	
7-12	10YR 4/2	100	—	—	-		Cl lo	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

__ Histosol (A1)
__ Histic Epipedon (A2)
__ Black Histic (A3)
__ Hydrogen Sulfide (A4)
__ Stratified Layers (A5) (**LRR C**)
__ 1 cm Muck (A9) (**LRR D**)
__ Depleted Below Dark Surface (A11)
__ Thick Dark Surface (A12)
__ Sandy Mucky Mineral (S1)
__ Sandy Gleyed Matrix (S4)
__ Sandy Redox (S5)
__ Stripped Matrix (S6)
__ Loamy Mucky Mineral (F1)
__ Loamy Gleyed Matrix (F2)
__ Depleted Matrix (F3)
__ Redox Dark Surface (F6)
__ Depleted Dark Surface (F7)
__ Redox Depressions (F8)
__ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

__ 1 cm Muck (A9) (**LRR C**)
__ 2 cm Muck (A10) (**LRR B**)
__ Reduced Vertic (F18)
__ Red Parent Material (TF2)
__ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ____ No ✓

Remarks:

Cl lo = Clayey loam

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

__ Surface Water (A1)
__ High Water Table (A2)
__ Saturation (A3)
__ Water Marks (B1) (**Nonriverine**)
__ Sediment Deposits (B2) (**Nonriverine**)
__ Drift Deposits (B3) (**Nonriverine**)
__ Surface Soil Cracks (B6)
__ Inundation Visible on Aerial Imagery (B7)
__ Water-Stained Leaves (B9)
__ Salt Crust (B11)
__ Biotic Crust (B12)
__ Aquatic Invertebrates (B13)
__ Hydrogen Sulfide Odor (C1)
__ Oxidized Rhizospheres along Living Roots (C3)
__ Presence of Reduced Iron (C4)
__ Recent Iron Reduction in Tilled Soils (C6)
__ Thin Muck Surface (C7)
__ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

__ Water Marks (B1) (**Riverine**)
__ Sediment Deposits (B2) (**Riverine**)
__ Drift Deposits (B3) (**Riverine**)
__ Drainage Patterns (B10)
__ Dry-Season Water Table (C2)
__ Crayfish Burrows (C8)
__ Saturation Visible on Aerial Imagery (C9)
__ Shallow Aquitard (D3)
__ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ____ No ✓ Depth (inches): ______

Water Table Present? Yes ____ No ✓ Depth (inches): ______

Saturation Present? (includes capillary fringe) Yes ____ No ✓ Depth (inches): ______

Wetland Hydrology Present? Yes ____ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland-Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18

Applicant/Owner: ACTC State: CA Sampling Point: #2

Investigator(s): Greg W.; Jared E. Section, Township, Range: S35; T1S; R4W

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%

Subregion (LRR): ______ Lat: 37.788247761 Long: -122.275972295 Datum: ______

Soil Map Unit Name: Xerorthents, Clayey NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ___	Is the Sampled Area within a Wetland? Yes ✓ No ___
Hydric Soil Present?	Yes ✓ No ___	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: ___)			
1. Distichlis spicata	70	✓	FACW
2. Salicornia pacifica	25	✓	OBL
3. Avena fatua	1		UPL
4. Raphanus sativus	1		UPL
5. Geranium californicum	2		FAC
6. Foeniculum vulgare	1-2		FACU
7.			
8.			
= Total Cover	100		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	25	x 1 = 25
FACW species	70	x 2 = 140
FAC species	2	x 3 = 6
FACU species	4	x 4 = 8
UPL species	2	x 5 = 10
Column Totals:	103 (A)	189 (B)

Prevalence Index = B/A = 1.83

Hydrophytic Vegetation Indicators:

Y Dominance Test is >50%

Y Prevalence Index is ≤3.0[1]

___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks:

SOIL

Sampling Point: TH #2

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
1-2	10YR 5/2	100					Clay	
2-5	10YR 4/3	60	10YR 5/4	40	RM	M	Clay	
6-11	Gley1 3/10Y	70	10YR 5/6	30	RM	M	Clay	
12-14	10YR 4/2	98	10YR 5/4	2	RM	M	Clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ✓ No ___

Remarks: Water present at bottom of test pit. (High water table)

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

	Yes	No	Depth (inches)
Surface Water Present?	✓		2-4
Water Table Present?	✓		14
Saturation Present? (includes capillary fringe)	✓		8-14

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:
- Some ponding in ditch; OHWM
- H_2O stained leaves.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland-Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18

Applicant/Owner: ACTC State: CA Sampling Point: #13

Investigator(s): Greg W; Jared E. Section, Township, Range: S35; T1S; R4W

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%

Subregion (LRR): ______ Lat: 37.787738403 Long: -122.27595486 Datum: ______

Soil Map Unit Name: Xerorthents, Clayey NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ____	No ✓
Hydric Soil Present?	Yes ____	No ✓
Wetland Hydrology Present?	Yes ____	No ✓

Is the Sampled Area within a Wetland? Yes ____ No ✓

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ______)			
1. Avena fatua	60	✓	UPL
2. Vicia sativa	10-15		UPL
3. Foeniculum vulgare	1		FACU
4. Geranium californicum	15-17		FAC
5. Medicago polymorpha	2		FACU
6. Hordeum brachyantherum	1-2		FACW
7. Elymus canadensis	3		FAC
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: Ø (A)

Total Number of Dominant Species Across All Strata: 1 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: Ø (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	Ø	x 1 = Ø
FACW species	2	x 2 = 4
FAC species	20	x 3 = 60
FACU species	3	x 4 = 12
UPL species	75	x 5 = 375
Column Totals:	100 (A)	451 (B)

Prevalence Index = B/A = 4.5

Hydrophytic Vegetation Indicators:

N Dominance Test is >50%

N Prevalence Index is ≤3.0[1]

__ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)

__ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ____ No ✓

Remarks:

SOIL

Sampling Point: TH #3

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
1-3	10YR 3/1	100	—	—	—	—	clay loam	organic layer
3-6	10YR 4/1	100	—	—	—	—	Clay	
6-10	10YR 5/4	100	—	—	—	—	sandy loam	
10-12	10YR 3/3	100	—	—	—	—	Sandy loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR C)**
- ___ 1 cm Muck (A9) **(LRR D)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR C)**
- ___ 2 cm Muck (A10) **(LRR B)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ___

Depth (inches): ___

Hydric Soil Present? Yes ___ No ✓

Remarks:

Rocky soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) **(Nonriverine)**
- ___ Sediment Deposits (B2) **(Nonriverine)**
- ___ Drift Deposits (B3) **(Nonriverine)**
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) **(Riverine)**
- ___ Sediment Deposits (B2) **(Riverine)**
- ___ Drift Deposits (B3) **(Riverine)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ___

Water Table Present? Yes ___ No ✓ Depth (inches): ___

Saturation Present? (includes capillary fringe) Yes ___ No ✓ Depth (inches): ___

Wetland Hydrology Present? Yes ___ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland-Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18

Applicant/Owner: ACTC State: CA Sampling Point: #4

Investigator(s): Greg W. ; Javed E Section, Township, Range: S35; T1S; R4W

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%

Subregion (LRR): ______ Lat: 37.78775648 Long: -122.27599520 Datum: ______

Soil Map Unit Name: Xerorthents, Clayey NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓ No ___	Is the Sampled Area within a Wetland? Yes ✓ No ___
Hydric Soil Present?	Yes ✓ No ___	
Wetland Hydrology Present?	Yes ✓ No ___	

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
= Total Cover			
Sapling/Shrub Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
= Total Cover			
Herb Stratum (Plot size: ______)			
1. Distichlis spicata	75	✓	FACW
2. Salicornia pacifica	25	✓	OBL
3.			
4.			
5.			
6.			
7.			
8.			
= Total Cover			
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
= Total Cover			

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	25	x 1 = 25
FACW species	75	x 2 = 150
FAC species	Ø	x 3 = Ø
FACU species	Ø	x 4 = Ø
UPL species	Ø	x 5 = Ø
Column Totals:	100 (A)	175 (B)

Prevalence Index = B/A = 1.75

Hydrophytic Vegetation Indicators:

- ✓ Dominance Test is >50%
- ✓ Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ___

Remarks: sample point in bed of ditch channel.

SOIL

Sampling Point: TH #4

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
1-2	10YR 5/2	100					clay loam	organic matter
3-8	10YR 4/2	90	10YR 5/3	10	RM	M	Clay	
8-12	Gley 1 3/10Y	95	10YR 4/4	5	RM	M	Clay	
12-14	Gley 1 5/10Y	50	10YR 5/4	50	RM	M	Sandy clay	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ✓ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ✓ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ✓ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ___	No ✓	Depth (inches): ______
Water Table Present?	Yes ✓	No ___	Depth (inches): >12
Saturation Present? (includes capillary fringe)	Yes ✓	No ___	Depth (inches): = 8

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks: No flows in ditch - ponding at culvert inlet.

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland - Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18
Applicant/Owner: ACTC State: CA Sampling Point: #5
Investigator(s): Greg W; Javed E. Section, Township, Range: S35; T1S; R4W
Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%
Subregion (LRR): ______ Lat: 37.786915789 Long: -122.275959606 Datum: ______
Soil Map Unit Name: Xerorthents, Clayey NWI classification: ______
Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ___ (If no, explain in Remarks.)
Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ___
Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ___	No ✓
Hydric Soil Present?	Yes ___	No ✓
Wetland Hydrology Present?	Yes ___	No ✓

Is the Sampled Area within a Wetland? Yes ___ No ✓

Remarks:

VEGETATION – Use scientific names of plants.

Tree Stratum (Plot size: ___)	Absolute % Cover	Dominant Species?	Indicator Status
1.			
2.			
3.			
4.			
	= Total Cover		
Sapling/Shrub Stratum (Plot size: ___)			
1.			
2.			
3.			
4.			
5.			
	= Total Cover		
Herb Stratum (Plot size: ___)			
1. Ranunculus repens	5		FAC
2. Hordeum brachyantherum	3-5		FACW
3. Elymus canadensis	25	✓	FAC
4. Geranium californicum	5		FAC
5. Vicia sativa	5-7		UPL
6. Silybum marianum	1-3		UPL
7. Avena fatua	50	✓	UPL
8.			
	100 = Total Cover		
Woody Vine Stratum (Plot size: ___)			
1.			
2.			
	= Total Cover		

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC:	1	(A)
Total Number of Dominant Species Across All Strata:	2	(B)
Percent of Dominant Species That Are OBL, FACW, or FAC:	50	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	Ø	x 1 = Ø
FACW species	3	x 2 = 6
FAC species	15	x 3 = 45
FACU species	Ø	x 4 = Ø
UPL species	60	x 5 = 300
Column Totals:	78 (A)	351 (B)

Prevalence Index = B/A = 4.5

Hydrophytic Vegetation Indicators:

- N Dominance Test is >50%
- N Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ___ No ✓

Remarks:

SOIL

Sampling Point: TH#5

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[1]	Loc[2]	Texture	Remarks
1-2	10YR 2/1	100	—	—	—	—	loam	organic matter
2-5	10YR 3/2	100	—	—	—	—	loam	
5-12	10YR 3/2	100	—	—	—	—	loam	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) (**LRR C**)
- ___ 1 cm Muck (A9) (**LRR D**)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) (**LRR C**)
- ___ 2 cm Muck (A10) (**LRR B**)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______________________

Depth (inches): ______________________

Hydric Soil Present? Yes ______ No ✓

Remarks:

Rocky soils.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) (**Nonriverine**)
- ___ Sediment Deposits (B2) (**Nonriverine**)
- ___ Drift Deposits (B3) (**Nonriverine**)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) (**Riverine**)
- ___ Sediment Deposits (B2) (**Riverine**)
- ___ Drift Deposits (B3) (**Riverine**)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ______ No N Depth (inches): ____________

Water Table Present? Yes ______ No N Depth (inches): ____________

Saturation Present? (includes capillary fringe) Yes ______ No N Depth (inches): ____________

Wetland Hydrology Present? Yes ______ No ✓

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

WETLAND DETERMINATION DATA FORM – Arid West Region

Project/Site: Oakland-Alameda Project City/County: Alameda Cty Sampling Date: 3/30/18

Applicant/Owner: ACTC State: CA Sampling Point: #6

Investigator(s): Greg W.; Jared E. Section, Township, Range: S35; T1S; R4 W

Landform (hillslope, terrace, etc.): Flat Local relief (concave, convex, none): None Slope (%): 1%

Subregion (LRR): ______ Lat: 37.786942415 Long: -122.275910726 Datum: ______

Soil Map Unit Name: Xerorthents, Clayey NWI classification: ______

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✓ No ____ (If no, explain in Remarks.)

Are Vegetation N, Soil N, or Hydrology N significantly disturbed? Are "Normal Circumstances" present? Yes ✓ No ____

Are Vegetation N, Soil N, or Hydrology N naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ✓	No ____
Hydric Soil Present?	Yes ✓	No ____
Wetland Hydrology Present?	Yes ✓	No ____

Is the Sampled Area within a Wetland? Yes ✓ No ____

Remarks:

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
		= Total Cover	
Sapling/Shrub Stratum (Plot size: ______)			
1.			
2.			
3.			
4.			
5.			
		= Total Cover	
Herb Stratum (Plot size: ______)			
1. Distichlis spicata	60	✓	FACW
2. Salicornia pacifica	30	✓	OBL
3. Plantago coronopus	3-5		FAC
4. Salsola australis	5		FACU
5.			
6.			
7.			
8.			
	100	= Total Cover	
Woody Vine Stratum (Plot size: ______)			
1.			
2.			
		= Total Cover	

% Bare Ground in Herb Stratum ______ % Cover of Biotic Crust ______

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 100 (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	30	x 1 =	30
FACW species	60	x 2 =	120
FAC species	5	x 3 =	15
FACU species	5	x 4 =	20
UPL species	0	x 5 =	0
Column Totals:	100 (A)		185 (B)

Prevalence Index = B/A = 1.85

Hydrophytic Vegetation Indicators:

- Y Dominance Test is >50%
- Y Prevalence Index is ≤3.0[1]
- ___ Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ___ Problematic Hydrophytic Vegetation[1] (Explain)

[1]Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? Yes ✓ No ____

Remarks:

SOIL

Sampling Point: TH #6

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)	Matrix %	Redox Color (moist)	Redox %	Type[1]	Loc[2]	Texture	Remarks
1-2	10YR 5/2	100	—	—	—	—	clay	organic matter
2-10	10YR 4/2	80	10YR 4/4	20	RM	m	clay	
10-14	10YR 5/1	75	7.5YR 5/6	25	RM	M	sandy	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

- ___ Histosol (A1)
- ___ Histic Epipedon (A2)
- ___ Black Histic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Stratified Layers (A5) **(LRR C)**
- ___ 1 cm Muck (A9) **(LRR D)**
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)
- ___ Vernal Pools (F9)

Indicators for Problematic Hydric Soils[3]:

- ___ 1 cm Muck (A9) **(LRR C)**
- ___ 2 cm Muck (A10) **(LRR B)**
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (TF2)
- ___ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: ______

Depth (inches): ______

Hydric Soil Present? Yes ✓ No ___

Remarks:

saturation in upper 10"
test pit dug in ditch channel.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ✓ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1) **(Nonriverine)**
- ___ Sediment Deposits (B2) **(Nonriverine)**
- ___ Drift Deposits (B3) **(Nonriverine)**
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Water-Stained Leaves (B9)
- ___ Salt Crust (B11)
- ___ Biotic Crust (B12)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Thin Muck Surface (C7)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water Marks (B1) **(Riverine)**
- ___ Sediment Deposits (B2) **(Riverine)**
- ___ Drift Deposits (B3) **(Riverine)**
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Crayfish Burrows (C8)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)

Field Observations:

Surface Water Present? Yes ___ No ✓ Depth (inches): ______

Water Table Present? Yes ✓ No ___ Depth (inches): ≤14

Saturation Present? Yes ✓ No ___ Depth (inches): 8
(includes capillary fringe)

Wetland Hydrology Present? Yes ✓ No ___

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

Appendix C Representative Site Photographs

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Site Photographs

1) Photograph of Wetland A, view looking north.

2) Photograph of close-up of Wetland A, looking north.

3) Photograph of Wetland A, view looking southeast.

4) Photograph of core soil sample (Test Pit #1).

5) Photograph of core soil sample (Test Pit #2).

6) Photograph overlooking Wetland B (saline emergent wetland), view looking south.

7) Photograph of culvert inlet into Wetland B (saline emergent wetland), view looking east.

8) Photograph of culvert inlet into Wetland B, view looking northeast.

9) Photograph of culvert inlet into Wetland B, view looking west.

10) Photograph of core soil sample (Test pit #3)

11) Photograph of Wetland B, view looking north.

12) Photograph of 45” concrete culvert outfall at Barnhill Marina, looking north.

13) Photograph of 45” concrete culvert at Barnhill Marina, looking south.

Appendix D Western Alameda County Soil Survey

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SOIL SURVEY OF

ALAMEDA COUNTY, CALIFORNIA, WESTERN PART

United States Department of Agriculture
Soil Conservation Service
in cooperation with
University of California Agricultural Experiment Station

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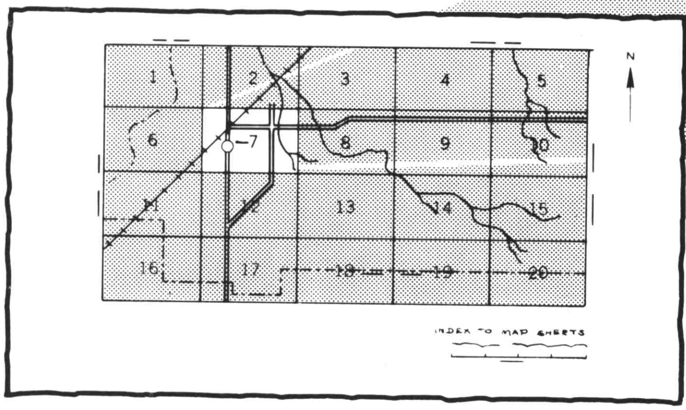
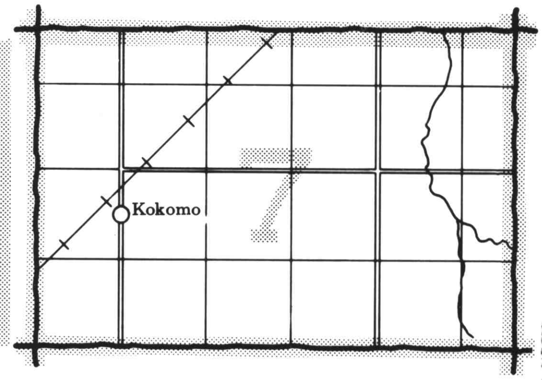
HOW TO USE

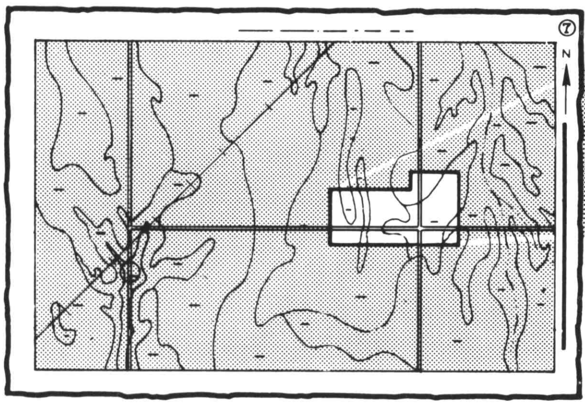
1. Locate your area of interest on the "Index to Map Sheets" (the last page of this publication).

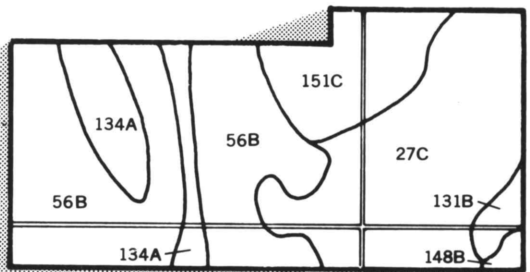




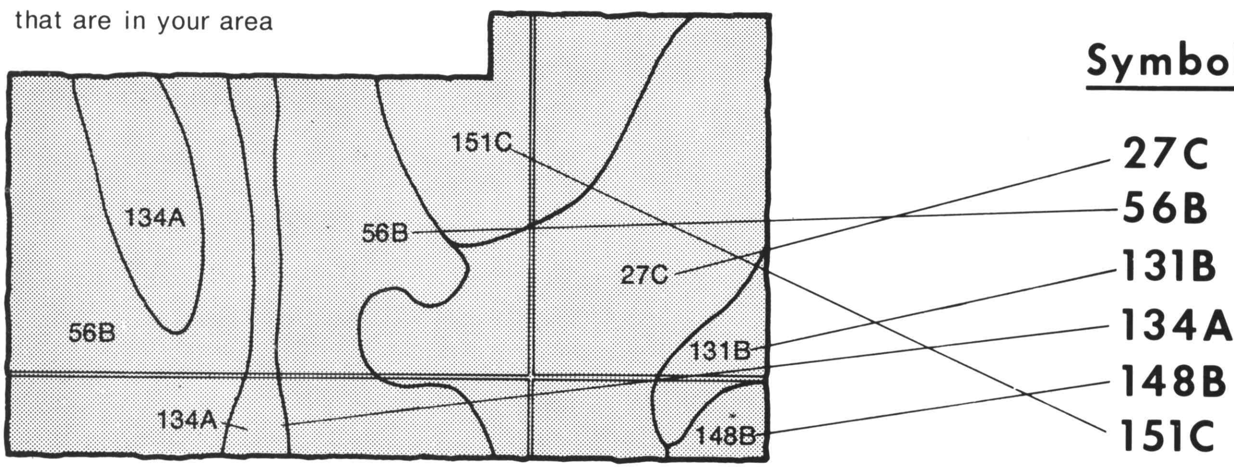
2. Note the number of the map sheet and turn to that sheet.

3. Locate your area of interest on the map sheet.



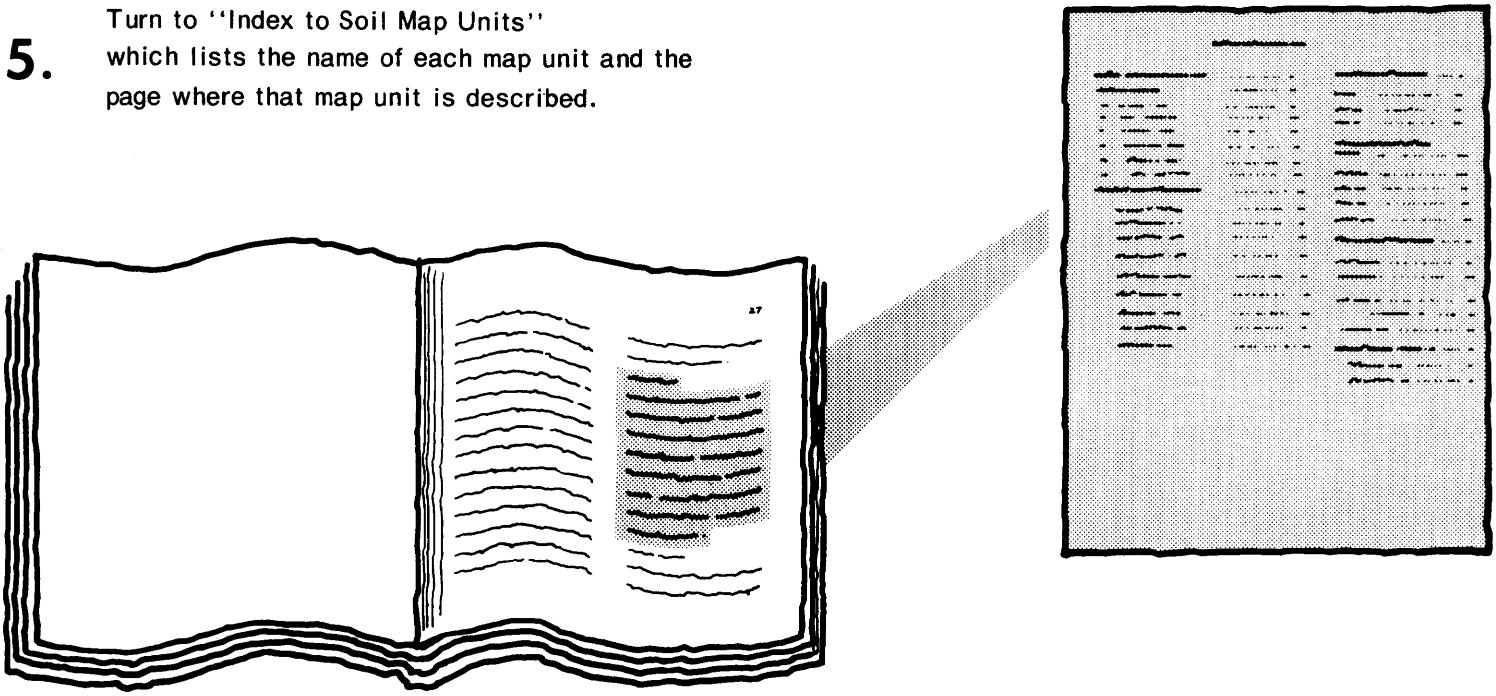


4. List the map unit symbols that are in your area

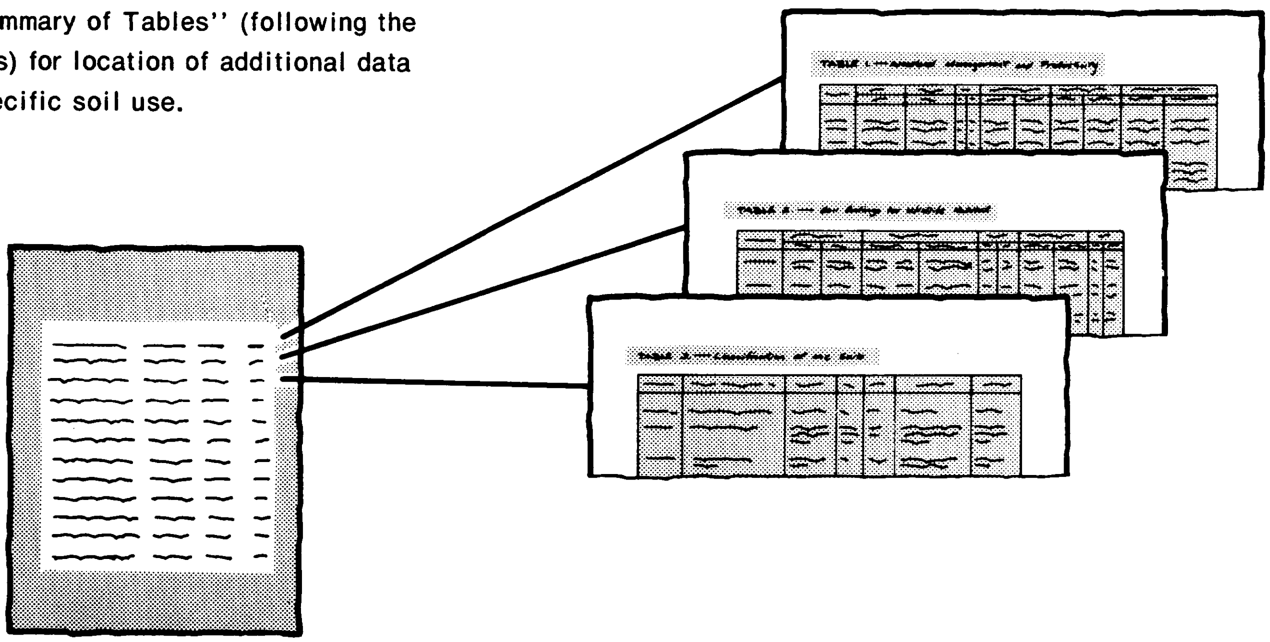


THIS SOIL SURVEY

5. Turn to "Index to Soil Map Units" which lists the name of each map unit and the page where that map unit is described.



6. See "Summary of Tables" (following the Contents) for location of additional data on a specific soil use.



7. Consult "Contents" for parts of the publication that will meet your specific needs. This survey contains useful information for farmers or ranchers, foresters or agronomists; for planners, community decision makers, engineers, developers, builders, or homebuyers; for conservationists, recreationists, teachers, or students; for specialists in wildlife management, waste disposal, or pollution control.

This is a publication of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and agencies of the States, usually the Agricultural Experiment Stations. In some surveys, other Federal and local agencies also contribute. The Soil Conservation Service has leadership for the Federal part of the National Cooperative Soil Survey. In line with Department of Agriculture policies, benefits of this program are available to all, regardless of race, color, national origin, sex, religion, marital status, or age.

Major fieldwork for this soil survey was completed in 1975. Soil names and descriptions were approved in April 1975. Unless otherwise indicated, statements in the publication refer to conditions in the survey area in 1975. This survey was made cooperatively by the Soil Conservation Service and the University of California Agricultural Experiment Station. It is part of the technical assistance furnished to the Alameda County Resource Conservation District.

Soil maps in this survey may be copied without permission, but any enlargement of these maps could cause misunderstanding of the detail of mapping and result in erroneous interpretations. Enlarged maps do not show small areas of contrasting soils that could have been shown at a larger mapping scale.

Contents

Issued March 1981

Index to soil map units

Summary of tables

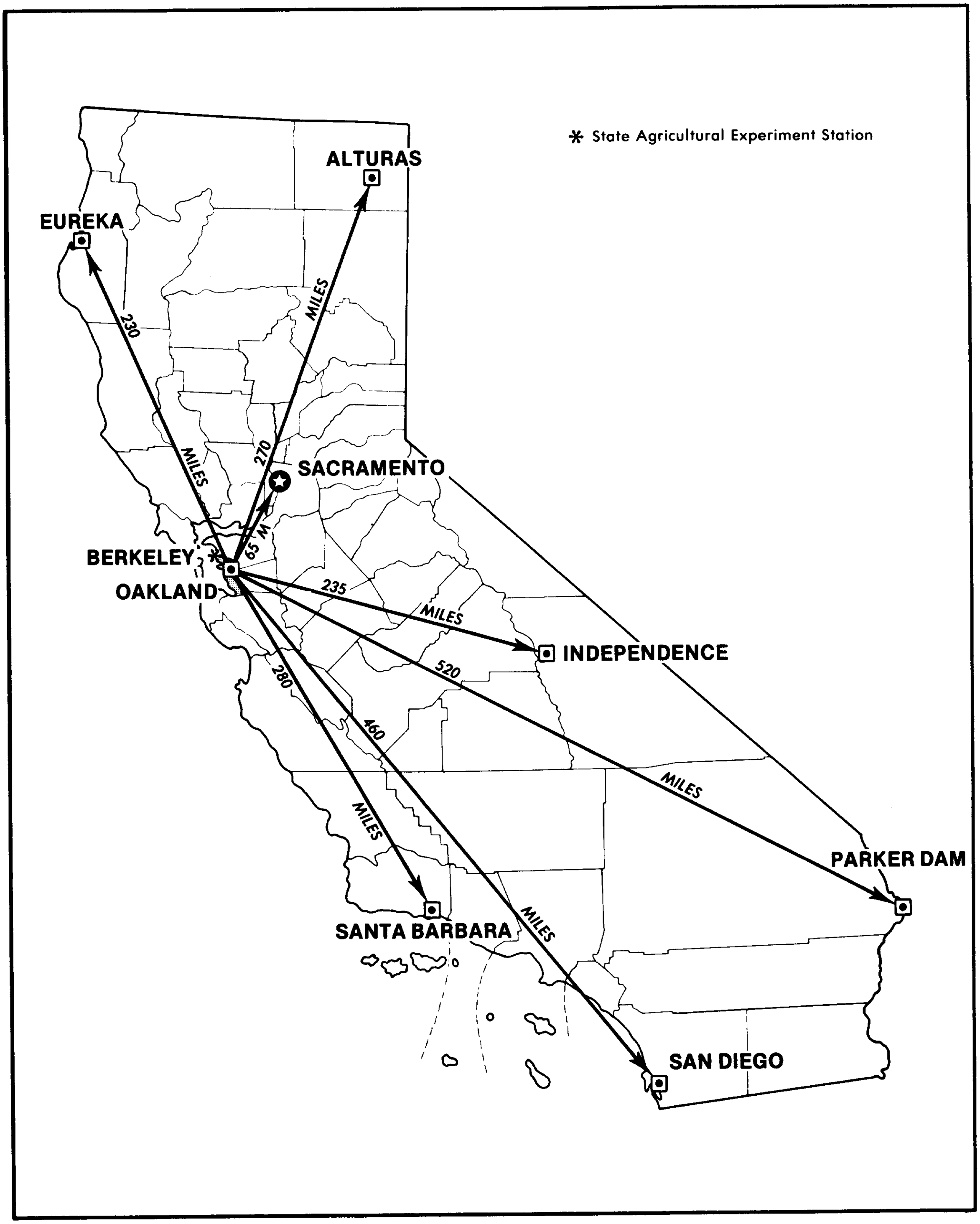
Preface

This soil survey contains much information useful in land-planning programs in Alameda County, Western Part. Of prime importance are the predictions of soil behavior for selected land uses. Also highlighted are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the impact that selected land uses will have on the environment.

This soil survey has been prepared for many different users. Farmers, ranchers, foresters, and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use it to plan land use, select sites for construction, develop soil resources, or identify any special practices that may be needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the soil survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be too unstable to be used as a foundation for buildings or roads. Very clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map; the location of each kind of soil is shown on detailed soil maps. Each kind of soil in the survey area is described, and much information is given about each soil for specific uses. Additional information or assistance in using this publication can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.



Location of Alameda County, Western Part, in California.

SOIL SURVEY OF ALAMEDA COUNTY, CALIFORNIA, WESTERN PART

By Lawrence E. Welch

Soils surveyed by Lawrence E. Welch, Clifford Landers, Paul Nazar, and William Harris, Soil Conservation Service

United States Department of Agriculture, Soil Conservation Service, in cooperation with University of California Agricultural Experiment Station

ALAMEDA COUNTY, WESTERN PART, is in the San Francisco drainage basin. The survey area is bounded on the west by San Francisco Bay and on the east by foothills and uplands of the Diablo Range. The area is 225 square miles, or about 144,120 acres in size. Elevation ranges from sea level to about 2,000 feet.

Most of the survey area is urban land. Oakland, the largest city in Alameda County, is the county seat. Agriculture is limited mainly to the southern part of the survey area. A few large vegetable farms are in an area east of Coyote Hills.

General nature of the area

This section provides general information about the survey area. Climate; physiography, relief, and drainage; history and development; transportation; industry; and farming are discussed.

Climate

The survey area has a marine climate characterized by very little change in temperature. Temperatures are moderate, and crops can be grown throughout the year. Rain falls mainly in winter. There is little or no rain in summer. Summer crops require irrigation, but winter crops or early-maturing grain crops require little or no irrigation.

The mean annual temperature ranges from 56.5 degrees F at Oakland Airport to 58.5 degrees at Alvarado. Temperatures reach 90 degrees or higher on about 4 days a year. Temperature data from five weather stations is shown in Table 1.

The average frost-free season is 293 days or more. The number of frost-free days (32 degrees F or higher) at Hayward is 306; at Newark, 293; and at Oakland, 333.

The average annual precipitation ranges from 13.64 inches at Newark to 25.42 inches near Hayward. In general, the amount of precipitation increases inland from the bay as the elevation increases. Most precipitation falls between October and April. Localized showers are infrequent. Storms are moderate in duration and intensity, but, at times, precipitation is heavy enough to cause flooding. Snow and hail are rare. Table 2 provides average monthly and annual precipitation data.

The relative humidity in winter is about 85 to 90 percent at night and 60 to 70 percent in the afternoon. It is less in spring, but increases at night in summer. Humidity is lowest in fall. It ranges from 50 percent during the day to 70 percent at night.

Strong winds are unusual in this survey area. The wind speed is less than 6 miles per hour more than 50 percent of the time and exceeds 12 miles per hour only 10 percent of the time. The strongest winds are usually associated with winter storms. Winds from the north and east are sometimes accompanied by cold temperatures in winter and spring. Westerly winds in summer are generated by the cool marine air flowing to the warmer interior. These winds are strongest early in summer, mainly late in the afternoon and in the evening.

Physiography, relief, and drainage

The survey area consists of three physiographic units: nearly level deltas and flood plains at sea level to an elevation of 200 feet; upland terraces and terrace remnants at an elevation of 100 to 300 feet; and foothills and uplands, along the eastern boundary, at an elevation of 200 to 2,000 feet. The soils on foothills and uplands are strongly sloping to very steep.

The survey area is drained mainly by Alameda Creek, which enters the area at Niles, and by San Leandro Creek, which enters the area at San Leandro. The flow of water in these creeks is regulated by reservoirs that are east of the survey area. Numerous intermittent streams that flow for short periods in winter also drain the area.

History and development

In the late eighteenth century, Spanish explorers and missionaries opened the survey area to settlement. As early as 1795, the Spaniards called the area that encompasses the southern part of the survey area "Alameda," and the stream running through it, "Rio de la Alameda." "Alameda" is derived from the Spanish word that means "grove of poplar trees." Mission San Jose de Guadalupe, which became one of the most prosperous and populous of the California missions, was established in 1797. In 1820, Rancho San Antonio was granted to Don Luis Peralta. This domain included the areas along the eastern shore of San Francisco Bay where the cities of Albany, Berkeley, Emeryville, Piedmont, Oakland, Alameda, and San Leandro are now. Other large Spanish land grants in the survey area were Rancho San Leandro and Rancho San Lorenzo.

American territorial claims in 1847 and the gold rush of 1849 promoted the settlement of the survey area. In 1852, tracts of land were staked out at the present site of the city of Oakland. Seventeen years later the first transcontinental railroad arrived in Oakland. The city's population increased from 1,543 in 1860 to 10,500 in 1870.

Alameda County was organized in 1853 from parts of Contra Costa and Santa Clara Counties. The population was 93,864 in 1890 and 908,209 in 1960.

Transportation

The bayshore cities in the county are natural terminals for long-distance transportation lines. Three transcontinental railways—Southern Pacific, Santa Fe, and Western Pacific—have terminals directly connected to port facilities. These major railroads, in addition to truck lines, provide transportation to all Pacific Coast cities and to interior valley areas.

The Port of Oakland has more than 19 miles of deepwater frontage. Before World War II, this port served more than 100 steamship lines engaged in coastal, intercoastal, and foreign trade.

The Metropolitan Oakland International Airport is 6 miles south of the center of Oakland. It is more than 1,000 acres in size. An additional 1,000 acres, adjacent to the airport, is reserved for harbor and airport industrial development. The airport accommodates intercontinental airlines. There are seven other airports in Alameda County. Two of these airports are municipally controlled, two are operated by the military, and three are privately owned.

The San Francisco-Oakland Bay Bridge provides passage for busses, trucks, and private automobiles. The San Mateo Bridge and the Dumbarton Bridge connect the southern part of Alameda County with San Mateo County and with the coastal highway.

The major paved highways in the area make Alameda County a center for bus and truck traffic. Alameda County has 219 miles of State highways and 562 miles of county roads, 227 miles of which are primary roads.

Industry

The food processing industry—mainly the canning of fruits, vegetables, and fish—ranks first in the economy of Alameda County. Most of the foods that are canned are produced outside of the survey area. The most important of these foods are peaches, pears, mixed fruits, apricots, spinach, tomatoes, and potatoes. Wineries produce table and dessert wines as well as vermouth and champagne.

The manufacturing of machinery is the second largest industry. The fabricated metals industry and the transportation equipment industry are also important to the county's economy. More than 100 chemical firms employ 5,000 workers, and primary metals production firms employ about the same number. Other important industries are printing and publishing, sand and gravel extraction, and the production of glass, paper, and allied products and electrical machinery.

Electricity for industry is provided by a system of hydroelectric plants, supplemented by steam electric-generating plants in key cities.

Natural gas is piped into Alameda County from the local fields and from fields in Texas, New Mexico, and Canada. Fuel oil and gasoline are available from the local refineries of four major oil companies.

A twin aqueduct, 93 miles long, brings soft mountain water from the Sierra Nevada to the area.

Farming

In the past, the southern part of the survey area supplied many vegetable crops to the cities surrounding San Francisco Bay. Today, the amount of farmland has been reduced because of the increase in residential and industrial development in the area. A few large areas east of the Coyote Hills are intensively cropped to vegetables. The most common cropping system includes head lettuce in summer and cauliflower in winter. Tomatoes are sometimes grown instead of head lettuce. Small acreages of fruit and nut crops, nursery products, and cut flowers are scattered throughout the southern part of the survey area.

Most of the water used for agriculture comes from wells. The hazard of salt water intrusion from San Francisco Bay has been reduced by importing water and diverting it into old gravel pits adjacent to Alameda Creek to recharge the ground water reservoir.

How this survey was made

Soil scientists made this survey to learn what kinds of soil are in the survey area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and they compared those profiles with others in counties nearby and in places more distant. Thus, through correlation, they classified and named the soils according to nationwide, uniform procedures.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show buildings, field borders, roads, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from aerial photographs.

The areas shown on a soil map are called map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material. Map units are discussed in the sections "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of soils are taken as needed for laboratory measurements and for engineering tests. The soils are field tested, and interpretations of their characteristics may be modified during the course of the survey. New interpretations are added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also, data are assembled from other sources, such as test results, records, field experience, and state and local specialists.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is usable to farmers, engineers, planners, developers and builders, home buyers, and others.

Where soil boundaries extend into urban areas, pavement and buildings restrict the examination of the soils at close intervals. In the cities of Oakland and Berkeley, for example, the original soil properties have been obscured in many places by cutting and filling for urban development. Areas of identifiable soils are mapped in complex with Urban land. The mapped soil boundaries represent the best possible estimate of soil patterns under these circumstances.

The soil maps showing the urban areas are suitable for extensive general planning. Onsite inspection is needed for some intensive uses of Urban land and may be necessary in other areas as well, for example, where soil properties need to be identified at very close intervals.

General soil map for broad land use planning

The general soil map at the back of this publication shows map units that have a distinct pattern of soils, relief, and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general kinds of land use. Areas that are, for the most part, suited to certain kinds of farming or to other land uses can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land uses can be located.

Because of its small scale, the map does not show the kind of soil at a specific site. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth, stoniness, drainage, or other characteristics that affect their management.

Map unit descriptions

1. Reyes-Urban land

Nearly level, very poorly drained clays on tidal flats, and Urban land

This map unit consists of soils that formed in alluvium on tidal flats adjacent to the bay. The slopes are less than 2 percent. The natural vegetation consists primarily of salt-tolerant grasses and brush. Elevation is near sea level. The average annual precipitation ranges from 14 to 18 inches, the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 320 days.

This map unit makes up 23 percent of the survey area. Reyes soils make up about 70 percent of this map unit and Urban land about 25 percent. Omni silty clay loam, strongly saline, and Pescadero clay, ponded, make up the rest.

Reyes soils are very deep and very poorly drained. The surface layer is olive gray, strongly alkaline clay about 6 inches thick. The underlying material, to a depth of 42 inches, is mottled dark greenish gray and black, strongly alkaline clay. Below that it is dark greenish gray, strongly alkaline silty clay. These soils contain polysulfides below a depth of about 6 inches.

Urban land consists of areas that are covered by industrial and commercial buildings, streets, and other structures. Many of these areas consist of heterogeneous fill made up of crushed rock and soil material.

Reyes soils are used mainly for commercial salt production. They can also be used as wildlife habitat and dryland pasture.

2. Clear Lake-Omni-Urban land

Nearly level to moderately sloping, poorly drained clays and silty clay loams, and Urban land; on the basin rim

This map unit consists of soils that formed in alluvium derived mainly from sedimentary rock. The slopes range from 0 to 9 percent but are mainly 0 to 2 percent. The soils are on the basin rim that parallels the bay. The natural vegetation consists of annual grasses, forbs, and scattered oaks. Elevation ranges from 5 to 200 feet. The average annual precipitation ranges from 14 to 20 inches, the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 330 days.

This map unit makes up 17 percent of the survey area. Clear Lake soils make up about 45 percent of this map unit; Omni soils, 17 percent; and Urban land, 13 percent. Marvin and Pescadero soils and Xerorthents, clayey, make up the rest.

Clear Lake soils are very deep. The surface layer is very dark gray, neutral to moderately alkaline clay about 37 inches thick. The underlying material is dark gray and grayish brown calcareous clay and silty clay and extends to a depth of more than 60 inches. Flood-control structures have lowered the water table to a depth of 48 inches or more in most places.

Omni soils are very deep. The surface layer is grayish brown, moderately alkaline silty clay loam and silty clay about 15 inches thick. The subsoil extends to a depth of 52 inches; it is mottled, dark gray and light olive brown, moderately alkaline clay. The substratum is mottled, light olive brown silty clay loam and extends to a depth of 60 inches or more. Flood-control structures have lowered the water table to a depth of 5 feet or more.

Urban land consists of areas that are covered by houses, industrial buildings, parking lots, and other structures. The soil material has been altered or mixed during urban development. The characteristics of the original soil material were probably similar to those of the Clear Lake soils.

Areas of this map unit are mainly used for urban development. Some areas of the Clear Lake and Omni soils are used for dryland grain and pasture.

3. Xeropsamments-Urban land-Baywood

Nearly level to moderately sloping, somewhat excessively drained sands and loamy sands, and Urban land; on the coastal plain

This map unit consists of soils that formed in sandy eolian deposits on mounds and ridges that derived from beach deposits and in sandy material dredged from beaches. The slopes range from 0 to 9 percent. The natural vegetation consists of annual grasses, forbs, and scattered oaks. Elevation ranges from sea level to 60 feet. The average annual precipitation ranges from 16 to 18 inches, the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 330 days.

This map unit makes up 8 percent of the survey area. Xeropsamments make up about 53 percent of this map unit; Urban land, 20 percent; and Baywood soils, 15 percent. Omni and Willows soils make up the rest.

Xeropsamments consist of very deep sandy material that was dredged from beaches. These areas are protected from tidal action by levees.

Urban land consists of areas that are covered by houses, industrial buildings, parking lots, and other structures. The soil material has been altered or mixed during urban development. The characteristics of the original soil material were probably similar to those of the Baywood soils.

Baywood soils are very deep. The surface layer is grayish brown and brown, slightly acid loamy sand about 32 inches thick. The underlying material is pale brown and light yellowish brown, slightly acid loamy sand. It extends to a depth of 60 inches or more.

Areas of this map unit are used mainly for urban development. Much of the acreage is already covered by residential and commercial buildings, parking lots, and airfields.

4. Xerorthents-Maymen-Millsholm

Steep to very steep, well drained and somewhat excessively drained soils that have various textures; on foothills

This map unit consists of soils that formed mainly in material that weathered from interbedded sedimentary rock and some intrusive rock. The slopes range from 30 to 75 percent. The natural vegetation consists of annual grasses, forbs, and oaks. Some areas have dense stands of eucalyptus, coyote bush, and deer wood and an understory of annual grasses and forbs. Elevation ranges from 5 to 2,000 feet. The average annual precipitation ranges from 15 to 26 inches, the mean annual temperature is 56 degrees F, and the frost-free season is 300 to 320 days.

This map unit makes up about 17 percent of the survey area. Xerorthents make up about 28 percent of this map unit; Maymen soils, 20 percent; and Millsholm soils, 20 percent. Los Osos, Diablo, Altamont, Los

Gatos, Contra Costa, Gaviota, Montara, and Vallecitos soils and Quarries make up the rest.

Xerorthents are well drained and somewhat excessively drained. These soils have few or no identifiable horizons because they have been altered by cutting and filling for urban development. The texture is clay, silty clay, clay loam, silty clay loam, loam, or silt loam; but in some areas, coarse fragments of sandstone or shale make up as much as 50 percent of the soil mass. Bedrock is exposed in many of the cut areas.

Maymen soils are shallow and somewhat excessively drained. The surface layer and subsoil are light brownish gray, strongly acid loam. Shale is at a depth of about 19 inches.

Millsholm soils are shallow and well drained. The surface layer is grayish brown, medium acid silt loam about 6 inches thick. The subsoil is light olive brown, medium acid silt loam. Shale is at a depth of 20 inches.

These soils are used mainly as sites for houses and parks. A few areas of Maymen and Millsholm soils are rangeland.

5. Danville-Botella

Nearly level to moderately sloping, well drained loams and silty clay loams; on low terraces and alluvial fans

This map unit consists of soils that formed in very deep alluvium derived primarily from sedimentary rock. The slopes range from 0 to 9 percent but are mainly 0 to 2 percent. The natural vegetation consists of annual grasses, forbs, and scattered oaks. Elevation ranges from 10 to 300 feet. The average annual precipitation ranges from 14 to 20 inches; the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 330 days.

This map unit makes up about 16 percent of the survey area. Danville soils make up about 50 percent of the map unit and Botella soils about 16 percent. Clear Lake, Omni, and Rincon soils and Urban land make up the rest.

Danville soils are very deep and well drained. The surface layer is grayish brown and dark gray, slightly acid silty clay loam about 21 inches thick. The subsoil is grayish brown, slightly acid silty clay and heavy silty clay loam that extends to a depth of about 61 inches. The substratum is grayish brown, neutral silty clay loam and extends to a depth of 80 inches or more.

Botella soils are very deep and well drained. The surface layer is grayish brown, neutral loam about 9 inches thick. The subsoil is dark grayish brown and dark brown, neutral light clay loam that extends to a depth of 33 inches. The substratum is brown, mildly alkaline clay loam and yellowish brown, moderately alkaline silt loam and extends to a depth of 60 inches or more.

These soils are used mainly for urban development. A few areas are used for vegetable crops.

6. Tierra-Urban land

Nearly level to moderately steep, moderately well drained loams, and Urban land; on upland terraces

This map unit consists of soils that formed in weakly consolidated alluvium on old dissected terraces. These soils and Urban land are on the foot slopes parallel to the bay. The natural vegetation consists primarily of plants that are used for landscaping. The slopes range from 0 to 30 percent. Elevation ranges from 100 to 250 feet. The average annual precipitation ranges from 15 to 20 inches, the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 320 days.

This map unit makes up about 7 percent of the survey area. Tierra soils make up about 47 percent of this map unit and Urban land, about 44 percent. Azule and Danville soils make up the rest.

The Tierra soils are very deep and moderately well drained. The surface layer is grayish brown, slightly acid loam about 11 inches thick. The subsurface layer is gray, slightly acid loam 1 inch thick. The subsoil is very dark grayish brown, grayish brown, and brown, neutral clay and extends to a depth of about 32 inches. The substratum is variegated yellowish brown and brown, neutral sandy clay loam and extends to a depth of 60 inches or more.

Urban land consists of areas that are covered by houses, industrial buildings, parking lots, and other urban structures. The soil material has been altered or mixed during urban development. The characteristics of this original soil material were probably similar to those of the Tierra soils.

Areas of this map unit are used almost entirely for urban development. A few areas of Tierra soils are grazed.

7. Sycamore-Yolo

Nearly level, well drained and poorly drained silt loams, on flood plains and alluvial fans

This map unit consists of soils that formed in very deep alluvium that derived from sedimentary rock. The slopes are 0 to 2 percent. The natural vegetation consists of annual grasses, forbs, and scattered oaks. Elevation ranges from 10 to 200 feet. The average annual precipitation ranges from 14 to 18 inches, the mean annual temperature is 57 degrees F, and the frost-free season is 300 to 320 days.

This map unit makes up 12 percent of the survey area. The Sycamore soils make up about 48 percent of the map unit and Yolo soils, 35 percent. Botella, Danville, and Omni soils and gravel pits make up the rest.

Sycamore soils are very deep and poorly drained. The surface layer is light brownish gray, moderately alkaline silt loam about 18 inches thick. The subsoil is mottled, grayish brown and light olive gray, moderately alkaline silt loam and extends to a depth of 44 inches. The substratum is mottled, light olive gray, moderately alkaline, heavy silt loam and extends to a depth of 60 inches or more. In most areas, the water table has been lowered to a depth of 6 feet or more.

Yolo soils are very deep and well drained. The surface layer is grayish brown, neutral silt loam about 8 inches thick. The underlying material is brown, mildly alkaline, and moderately alkaline silt loam and extends to a depth of 60 inches or more.

These are among the most productive soils in the survey area. They are used primarily for vegetable crops.

Soil maps for detailed planning

The map units shown on the detailed soil maps at the back of this publication represent the kinds of soil in the survey area. They are described in this section. The descriptions together with the soil maps can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting, and preserving the environment. More information for each map unit, or soil, is given in the section "Use and management of the soils."

Preceding the name of each map unit is the symbol that identifies the soil on the detailed soil maps. Each map unit description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the detailed soil maps represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils that have profiles that are almost alike make up a *soil series*. Except for allowable differences in texture of the surface layer or of the underlying substratum, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that series was first observed and mapped. The Altamont series, for example, was named for the town of Altamont in Alameda County.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness, or other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a *soil phase* commonly indicates a feature that affects use or management. For example, Altamont clay, 5 to 15 percent slopes, is one of several phases within the Altamont series.

Some map units are made up of two or more dominant kinds of soil. Such map units are called soil complexes, soil associations, and undifferentiated groups.

A *soil complex* consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Xerorthents-Altamont complex, 30 to 50 percent slopes, is an example.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and thus could significantly affect use and management of the map unit. These soils are described in the description of each map unit. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Most mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called *miscellaneous areas*; they are delineated on the soil map and given descriptive names. Riverwash is an example. Some of these areas are too small to be delineated and are identified by a special symbol on the soil map.

The acreage and proportionate extent of each map unit are given in table 3, and information on properties, limitations, and capabilities for many soil uses is given for each kind of soil in other tables. (See "Summary of tables.") Many of the terms used in describing soils are defined in the Glossary.

Soil descriptions

100—Altamont clay, 5 to 15 percent slopes. This is a deep, well drained soil that formed in material that weathered from interbedded soft shale and fine-grained sandstone or from soft conglomerate. This soil is on the foothills near Mission San Jose. Elevation ranges from 200 to 1,000 feet. The average annual precipitation is 16 inches and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is dark brown and brown, slightly acid to mildly alkaline clay about 28 inches thick. The next layer is finely mixed dark brown and dark yellowish brown, calcareous clay about 9 inches thick. The underlying material is yellowish brown, calcareous clay and extends to a depth of 50 inches. It is underlain by highly fractured and weathered fine-grained sandstone and shale.

Included in mapping are small areas of Diablo clay and Climara clay. Also included are a few small areas of a grayish brown, calcareous clay that is 20 to 40 inches deep to soft sedimentary rock. Small areas of Rincon clay loam are along small drainageways.

Permeability is slow. The available water capacity is 5.0 to 9.5 inches. The root zone is 40 to 60 inches deep. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are in natural vegetation. These areas are commonly left idle and are only of esthetic value. The existing vegetation needs to be protected from fire and other destructive forces. If this soil is left bare, it is subject to erosion, and areas downslope are subject to sedimentation.

In a few areas, this soil is used for urban development.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the erosion hazard during establishment of the grass cover. If runoff from higher areas is a problem, diversions at the head of these slopes may be needed.

The water intake rate and permeability are slow, therefore, lawns should be watered slowly so that the amount of water lost as runoff is reduced. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if about 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. The addition of organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIe-5(15), nonirrigated.

101—Altamont clay, 15 to 30 percent slopes. This is a deep, well drained soil that formed in material that weathered from shale and fine-grained sandstone or from soft conglomerate. This soil is on the foothills near Mission San Jose. Elevation ranges from 200 to 1,000 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is dark brown and brown, slightly acid to moderately alkaline clay about 28 inches thick. The next layer is finely mixed dark brown and dark yellowish brown, calcareous clay about 9 inches thick. The underlying material is yellowish brown, calcareous clay and extends to a depth of 50 inches. It is underlain by highly fractured and weathered, fine-grained sandstone and shale.

Included in mapping are small areas of grayish brown, moderately alkaline clay that is 20 to 40 inches deep to sedimentary rock. Also included are small areas of Climara clay and Rincon clay loam.

Permeability is slow. The available water capacity is 5.0 to 9.5 inches. The root zone is 40 to 60 inches deep. Runoff is rapid, and the hazard of erosion is moderate to high.

Most areas of this soil are in natural vegetation. These areas are commonly left idle and are only of esthetic value. The existing vegetation needs to be protected from fire and other destructive forces.

This soil has limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the erosion hazard during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow, therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if about 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. The addition of organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IVe-5(15), nonirrigated.

102—Altamont clay, 30 to 50 percent slopes. This is a deep, well drained soil that formed in material weathered from interbedded soft shale and fine-grained sandstone or from soft conglomerate. This soil is on foothills at an elevation of 200 to 1,000 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is dark brown and brown, slightly acid to mildly alkaline clay about 28 inches thick. The next layer is finely mixed dark brown and dark yellowish brown, calcareous clay about 9 inches thick. The underlying material is yellowish brown, calcareous clay and extends to a depth of 50 inches. It is underlain by highly fractured and weathered fine-grained sandstone and shale.

Included in mapping are small areas of grayish brown, moderately alkaline clay that is 20 to 40 inches deep to sedimentary rock. Also included are small areas of Climara clay, Rincon clay loam, and landslips.

Permeability is slow. The available water capacity is 5.0 to 9.5 inches. The root zone is 40 to 60 inches deep. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are in natural vegetation. These areas are commonly left idle and are only of esthetic value. The existing vegetation needs to be protected from fires and other destructive forces.

In a few small areas, this soil is used for urban development.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Solid base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. Retaining walls may be needed in addition to a fast-growing vegetative cover to reduce the hazards of erosion. The use of straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Lawn grasses grow best if about 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Shrubs and trees can be drip irrigated to encourage deep rooting. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability subclass VIe(15), nonirrigated.

103—Azule clay loam, 9 to 30 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from consolidated alluvial sediment, soft shale, or fine-grained sandstone. This soil is on foothills. Elevation ranges from 100 to 500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, slightly acid clay loam about 6 inches thick. The subsoil extends to a depth of 25 inches. It is grayish brown and dark grayish brown, slightly acid clay that grades to grayish brown and light yellowish brown, slightly acid clay. It is underlain by light yellowish brown consolidated alluvial sediment.

Included in mapping are small areas of Los Osos silty clay loam and Tierra loam.

Permeability is slow. The available water capacity is 3.5 to 7.0 inches. The root zone is 24 to 40 inches deep. Runoff is medium to rapid. The hazard of erosion is moderate to high.

This soil is used mainly as sites for houses. In some areas it is used for grazing.

The natural vegetation should be protected from fire. If the areas in natural vegetation are used as rangeland, they should not be grazed before the grasses are 4 to 6 inches high, and enough residue should be left on the surface after the grazing season to reduce the hazard of erosion and help prevent weed infestation.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

Since the water intake rate and permeability are slow, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IVe-3(15), nonirrigated.

104—Azule clay loam, 30 to 50 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from consolidated alluvial sediment, soft shale, or fine-grained sandstone. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, slightly acid clay loam about 6 inches thick. The subsoil extends to a depth of 25 inches. It is grayish brown and dark grayish brown, slightly acid clay that grades to grayish brown and light yellowish brown, slightly acid clay. It is underlain by light yellowish brown consolidated alluvial sediment.

Included in mapping are small areas of Los Osos silty clay loam and Los Gatos loam.

Permeability is slow. The available water capacity is 3.5 to 7.0 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

This soil is used mainly as sites for houses. In some areas it is used for grazing.

The natural vegetation should be protected from fire. If the areas in natural vegetation are used for grazing, they should not be grazed before grasses are 4 to 6 inches high, and enough residue should be left on the surface after the grazing season to reduce the hazard of erosion and to help prevent weed infestation.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength also affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. Supporting walls are often needed to hold fill material in place. The banks should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

Since the water intake rate and permeability are slow, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability subclass VIe(15), nonirrigated.

105—Baywood Variant, sand. This is a very deep, somewhat poorly drained soil that formed in sandy sediment on old coastal plains. Elevation ranges from 5 to 15 feet. The slopes are less than 2 percent. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 330 days.

Typically, the upper part of the surface layer is dark grayish brown, mildly alkaline sand about 14 inches thick. The lower part is mottled, very dark grayish brown, mildly alkaline sand about 7 inches thick. The underlying material is mottled, brown, neutral sand to a depth of 32 inches. Below that it is yellowish brown, neutral sand that extends to a depth of 60 inches or more.

Included in mapping are small areas of Xeropsamments, fill, and Baywood loamy sand.

Permeability is rapid. The available water capacity is 3 to 5 inches. The root zone for water-tolerant plants is 60 inches deep. The water table restricts the root zone for water-sensitive plants to a depth of 40 or 50 inches. Runoff is very slow. Soil blowing is a hazard if the soil is left bare.

In most areas this soil is used for urban development. A few areas are farmed.

The water table limits the use of this soil for urban development. This limitation can be overcome by installing drainage systems or by designing buildings and streets to overcome the wetness problem.

Because of the low available water capacity and rapid permeability, plants used in landscaping should be watered lightly and frequently. Plants respond to nitrogen and to iron and aluminum chelates.

Farmed areas are double cropped. A common cropping sequence includes head lettuce in summer and cauliflower in winter. Nitrogen and phosphorus are needed for maximum yields. Irrigation water should be applied frequently and in light amounts to prevent the leaching of nutrients and the elevation of the water table.

Capability unit IIIw-4(14), nonirrigated and irrigated.

106—Botella loam, 0 to 2 percent slopes. This is a very deep, well drained soil on low terraces and alluvial fans. This soil formed in alluvium that derived from sedimentary rock. Elevation ranges from 10 to 200 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, neutral loam about 9 inches thick. The subsoil extends to a depth of 33 inches. It is dark grayish brown and dark brown, neutral, light clay loam. The substratum is brown and yellowish brown, mildly alkaline to moderately alkaline silt loam and extends to a depth of 60 inches or more.

Included in mapping are small areas of Danville silty clay loam, Omni silty clay loam, drained, and Yolo silt loam.

Permeability is moderately slow. The available water capacity is 9 to 11 inches. The root zone is more than 60 inches deep. Surface runoff is slow, and the hazard of erosion is slight.

In most areas this soil is used for urban development. In some areas it is used for vegetable crops.

This soil has some limitations for urban development. Because of low strength and the moderate shrink-swell potential, foundations for houses and roads need to be specially designed. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the building dry and reducing the hazard of differential settlement.

Most plants used for landscaping do well on this soil and will respond to nitrogen and phosphate fertilizer. For maximum growth, lawns need 1 pound of elemental nitrogen per 1,000 square feet every 8 weeks, from April through October. Irrigation water should be applied at a slow rate to encourage deep rooting. Shrubs and trees should be drip irrigated to encourage deep rooting.

Head lettuce and cauliflower are the major crops. They are double cropped using head lettuce in summer and cauliflower in winter. In a few areas, tomatoes are grown instead of head lettuce. Returning crop residue to the soil helps to maintain tilth and improve the rate of water intake. Minimum tillage reduces soil compaction. Water should be applied only in the amount that meets the needs of the crop; over-irrigation wastes water and leaches nutrients from the soil. Nitrogen is needed for good crop growth. The average yield per acre of head lettuce is 550 cartons; cauliflower, 460 cartons; and tomatoes, 25 tons.

Capability unit IIIc-1(14), nonirrigated; capability class I(14), irrigated.

107—Clear Lake clay, 0 to 2 percent slopes, drained. This is a very deep, poorly drained soil that formed in alluvium in basins. Elevation ranges from 10 to 200 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 330 days.

Typically, the surface layer is very dark gray, neutral and moderately alkaline clay about 37 inches thick. The underlying material is calcareous, dark gray and grayish brown clay and silty clay to a depth of 60 inches or more.

Included in mapping are small areas of Omni silty clay loam, drained; Willows clay, drained; and Pescadero clay, drained.

Permeability is slow. The available water capacity is 7.0 to 9.5 inches. The root zone for water-tolerant plants is 60 or more inches deep, but it is restricted to a depth of 48 to 60 inches for water-sensitive plants. Drainage has been improved by reclamation and flood control structures, and the water table is now at a depth of 48 to 60 inches. Runoff is slow, and there is no hazard of erosion.

This soil is used for urban development. A few areas are used as dryland pasture and for volunteer hay.

This soil has limitations that must be overcome before construction is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped to provide drainage away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. The slow permeability and the high water table are limitations for septic tank absorption fields and can contribute to failure of septic systems.

Since the water intake rate and permeability are slow, lawns should be watered slowly to reduce runoff. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Shrubs and trees can be drip irrigated to encourage deep rooting. Plants that require good drainage and aeration should not be planted. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil improves the rate of water intake, aeration, and soil tilth.

If areas of this soil are used as pasture, grazing should be delayed until the grasses are 4 to 6 inches high and until the soil is dry. If this soil is grazed when wet, it is subject to churning and puddling. Enough residue should be left on the surface after the grazing season to prevent deterioration of the soil and to prevent the infestation of weeds.

Capability unit IIIs-5(14), nonirrigated; IIs-5(14), irrigated.

108—Clear Lake clay, 2 to 9 percent slopes, drained. This is a very deep, poorly drained soil that formed in alluvium. Elevation ranges from 10 to 200 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is very dark gray, neutral to moderately alkaline clay about 37 inches thick. The underlying material is dark gray and grayish brown, calcareous clay and silty clay to a depth of 60 inches or more.

Included in mapping are small areas of Danville silty clay loam, Omni silty clay loam, drained, and Rincon clay loam.

Permeability is slow. The available water capacity is 7.0 to 9.5 inches. Drainage has been improved by flood control structures and natural stream cutting. The root zone is more than 60 inches deep. The water table is below a depth of 60 inches. Runoff is medium, and the hazard of erosion is slight to moderate.

This soil is used primarily for urban development. A few areas are used as dryland pasture and for volunteer hay.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from moving beneath the roads. Revegetation is needed to control erosion if this soil is disturbed during construction.

Since the water intake rate and permeability are slow, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

If areas of this soil are used as pasture, the soil should not be grazed before grasses are 4 to 6 inches high, and enough residue should be left on the surface after the grazing season to reduce weed infestation and the hazard of erosion.

Capability unit IIIe-5(14), nonirrigated; IIe-5(14), irrigated.

109—Climara clay, 30 to 50 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from ultrabasic rock on uplands. Elevation ranges from 100 to 750 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 310 days.

Typically, the surface layer is black, neutral and mildly alkaline clay 27 inches thick. The underlying material is variegated very dark brown, olive brown, and olive, moderately alkaline, calcareous clay to a depth of 33 inches. Below that, there is soft, weathered ultrabasic rock. Hard ultrabasic rock is at a depth of 40 inches.

Included in mapping are small areas of Altamont clay, Diablo clay, and Montara clay loam. Also included are small areas of a dark grayish brown clay that is 20 to 40 inches deep to bedrock and a few areas that have bedrock outcrops or landslips.

Permeability is slow. The available water capacity is 2.5 to 6.0 inches. The root zone is 20 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

This soil is used primarily for urban development. Some small areas are used for grazing and for recreation. They should be protected from fire, excessive foot traffic, and overgrazing to reduce erosion and sedimentation.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus helping to keep the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. Walls generally are needed to hold fill material in place. Exposed areas should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

Since the water intake rate and permeability are slow, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability subclass VIe(15), nonirrigated.

110—Contra Costa clay loam, 30 to 50 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from metabasic and metasedimentary rock. This soil is in the Coyote Hills. Elevation ranges from 5 to 290 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is brown, neutral clay loam about 24 inches thick. The subsoil extends to a depth of 35 inches. It is reddish brown, neutral heavy clay loam in the upper part and yellowish red, neutral gravelly clay in the lower part. Fractured, partly weathered, metasedimentary rock is at a depth of 35 inches.

Included in mapping are small areas of Vallecitos gravelly loam; a few areas of a moderately deep, dark reddish brown clay loam; and a few areas of soils that are more than 35 percent angular pebbles.

Permeability is slow. The available water capacity is 3.0 to 7.5 inches. The root zone is 20 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

This soil is used for recreation. It is in natural vegetation. The vegetation needs to be protected from fire and excessive foot traffic to reduce the hazard of erosion and to maintain its scenic value. Trails are difficult to build because of the steep slope and the clay loam surface texture. They should be constructed across the slope or along ridges to reduce the hazard of erosion.

This soil is poorly suited to use as septic tank filter fields because of the steep slope, the depth to bedrock, and the slow permeability of the subsoil.

Capability subclass VIe(15), nonirrigated.

111—Danville silty clay loam, 0 to 2 percent slopes. This is a very deep, well drained soil that formed on low terraces in alluvium that derived mainly from sedimentary rock. Elevation ranges from 20 to 300 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown and dark gray, slightly acid silty clay loam about 21 inches thick. The subsoil extends to a depth of 61 inches. It is grayish brown, slightly acid silty clay and heavy silty clay loam. The substratum is grayish brown, neutral silty clay loam and extends to a depth of more than 60 inches.

Included in mapping are small areas of Botella loam; Clear Lake clay, drained; and Rincon clay loam.

Permeability is slow. The available water capacity is 8.5 to 10.5 inches. The root zone is more than 60 inches deep. Runoff is slow, and there is no hazard of erosion.

This soil is used for urban development. In a few areas it is used for grain and vegetable crops.

This soil has certain limitations that must be overcome before the construction of buildings is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads. Structural measures for erosion control may be needed.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIs-3(14), nonirrigated; IIs-3(14), irrigated.

112—Danville silty clay loam, 2 to 9 percent slopes. This is a very deep, well drained soil that formed in alluvium that derived mainly from sedimentary rock. It is on low terraces and alluvial fans. Elevation ranges from 20 to 300 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown and dark gray, slightly acid silty clay loam about 21 inches thick. The subsoil extends to a depth of 61 inches. It is grayish brown, slightly acid silty clay and heavy silty clay loam. The substratum is grayish brown, neutral silty clay loam and extends to a depth of more than 60 inches.

Included in mapping are small areas of Botella loam, Tierra loam, and Rincon clay loam.

Permeability is slow. The available water capacity is 8.5 to 10.5 inches. The root zone is more than 60 inches deep. Runoff is slow to medium, and the hazard of erosion is slight to moderate.

This soil is used for urban development; however, certain limitations must be overcome before buildings can be constructed. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads. If this moderately sloping soil is disturbed during construction, it may need to be revegetated to control erosion.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIe-3(14), nonirrigated; IIe-3(14), irrigated.

113—Diablo clay, 9 to 15 percent slopes. This is a deep, well drained soil that formed in material that weathered from soft, fine-grained sandstone or shale. Elevation ranges from 200 to 800 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The frost-free season is 300 to 320 days.

Typically, the upper part of the surface layer is dark gray, neutral and mildly alkaline clay and silty clay about 15 inches thick. The lower part is variegated gray and olive gray, mildly alkaline silty clay about 17 inches thick. The next layer is light olive gray, mildly alkaline silty clay about 10 inches thick. The underlying material is variegated light olive gray and olive gray, moderately alkaline silty clay loam to a depth of 50 inches. Below that is calcareous shale.

Included in mapping are small areas of Altamont clay and Clear Lake clay, drained.

Permeability is slow. The available water capacity is 5.5 to 11.0 inches. The root zone is 40 to 60 inches deep. Runoff is medium, and the hazard of erosion is moderate.

In most areas this soil is in natural vegetation. Some of these areas are grazed. A few are used for urban development.

The vegetation should be protected from fire and other destructive forces. If this soil is exposed, it is subject to erosion, and sedimentation is a hazard. Grasses should be 4 to 6 inches high before they are grazed in fall, and enough residue should be left on the surface after the grazing season to reduce the hazard of erosion.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. The use of straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIe-5(15), nonirrigated.

114—Diablo clay, 15 to 30 percent slopes. This is a deep, well drained soil that formed in material that weathered from soft, fine-grained sandstone or shale. Elevation ranges from 200 to 800 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the upper part of the surface layer is dark gray, neutral and mildly alkaline clay and silty clay about 15 inches thick. The lower part is variegated gray and olive gray, mildly alkaline silty clay about 17 inches thick. The next layer is light olive gray, mildly alkaline silty clay about 10 inches thick. The underlying material is variegated light olive gray and olive gray, moderately alkaline silty clay loam and extends to a depth of 50 inches. Below that is calcareous shale.

Included in mapping are small ares of Altamont clay and Clear Lake clay, drained.

Permeability is slow. The available water capacity is 5.5 to 11.0 inches. The root zone is 40 to 60 inches deep. Runoff is rapid, and the hazard of erosion is moderate to high.

In most areas this soil is used as sites for houses. Some areas are in natural vegetation.

To reduce the hazard of erosion and to maintain its scenic value, the existing vegetation should be protected from fire and other destructive forces.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Walls may be needed to stabilize fill areas on the steepest slopes. Suitable base material is needed. On sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the erosion hazard during establishment of the cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IVe-5(15), nonirrigated.

115—Diablo clay, 30 to 50 percent slopes. This is a deep, well drained soil that formed in material that weathered from fine-grained sandstone or shale in the foothills near Mission San Jose. It is at an elevation of 200 to 800 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the upper part of the surface layer is dark gray, neutral and mildly alkaline clay and silty clay about 15 inches thick. The lower part is variegated gray and olive gray, mildly alkaline clay about 17 inches thick. The next layer is light olive gray, mildly alkaline silty clay about 10 inches thick. The underlying material is variegated light olive gray and olive gray, moderately alkaline, calcareous silty clay loam to a depth of 50 inches. Below that is calcareous shale.

Included in mapping are small areas of Altamont clay, Climara clay, and a moderately deep, grayish brown, neutral clay loam.

Permeability is slow. The available water capacity is 5.5 to 11.0 inches. The root zone is 40 to 60 inches deep. Runoff is rapid, and the hazard of erosion is high.

In most areas this soil is used for low-density housing. Many areas are in natural vegetation and have esthetic value. The vegetation should be protected from fire and excessive foot traffic to reduce the hazard of erosion.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for building sites are highly erodible. Walls may be required to stabilize fill areas created by leveling for construction. The banks should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability subclass VIe(15), nonirrigated.

116—Gaviota-Rock outcrop complex, 15 to 50 percent slopes. This map unit consists of moderately steep to steep soils and Rock outcrop on uplands at an elevation of about 200 to 1,500 feet. The average annual precipitation is about 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. Gaviota soils make up about 70 percent of the complex; Rock outcrop, 20 percent. Included in mapping and making up about 10 percent of the complex are small areas of Millsholm silt loam and Maymen loam.

Gaviota soils are shallow and well drained. They formed in material that weathered from sandstone. Typically, the surface layer is brown, slightly acid and medium acid sandy loam and extends to a depth of 11 inches; it is underlain by sandstone bedrock.

Permeability is moderately rapid. Runoff is rapid, and the hazard of erosion is high.

Rock outcrop is large sandstone boulders and exposed sandstone bedrock. Runoff is very rapid.

Areas of this complex are used for urban development and recreation. Sanitary facilities are difficult to establish because of the shallow depth to rock, steep slopes, and Rock outcrop. Gaviota soils are poorly suited to most recreation uses because of steep slopes. The number of paths and trails should be kept to a minimum. Those established should be across the slope to reduce the hazard of erosion. Natural vegetation should be protected from fire to maintain its scenic value and to reduce the hazard of erosion.

Landscaped areas should be irrigated lightly and frequently to prevent loss of water and to reduce the hazard of erosion. Most plants respond to nitrogen and phosphate fertilizer. Large trees and shrubs are susceptible to windthrow.

Capability subclass VIIe(15), nonirrigated.

117—Laugenour loam, drained. This is a very deep and poorly drained soil that formed in recent alluvium adjacent to streams. Elevation ranges from 5 to 40 feet. The slopes are 0 to 2 percent. The average annual precipitation is about 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the upper part of the surface layer is grayish brown, moderately alkaline loam 8 inches thick. The lower part is mottled, grayish brown, moderately alkaline fine sandy loam about 15 inches thick. The underlying material is mottled, olive gray, moderately alkaline light loam to a depth of 40 inches. Below that, it is grayish brown and yellow, moderately alkaline silty clay loam to a depth of 60 inches or more.

Included in mapping are small areas of Sycamore silt loam, drained; Omni silty clay loam, drained; and a few small areas of a soil that is similar to this Laugenour soil but is underlain by silty clay between depths of 24 and 40 inches.

Permeability is moderately rapid to a depth of 40 inches and moderately slow below that depth. The available water capacity is 8.0 to 9.5 inches. Drainage has been improved by flood control structures that have lowered the water table to a depth of 40 to 60 inches. The root zone is 60 inches deep for water-tolerant plants, but in some areas it is restricted to a depth of 40 inches for water-sensitive plants. Runoff is slow, and there is no hazard of erosion.

In nearly all areas, this soil is used for urban development. Most areas are protected from flooding by channels and levees. The water table precludes the use of septic tank filter fields in most areas of this soil.

Most of the plants used for landscaping respond to nitrogen and phosphate fertilizer. Adding organic matter to the soil can help to improve tillage and increase the rate of water intake. Lawn grasses require 1 pound of elemental nitrogen per 1,000 square feet every 8 weeks, between April and November.

Capability unit IIIw-2(14), nonirrigated; IIw-2(14), irrigated.

118—Los Gatos-Los Osos complex, 30 to 50 percent slopes. This complex consists of soils on uplands at an elevation of 400 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. This complex is about 50 percent Los Gatos loam, which is mainly on north-facing slopes, and 35 percent Los Osos silty clay loam, which is mainly on south-facing slopes. The components of this map unit are so intricately intermingled that it was not practical to map them separately at the scaled used.

Included in mapping and making up about 15 percent of this complex are Maymen loam and some outcrops of bedrock along the ridges. Also included in seep areas is a very strongly acid soil.

The Los Gatos soil is a moderately deep, well drained soil that formed in material weathered from sedimentary rock. Typically, the surface layer is brown, neutral loam about 11 inches thick. The subsoil is brown and reddish brown, neutral and slightly acid loam and heavy loam and extends to a depth of 40 inches. It is underlain by sandstone bedrock.

The Los Gatos soil has moderately slow permeability. The available water capacity is 3.5 to 8.0 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

The Los Osos soil is a moderately deep, well drained soil that formed in material that weathered from sedimentary rock. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil is dark grayish brown, slightly acid silty clay loam and extends to a depth of 30 inches. It is underlain by weathered shale.

Permeability of the Los Osos soil is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

The soils in this complex are used mainly for urban development. The steep slopes and shallowness to bedrock are limitations to the use of these soils as homesites and for local streets. Fill areas may require supporting walls. Cutbanks should be mulched and seeded with a fast-growing cover as soon as possible to reduce the hazard of erosion. The shrink-swell potential of Los Osos soils is high, and that of Los Gatos soils is moderate. As a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

Most of the plants used in landscaping respond to nitrogen and phosphate fertilizer. Drip irrigation is the best method for watering shrubs and trees because it helps to reduce runoff.

In some areas these soils are in natural vegetation. The vegetation has esthetic value and should be protected from fire and excessive foot traffic.

Capability subclass VIe(15), nonirrigated.

119—Los Gatos-Los Osos complex, 50 to 75 percent slopes. This complex consists of very steep soils on upland slopes at an elevation of 400 to 1,500 feet. The average annual precipitation is 20 to 25 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. This complex is about 50 percent Los Gatos loam, which is mainly on north-facing slopes, and 35 percent Los Osos silty clay loam, which is mainly on south-facing slopes. The components of this map unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in mapping and making up about 15 percent of this complex are small areas of Millsholm silt loam and Maymen loam and some bedrock outcrops along ridges. Also included in seep areas is a very strongly acid soil.

The Los Gatos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock. Typically, the surface layer is brown, neutral loam about 11 inches thick. The subsoil is brown and reddish brown, neutral and slightly acid loam and heavy loam and extends to a depth of 40 inches. It is underlain by sandstone bedrock.

The Los Gatos soil has moderately slow permeability. The available water capacity is 3.5 to 8.0 inches. The root zone is 24 to 40 inches deep. Runoff is very rapid, and the hazard of erosion is very high.

The Los Osos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam. Below that is weathered shale.

Permeability of the Los Osos soil is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is very rapid, and the hazard of erosion is very high.

The soils in this complex are used for recreation. Much of this complex is in natural vegetation that consists of thick stands of oak, California bay, poison oak, laurel, madrone, and some patches of coyote brush. The understory consists of scattered grasses and forbs. To maintain the scenic value of the area, vegetation should be protected from fire. The dense vegetation provides good habitat for wildlife.

Capability subclass VIIe(15), nonirrigated.

120—Los Osos silty clay loam, 9 to 30 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from sedimentary rock. It is on uplands at an elevation of 400 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam. It is underlain by weathered shale.

Included in mapping are small areas of Los Gatos loam, Altamont clay, Climara clay, and Montara clay loam.

Permeability is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

This Los Osos soil is used mainly for urban development and recreation. A few areas are used as range.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for use as building sites are highly erodible. Walls may be required to stabilize fill areas. The steep areas should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth. The natural vegetation has scenic value and should be protected from fire. Paths and trails should be laid out across the slope to prevent erosion.

If this soil is used as range, the hazard of erosion and weed infestation need to be controlled. Grasses should be 4 to 6 inches high before they are grazed, and enough residue should be left on the surface after the grazing season.

Capability unit IVe-3(15), nonirrigated.

121—Los Osos silty clay loam, 30 to 50 percent slopes. This is a moderately deep, well drained soil that formed in material that weathered from sedimentary rock. It is on uplands at an elevation of 400 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam. It is underlain by weathered shale.

Included in mapping are small areas of Los Gatos loam and Millsholm silt loam.

Permeability is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

This Los Osos soil is used as sites for houses and for recreation. Areas of natural vegetation provide esthetic value.

This soil has many limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads.

The steep banks that result from shaping this soil for use as buildling sites are highly erodible. Walls may be required to stabilize fill areas. The steep areas should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

This soil can be used as a site for paths and trails; however, because the slopes are very steep, the paths and trails need to be constructed across the slope to reduce the hazard of erosion. The vegetation in these areas should be protected from fire.

Capability subclass VIe(15), nonirrigated.

122—Los Osos-Millsholm complex, 9 to 30 percent slopes. This complex consists of strongly sloping and moderately steep soils on uplands. Elevation ranges from 300 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days. This complex is about 60 percent Los Osos silty clay loam and 30 percent Millsholm silt loam. The components of this map unit are so intricately intermingled that it was not practical to map them separately at the scale used. Included in mapping, and making up about 10 percent of this complex, are Los Gatos loam and a few small areas of Rock outcrop.

The Los Osos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock. This soil is on side slopes. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam. It is underlain by weathered shale.

Permeability of the Los Osos soil is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

The Millsholm soil is shallow and well drained. It formed in material that weathered from sedimentary rock. This soil is on ridges. Typically, the surface layer is grayish brown, medium acid silt loam about 7 inches thick. The subsoil extends to a depth of 20 inches. It is light olive brown, medium acid silt loam and is underlain by shale bedrock.

Permeability of the Millsholm soil is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

These soils are used mainly for urban development or recreation. A few areas are grazed.

These soils have many limitations for use as building sites. The Los Osos soil is subject to slippage if it becomes wet, especially if slopes are altered and the natural grade is increased. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath roads. Because the Millsholm soil is shallow to bedrock, installing buried utility lines is difficult.

The steep banks that result from shaping these soils for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

Because the available water capacity is low, lawns should be watered frequently and lightly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deeper rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

If the soils in this complex are used for recreation, the best use is paths and trails, which should be constructed across the slope to reduce the hazard of erosion. Natural vegetation should be protected from fire and excessive foot traffic to control erosion and maintain the esthetic value of the site.

Capability unit IVe-3(15), nonirrigated.

123—Los Osos-Millsholm complex, 30 to 50 percent slopes. This complex consists of steep soils on uplands at an elevation between 300 and 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. This complex is about 60 percent Los Osos silty clay loam and 30 percent Millsholm silt loam. The components of this map unit are so intricately intermingled that it was not practical to map them separately at the scale used. Included in mapping, and making up about 10 percent of this map unit, are Los Gatos loam and a few small areas of Rock outcrop.

The Los Osos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock. This soil is on side slopes. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam. It is underlain by weathered shale.

Permeability of the Los Osos soil is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

The Millsholm soil is shallow and well drained. It formed in material that weathered from sedimentary rock. This soil is on ridges. Typically, the surface layer is grayish brown, medium acid silt loam about 7 inches thick. The subsoil extends to a depth of 20 inches. It is light olive brown, medium acid silt loam. It is underlain by shale bedrock.

Permeability of the Millsholm soil is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is rapid, and the hazard of erosion is high.

These soils are used mainly for urban development and recreation. In a few areas they are used as range.

These soils have many limitations for use as building sites. The Los Osos soil is subject to slippage if it is wet, especially if slopes have been altered and the natural grade has been increased. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, interceptor drains should be provided to keep moisture from beneath the roads. Because the Millsholm soil is shallow to bedrock, installing buried utility lines is difficult.

The steep banks that result from shaping these soils for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

Because the available water capacity is low, lawns should be watered frequently and lightly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deeper rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

If used for recreation, the soils in this complex are best suited as sites for paths and trails that are established across the slope to reduce the hazard of erosion. Natural vegetation should be protected from fire and excessive foot traffic to control erosion and to maintain its esthetic value.

Capability subclass VIe(15), nonirrigated.

124—Los Osos-Millsholm complex, 50 to 75 percent slopes. This complex consists of very steep soils on uplands at an elevation between 300 and 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. This complex is about 50 percent Los Osos silty clay loam and 30 percent Millsholm silt loam. The components of this map unit are so intricately intermingled that it was not practical to map them separately at the scale used. Included in mapping, and making up about 20 percent of this map unit, are Los Gatos loam and Rock outcrop.

The Los Osos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock. This soil is on side slopes. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil is dark grayish brown, slightly acid silty clay loam and heavy silty clay loam and extends to a depth of 30 inches. It is underlain by weathered shale.

Permeability of the Los Osos soil is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is very rapid, and the hazard of erosion is very high.

The Millsholm soil is shallow and well drained. It formed in material that weathered from sedimentary rock. This soil is on ridges. Typically, the surface layer is grayish brown, medium acid silt loam about 7 inches thick. The subsoil is light olive brown, medium acid silt loam and extends to a depth of 20 inches. It is underlain by shale bedrock.

Permeability of the Millsholm soil is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is very rapid, and the hazard of erosion is very high.

These soils are used mainly for recreation. The steep slopes limit the potential for recreation uses to a few paths and trails. To reduce the hazard of erosion, natural vegetation should be protected from fire, and paths and trails should be established across the slope.

Capability subclass VIIe(15), nonirrigated.

125—Marvin silt loam, saline-alkali. This is a very deep, somewhat poorly drained soil on low alluvial terraces. This soil is slightly affected by alkali. It formed in alluvium that derived mainly from sedimentary rock. Elevation ranges from 10 to 40 feet. Slopes are 0 to 2 percent. The average annual precipitation ranges from 16 to 18 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the surface layer is grayish brown, neutral silt loam about 4 inches thick. The subsoil extends to a depth of 36 inches. It is grayish brown, moderately alkaline heavy silty clay loam and clay. The substratum is mottled, light brownish gray and light yellowish brown heavy clay loam extending to a depth of 60 inches or more.

Included in mapping are small areas of Pescadero clay and Willows clay.

Permeability is slow. The available water capacity is 8.0 to 9.0 inches. The root zone for water-loving plants is 60 inches deep; for most of the commonly grown cultivated crops, the water table restricts the root zone to a depth of about 50 inches. Drainage has been improved by flood control structures. The water table is below a depth of 50 inches. Five percent of this map unit is not suited to most crops because of excess alkali.

This soil is used for urban development. A few small areas are used for vegetable crops.

Urban structures require special design because of the low strength and the high shrink-swell potential. Most of the plants used in landscaping should be tolerant of saline-alkali salts. Irrigation water should be applied slowly. Lawns respond to 1 pound of elemental nitrogen per 1,000 square feet every 6 to 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Salt accumulation is a hazard on this slowly permeable soil if it is used for irrigated crops. Water should be applied slowly, and drainage is needed to remove excess surface and subsurface water and to maintain the water table below a depth of 50 inches. All crops respond to nitrogen and phosphate fertilizer.

Capability unit IVs-6(14), nonirrigated; IIIw-6(14), irrigated.

126—Maymen loam, 30 to 75 percent slopes. This is a shallow, somewhat excessively drained soil on uplands. It formed in material that weathered from sedimentary rock. Elevation ranges from 100 to 2,000 feet. The average annual precipitation is 22 inches, and the mean annual temperature is 56 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer and subsoil are light brownish gray, strongly acid loam underlain by shale bedrock at a depth of 19 inches.

Included in mapping are small areas of Millsholm silt loam, Los Gatos loam, and a few areas of a very strongly acid, moderately deep, loamy soil.

Permeability is moderate. The available water capacity is 1 to 3 inches. The root zone is 10 to 20 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

This soil is used for urban development, recreation, and watershed. If it is used for urban development, steep slopes and shallowness to bedrock are the main limitations. The steep banks that result from shaping this soil for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes. Tall trees used in landscaping are susceptible to windthrow because the soil is shallow. This soil is best suited to short trees. Lawn grasses grow best if about 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

The natural vegetation in recreation areas needs to be protected from fire and other destructive forces. To reduce the hazards of erosion and sedimentation, thick stands of eucalyptus trees should be thinned and regrowth controlled to reduce the fire hazard. The natural vegetation provides cover and food for deer, bush rabbits, quail, and songbirds.

Capability class VIIe(15), nonirrigated.

127—Maymen-Los Gatos complex, 30 to 75 percent slopes. This complex consists of steep and very steep soils on uplands at an elevation of 400 to 1,500 feet. Slopes range from 30 to 75 percent but are mainly 50 to 75 percent. The average annual precipitation is 21 inches, and the mean annual temperature is 56 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 50 percent Maymen soils and 35 percent Los Gatos soils. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used. Included in mapping, and making up 15 percent of this complex, are small areas of Millsholm silt loam and some Rock outcrop.

The Maymen soil is shallow and somewhat excessively drained. This soil is on the upper part of slopes and on ridges. It formed in material that weathered from sedimentary rock. Typically, the surface layer and subsoil are light brownish gray, strongly acid loam. They are underlain by shale at a depth of 19 inches.

Permeability of the Maymen soil is moderate. The available water capacity is 1 to 3 inches. The root zone is 10 to 20 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

The Los Gatos soil is moderately deep and well drained. It is on lower slopes and north-facing slopes. Typically, the surface layer is brown, neutral loam about 11 inches thick. The subsoil extends to a depth of 40 inches. It is brown and reddish brown, neutral and slightly acid loam and heavy loam and is underlain by sandstone.

Permeability of the Los Gatos soil is moderately slow. The available water capacity is 3.5 to 8.0 inches. The root zone is 24 to 40 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

These soils are used for low density urban development, recreation, and watershed.

Urban development is limited by steep slopes and shallowness or moderate depth to bedrock. The steep banks that result from shaping these soils for use as building sites are highly erodible. They should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The Maymen soil is best suited to short trees. Tall trees are susceptible to windthrow. Shrubs and trees can be drip irrigated to encourage deeper rooting. Lawn grasses grow best if about 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

The natural vegetation has esthetic value and supplies food and shelter for deer, rabbits, quail, and songbirds. It should be protected from fire. Thick stands of eucalyptus trees should be thinned to reduce the hazard of fire. Protecting the vegetation reduces the hazards of erosion and sedimentation.

Capability subclass VIIe(15), nonirrigated.

128—Millsholm silt loam, 30 to 50 percent slopes. This is a shallow, well drained soil on uplands. This soil formed in material that weathered from sedimentary rock. The elevation ranges from 300 to 1,500 feet. The average annual precipitation is 20 inches, the mean annual temperature is 57 degrees F, and the average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, medium acid silt loam about 6 inches thick. The subsoil extends to a depth of 20 inches. It is a light olive brown, medium acid silt loam and it is underlain by shale bedrock.

Included in mapping are small areas of Maymen loam and Los Gatos loam and a shallow, brown silt loam soil that is underlain by soft bedrock.

Permeability is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is rapid, and the hazard of erosion is high.

This soil is used as rangeland and watershed and for recreation and low density urban uses. Because this soil is shallow and steep, it is poorly suited to intensive urban development. Cuts should be protected from erosion by structural measures, mulching, and seeding with a fast-growing cover. Most of the plants that are used for landscaping respond to nitrogen fertilizer. Water should be applied frequently and slowly to reduce runoff. Natural vegetation should be protected from fire and other destructive forces to reduce soil loss and sedimentation.

Capability subclass VIIe(15), nonirrigated.

129—Millsholm silt loam, 50 to 75 percent slopes. This is a shallow, well drained soil that formed in material that weathered from sedimentary rock. This soil is on uplands at an elevation of 300 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the surface layer is grayish brown, medium acid silt loam about 6 inches thick. The subsoil extends to a depth of 20 inches. It is light olive brown, medium acid silt loam and is underlain by shale bedrock.

Included in mapping are small areas of Maymen loam, Los Gatos loam, and Rock outcrop.

Permeability is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for recreation, watershed, and homesites. In most areas this soil is in natural vegetation that has a high esthetic value. The natural vegetation provides food and cover for deer, rabbits, quail, and songbirds. It should be protected from fire and other destructive forces to reduce the hazards of erosion and sedimentation.

Capability subclass VIIe(15), nonirrigated.

130—Montara-Rock outcrop complex, 30 to 75 percent slopes. This complex consists of steep and very steep soils on uplands at an elevation of about 200 to 1,500 feet. The average annual precipitation is 19 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. Montara soils make up about 65 percent of the complex and Rock outcrop, 20 percent. Included in mapping, and making up about 15 percent of this complex are small areas of Millsholm silt loam and Los Gatos loam.

Montara soils are shallow and somewhat excessively drained. Typically, the surface layer is very dark grayish brown, mildly alkaline and moderately alkaline clay loam about 14 inches thick. It is underlain by ultrabasic rock.

Permeability is moderately slow. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

Rock outcrop consists of large areas of exposed ultrabasic rock. Runoff is very rapid, but the hazard of erosion is slight.

Most areas of Montara soils are used as parks; some areas are used as homesites. The natural vegetation needs to be protected from fire and other destructive forces to reduce the hazard of erosion.

Capability subclass VIIs(15), nonirrigated.

131—Omni silty clay loam, drained. This is a very deep, poorly drained soil on flood plains. It formed in alluvium that derived from mixed rock sources. Elevation ranges from 5 to 30 feet. The slopes are 0 to 2 percent. The average annual precipitation is 15 inches, and the mean annual air temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, moderately alkaline silty clay loam and silty clay about 15 inches thick. The subsoil extends to a depth of 52 inches. It is mottled, dark gray, mildly alkaline clay in the upper part and mottled light olive brown, moderately alkaline clay in the lower part. The substratum is mottled, light olive brown, moderately alkaline silty clay loam to a depth of 60 inches or more.

Included in mapping are small areas of Botella loam; Danville silty clay loam; and Clear Lake clay, drained.

Permeability is slow. The available water capacity is 7.5 to 10 inches. The root zone is 60 inches deep. Runoff is slow, and the hazard of erosion is slight. Drainage has been improved by flood control structures. The water table is below a depth of 5 feet.

This soil is used for urban development and for vegetable crops. The potential of this soil for urban use is limited by low strength and by the high shrink-swell potential.

The major crops are head lettuce and tomatoes, which are double-cropped with cauliflower. Head lettuce or tomatoes are grown and harvested in summer, and cauliflower is grown in winter. The yield of head lettuce is 550 crates; tomatoes, 25 tons; cauliflower, 460 crates. Crop residue should be returned to the soil to help maintain soil tilth and improve the water intake rate. Proper tillage practices minimize soil compaction. Water should be applied slowly and only in the amount needed for crop growth. Over-irrigation wastes water, leaches nutrients, and increases the risk of salt accumulation at the lower end of the run. Nitrogen fertilizer is needed for good crop growth.

Capability unit IIIs-3(14), nonirrigated; IIs-3(14), irrigated.

132—Omni silty clay loam, strongly saline. This is a very deep, poorly drained soil on flood plains. This soil formed in alluvium that derived from mixed rock sources. The slopes are less than 2 percent. Elevation ranges from 5 to 15 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, moderately alkaline silty clay loam and silty clay about 15 inches thick. The subsoil extends to a depth of 52 inches. It is mottled, dark gray, mildly alkaline clay in the upper part and mottled, light olive brown, moderately alkaline clay in the lower part. The substratum is mottled, light olive brown silty clay loam to a depth of 60 inches or more.

Included in mapping are small areas of Willows clay, drained.

Permeability is slow. The available water capacity is 1.5 to 4.0 inches. The root zone for water-tolerant plants is 60 inches deep; but it is restricted to a depth of 48 inches for water-sensitive plants. Runoff is slow, and there is no hazard of erosion. The surface layer has excess saline salts.

Areas of this Omni soil were shaped for use as commercial salt ponds. Low levees were built around these areas. Most of these ponds have been abandoned and are now idle or are used as a source of sanitary landfill, though the high water table presents some problems for this use. Although the surface layer does have varying amounts of saline salts, this soil has fair potential for the development of habitat for wetland wildlife. Pickleweed, cordgrass, and saltgrass provide food and cover for wildlife.

Capability subclass VIw(14), nonirrigated.

133—Pescadero clay, drained. This is a very deep, poorly drained soil that formed on basin rims in alluvium that derived from sedimentary rock. Elevation ranges from 5 to 50 feet. The slopes are 0 to 2 percent. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the surface layer is a gray, slightly acid clay loam about 2 inches thick. The subsoil extends to a depth of 30 inches. It is mottled, dark gray and light gray, moderately alkaline clay. The substratum is gray, light olive gray, and light gray calcareous clay loam and extends to a depth of more than 60 inches.

Included in mapping are small areas of Willows clay, drained, and Omni silty clay loam, drained.

Permeability is very slow. The available water capacity is 3 to 7 inches. The water table has been lowered to a depth of 60 inches in most areas by flood control structures and natural stream cutting. The root zone for salt-tolerant plants is 60 inches deep. About 10 to 20 percent of this map unit is not suited to most vegetation. Runoff is very slow and some areas are ponded. Erosion is not a hazard.

This Pescadero soil is used mainly as dryland pasture and for open-type sanitary landfill. The main limitations to these uses are the clayey texture, excess salts, and ponding of water in winter. The clayey texture makes the soil material poorly suited to use as landfill cover material. This soil is difficult to work when wet or dry. Excess saline and alkali salts make revegetation difficult.

If used as dryland pasture, this soil should not be grazed when wet. Natural vegetation should be protected from over-grazing to help reduce invasion of undesirable weeds. Surface drainage is needed to reduce ponding in rainy periods.

Capability subclass VIs(14), nonirrigated.

134—Pescadero clay, ponded. This is a very deep, poorly drained soil that formed on basin rims in alluvium that derived from sedimentary rock. The slope is less than 2 percent. Elevation ranges from 5 to 15 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Typically, the surface layer is gray, strongly alkaline clay loam about 2 inches thick. The subsoil extends to a depth of 30 inches. It is mottled, dark gray and light gray, strongly alkaline clay. The substratum is gray, light olive gray, and light gray, calcareous clay loam and extends to a depth of more than 60 inches.

Included in mapping are areas of Omni silty clay loam, strongly saline, and Reyes clay, ponded.

Permeability is very slow. The available water capacity is 2 to 6 inches. All rainfall is ponded unless levees or outlets are open. Most areas have no vegetation. The water table is usually at a depth of about 4 feet, but in winter it can rise up to 1 1/2 feet from the surface. Runoff is very slow, and erosion is not a hazard.

In most areas this soil has been shaped and ponded for use as commercial salt ponds. Areas that have been used as salt ponds have a high concentration of salt in the upper 30 inches of the soil material and are covered by water up to 3 feet deep.

If this soil is drained and if the excess salts are flushed out of the surface layer, salt-tolerant plants can provide some food and cover for wetland wildlife.

Capability subclass VIIIw(14), nonirrigated.

135—Pits, gravel. This miscellaneous area consists of large excavations that are the result of commercial sand and gravel extraction operations. Many of these gravel pits are now used to recharge the water table reservoir with imported water to prevent salt water intrusion of wells.

Capability classification not assigned.

136—Pleasanton gravelly loam, 0 to 5 percent slopes. This is a very deep, well drained soil on low terraces. This soil formed in alluvium that derived from sedimentary rock. Elevation ranges from 100 to 300 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 310 days.

Typically, the surface layer is grayish brown, slightly acid and neutral gravelly loam about 21 inches thick. The subsoil extends to a depth of 64 inches. It is brown, neutral gravelly sandy clay loam and gravelly loam about 43 inches thick. The substratum is yellowish brown, mildly alkaline gravelly fine sandy loam and extends to a depth of more than 60 inches.

Included in mapping are areas of Botella loam, Danville silty clay loam, and Rincon clay loam.

Permeability is moderately slow. The available water capacity is 5.5 to 8.0 inches. The root zone is more than 60 inches deep. Runoff is slow, and the hazard of erosion is slight.

This soil is used as dryland pasture and for low-density urban development. The natural vegetation should be protected from over-grazing to prevent infestation by weeds that are poisonous to livestock. There are few limitations for low-density urban uses. Septic tank filter fields should be enlarged or installed below a depth of about 5 feet because of the moderately slow permeabilty of the subsoil. Most of the plants used in landscaping respond to nitrogen and phosphate fertilizer. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from March to November.

Capability unit IIIe-3(14), nonirrigated; IIe-3(14), irrigated.

137—Reyes clay. This is a very deep, very poorly drained soil that formed in alluvium that derived from mixed sources. This soil is on tidal flats. The slope is less than 2 percent. The elevation ranges from sea level to 5 feet. The average annual rainfall is 15 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is olive gray, strongly alkaline clay about 6 inches thick. The underlying material, to a depth of 42 inches, is mottled dark greenish gray and black, strongly alkaline clay. Below that, to a depth of 72 inches, it is dark greenish gray, strongly alkaline silty clay. The underlying material contains polysulfides.

Included in mapping are small areas of a very poorly drained, strongly saline clay that does not contain polysulfides. Also included are small areas of Pescadero clay, drained.

Permeability is very slow. The available water capacity is 0.5 inch to 3.0 inches. The water table is between depths of 8 and 24 inches. Runoff is very slow, and most areas are subject to tidal inundation. There is no hazard of erosion. This soil is extremely acid when drained.

This soil is used for wildlife habitat. The natural vegetation is pickleweed, cordgrass, saltgrass, and other salt-tolerant plants that provide cover and food for waterfowl and other birds.

Capability subclass VIIIw(14), nonirrigated.

138—Reyes clay, ponded. This is a very deep, very poorly drained soil that formed in alluvium that derived from mixed sources. This soil is on tidal flats. The slope is less than 2 percent. The elevation ranges from sea level to 5 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is olive gray, strongly alkaline clay about 6 inches thick. The underlying material, to a depth of 42 inches, is mottled dark greenish gray and black, strongly alkaline clay. Below that, to a depth of 72 inches, it is dark greenish gray, strongly alkaline silty clay. The underlying material contains polysulfides.

Included in mapping are small areas of a very poorly drained, strongly saline clay that does not contain polysulfides. Also included are small areas of Pescadero clay, ponded.

Permeability is very slow. This soil is ponded and is protected from tidal inundation by levees. Erosion is not a hazard. The areas are devoid of vegetation. This soil becomes extremely acid when drained.

This soil is used for commercial salt ponds and wildlife habitat.

Capability subclass VIIIw(14), nonirrigated.

139—Reyes clay, drained. This is a very deep, very poorly drained soil that formed in alluvium that derived from mixed sources. This soil is on tidal flats. The slope is less than 2 percent. This soil is at sea level and ranges to an elevation of 5 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is olive gray, strongly acid clay about 6 inches thick. The underlying material to a depth of 42 inches is mottled dark greenish gray and black, extremely acid clay. Below that, to a depth of 72 inches, it is dark greenish gray, extremely acid silty clay. The underlying material contains polysulfides.

Included in mapping are small areas of a very poorly drained, strongly saline clay soil that does not contain polysulfides. Also included are small areas of Pescadero clay, drained.

Permeability is very slow. The available water capacity is 2.0 to 3.5 inches. The root zone for salt- and water-tolerant plants is 60 inches deep, and it is 2 to 4 feet deep for water-sensitive plants. The water table has been lowered to a depth of about 4 feet. Runoff is very slow, and there is no hazard of erosion.

This soil is used as dryland pasture and for barley. The natural vegetation is mainly mouse barley, saltgrass, pickleweed, and saltbush. The grazing capacity is about 1.5 AUM per acre. Pasture grasses should not be grazed when this soil is wet.

Capability unit IVw-9(14), nonirrigated.

140—Rincon clay loam, 0 to 2 percent slopes. This is a very deep, well drained soil that formed in alluvium that derived from sedimentary rock. It is on low terraces. Elevation ranges from 20 to 200 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown and dark grayish brown neutral clay loam about 16 inches thick. The subsoil extends to a depth of 52 inches. It is dark grayish brown, neutral heavy clay loam in the upper part, and brown, neutral and mildly alkaline clay in the lower part. The substratum is yellowish brown, calcareous clay loam and extends to a depth of 60 inches or more.

Included in mapping are small areas of Danville silty clay loam; Clear Lake clay, drained; and Yolo silt loam.

Permeability is slow. The available water capacity is 8 to 10 inches. The root zone is more than 60 inches deep. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for urban development. In a few small areas it is used for row crops.

This soil has limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, intercepting drains should be provided to keep moisture from beneath the roads.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIs-3(14), nonirrigated; IIs-3(14), irrigated.

141—Riverwash. This miscellaneous area consists of very gravelly, cobbly, or stony sediment on creek bottoms. Most areas are in the vicinity of the city of Niles. In some areas, Riverwash has been used as a source of construction material and fill.

Capability subclass VIIIw(14), nonirrigated.

142—Quarry. This miscellaneous area consists of large excavations, on uplands, from which rock is extracted for use as landfill.

Capability classification not assigned.

143—Sycamore silt loam, drained. This is a very deep, poorly drained soil that formed in alluvium that derived from sedimentary rock. It is on flood plains and has slopes of 0 to 2 percent. Elevation ranges from 10 to 50 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 18 inches thick. The subsoil extends to a depth of 44 inches. It is mottled, grayish brown and light olive gray, moderately alkaline silt loam. The substratum is mottled, light olive gray, moderately alkaline heavy silt loam and extends to a depth of 60 inches or more.

Included in mapping are small areas of Laugenour loam, drained, and Omni silty clay loam, drained.

Permeability is moderate. The available water capacity is 8.0 to 10.5 inches. The root zone is more than 60 inches deep. In most places, natural stream cutting and flood control structures have lowered the water table to a depth of 72 inches. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for row crops. Head lettuce, cauliflower, and tomatoes are the major crops. Head lettuce or tomatoes are grown and harvested in summer, cauliflower in winter. Returning crop residue to the soil helps to maintain tilth and improve the rate of water intake. Minimum tillage reduces soil compaction. Water should be applied only in the amount necessary for crop growth. Overirrigation wastes water and leaches nutrients. Nitrogen is needed for good crop growth. In a few areas this soil is used for urban development.

Capability unit IIIc-1(14), nonirrigated; class I(14), irrigated.

144—Sycamore silt loam, clay substratum. This is a very deep, poorly drained soil that formed in recent alluvium that derived from sedimentary rock. It is on flood plains and has slopes of 0 to 2 percent. Elevation ranges from 10 to 50 feet. The average annual precipitation is about 16 inches, and the mean annual temperature is about 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 18 inches thick. The subsoil extends to a depth of 44 inches. It is mottled, grayish brown and light olive gray, moderately alkaline silt loam. The substratum is very dark gray clay and extends to a depth of 60 inches or more.

Included in mapping are small areas of a light brownish gray silt loam that is underlain by clay at a depth of 24 to 40 inches.

Permeability is moderate in the surface layer and subsoil and slow in the clay substratum. The available water capacity is 7 to 9 inches. The root zone is 60 inches deep for most crops. In places, root development is restricted to structural faces or cracks in the substratum. Drainage has been improved by flood control structures that have lowered the water table to a depth of 6 feet or more in most areas. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for urban development. It has few limitations for small structures or for local roads and streets. If irrigation for landscaping or gardening is in excess of the plant needs, a perched water table can form over the clay substratum. Most plants respond to nitrogen fertilizer. Some ornamental plants respond to sulfur and to aluminum chelates.

Capability unit IIIs-3(14), nonirrigated; IIs-3(14), irrigated.

145—Tierra loam, 0 to 5 percent slopes. This is a very deep, moderately well drained soil that formed in old alluvium on dissected terraces and terrace remnants. Elevation ranges from 100 to 250 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, the surface layer is grayish brown, slightly acid loam about 11 inches thick. The subsurface layer is gray, slightly acid loam about one inch thick. The subsoil extends to a depth of 32 inches. It is very dark grayish brown, grayish brown, and brown, neutral clay. The substratum is variegated yellowish brown and brown, neutral sandy clay loam and extends to a depth of 60 inches or more.

Included in mapping are small areas of Azule clay loam and Danville silty clay loam.

Permeability is very slow. The available water capacity is 6 to 8 inches. The root zone is 60 or more inches deep, but roots may be restricted to the surface of peds in the clay subsoil. Runoff is slow, and the hazard of erosion is slight.

This Tierra soil is used mainly for low-density urban development. A few small areas are used as dryland pasture.

This soil has limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed.

The water intake rate and permeability are very slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deeper rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

If this soil is used for dryland pasture, the natural vegetation should not be grazed until the plants are 4 to 6 inches high. Enough residue should be left on the surface after the grazing period to prevent infiltration by weeds.

Capability unit IVe-3(15), nonirrigated.

146—Urban land. This miscellaneous area consists of land that is covered by buildings, roads, parking lots, and other urban structures. The soil material is mainly heterogeneous fill. Most areas are adjacent to San Francisco Bay.

Capability classification not assigned.

147—Urban land-Baywood complex. This complex consists of Urban land and Baywood loamy sand on mounds and ridges adjacent to the beaches at an elevation of 10 to 60 feet. Slope ranges from 0 to 8 percent, but the range is mainly 2 to 5 percent. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 60 percent Urban land, 35 percent Baywood loamy sand, and 5 percent other soils, including Laugenour loam, drained, and Omni silty clay loam, drained. Also included are small areas of a very deep, loamy sand that is weakly cemented below a depth of 30 inches.

Urban land consists of areas that are covered by buildings and other structures. The soil material has been altered or mixed, but it closely resembles the Baywood soil.

The Baywood soil is very deep and somewhat excessively drained. It formed in eolian sediment that derived from old beach deposits. Typically, the surface layer is grayish brown and brown, slightly acid loamy sand about 32 inches thick. The underlying material is pale brown and light yellowish brown, slightly acid loamy sand and extends to a depth of 60 inches or more.

Permeability is rapid. The available water capacity is 4.0 to 5.5 inches. The root zone is more than 60 inches deep. Runoff is slow to medium. Soil blowing is a serious hazard if this soil is left bare.

This soil has few limitations for urban development. Landscaped areas or gardens should be irrigated frequently and sparingly. Most plants respond to nitrogen and phosphate fertilizers, which are most effective if applied frequently and at low rates.

Capability classification not assigned.

148—Urban land-Clear Lake complex. This complex consists of Urban land and Clear Lake clay on basin rims. The slope ranges from 0 to 5 percent. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 55 percent Urban land and 35 percent Clear Lake clay. Included in mapping and making up about 10 percent of the acreage are a few small areas of Omni silty clay loam, drained, and Marvin silt loam, saline-alkali.

Urban land consists of areas that are covered by buildings and other related urban structures. The soil material has been altered or mixed during urban development.

The Clear Lake soil is very deep and poorly drained. It formed in alluvium that derived mainly from sedimentary rock. Typically, the surface layer is very dark gray, neutral and moderately alkaline clay about 37 inches thick. The underlying material is dark gray and grayish brown, calcareous clay and silty clay and extends to a depth of 60 inches or more.

Permeability is slow. The available water capacity is 7.0 to 9.5 inches. The root zone is 60 inches deep for water-tolerant plants and 48 inches deep for water-sensitive plants. Drainage has been improved by flood control structures, and the water table is below a depth of 48 to 60 inches. Runoff is slow, and there is no hazard of erosion.

The Clear Lake soil has certain limitations that should be overcome before construction is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability classification not assigned.

149—Urban land-Danville complex. This complex is on low terraces and alluvial fans at an elevation of about 20 to 300 feet. The slopes are mainly nearly level; in a few areas, they are moderately sloping. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 60 percent Urban land and 30 percent Danville silty clay loam. Included in mapping and making up 10 percent of the complex are small areas of Botella loam; Clear Lake clay, drained; and Tierra loam.

Urban land consists of areas that are covered by buildings and related urban structures. The soil material has been altered or mixed during construction. Along freeways the soil material has been extensively altered.

The Danville soil is very deep and well drained. It formed in alluvium that derived mainly from sedimentary rock. Typically, the surface layer is grayish brown and dark gray, slightly acid silty clay loam about 21 inches thick. The subsoil extends to a depth of 61 inches. It is grayish brown, slightly acid and neutral silty clay, silty clay loam, and heavy silty clay loam. The substratum is grayish brown, neutral silty clay loam and extends to a depth of 80 inches or more.

Permeability is slow. The available water capacity is 8.5 to 10.5 inches. The root zone is more than 60 inches deep. Runoff is slow, and the hazard of erosion is slight.

This soil has certain limitations that should be overcome before construction is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability classification not assigned.

150—Urban land-Tierra complex, 2 to 5 percent slopes. This complex consists of Urban land and Tierra loam on old dissected terraces at an elevation of 100 to 250 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 50 percent Urban land and 42 percent Tierra loam. Included in mapping and making up about 8 percent of the complex are small areas of Azule clay loam and Danville silty clay loam.

Urban land consists of areas that are covered by buildings and other urban structures. The soil material has been altered or mixed during urban development.

The Tierra soil is very deep and moderately well drained. It formed in weakly consolidated old alluvium. Typically, the surface layer is grayish brown, slightly acid loam about 11 inches thick. The subsurface layer is gray, slightly acid loam about 1 inch thick. The subsoil extends to a depth of 32 inches. It is very dark grayish brown, grayish brown, and brown, neutral clay. The substratum is variegated yellowish brown and brown, neutral sandy clay loam and extends to a depth of 60 inches or more.

Permeability is very slow. The available water capacity is 6 to 8 inches. The root zone is 60 inches deep, but roots may be restricted to the surface of peds in the clay subsoil. Runoff is slow, and the hazard of erosion is slight.

In landscaping, Tierra soils are best suited to shallow-rooted plants. The very slowly permeable subsoil restricts root development and water penetration. If more irrigation water is used than plants need, it can accumulate above the subsoil. Most plants respond to nitrogen fertilizer.

The shrink-swell potential of the subsoil is high; therefore, patios and other slablike structures require a sand base to reduce the hazard of cracking.

Capability classification not assigned.

151—Urban land-Tierra complex, 5 to 15 percent slopes. This complex consists of Urban land and Tierra loam on old dissected terraces at an elevation of 100 to 250 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 50 percent Urban land and 38 percent Tierra loam. Included in mapping and making up about 12 percent of the complex are small areas of Azule clay loam and Danville silty clay loam.

Urban land consists of areas that are covered by buildings and other urban structures. The soil material has been altered or mixed during urban development.

The Tierra soil is very deep and moderately well drained. It formed in weakly consolidated old alluvium. Typically, the surface layer is grayish brown, slightly acid loam about 11 inches thick. The subsurface layer is gray, slightly acid loam about 1 inch thick. The subsoil extends to a depth of 32 inches. It is very dark grayish brown, grayish brown, and brown, neutral clay. The substratum is variegated yellowish brown and brown, neutral sandy clay loam and extends to a depth of 60 inches or more.

Permeability is very slow. The available water capacity is 6 to 8 inches. The root zone is 60 inches deep, but roots may be restricted to the surface of peds in the clay subsoil. Runoff is medium, and the hazard of erosion is moderate.

In landscaping, Tierra soils are best suited to shallow-rooted plants. The subsoil restricts root development and water penetration. If irrigation water is applied in excess of plant needs, water can accumulate above the subsoil. Most plants respond to nitrogen fertilizer. Exposed banks should be planted to ground cover to reduce the hazard of erosion.

The shrink-swell potential of the subsoil is high; therefore, small structures need to be specially designed.

Capability classification not assigned.

152—Urban land-Tierra complex, 15 to 30 percent slopes. This complex consists of Urban land, Tierra loam, and Azule clay loam on old dissected terraces at an elevation of 100 to 250 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The frost-free season ranges from 300 to 320 days.

This complex is about 50 percent Urban land, 25 percent Tierra loam, and 20 percent Azule clay loam. Included in mapping and making up about 5 percent of the complex are small areas of Los Osos silty clay loam.

Urban land consists of areas that are covered by houses and other urban structures. The soil material has been altered or mixed during urban development.

The Tierra soil is very deep and moderately well drained. It formed in weakly consolidated old alluvium. Typically, the surface layer is grayish brown, slightly acid loam about 11 inches thick. The subsurface layer is gray, slightly acid loam about 1 inch thick. The subsoil extends to a depth of 32 inches. It is very dark grayish brown, grayish brown, and brown, neutral clay. The substratum is variegated yellowish brown and brown, neutral sandy clay loam and extends to a depth of 60 inches or more.

Permeability is very slow. The root zone is 60 inches deep, but roots may be restricted to the surface of peds in the clay subsoil. The available water capacity is 6 to 8 inches. Runoff is rapid, and the hazard of erosion is moderate to high.

The Azule soil is moderately deep and well drained. It formed in material that weathered from consolidated alluvium. Typically, the surface layer is grayish brown, slightly acid clay loam about 6 inches thick. The subsoil extends to a depth of about 25 inches. It is grayish brown and dark grayish brown slightly acid clay in the upper part, and it grades to grayish brown and light yellowish brown, slightly acid clay in the lower part. Light yellowish brown, weakly cemented alluvial sediment is at a depth of about 25 inches.

Permeability is slow. The available water capacity is 3 to 6 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is moderate to high.

In landscaping, the soils in this complex are best suited to shallow-rooted plants. Irrigation water should be applied slowly to reduce the loss of water and the hazard of erosion. Most plants respond to nitrogen and phosphate fertilizer. One pound of elemental nitrogen per 1,000 square feet should be applied to lawn grasses every 8 weeks, from April to November. If the subsoil is exposed, adding organic matter to the soil improves tilth and increases the rate of water intake and aeration.

Capability classification not assigned.

153—Vallecitos-Rock outcrop complex, 30 to 50 percent slopes. This complex of steep soils and Rock outcrop is in the Coyote Hills at an elevation of 5 to 290 feet. The average annual precipitation is 15 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. This complex is about 65 percent Vallecitos gravelly loam and 20 percent Rock outcrop. Included in mapping and making up about 15 percent of the complex are small areas of Contra Costa clay loam.

The Vallecitos soil is shallow and well drained. It formed in residual material that weathered from metasedimentary rock. Typically, the surface layer is brown, neutral gravelly loam about 6 inches thick. The subsoil extends to a depth of 16 inches. It is reddish brown neutral heavy clay loam and brown, slightly acid heavy clay loam. It is underlain by sandstone bedrock.

Permeability is slow. The root zone is 10 to 20 inches deep. The available water capacity is 1 to 3 inches. Runoff is rapid, and the hazard of erosion is high.

Rock outcrop consists of exposed metamorphosed sandstone and large sandstone boulders.

Areas of this complex are used for recreation. The natural vegetation should be protected from fire and excessive foot traffic to maintain its esthetic value. If paths and trails are built, they should be established across the slope to reduce the hazard of erosion.

Capability subclass VIIe(15), nonirrigated.

154—Willows clay, drained. This is a very deep, poorly drained soil on basin rims. It formed in alluvium that derived mainly from sedimentary rock. The slope ranges between 0 and 2 percent. The elevation is 10 to 200 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Included in mapping are small areas of Clear Lake clay and Omni silty clay loam.

Typically, the surface layer is black, moderately alkaline clay about 19 inches thick. The next layer is mottled, dark gray, moderately alkaline clay about 10 inches thick. The underlying material consists of mottled, grayish brown, calcareous clay and extends to a depth of more than 60 inches.

Permeability is very slow. The available water capacity is 4.0 to 6.5 inches. The root zone is 60 inches deep. The water table has been lowered to a depth of 5 to 6 feet by flood control structures and natural downcutting of stream beds. Runoff is slow, and there is no hazard of erosion.

This soil is used mainly for industrial and commerical development. A few areas are used as dryland pasture.

This soil has limitations for use as building sites. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed.

The water intake rate and permeability are slow; therefore lawns should be watered slowly to reduce runoff. Shrubs can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability unit IIIs-5(14), nonirrigated, and IIs-5(14), irrigated.

155—Xerorthents, clayey. This map unit consists of clayey material that is used as fill for building sites. The slopes are less than 2 percent. Elevation ranges from near sea level to 50 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Typically, these soils are dark brown, dark grayish brown, grayish brown, or brown. The texture is mainly heavy clay loam, but the range includes silty clay and clay. Reaction is mildly acid to moderately alkaine except where these soils are limed. Large pieces of asphalt, concrete, and sandstone and fragments of glass and other debris make up as much as 15 percent, by volume, of the profile.

Permeability is slow to very slow. The available water capacity is 6 to 7 inches. The root zone is 60 inches deep. Runoff is slow, and erosion is not a hazard.

Areas of this map unit are used mainly as sites for industrial development; however, certain limitations should be overcome before construction is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates. Adding organic matter to the soil can improve the rate of water intake, aeration, and tilth.

Capability classification not assigned.

156—Xeropsamments, fill. This unit consists of sandy material that was dredged from old beach areas. Slopes are less than 2 percent. Elevation ranges from near sea level to 10 feet. The average annual precipitation is 17 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Included in mapping, and making up about 10 percent of the map unit, are a few areas that are underlain by strongly alkaline clay at a depth of 36 to 48 inches. Also included, and making up about 5 percent of the map unit, are concave areas that have a water table within a depth of 36 inches and can be ponded in winter.

Typically, Xeropsamments are moderately alkaline sands that extend to a depth of 60 inches. In a few areas they are as much as 5 percent, by volume, shells that are less than one inch in diameter.

These soils are rapidly permeable. The root zone for water-tolerant plants is 60 inches deep; the water table restricts the root zone for water-sensitive plants to a depth of 40 to 60 inches. The available water capacity is 3 to 4 inches. Runoff is slow, and the hazard of erosion is slight. Soil blowing is a serious hazard.

These soils are used mainly for urban and industrial development and as airfields. A few areas are used for small grain. Levees prevent erosion of this fill material.

Frequent and light applications of irrigation water and fertilizer are needed to establish a vegetative cover. Most plants respond to nitrogen and phosphate fertilizer. Iron and aluminum chelates are needed for some ornamental plants.

Capability classification not assigned.

157—Xerorthents-Altamont complex, 30 to 50 percent slopes. This complex consists of soils on foothills adjacent to the bay. The elevation ranges from 200 to 1,500 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days. Xerorthents, clayey, make up about 75 percent of this complex; Altamont clay, 20 percent.

Xerorthents consist of soil material that resulted from cutting or filling for urban development; therefore, the soil characteristics are variable. Fill areas consist of heavy clay loam, silty clay, and clay and are as much as 20 percent angular fragments of shale and sandstone. Colors are variable. Reaction is mildly alkaline or moderately alkaline, and these soils are calcareous throughout the profile. Cut areas consist of interbedded shale and fine-grained sandstone. The bedrock dips between 50 and 80 degrees.

Permeability is slow or very slow, depending on the soil texture and on the amount of compaction that takes place during construction.

The Altamont soil is deep and well drained. It formed in the material that weathered from soft, interbedded sedimentary rock and makes up most of the undisturbed areas of this complex. Typically, the surface layer is dark brown, slightly acid to mildly alkaline clay about 28 inches thick. The next layer is finely mixed dark brown and dark yellowish brown, calcareous clay about 9 inches thick. The underlying material extends to a depth of 50 inches. It is yellowish brown, calcareous clay. Below that is highly fractured and weathered fine-grained sandstone and shale.

Permeability is slow. The available water capacity is 5.0 to 9.5 inches. The root zone is 40 to 60 inches deep. Runoff is rapid, and the hazard of erosion is high.

Areas of this complex are used mainly for residential developments that have a density of two to four single family dwellings per acre. Approximately 25 percent of the area is covered by buildings or other urban related structures.

Certain limitations should be overcome before construction is feasible. The shrink-swell potential is high; as a result, foundations can shift and crack. Building pads should be shaped so that water is drained away from the building site, thus keeping the soil beneath the foundation dry and reducing the hazards of differential settlement and shrink-swell. The high shrink-swell potential and low strength affect the construction of roads and streets. Suitable base material is needed. In sloping areas, intercepting drains should be provided to keep moisture from beneath the roads.

Steep banks that result from reshaping these soils for use as building sites are highly erodible. These soils should be seeded to a fast-growing cover as soon as possible to reduce the hazard of erosion. Using straw mulch or jute netting helps to reduce the hazard of erosion during establishment of the grass cover. If runoff from higher areas is a problem, diversions may be needed at the head of these slopes.

The water intake rate and permeability are slow; therefore, lawns should be watered slowly to reduce runoff. Shrubs and trees can be drip irrigated to encourage deep rooting. Lawn grasses grow best if 1 pound of nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Some ornamental plants respond to sulfur and to iron and aluminum chelates.

Adding organic matter to the soil can improve the rate of water intake, aeration, and soil tilth.

Capability classification not assigned.

158—Xerorthents-Los Osos complex, 30 to 50 percent slopes. This complex consists of soils on hills at an elevation of 200 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season is 300 to 320 days.

Xerorthents, loamy, make up about 70 percent of this complex; Los Osos silty clay loam, 20 percent. Included in mapping and making up about 10 percent of the complex are small areas of Altamont clay, Climara clay, and Millsholm silt loam.

Xerorthents consist of soil material that resulted from cutting or filling for urban development, therefore; the soil characteristics are quite variable. Fill areas consist of clay loam, heavy loam, and silty clay loam and are as much as 20 percent angular fragments of shale and sandstone. Colors are variable. Reaction is slightly acid to mildly alkaline. In a few areas these soils are calcareous.

Permeability is slow. The rooting zone is more than 10 inches deep. Runoff is rapid, and the hazard of erosion is high.

The Los Osos soil is moderately deep and well drained. It formed in material that weathered from sedimentary rock and makes up most of the undisturbed areas in this complex. Typically, the surface layer is grayish brown, medium acid silty clay loam about 8 inches thick. The subsoil extends to a depth of 30 inches. It is dark grayish brown, slightly acid silty clay loam and heavy silt clay loam and is underlain by weathered shale.

Permeability is slow. The available water capacity is 3.5 to 6.5 inches. The root zone is 24 to 40 inches deep. Runoff is rapid, and the hazard of erosion is high.

Areas of this complex are used mainly for residential developments that have a density of two to four single family dwellings per acre. Approximately 25 percent of the area is covered by streets, shopping areas, and other related urban structures. Exposed banks should have a vegetative or structural protective cover. Only the minimum amount of irrigation water needed for maintaining plant growth should be used. Water should be applied slowly to reduce the hazard of erosion. Surface drainage should be provided to remove excess water, and the outlets of drains and downspouts should be protected against gullying.

Most plants respond to nitrogen fertilizer. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October.

To reduce cracking in paths and sidewalks, the soil material should be compacted and covered by a blanket of sand.

Capability classification not assigned.

159—Xerorthents-Millsholm complex, 30 to 50 percent slopes. The soils in this complex are on hills at an elevation of 200 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

This complex is about 70 percent loamy Xerorthents and 20 percent Millsholm loam. Included in mapping, and making up about 10 percent of the complex, are small areas of Maymen loam and Los Gatos loam.

The Xerorthents in this complex are well drained to somewhat excessively drained. They consist of soil material that has been altered by cutting or filling for urban development; as a result, they have variable soil characteristics. Fill areas consist of loam and silt loam and are as much as 25 percent angular fragments of shale and sandstone. The color varies. Reaction is medium acid to mildly alkaline. In a few areas these soils are calcareous. Cut areas consist of interbedded shale and fine-grained sandstone. Bedrock has a dip of 30 to 80 degrees.

Permeability is moderate. The root zone is more than 20 inches deep. Runoff is rapid, and the hazard of erosion is high.

The Millsholm soil is shallow and well drained. It formed in material that weathered from shale or fine-grained sandstone. This soil makes up most of the undisturbed areas in this complex. Typically, the surface layer is grayish brown, medium acid silt loam about 7 inches thick. The subsoil is light olive brown, medium acid silt loam and extends to a depth of 20 inches; it is underlain by shale bedrock.

Permeability of the Millsholm soil is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is rapid, and the hazard of erosion is high.

Areas of this complex are used primarily as sites for residential developments that consist of two to four single family dwellings per acre. Approximately 25 percent of the area is covered by roads, parking lots, and small shopping centers.

These soils require careful water management to reduce erosion and prevent the saturation of fill areas. A permanent vegetative cover should be maintained. Only the minimum amount of irrigation water should be applied to prevent mud flow. Surface drains can remove excess water from buildings.

Most of the plants in areas of this complex respond to nitrogen fertilizer. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied about every 8 weeks, from April through October.

Capability classification not assigned.

160—Xerorthents-Millsholm complex, 50 to 75 percent slopes. This complex consists of soils on hills at an elevation of 200 to 1,500 feet. The average annual precipitation is 20 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 330 days. Xerorthents, loamy, makes up about 60 percent of this complex; Millsholm loam, 20 percent. Included in mapping and making up about 20 percent of the complex are small areas of Maymen loam, Los Gatos loam, and Los Osos silty clay loam.

Xerorthents consist of well drained and somewhat excessively drained soils. These soils have resulted from cutting or filling for urban development; therefore, the soil characteristics are variable. Fill areas consist of loam, silt loam, and light silty clay loam and are as much as 50 percent angular fragments of shale and sandstone. Colors are variable. Reaction is medium acid to mildly alkaline. In a few areas, these soils are calcareous. Cut areas consist of interbedded shale and fine-grained sandstone. Bedrock has a dip of 30 to 80 degrees.

Permeability is moderate. The root zone is more than 20 inches deep. Runoff is rapid to very rapid, and the hazard of erosion is high to very high.

The Millsholm soil is shallow and well drained. It formed in the residuum of weathered shale or fine-grained sandstone. This soil makes up most of the undisturbed areas in this complex. Typically, the surface layer is grayish brown, medium acid silt loam about 7 inches thick. The subsoil extends to a depth of 20 inches; it is light olive brown, medium acid silt loam and is underlain by shale bedrock.

Permeability is moderate. The available water capacity is 1.5 to 3.5 inches. The root zone is 10 to 20 inches deep. Runoff is rapid, and the hazard of erosion is high.

The soils of this map unit are used mainly for homesites. The density is less than one single family dwelling per acre. Approximately 15 percent of the area is covered by roads and other urban works and structures.

Plants selected for landscaping and stabilizing banks should be drought resistant. Irrigation water should not be applied in excess of plant needs. Terracing can be used to reduce erosion. Surface drains should be provided to remove excess water from building sites, and the outlets of drains and downspouts should be protected against gullying.

Most plants respond to nitrogen fertilizers. Lawn grasses grow best if 1 pound of elemental nitrogen per 1,000 square feet is applied every 8 weeks, from April through October. Vegetative cover other than lawns may be desirable to reduce the hazard of soil saturation by over-irrigating. Sloping areas that are not landscaped should be mulched, fertilized, and seeded with annual grasses and legumes.

Capability classification not assigned.

161—Yolo silt loam, 0 to 2 percent slopes. This is a very deep, well drained soil that formed in alluvium that derived from sedimentary rock. It is on flood plains and alluvial fans. Elevation ranges from 20 to 200 feet. The average annual precipitation is 16 inches, and the mean annual temperature is 57 degrees F. The average frost-free season ranges from 300 to 320 days.

Included in mapping are small areas of Sycamore silt loam, drained, and Botella loam.

Typically, the surface layer is grayish brown, neutral silt loam about 8 inches thick. The underlying material is brown, mildly and moderately alkaline silt loam and extends to a depth of more than 60 inches.

Permeability is moderate. The root zone is more than 60 inches deep. The available water capacity is 9.5 to 11.0 inches. Runoff is slow, and there is no erosion hazard.

Areas of this Yolo soil are used mainly for urban development. A few areas are used for vegetable crops.

This soil has few limitations for urban development. Because of low strength and a moderate shrink-swell potential, special design is needed for urban buildings and roads and streets.

Most of the plants used for landscaping respond to nitrogen fertilizer. The addition of organic matter will increase the rate of water intake. Some ornamental plants respond to sulfur and to iron and aluminum chelates.

Capability unit IIIc-1(14), nonirrigated; class I(14), irrigated.

Use and management of the soils

The soil survey is a detailed inventory and evaluation of the most basic resource of the survey area—the soil. It is useful in adjusting land use, including urbanization, to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in uses of the land.

While a soil survey is in progress, soil scientists, conservationists, engineers, and others keep extensive notes about the nature of the soils and about unique aspects of behavior of the soils. These notes include data on erosion, drought damage to specific crops, flooding, the functioning of septic tank disposal systems, and other factors affecting the productivity, potential, and limitations of the soils under various uses and management. In this way, field experience and measured data on soil properties and performance are used as a basis for predicting soil behavior.

Information in this section is useful in planning use and management of soils for crops and pasture, as sites for buildings, highways and other transportation systems, sanitary facilities, and parks and other recreation facilities, and for wildlife habitat. From the data presented, the potential of each soil for specified land uses can be determined, soil limitations to these land uses can be identified, and costly failures in houses and other structures, caused by unfavorable soil properties, can be avoided. A site where soil properties are favorable can be selected, or practices that will overcome the soil limitations can be planned.

Planners and others using the soil survey can evaluate the impact of specific land uses on the overall productivity of the survey area or other broad planning area and on the environment. Productivity and the environment are closely related to the nature of the soil. Plans should maintain or create a land-use pattern in harmony with the natural soil.

Contractors can find information that indicates the presence of bedrock, wetness, or very firm soil horizons that cause difficulty in excavation.

Health officials, highway officials, engineers, and many other specialists also can find useful information in this soil survey. The safe disposal of wastes, for example, is closely related to properties of the soil. Pavements, sidewalks, picnic areas, playgrounds, lawns, and trees and shrubs are influenced by the nature of the soil.

Capability classification

Capability classification shows, in a general way, the suitability of soils for most kinds of field crops. The soils are classed according to their limitations when they are used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops that require special management. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees, or for engineering purposes.

In the capability system, soils can be grouped at three levels: capability class, subclass, and unit. These levels are defined in the following paragraphs. A survey area may not have soils of all classes.

Capability classes, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class; they are designated by adding a small letter, *e, w, s,* or *c,* to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w, s,* or *c* because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

Capability units are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity. Thus, the capability unit is a convenient grouping for making many statements about management of soils for cropland. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe-4 or IIIe-6. The capability units for this survey area are defined as follows:

0.—Indicates that a problem or limitation is caused by stony, cobbly, or gravelly material in the substratum.

1.—Indicates that a problem or limitation is caused by slope or by actual or potential erosion hazard.

2.—Indicates that a problem or limitation of wetness is caused by poor drainage or flooding.

3.—Indicates that a problem or limitation of slow or very slow permeability of the subsoil or substratum is caused by a clayey subsoil or a substratum that is semiconsolidated.

4.—Indicates that a problem or limitation is caused by sandy or gravelly soils that have a low available water capacity.

5.—Indicates that a problem or limitation is caused by a fine textured or very fine textured surface layer.

6.—Indicates that a problem or limitation is caused by salt or alkali.

7.—Indicates that a problem or limitation is caused by rocks, stones, or cobblestones.

8.—Indicates that a problem or limitation exists in the root zone, which generally is less than 40 inches over massive bedrock and lacks moisture for plants.

9.—Indicates that a problem or limitation is caused by low or very low fertility, acidity, or toxicity that cannot be corrected by adding normal amounts of fertilizer, lime, or other amendments.

No unit designations are shown for class I soils since soil characteristics are similar for all soils in this class. Unit designations are also deleted from classes V through VIII soils since these soils are normally not intensively managed for cropland.

The capability classification is identified in the description of each soil map unit in the section "Soil maps for detailed planning."

Land resource areas

In this survey, capability classification is further refined by designating land resource areas. A land resource area is a distinct combination of climate, soils, vegetation, management needs, and kinds of crops. The 48 conterminous states in the nation have been divided into 156 land resource areas. Parts of two of these areas are in this survey area. These areas and their numbers are Central California Coastal Valleys (14), and Central California Coast Range (15). The number of the resource area is added in parenthesis to the class, subclass, and unit designation at the end of the map unit description.

Land resource area (14) consists of the flood plains, alluvial fans, and low terraces adjacent to the Bay Area. Elevation ranges from sea level to about 300 feet. This area receives sea breezes from San Francisco Bay during much of the year. Morning and evening fog is common. Precipitation ranges from 14 to 20 inches and the frost-free season is 300 to 330 days.

Major agricultural problems are poor drainage, excessive amounts of salts that are toxic to plant growth, lack of precipitation during the growing season, and poor quality water for irrigation.

Most of the land in this resource area is being used for urban development. A large area adjacent to the bay is used for salt ponds. The land remaining in agriculture is used mainly for irrigated row crops. A few areas are used as dryland pasture or are idle because of poor soil conditions.

Land resource area (15) consists of high terraces and uplands. Except for a few small areas adjacent to the San Francisco Bay, this area is along the eastern edge of the survey area. It is at sea level near the Coyote Hills, and ranges to an elevation of about 2,000 feet along ridges and peaks east of the city of Oakland. This area receives sea breezes during much of the year. Morning and evening fog is common. Precipitation ranges from 14 to 25 inches, and the frost-free season is 300 to 330 days.

Major agricultural problems are steep slopes, shallowness to bedrock, lack of precipitation during the growing season, and lack of water for irrigation.

Most of the land in this resource area is used for urban development. The little remaining acreage is used for parks, range, and dryland grains.

Engineering

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material. Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, shrink-swell potential, available water capacity, shear strength, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems, and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational areas; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) plan farm drainage systems, irrigation systems, ponds, and other structures for soil and water conservation; (7) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (8) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 or 6 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soils that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 4 shows, for each kind of soil, the degree and kind of limitations for building site development; table 5, for sanitary facilities; and table 6, for water management.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

Some of the terms used in this soil survey have a special meaning in soil science. Many of these terms are defined in the Glossary.

Building site development

The degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets are indicated in table 4. A *slight* limitation indicates that soil properties generally are favorable for the specified use and that limitations are minor and easily overcome. A *moderate* limitation indicates that soil properties and site features are unfavorable for the specified use, but the limitations can be overcome or minimized by special planning and design. A *severe* limitation indicates that one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort, special design, or intensive maintenance is required. For some soils rated severe, such costly measures may not be feasible.

Shallow excavations are made for pipelines, sewerlines, communications and power transmission lines, open ditches, and cemeteries. Such digging or trenching is influenced by soil wetness caused by a seasonal high water table; the texture and consistence of soils; the tendency of soils to cave in or slough; and the presence of very firm, dense soil layers, bedrock, or large stones. In addition, excavations are affected by slope of the soil and the probability of flooding. Ratings do not apply to soil horizons below a depth of 6 feet unless otherwise noted.

In the soil series descriptions, the consistence of each soil horizon is given, and the presence of very firm or extremely firm horizons, usually difficult to excavate, is indicated.

Dwellings and *small commercial buildings* referred to in table 4 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. Separate ratings are made for small commercial buildings without basements and for dwellings with and without basements. For such structures, soils should be sufficiently stable that cracking or subsidence of the structure from settling or shear failure of the foundation does not occur. These ratings were determined from estimates of the shear strength, compressibility, and shrink-swell potential of the soil. Soil texture, plasticity and in-place density, soil wetness, and depth to a seasonal high water table were also considered. Soil wetness and depth to a seasonal high water table indicate potential difficulty in providing adequate drainage for basements, lawns, and gardens. Depth to bedrock, slope, and large stones in or on the soil are also important considerations in the choice of sites for these structures and were considered in determining the ratings. Susceptibility to flooding is a serious hazard.

Local roads and streets referred to in table 4 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material; a base of gravel, crushed rock fragments, or soil material stabilized with lime or cement; and a flexible or rigid surface, commonly asphalt or concrete. The roads are graded with soil material at hand, and most cuts and fills are less than 6 feet deep.

The load supporting capacity and the stability of the soil as well as the quantity and workability of fill material available are important in design and construction of roads and streets. The classifications of the soil and the soil texture, density, and shrink-swell potential are indicators of the traffic supporting capacity used in making the ratings. Soil wetness, flooding, slope, depth to hard rock or very compact layers, and content of large stones affect stability and ease of excavation.

Sanitary facilities

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 5 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as *slight*, soils are generally favorable for the specified use and limitations are minor and easily overcome; if *moderate*, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if *severe*, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms *good*, *fair*, and *poor*, which mean about the same as *slight*, *moderate*, and *severe*.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 18 and 72 inches are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil slippage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 4 feet below the tile lines. In these soils the absorption field does not adequately filter the effluent, and ground water in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of ground water is a hazard if the seasonal high water table is above the level of the lagoon floor. If the water table is seasonally high, seepage of ground water into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting ground water and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate ground water. Soil wetness can be a limitation because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of ground water.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in table 5 apply only to the soil material within a depth of about 6 feet. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

If it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the site should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 6, soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

Pond reservoir areas hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

Embankments, dikes, and levees require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of the soil for use in embankments, dikes, and levees.

Drainage of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

Irrigation is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

Recreation

The soils of the survey area are rated in table 7 according to limitations that affect their suitability for recreation uses. The ratings are based on such restrictive soil features as flooding, wetness, slope, and texture of the surface layer. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, potential water impoundment sites available, and either access to public sewerlines or capacity of the soil to absorb septic tank effluent. Soils subject to flooding are limited, in varying degree, for recreation use by the duration and intensity of flooding and the season when flooding occurs. Onsite assessment of height, duration, intensity, and frequency of flooding is essential in planning recreation facilities.

The degree of the limitation of the soils is expressed as slight, moderate, or severe. *Slight* means that the soil properties are generally favorable and that the limitations are minor and easily overcome. *Moderate* means that the limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 7 can be supplemented by information in other parts of this survey. Especially helpful are interpretations for septic tank absorption fields, given in table 5, and interpretations for dwellings without basements and for local roads and streets, given in table 4.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing camping sites.

Picnic areas are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for use as picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that will increase the cost of shaping sites or of building access roads and parking areas.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones or boulders, is firm after rains, and is not dusty when dry. If shaping is required to obtain a uniform grade, the depth of the soil over bedrock or hardpan should be enough to allow necessary grading.

Paths and trails for walking, horseback riding, bicycling, and other uses should require little or no cutting and filling. The best soils for this use are those that are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once during the annual period of use. They should have moderate slopes and have few or no stones or boulders on the surface.

Wildlife habitat

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover, and they affect the construction of water impoundments. The kind and abundance of wildlife that populate an area depend largely on the amount and distribution of food, cover, and water. If any one of these elements is missing, is inadequate, or is inaccessible, wildlife either are scarce or do not inhabit the area.

If the soils have the potential, wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by helping the natural establishment of desirable plants.

In table 8, the soils in the survey area are rated according to their potential to support the main kinds of wildlife habitat in the area. This information can be used in planning for parks, wildlife refuges, nature study areas, and other developments for wildlife; selecting areas that are suitable for wildlife; selecting soils that are suitable for creating, improving, or maintaining specific elements of wildlife habitat; and determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* means that the element of wildlife habitat or the kind of habitat is easily created, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected if the soil is used for the designated purpose. A rating of *fair* means that the element of wildlife habitat or kind of habitat can be created, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* means that limitations are severe for the designated element or kind of wildlife habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* means that restrictions for the element of wildlife habitat or kind of habitat are very severe and that unsatisfactory results can be expected. Wildlife habitat is impractical or even impossible to create, improve, or maintain on soils having such a rating.

The elements of wildlife habitat are briefly described in the following paragraphs.

Grain and seed crops are seed-producing annuals used by wildlife. The major soil properties that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of grain and seed crops are corn, wheat, oats, and barley.

Grasses and legumes are domestic perennial grasses and herbaceous legumes that are planted for wildlife food and cover. Major soil properties that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, hardinggrass, bromegrass, vetch, clover, and alfalfa.

Wild herbaceous plants are native or naturally established grasses and forbs, including weeds, that provide food and cover for wildlife. Major soil properties that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are milkthistle, dove weed, tarweed, filaree, soft chess, needlegrass, and wild oats.

Shrubs are bushy woody plants that produce fruit, buds, twigs, bark, or foliage used by wildlife or that provide cover and shade for some species of wildlife. Major soil properties that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and moisture. Examples of shrubs are coyotebush, toyon, manzanita, snowberry, and California sagebrush.

Wetland plants are annual and perennial wild herbaceous plants that grow on moist or wet sites, exclusive of submerged or floating aquatics. They produce food or cover for wildlife that use wetland as habitat. Major soil properties affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, pickleweed, saltgrass, and cordgrass and rushes, sedges, and reeds.

Shallow water areas are bodies of water that have an average depth of less than 5 feet and that are useful to wildlife. They can be naturally wet areas, or they can be created by dams or levees or by water-control structures in marshes or streams. Major soil properties affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. The availability of a dependable water supply is important if water areas are to be developed. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The kinds of wildlife habitat are briefly described in the following paragraphs.

Openland habitat consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The kinds of wildlife attracted to these areas include California quail, pheasant, meadowlark, field sparrow, cottontail rabbit, and skunk.

Wetland habitat consists of open, marshy or swampy, shallow water areas where water-tolerant plants grow. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

Rangeland habitat consists of areas of wild herbaceous plants and shrubs. Wildlife attracted to rangeland include antelope, black-tailed deer, California mule deer, mourning dove, meadowlark, and horned lark.

Soil properties

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many thousands of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists can identify several important soil properties. They note the seasonal soil moisture condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine all major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are not conducted for all soil series in the survey area, but laboratory data for many soil series not tested are available from nearby survey areas.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

Engineering properties

Table 9 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area.

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 9 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 9 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added, for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (*2*) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (*1*).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

When laboratory data are available, the A-1, A-2, and A-7 groups are further classified as follows: A-1-a, A-1-b, A-2-4, A-2-5, A-2-6, A-2-7, A-7-5, and A-7-6. As an additional refinement, the desirability of soils as subgrade material can be indicated by a group index number. These numbers range from 0 for the best subgrade material to 20 or higher for the poorest. The estimated classification, without group index numbers, is given in table 9. Also in table 9 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

Liquid limit and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

The estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

Physical and chemical properties

Table 10 shows estimated values for several soil characteristics and features that affect behavior of soils in engineering uses. These estimates are given for each major horizon, at the depths indicated, in the typical pedon of each soil. The estimates are based on field observations and on test data for these and similar soils.

Permeability is estimated on the basis of known relationships among the soil characteristics observed in the field—particularly soil structure, porosity, and gradation or texture—that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated. Not considered in the estimates is lateral seepage or such transient soil features as plowpans and surface crusts. Permeability of the soil is an important factor to be considered in planning and designing drainage systems, in evaluating the potential of soils for septic tank systems and other waste disposal systems, and in many other aspects of land use and management.

Available water capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure. Shallow-rooted plants are not likely to use the available water from the deeper soil horizons. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design of irrigation systems.

Soil reaction is expressed as a range in pH values. The range in pH of each major horizon is based on many field checks. For many soils, the values have been verified by laboratory analyses. Soil reaction is important in selecting the crops, ornamental plants, or other plants to be grown; in evaluating soil amendments for fertility and stabilization; and in evaluating the corrosivity of soils.

Salinity is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of the nonirrigated soils. The salinity of individual irrigated fields is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of individual fields can differ greatly from the value given in table 10. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its potential to corrode metal and concrete.

Shrink-swell potential depends mainly on the amount and kind of clay in the soil. Laboratory measurements of the swelling of undisturbed clods were made for many soils. For others the swelling was estimated on the basis of the kind and amount of clay in the soil and on measurements of similar soils. The size of the load and the magnitude of the change in soil moisture content also influence the swelling of soils. Shrinking and swelling of some soils can cause damage to building foundations, basement walls, roads, and other structures unless special designs are used. A high shrink-swell potential indicates that special design and added expense may be required if the planned use of the soil will not tolerate large volume changes.

Erosion factors are used to predict the erodibility of a soil and its tolerance to erosion in relation to specific kinds of land use and treatment. The soil erodibility factor (K) is a measure of the susceptibility of the soil to erosion by water. Soils having the highest K values are the most erodible. K values range from 0.10 to 0.64. To estimate annual soil loss per acre, the K value of a soil is modified by factors representing plant cover, grade and length of slope, management practices, and climate. The soil-loss tolerance factor (T) is the maximum rate of soil erosion, whether from rainfall or soil blowing, that can occur without reducing crop production or environmental quality. The rate is expressed in tons of soil loss per acre per year.

Soil and water features

Table 11 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

Flooding is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency and duration of flooding and the time of year when flooding is most likely. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about floodwater levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

High water table is the highest level of a saturated zone more than 6 inches thick for a continuous period of more than 2 weeks during most years. The depth to a seasonal high water table applies to undrained soils. Estimates are based mainly on the relationship between grayish colors or mottles in the soil and the depth to free water observed in many borings made during the course of the soil survey. Indicated in table 11 are the depth to the seasonal high water table; the kind of water table, that is, perched, artesian, or apparent; and the months that the water table commonly is high. Only saturated zones above a depth of 5 or 6 feet are indicated.

Information about the seasonal high water table helps in assessing the need for specially designed foundations, the need for specific kinds of drainage systems, and the need for footing drains to insure dry basements. Such information is also needed to decide whether or not construction of basements is feasible and to determine how septic tank absorption fields and other underground installations will function. Also, a seasonal high water table affects ease of excavation.

Depth to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock requires blasting.

Classification of the soils

The system of soil classification used has six categories (*5*). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In table 12, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in *sol*. An example is Mollisol.

SUBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning dry, plus *oll*, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Argixerolls (*Argi*, meaning argillic horizon, plus *xeroll*, the suborder of Mollisols that have a xeric moisture regime).

SUBGROUP. Each great group may be divided into three subgroups: the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades, which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective *Typic* identifies the subgroup that is thought to typify the great group. An example is Typic Argixerolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiae. An example is fine, montmorillonitic, thermic, Typic Argixerolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineral and chemical composition.

Soil series and morphology

In this section, each soil series recognized in the survey area is described in detail. The descriptions are arranged in alphabetic order by series name.

Characteristics of the soil and the material in which it formed are discussed for each series. The soil is then compared to similar soils and to nearby soils of other series. Then a pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed descriptions of each soil horizon follow standards in the Soil Survey Manual (*3*). Unless otherwise noted, colors described are for dry soil.

Following the pedon description is the range of important characteristics of the soil series in this survey area. Phases, or map units, of each soil series are described in the section "Soil maps for detailed planning."

Some of the pedons described are outside the survey area. They are typical pedons in the area mapped for the "Soil Survey of Alameda Area, California," which was published in 1966 (*4*).

Altamont series

The Altamont series consists of deep, well drained soils that formed in residuum of soft interbedded sedimentary rock. Altamont soils are on foothills. Slope ranges from 5 to 50 percent. The average annual precipitation ranges from 14 to 20 inches, and the mean annual temperature is 57 degrees F.

Altamont soils are similar to the Clear Lake, Diablo, and Climara soils. The Clear Lake soils have slopes of 0 to 9 percent and do not have a paralithic or lithic contact. The Diablo and Climara soils when moist have chroma of less than 1.5 in the upper part of the solum.

Typical pedon of Altamont clay, 30 to 50 percent slopes, 750 feet east and 2,250 feet south of the northeast corner of sec. 19, T. 2 S., R. 3 E. (outside the survey area):

A11—0 to 7 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; grayish brown (10YR 5/2) in the very thin surface crust; strong coarse prismatic structure parting to strong coarse and medium blocky, with very dark brown to black carbonaceous films and mats on some ped faces; very hard, very firm, sticky and very plastic; many fine flattened, exped roots; few very fine tubular pores; slightly acid; clear smooth boundary.

A12—7 to 19 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate coarse blocky; very hard, very firm, sticky and very plastic; few fine exped roots; few very fine tubular pores; many slickensides; matrix is noneffervescent but has few whitish lime coats on faces of peds in lower part; neutral; clear smooth boundary.

A13—19 to 28 inches; dark brown (10YR 4/3) clay, dark brown (10YR 3/3) moist; moderate coarse prismatic structure parting to moderate coarse and medium blocky; very hard, very firm, sticky and very plastic; few fine exped roots; few very fine tubular pores; many slickensides; slightly effervescent with few fine whitish soft coatings on faces of peds; mildly alkaline; clear smooth boundary.

ACca—28 to 37 inches; finely mixed dark brown (10YR 4/3) and dark yellowish brown (10YR 4/4) clay, dark brown (10YR 3/3) and dark yellowish brown (10YR 3/4) moist; weak coarse prismatic structure parting to moderate medium blocky; very hard, very firm, sticky and very plastic; few fine exped roots; few very fine tubular pores; few soft, fine, yellowish brown (10YR 5/6, 5/8) segregations of iron oxide; few small embedded fragments of shale; many slickensides; strongly effervescent; carbonates mostly disseminated with few fine whitish soft to slightly hard segregations and films of lime; mildly alkaline; clear smooth boundary.

C1ca—37 to 50 inches; yellowish brown (10YR 5/4) clay, dark yellowish brown (10YR 4/4) moist; weak medium blocky structure; very hard, very firm, sticky and plastic; few fine roots mostly along structural faces; few very fine tubular pores; few small fragments of shale; few slickensides; strongly effervescent; many whitish, soft to slightly hard segregations and nodules of lime; moderately alkaline; clear smooth boundary.

C2r—50 inches; olive (5Y 5/3) highly fractured and weathered fine grained sandstone and shale, dark olive (5YR 3/3) moist.

Depth to sedimentary rock ranges from 40 to 60 inches. The A horizon is dark brown, brown, dark grayish brown, or very dark grayish brown (10YR 4/3, 5/3, 4/2, or 3/2). Reaction is slightly acid to mildly alkaline. Thickness of the A horizon ranges from 20 to 28 inches. After a long dry period, cracks 1/4 inch to 2 inches wide extend from the surface through the A horizon and into the upper part of the C horizon. Coarse and very coarse prismatic structure is formed as a result of the cracking. Depth to free lime ranges from 15 to 36 inches.

The C1ca horizon ranges from 6 to 14 inches in thickness. This horizon is clay or silty clay and is as much as 10 percent gravel in areas where the soil formed in soft conglomerate.

Azule series

The Azule series consists of moderately deep, well drained soils that formed in residuum of consolidated alluvial sediment, soft shale, or fine grained sandstone. Azule soils are on uplands and have slopes ranging from 9 to 50 percent. The average annual precipitation ranges from 14 to 24 inches, and the mean annual temperature is 57 degrees F.

Azule soils are similar to Contra Costa, Los Osos, and Rincon soils and are near Altamont, Diablo, Los Osos, Tierra, and Rincon soils. Contra Costa soils have hue of 7.5YR or 5YR in the Bt horizon and have hard bedrock at a depth of 20 to 40 inches. Los Osos soils have a mollic epipedon. Rincon soils are very deep. Altamont and Diablo soils are more than 35 percent clay throughout. Tierra soils are very deep and have an abrupt boundary between the A and B horizons.

Typical pedon of Azule clay loam, about 10 miles southeast of Pleasanton, in the SE1/4SE1/4NW1/4 of sec. 24, T. 4 S., R. 1 E. (projected in the Valle de San Jose Land Grant). This site is outside the survey area:

A1—0 to 6 inches; grayish brown (10YR 5/2) clay loam, very dark grayish brown (2.5Y 3/2) moist; massive; hard, firm, sticky and plastic; many fine and very fine roots; many very fine, common fine, and few medium tubular pores; slightly acid; clear smooth boundary.

B21t—6 to 12 inches; grayish brown (10YR 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to strong medium angular blocky; very hard, very firm, sticky and plastic; many fine and common very fine roots; many very fine and fine tubular pores; common thin clay films on faces of peds and in pores; slightly acid; diffuse smooth boundary.

B22t—12 to 21 inches; dark grayish brown (2.5Y 4/2) clay, very dark grayish brown (2.5Y 3/2) moist; moderate coarse prismatic structure parting to moderate medium angular blocky; very hard, very firm, sticky and very plastic; many fine and very fine roots; many very fine and fine and few medium pores; common moderately thick clay films on faces of peds and in pores; slightly acid; gradual irregular boundary.

B3—21 to 25 inches; grayish brown (2.5Y 5/2) and light yellowish brown (2.5Y 6/4) clay that has a mottled appearance, very dark grayish brown (2.5Y 3/2) and light olive brown (2.5Y 5/4) moist; moderate coarse subangular blocky structure; very hard, very firm, sticky and very plastic; few very fine roots; many very fine and fine tubular pores; common thin clay films on faces of peds and in pores; slightly acid; clear smooth boundary.

Cr—25 inches; light yellowish brown (2.5Y 6/4) consolidated alluvial sediment, light olive brown (2.5Y 5/4) moist.

The solum is 24 to 40 inches thick. The content of coarse fragments in the solum is 0 to 15 percent. Reaction ranges from medium acid through neutral.

The A1 horizon is grayish brown or dark grayish brown (10YR 5/2, 4/2). It is clay loam or silty clay loam. The B2t horizon is grayish brown, dark grayish brown, or brown (10YR 5/2, 4/2, 5/3). It ranges from clay to sandy clay. The Cr horizon is light yellowish brown or yellowish brown (2.5Y 6/4; 10YR 5/6). Depth to the Cr horizon is 24 to 40 inches.

Baywood series

The Baywood series consists of very deep, somewhat excessively drained soils that formed in sandy eolian deposits that derived from old beach deposits. These soils are on mounds and ridges. The slopes range from 0 to 9 percent. The average annual precipitation ranges from 16 to 18 inches, and the mean annual temperature is about 57 degrees F.

Baywood soils are associated with and are similar to the sandy Xerorthents, which do not have a mollic epipedon. They are associated with the Tierra and Reyes soils. Tierra soils have an argillic horizon and a fine control section. Reyes soils are very poorly drained and clayey.

Typical pedon of Baywood loamy sand, in an area of Urban land-Baywood complex, in the city of Alameda, at the intersection of Eighth Street and Santa Clara Avenue:

A11—0 to 16 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; weak medium and fine granular structure; soft, very friable, nonsticky and nonplastic; many very fine roots; many fine interstitial pores; slightly acid; clear smooth boundary.

A12—16 to 32 inches; brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) moist; massive; soft, very friable, nonsticky and nonplastic; few very fine roots; many fine interstitial pores; slightly acid; diffuse wavy boundary.

C1—32 to 44 inches; pale brown (10YR 6/3) loamy sand, light brownish gray (10YR 6/2) moist; massive; soft, very friable, nonsticky and nonplastic; few fine roots; many fine interstitial pores; slightly acid; diffuse wavy boundary.

C2—44 to 60 inches; light yellowish brown (10YR 6/4) loamy sand, dark brown (7.5YR) moist; thin discontinuous wavy sandy loam lamellae, reddish brown (5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; no roots; few very fine tubular pores in the lamellae; slightly acid.

Reaction is neutral to strongly acid. In many pedons, the soil material is more acid as depth increases. It is sand or loamy sand throughout. The profile is not stratified.

The A horizon is grayish brown, brown, dark brown, or very dark gray (10YR 5/2, 5/3, 3/3, 3/1). The C horizon is light yellowish brown or pale brown (10YR 6/4, 6/3). Lamellae are dark brown, strong brown, reddish brown, or reddish yellow (7.5YR 3/3, 5/6; 5YR 5/4, 6/6). In some pedons there are a few dark reddish brown (5YR 3/3) concretions ranging from 2 to 5 mm in diameter.

Baywood Variant

The Baywood Variant soils are very deep and somewhat poorly drained. They formed in sandy sediment on old coastal plains. The slopes are 0 to 2 percent. The average annual precipitation ranges from 15 to 18 inches, and the mean annual temperature is 57 degrees F.

Baywood Variant soils are similar to Xeropsamments, which are fill soils that consist of beach sand that was dredged from the peripheral areas of Alameda Naval Air Station and Oakland Airport.

Typical pedon of Baywood Variant, sand, on Bay Farm Island, 200 feet north of center of sec. 25, T. 2 S., R. 4 W.

Ap—0 to 14 inches; dark grayish brown (10YR 4/2) sand, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, nonsticky and nonplastic; common fine and very fine roots; few very fine tubular and interstitial pores; slightly effervescent; mildly alkaline; gradual smooth boundary.

A12—14 to 21 inches; very dark grayish brown (10YR 3/2) sand, very dark brown (10YR 2/2) moist; common medium distinct strong brown mottles (7.5YR 5/6, 5/8); weak fine granular structure; soft, very friable, nonsticky and nonplastic; common very fine and fine roots; very few very fine tubular and interstitial pores; slightly effervescent; mildly alkaline; gradual smooth boundary.

C1—21 to 32 inches; brown (10YR 5/3) sand, dark brown (7.5YR 4/4) moist; common fine distinct strong brown (7.5YR 5/6, 5/8) mottles; single grained; loose; neutral; gradual smooth boundary.

C2—32 to 60 inches; yellowish brown (10YR 5/4) sand, dark yellowish brown (10YR 4/4) moist; single grained; loose; neutral.

The water table generally is at a depth of 40 to 50 inches; in a few areas it is at a depth of 18 inches in winter.

The A horizon is gray, dark gray, grayish brown, dark grayish brown, and very dark grayish brown (10YR 5/1, 4/1, 5/2, 4/2, 3/2). In some places it is noncalcareous, and in other places it is calcareous and may contain small shells. The A horizon is 20 to 24 inches thick. Reaction is neutral to moderately alkaline. The C horizon is brown, yellowish brown, light yellowish brown, or light olive brown (10YR 5/3, 5/4, 6/4; 2.5Y 5/4).

Botella series

The Botella series consists of very deep, well drained soils that formed in alluvium that derived mainly from sedimentary rock sources. Botella soils are on low terraces and alluvial fans and have slopes ranging from 0 to 2 percent. The average annual precipitation ranges from 14 to 20 inches. The mean annual temperature is 57 degrees F.

Botella soils are similar to Danville soils and are associated with Rincon and Yolo soils. Danville soils have an argillic horizon and a fine control section. Rincon soils have an ochric epipedon. Yolo soils have an ochric epipedon and do not have an argillic horizon.

Typical pedon of Botella loam, in the town of Fremont, 1,800 feet northwest and 600 feet south of the intersection of Fremont Boulevard and Mowry Avenue:

Ap—0 to 9 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; many very fine, fine, and medium roots; many fine and medium and common coarse tubular pores; neutral; clear smooth boundary.

B2t—9 to 22 inches; dark grayish brown (10YR 4/2) light clay loam, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to moderate medium angular blocky; very hard, firm, sticky and slightly plastic; common very fine and fine roots; common very fine and fine and few medium tubular and interstitial pores; common moderately thick clay films lining pores and on faces of peds; neutral; gradual smooth boundary.

B3t—22 to 33 inches; dark brown (10YR 4/3) light clay loam, dark brown (10YR 3/3) moist; moderate medium angular blocky structure; hard, friable, sticky and slightly plastic; few moderately thick clay films lining pores and on faces of peds; neutral; gradual smooth boundary.

C1—33 to 42 inches; brown (10YR 5/3) clay loam, dark brown (10YR 4/3) moist; weak moderate and fine angular blocky structure; hard, friable, sticky and slightly plastic; mildly alkaline; diffuse smooth boundary.

C2—42 to 60 inches; yellowish brown (10YR 5/4) when moist; silt loam; weak coarse angular blocky structure; hard, friable, sticky and slightly plastic; slightly effervescent; moderately alkaline.

The A horizon is grayish brown or dark grayish brown (10YR 5/2, 4/2). It is granular or subangular blocky in structure. It is neutral or mildly alkaline. The B2t horizon is dark brown, dark grayish brown, or very dark grayish brown (10YR 4/3, 4/2, 3/2). It ranges from heavy loam to clay loam. The B2t horizon is neutral or mildly alkaline. The C horizon is dark grayish brown, grayish brown, brown, or yellowish brown (10YR 4/2, 5/2, 4/3, 5/3, 5/4). It is sandy loam, silt loam, loam, or clay loam. The C horizon is mildly alkaline or moderately alkaline. Botella soils in this survey area are browner and have higher pH values than is defined in the range for the series. This difference, however, does not significantly affect their use and management.

Clear Lake series

The Clear Lake series consists of very deep, poorly drained soils that formed in alluvium that derived mainly from sedimentary rock sources. These soils are in basins or in areas of the coastal valley. The slopes are concave and range from 0 to 9 percent. The average annual precipitation ranges from 14 to 20 inches. The mean annual temperature is 57 degrees F.

Clear Lake soils are similar to Altamont, Diablo, and Climara soils. They are associated with Omni and Pescadero soils. Altamont, Diablo, and Climara soils have a lithic or paralithic contact within a depth of 60 inches and in some horizons have moist chroma of 1.5 or more above a depth of 40 inches. Omni soils do not have intersecting slickensides, and the content of organic matter decreases irregularly with depth. The Pescadero soils have a natric horizon.

Typical pedon of Clear Lake clay, drained, near Russell City, 2,000 feet east and 1,650 feet north of the sewage disposal plant on Depot Road:

Ap—0 to 9 inches; very dark gray (N 3/0) clay, black (N 2/0) moist; strong coarse prismatic structure parting to coarse angular blocky; extremely hard, very firm, very sticky and very plastic; many fine tubular pores; neutral; gradual smooth boundary.

A12—9 to 26 inches; very dark gray (N 3/0) clay, black (N 2/0) moist; strong coarse prismatic structure parting to coarse angular blocky; extremely hard, very firm, very sticky and very plastic; many very fine roots; very few very fine tubular pores; many slickensides; moderately alkaline; gradual wavy boundary.

ACca—26 to 37 inches; very dark gray (N 3/0) clay, black (10YR 2/1) moist; strong coarse prismatic structure parting to coarse angular blocky; extremely hard, firm, very sticky and very plastic; common very fine roots; very few very fine tubular pores; many intersecting slickensides; lime occurring in seams; moderately alkaline; gradual smooth boundary.

C1ca—37 to 48 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; many fine distinct yellowish brown (10YR 5/4) mottles; weak fine angular blocky structure; slightly hard, friable, sticky and plastic; few very fine roots; few very fine pores; many intersecting slickensides; lime occurring as fine soft masses; moderately alkaline; gradual smooth boundary.

C2ca—48 to 60 inches; grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; many fine distinct yellowish brown (10YR 5/6) mottles; weak fine angular blocky structure; hard, friable, sticky and plastic; no roots; many very fine tubular pores; lime occurring throughout the soil matrix; moderately alkaline.

In summer, cracks that are 1/2 inch to 2 inches wide extend from the surface to the C horizon and form very coarse and coarse prismatic structure.

The A horizon is dark gray, very dark gray, or black (N 4/0, 3/0, 2/0). It is slightly acid to moderately alkaline. In some pedons, a few fine concretions of lime are in the Ap or A12 horizon. The C horizon is olive, light olive brown, grayish brown, dark gray, or dark grayish brown (5Y 5/3; 2.5Y 5/4, 5/2, 4/1, 4/2) clay loam, silty clay loam, silty clay, or clay.

Climara series

The Climara series consists of moderately deep, well drained soils that formed in residuum of ultrabasic rock. Climara soils are on uplands and have slopes ranging from 30 to 50 percent. The average annual precipitation ranges from 18 to 22 inches, and the mean annual temperature is 57 degrees F.

Climara soils are similar to Altamont, Diablo, and Clear Lake soils and are near Los Osos and Altamont soils. Altamont and Diablo soils have a paralithic contact at a depth greater than 40 inches. Clear Lake soils have chroma of less than 1.5 at a depth of 40 inches or more and do not have a paralithic or lithic contact. Los Osos soils have a mollic epipedon and an argillic horizon.

Typical pedon of Climara clay, on a moderately steep west-facing grassy slope, in the hills east of San Leandro, 400 feet north of the county dog pound, in the NW1/4SW1/4NW1/4 of sec. 32, T. 2 W., R. 2 S. (projected):

A11—0 to 9 inches; black (10YR 2/1) clay, dry and moist; strong coarse prismatic structure; very hard, firm, sticky and very plastic; common fine roots; common fine tubular pores; neutral; diffuse wavy boundary.

A12—9 to 22 inches; black (10YR 2/1) clay, dry and moist; strong coarse prismatic structure; very hard, firm, sticky and very plastic; common fine roots; common fine tubular pores; few intersecting slickensides; neutral; clear wavy boundary.

A13—22 to 27 inches; black (10YR 2/1) clay, dry and moist; some splotches of variegated very dark grayish brown (2.5Y 3/2) and olive (5Y 4/4, 5/6) moist; strong coarse prismatic structure; very hard, firm, sticky and very plastic; common fine roots; common fine tubular pores; numerous slickensides; mildly alkaline; clear wavy boundary.

C1ca—27 to 33 inches; variegated very dark brown (10YR 2/2), olive brown (2.5Y 4/4), and olive (2.5Y 4/4) clay, dry and moist; moderate medium subangular blocky structure; very hard, firm, sticky and plastic; few fine roots; common fine tubular pores;

strongly effervescent; moderately alkaline; abrupt wavy boundary.

C2r—33 to 40 inches; soft weathered ultrabasic rock that has yellowish brown and dark brown (10YR 5/6, 3/3) coatings along fracture planes.

R—40 inches; hard ultrabasic rock.

These soils have cracks more than one inch wide that extend to a depth of 20 inches or more. Depth to bedrock is 20 to 40 inches. The A horizon ranges from 16 to 31 inches in thickness. In places, the lower part of this horizon is calcareous. The A horizon is black, very dark gray, or dark gray (10YR 2/1, 3/1, 4/1). The C horizon is as much as 35 percent pebbles. Some pedons do not have a C2r horizon.

Contra Costa series

The Contra Costa series consists of moderately deep, well drained soils that formed in residuum of metabasic and metasedimentary rock. These soils are on uplands. The slopes range from 30 to 50 percent. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Contra Costa soils are similar to Azule soils and are associated with Vallecitos soils. Azule soils have a paralithic contact between 24 and 40 inches. Vallecitos soils have a lithic contact at a depth between 10 and 20 inches.

Typical pedon of Contra Costa clay loam, in a roadcut overlooking salt ponds, in Coyote Hills Regional Park, 700 feet west and 700 feet north of water tower:

A11—0 to 7 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, sticky and plastic; many very fine, fine, and medium roots; common fine and very fine tubular pores; 5 percent small angular gravel; neutral; diffuse smooth boundary.

A12—7 to 24 inches; brown (7.5YR 5/2) clay loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, sticky and plastic; common medium and very fine roots; few medium and fine tubular pores; 5 percent small angular gravel; neutral; gradual smooth boundary.

B21t—24 to 30 inches; reddish brown (5YR 4/4) heavy clay loam, dark reddish brown (5YR 3/3) moist; massive; very hard, friable, sticky and plastic; common very fine roots; few medium tubular pores; few very thin clay films; neutral; clear smooth boundary.

B22t—30 to 35 inches; yellowish red (5YR 4/6) gravelly clay, dry and moist; massive; hard, firm, sticky and very plastic; few very fine roots; few very thin clay films; 15 percent gravel; neutral; abrupt wavy boundary.

R—35 inches; fractured, partly weathered, metasedimentary bedrock.

The A horizon is dark reddish brown, brown, or dark brown (5YR 3/2, 3/3; 7.5YR 5/2, 4/2, 3/2). Gravel content ranges from 5 to 15 percent. The A horizon is slightly acid or neutral. The B2t horizon is dark brown, reddish brown, or yellowish red (7.5YR 3/2, 4/4; 5YR 4/4, 4/6). It is heavy clay loam or light clay and is as much as 25 percent cobbles, the largest percentage making up the lower part of the horizon. The B2t horizon is medium acid to neutral. Depth to bedrock ranges from 20 to 40 inches.

Danville series

The Danville series consists of very deep, well drained soils that formed in alluvium that derived mainly from sedimentary rock sources. These soils are on low terraces and alluvial fans and have slopes ranging from 0 to 9 percent. The average annual precipitation ranges from 14 to 20 inches, and the mean annual temperature is 57 degrees F.

Danville soils are similar to and are near Botella and Rincon soils. Botella soils have a fine-loamy control section. Rincon soils have an ochric epipedon.

Typical pedon of Danville silty clay loam, 2.5 miles north of intersection of Crow Canyon Road and Cull Canyon Road, in a roadcut on the east side of Cull Canyon Road (outside of the survey area):

A11—0 to 10 inches; grayish brown (10YR 5/2) silty clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; slightly hard, friable, sticky and plastic; many very fine roots; many very fine, common fine and medium, and few coarse pores; slightly acid; gradual smooth boundary.

A12—10 to 21 inches; dark gray (10YR 4/1) silty clay loam, very dark gray (10YR 3/1) moist; weak fine granular structure; hard, friable, sticky and plastic; many very fine roots; many very fine, common fine, and few medium pores; slightly acid; gradual smooth boundary.

B21t—21 to 39 inches; grayish brown (10YR 5/2) silty clay, very dark grayish brown (10YR 3/2) moist; weak medium prismatic structure parting to strong medium blocky; very hard, firm, very sticky and plastic; common very fine roots; many very fine tubular pores; common thick continuous clay films on faces of peds and in pores; slightly acid; gradual smooth boundary.

B22t—39 to 53 inches; grayish brown (10YR 5/2) heavy silty clay loam, dark grayish brown (10YR 4/2) moist; strong coarse blocky structure; very hard, firm, very sticky and plastic; few very fine roots; many very fine pores; common thick continuous clay films on faces of peds and in tubular pores; slightly acid; gradual smooth boundary.

B3t—53 to 61 inches; grayish brown (10YR 5/2) silty clay loam, dark grayish brown (10YR 4/2) moist;

moderate coarse blocky structure; hard, friable, sticky and plastic; few very fine roots; common very fine pores; thick continuous clay films in tubular pores; few thick continuous clay films on faces of peds; neutral; gradual smooth boundary.

C—61 to 80 inches; grayish brown (10YR 5/2) silty clay loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; few very fine roots; few very fine pores; thin discontinuous clay films in some pores; neutral.

The A1 horizon is dark gray, very dark gray, grayish brown, or dark grayish brown (10YR 4/1, 3/1, 5/2, 4/2). Structure is granular or subangular blocky. The B2t horizon is grayish brown or dark grayish brown (10YR 5/2, 4/2) heavy silty clay loam, silty clay, or clay. It is slightly acid or neutral. The C horizon is grayish brown, brown, or dark yellowish brown (10YR 5/2, 5/3, 4/4). It is neutral to moderately alkaline. In some pedons, the C horizon is calcareous.

Diablo series

The Diablo series consists of deep, well drained soils that formed in residuum of calcareous, soft fine-grained sandstone or shale. These soils are on foothills near Mission San Jose. The slopes range from 9 to 50 percent. The average annual precipitation ranges from 14 to 20 inches, and the mean annual temperature is 57 degrees F.

Diablo soils are similar to and are geographically associated with Altamont, Clear Lake, and Climara soils. Altamont soils have chroma of 2 or more throughout the profile. Clear Lake soils are very deep, nearly level to moderately sloping soils that do not have a paralithic contact within a depth of 80 inches. Climara soils have a lithic contact between depths of 20 and 40 inches.

Typical pedon of Diablo clay, 1,325 feet east and 275 feet north of the southwest corner of sec. 25, T. 2 S., R. 1 E. (outside the survey area):

Ap—0 to 6 inches; dark gray (5Y 4/1) clay, the immediate surface crust being light gray (5Y 7/1), very dark gray (5Y 3/1) moist; strong medium granular structure in the upper 3 inches and strong coarse and medium blocky in the lower 3 inches; very hard, very firm, sticky and very plastic; common fine roots; few fine and very fine tubular pores; neutral; clear wavy boundary.

A12—6 to 15 inches; dark gray (5Y 4/1) silty clay, very dark gray (5Y 3/1) moist; moderate coarse prismatic structure parting to moderate coarse blocky; very hard, very firm, very sticky and very plastic; few fine exped roots; few fine and very fine tubular pores; few slickensides; matrix is noneffervescent except for occasional fine hard whitish lime nodules; mildly alkaline; clear smooth boundary.

A13ca—15 to 26 inches; variegated gray (5Y 5/1) and olive gray (5Y 5/2) silty clay, dark gray (5Y 4/1) and olive gray (5Y 4/2) moist; moderate coarse prismatic structure parting to moderate medium blocky; very hard, very firm, sticky and very plastic; few fine exped roots; few fine and very fine tubular pores; many intersecting slickensides; slightly effervescent with few fine hard whitish lime nodules; mildly alkaline; clear wavy boundary.

A14ca—26 to 32 inches; variegated gray (5Y 5/1) and olive gray (5Y 5/2) silty clay, dark gray (5Y 4/1) and olive gray (5Y 4/2) moist; weak coarse prismatic structure that parts to weak medium blocky; very hard, very firm, sticky and very plastic; few fine exped roots; few fine and very fine tubular pores; numerous intersecting slickensides; slightly effervescent with few fine exped roots; few fine and very fine tubular pores; numerous intersecting slickensides; slightly effervescent with few fine hard whitish lime nodules; mildly alkaline; diffuse smooth boundary.

ACca—32 to 42 inches; light olive gray (5Y 6/2) silty clay, olive gray (5Y 5/2) moist; weak medium subangular blocky structure; very hard, very firm, slightly sticky and plastic; few fine roots; few fine and very fine tubular pores; strongly effervescent with many fine whitish soft lime segregations; mildly alkaline; clear wavy boundary.

C1—42 to 50 inches; variegated olive gray (5Y 5/2) and light olive gray (5Y 6/2) silty clay loam that has many soft shale fragments, olive gray (5Y 5/2 and 4/2) moist; weak fine and medium subangular blocky structure; very hard, very firm, slightly sticky and plastic; few fine roots; few fine and very fine tubular pores; strongly effervescent with many fine and medium whitish lime films and soft to hard lime nodules; moderately alkaline; clear smooth boundary.

C2r—50 inches; light olive gray (5Y 6/2) thinly bedded shale; whitish lime coatings along bedding planes.

Depth to bedrock ranges from 40 to 60 inches. The A horizon is dark gray, gray, or very dark gray (5Y 4/1, 5/1, 3/1) but may be mixed with olive gray (5Y 4/2) in the lower part. After a long dry period, cracks that are as much as 4 inches wide at the surface extend into the C horizon. The A horizon is slightly acid to mildly alkaline in the upper part and mildly alkaline or moderately alkaline in the lower part. In the upper part of the A horizon the soil material typically is noncalcareous, but in some pedons there are a few fine lime nodules.

Gaviota series

The Gaviota series consists of shallow, well drained soils that formed in residuum of sandstone. These soils are on uplands and have slopes ranging from 15 to 50 percent. The average annual precipitation ranges from 15 to 25 inches, and the mean annual air temperature is 57 degrees F.

Gaviota soils are similar to and are near the Maymen and Millsholm soils. The Maymen soils have a base saturation of less than 60 percent. The Millsholm soils have a cambic horizon.

Typical pedon of Gaviota sandy loam, in the NW1/4NE1/4 of sec. 30, T. 3 S., R. 2 W. (outside the survey area):

A11—0 to 1 inch; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; weak very fine granular structure; soft, friable, nonsticky and nonplastic; many very fine roots; many very fine pores; slightly acid; clear wavy boundary.

A12—1 inch to 11 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) moist; massive; slightly hard, friable, nonsticky and nonplastic; medium acid; abrupt irregular boundary.

R—11 inches; yellowish brown (10YR 5/6) hard sandstone.

The A1 horizon is brown or grayish brown (10YR 4/3, 5/3). It is medium acid to neutral. It is as much as 15 percent pebbles. Depth to bedrock ranges from 10 to 20 inches.

Laugenour series

The Laugenour series consists of very deep, poorly drained soils that formed in recent alluvium from mixed sources. These soils are on alluvial plains adjacent to streams. They have slopes ranging from 0 to 2 percent. The average annual precipitation ranges from 15 to 18 inches. The mean annual temperature is 57 degrees F.

The Laugenour soils are associated with and are similar to Sycamore soils. Sycamore soils are more than 18 percent clay in the control section.

Typical pedon of Laugenour loam, drained, in Fremont, .15 mile northwest of San Lorenzo Creek, 100 feet northeast of railroad track, .15 mile south-southwest of intersection of Lewelling and Wick Boulevard, at the end of the trailer park:

Ap—0 to 8 inches; grayish brown (2.5Y 5/2) loam, mixed very dark grayish brown and dark grayish brown (2.5Y 3/2, 4/2) moist; massive; hard, friable, sticky and plastic; many very fine and few fine roots; common fine tubular pores; moderately alkaline; clear smooth boundary.

A12—8 to 19 inches; grayish brown (2.5Y 5/2) fine sandy loam, dark grayish brown (2.5Y 4/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; slightly effervescent; moderately alkaline; abrupt wavy boundary.

A13—19 to 23 inches; grayish brown (2.5Y 5/2) fine sandy loam, very dark grayish brown (2.5Y 3/2) moist; many fine prominent dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable, slightly sticky and nonplastic; common very fine roots; many very fine and fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

C1—23 to 40 inches; olive gray (5Y 5/2) loam, dark olive gray (5Y 3/2) moist; many medium prominent light brownish gray (2.5Y 6/2) and light gray (2.5Y 7/2) mottles; massive; slightly hard, friable, sticky and slightly plastic; few very fine roots; common very fine tubular pores; slightly effervescent; moderately alkaline; abrupt smooth boundary.

IIC2—40 to 60 inches; grayish brown (2.5Y 5/2) and yellow (2.5Y 7/6) silty clay loam, olive gray (5Y 4/2) and olive (5Y 4/4) moist; massive; slightly hard, friable, sticky and plastic; no roots; few very fine pores; slightly effervescent with lime disseminated and in small soft masses; moderately alkaline.

The A horizon is grayish brown or light grayish brown (2.5Y 5/2, 6/2). The soils are calcareous below a depth of 8 to 20 inches. The control section is stratified with thin lenses of silt loam.

Los Gatos series

The Los Gatos series consists of moderately deep, well drained soils that formed in residuum of interbedded sedimentary rock. These soils are on north-facing slopes or on toe slopes on uplands. The slopes range from 30 to 75 percent. The average annual precipitation ranges from 15 to 25 inches. The mean annual temperature is 56 degrees F.

Los Gatos soils are associated with and are similar to Los Osos, Maymen, and Millsholm soils. Los Osos soils have a fine control section. Maymen and Millsholm soils have a lithic contact within a depth of 20 inches.

Typical pedon of Los Gatos loam, in a roadcut in the SE1/4SE1/4SW1/4SW1/4 of sec. 3, T. 4 S., R. 2 E. (projected). This site is outside the survey area:

A11—0 to 5 inches; brown (10YR 4/3) loam, dark brown (10YR 3/3) moist; moderate fine granular structure; slightly hard, friable, slightly sticky and slightly plastic; many very fine roots; few fine and very fine interstitial pores; neutral; clear smooth boundary.

A12—5 to 11 inches; brown (10YR 4/3) loam, dark brown (7.5YR 3/2) moist; moderate medium granular structure; hard, friable, slightly sticky and slightly plastic; many very fine roots; few medium and fine tubular pores, many very fine tubular pores, and many very fine interstitial pores; neutral; gradual smooth boundary.

B1—11 to 19 inches; brown (10YR 4/3) loam, dark brown (7.5YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; few medium and fine tubular pores, many very fine tubular pores, and many very fine interstitial pores; many discontinuous clay films in pores; neutral; gradual smooth boundary.

B2t—19 to 32 inches; reddish brown (5YR 5/4) heavy loam, dark reddish brown (5YR 3/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; many very fine and few fine and medium roots; few medium and fine and many very fine tubular pores and many very fine interstitial pores; continuous clay films in pores; neutral; gradual smooth boundary.

B3t—32 to 40 inches; brown (7.5YR 5/4) loam, dark brown (7.5YR 4/4) moist; massive; slightly hard, friable, slightly sticky and slightly plastic; few very fine, fine, and medium roots; many very fine tubular and interstitial pores; slightly acid; gradual irregular boundary.

R—40 inches; very pale brown (10YR 7/4) shattered sandstone.

The A11 horizon is loam or silt loam. It is brown or dark brown (10YR 4/3, 3/3). Structure is moderate fine or moderate medium granular or subangular blocky. Reaction ranges from medium acid to neutral. The B2t horizon is heavy loam or clay loam that is as much as 15 percent pebbles. It is brown or reddish brown (7.5YR 5/4, 5YR 4/4). Depth to bedrock is 24 to 40 inches.

Los Osos series

The Los Osos series consists of moderately deep, well drained soils that formed in residuum of interbedded sedimentary rock. The slopes range from 9 to 75 percent. The average annual precipitation ranges from 15 to 25 inches, and the mean annual temperature is 57 degrees F.

Los Osos soils are similar to Los Gatos soils and are associated with Los Gatos, Maymen, and Millsholm soils. Los Gatos soils have a fine-loamy control section. Maymen and Millsholm soils have a lithic contact within a depth of 20 inches.

Typical pedon of Los Osos silty clay loam, 40 feet east and 120 feet south of the northwest corner of sec. 19, T. 2 S., R. 1 W. (projected). This site is outside the survey area:

A1—0 to 8 inches; grayish brown (10YR 5/2) silty clay loam, very dark grayish brown (2.5Y 3/2) moist; moderate medium granular structure; hard, friable, sticky and plastic; few medium and many fine and very fine roots; few medium and common very fine pores; few worm casts; medium acid; gradual wavy boundary.

B21t—8 to 24 inches; dark grayish brown (10YR 4/2) heavy silty clay loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and many very fine roots; few medium and common very fine pores; many moderately thick clay films on faces of peds; slightly acid; gradual wavy boundary.

B22t—24 to 30 inches; dark grayish brown (10YR 4/2) silty clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and many very fine roots; few medium and fine and common very fine pores; common thin clay films in pores and on faces of peds; slightly acid; clear irregular boundary.

Cr—30 inches; pale olive (5Y 6/3) weathered shale.

The A1 horizon is grayish brown or dark grayish brown (10YR 5/2, 4/2). It is medium acid or slightly acid. Structure is weak to moderate medium granular or fine subangular blocky. The B2t horizon is dark grayish brown or grayish brown (10YR 4/2, 5/2). Interbedded sedimentary rock is at a depth of 24 to 40 inches.

Marvin series

The Marvin series consists of very deep, somewhat poorly drained soils on low alluvial terraces. These soils formed in mixed alluvium that derived mainly from sedimentary rock sources. The slopes range from 0 to 2 percent. The average annual precipitation ranges from 15 to 18 inches. The mean annual temperature is 57 degrees F.

Marvin soils are similar to Rincon soils and are associated with Danville and Pescadero soils. Rincon soils are well drained. Danville soils have a mollic epipedon. Pescadero soils have a natric horizon.

Typical pedon of Marvin silt loam, saline-alkali, in the city of Newark, about 1,200 feet northwest of the intersection of Central and Filbert Streets, 1,300 feet southwest of Filbert Street, SE1/4SW1/4SW1/4 of sec. 1, T. 5 S., R. 2 W.

Ap—0 to 4 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and few fine tubular pores; neutral; clear smooth boundary.

B1t—4 to 11 inches; grayish brown (10YR 5/2) heavy silty clay loam, very dark gray (10YR 3/1) moist; dark grayish brown (2.5Y 4/2) stains, very dark grayish brown (2.5Y 3/2) moist; moderate coarse angular blocky structure; very hard, firm, sticky and plastic; many very fine roots; many very fine tubular pores; moderately alkaline; gradual smooth boundary.

B21t—11 to 23 inches; grayish brown (2.5Y 5/2) clay, very dark grayish brown (2.5Y 3/2) moist; few fine distinct light yellowish brown (2.5Y 6/4) mottles, olive brown (2.5Y 4/4) moist; moderate coarse angular blocky structure; hard, firm, sticky and plastic; common very fine roots; common very fine tubular pores; continuous moderately thick clay films on faces of peds; very slightly effervescent; moderately alkaline; diffuse smooth boundary.

B22t—23 to 36 inches; grayish brown (2.5Y 5/2) clay, dark grayish brown (2.5Y 4/2) moist; common medium and coarse distinct gray (10YR 5/1) mottles, very dark gray (10YR 3/1) moist; moderate coarse angular blocky structure; hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; common moderately thick clay films on faces of peds; strongly effervescent, soft masses of lime; moderately alkaline; clear smooth boundary.

C—36 to 60 inches; light brownish gray (2.5Y 6/2) and light yellowish brown (2.5Y 6/3) heavy clay loam, dark grayish brown (2.5Y 4/2) and olive brown (2.5Y 4/4) moist; few fine and medium distinct olive gray (5Y 5/2) mottles, dry and moist; weak coarse angular blocky structure; hard, friable, sticky and slightly plastic; many very fine tubular pores; few thin clay films on faces of peds and lining pores; violently effervescent, soft masses of lime; moderately alkaline.

The A horizon is 3 to 12 inches thick. It ranges from grayish brown to dark grayish brown (10YR 5/2, 4/2). The A horizon is neutral to mildly alkaline. The B2t horizon is 20 to 25 inches thick. It is grayish brown or dark grayish brown (2.5Y 5/2, 4/2) heavy clay loam, heavy silty clay loam, silty clay, or clay. The C horizon is dark grayish brown, light brownish gray, or light olive brown (2.5Y 4/2, 6/2, 5/6). It ranges from loam to heavy clay loam. In places, small concretions and soft masses of lime are in the upper part of the C horizon.

Maymen series

The Maymen series consists of shallow, somewhat excessively drained soils that formed in residuum of sedimentary rock. The slopes range from 30 to 75 percent. The average annual precipitation ranges from 18 to 26 inches. The mean annual temperature is 56 degrees F.

Maymen soils are similar to and are associated with Gaviota and Millsholm soils. Gaviota and Millsholm soils have a base saturation of more than 60 percent.

Typical pedon of Maymen loam, in the city of Oakland, on a southwest-facing slope at the intersection of Skyline Boulevard and Manzanita Drive, opposite Snake Road:

A1—0 to 9 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; slightly hard, friable, sticky and slightly plastic; many fine, medium, and coarse roots; many fine interstitial and tubular pores; strongly acid; diffuse wavy boundary.

B2—9 to 19 inches; light brownish gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) moist; weak medium and fine subangular blocky structure; slightly hard, friable, sticky and slightly plastic; many fine, medium, and coarse roots; many fine interstitial and tubular pores; strongly acid; clear wavy boundary.

R—19 inches; light yellowish brown (10YR 6/4) shale that has dark yellowish brown (10YR 4/4) coatings.

The A horizon is light brownish gray or pale brown (10YR 6/2, 6/3). The B2 horizon is loam, silt loam, and light clay loam. Depth to bedrock ranges from 10 to 20 inches.

Millsholm series

The Millsholm series consists of shallow, well drained soils that formed in residuum of shale and fine grained sandstone. The slopes range from 9 to 75 percent. The average annual precipitation ranges from 15 to 25 inches. The mean annual temperature is 57 degrees F.

Millsholm soils are similar to Gaviota and Maymen soils. Gaviota soils are less than 18 percent clay and do not have a cambic horizon. Maymen soils have a base saturation of less than 60 percent.

Typical pedon of Millsholm silt loam, near the junction of Palomares and Stonybrook Roads, in the SE1/4SE1/4NE1/4 sec. 28, T. 3 S., R. 1 W.

A1—0 to 7 inches; grayish brown (2.5Y 5/2) silt loam, olive brown (2.5Y 4/3) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; few worm casts; medium acid; clear smooth boundary.

B21—7 to 14 inches; light olive brown (2.5Y 5/3) silt loam, olive brown (2.5Y 3/3) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine roots; many very fine pores; few thin discontinuous clay films in pores; medium acid; clear smooth boundary.

B22—14 to 20 inches; light olive brown (2.5Y 5/4) silt loam, olive brown (2.5Y 4/4) moist; massive; very hard, firm, sticky and plastic; many fine roots; many very fine pores; few thin continuous clay films in pores; medium acid; clear irregular boundary.

R—20 inches; grayish brown (2.5Y 5/2) shale, dark grayish brown (2.5Y 4/2) moist.

The A1 horizon is light olive brown (2.5Y 5/4) or grayish brown (2.5Y 5/2) loam or silt loam. It is medium acid or slightly acid. The B2 horizon is massive or has weak fine to medium subangular blocky structure. The bedrock is at a depth of 10 to 20 inches.

Montara series

The Montara series consists of shallow, well drained soils that formed in residuum of ultrabasic rock. The slopes range from 30 to 75 percent. The average annual precipitation ranges from 18 to 20 inches. The mean annual temperature is 58 degrees F.

Montara soils are similar to Climara, Maymen, and Millsholm soils. Climara soils are fine textured and have slickensides. Millsholm and Maymen soils have an ochric epipedon.

Typical pedon of Montara clay loam, in the Oakland Hills, on an east-facing slope, in Joaquin Miller Park, in the SW1/4NW1/4, sec. 34, T. 1 S., R. 3 W. (projected):

A11—0 to 6 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate fine granular structure; slightly hard, friable, sticky and plastic; many fine, medium, and coarse roots; many fine interstitial pores; mildly alkaline; diffuse smooth boundary.

A12—6 to 14 inches; very dark grayish brown (10YR 3/2) clay loam, very dark brown (10YR 2/2) moist; moderate very fine granular structure; slightly hard, friable, sticky and plastic; many fine, medium, and coarse roots; many very fine interstitial pores; moderately alkaline; abrupt wavy boundary.

R—14 inches; ultrabasic rock.

The A1 horizon is very dark grayish brown, dark grayish brown, dark gray, or very dark gray (10YR 3/2, 4/2, 4/1, 3/1). In places, the lower part of the A12 horizon is calcareous. Depth to bedrock is 10 to 20 inches.

Omni series

The Omni series consists of very deep, poorly drained soils that formed in alluvium that derived from mixed rock sources. These soils are on the lower flood plains. The slopes are 0 to 2 percent. The average annual precipitation ranges from 15 to 18 inches. The mean annual temperature is 57 degrees F.

Omni soils are associated with Botella, Clear Lake, and Marvin soils. Botella soils are well drained and have a fine-loamy control section. Clear Lake soils have intersecting slickensides. Marvin soils are somewhat poorly drained and have a fine control section.

Typical pedon of Omni silty clay loam, drained, in the NW1/4NW1/4NE1/4 of sec. 27, T. 4 S., R. 2 W. (projected):

Ap—0 to 6 inches; grayish brown (10YR 5/2) silty clay loam, very dark brown (10YR 2/2) moist; weak fine granular structure; hard, friable, slightly sticky and plastic; many very fine and fine and few medium roots; many fine tubular and interstitial pores; moderately alkaline; clear wavy boundary.

A12—6 to 15 inches; grayish brown (10YR 5/2) silty clay that has common fine distinct mottles; very dark gray (5Y 3/1) moist; weak fine subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many very fine tubular pores; slightly effervescent; moderately alkaline; diffuse wavy boundary.

B21g—15 to 25 inches; dark gray (5Y 4/1) clay with common medium prominent light yellowish brown (2.5Y 6/4) mottles, dark olive gray (5Y 3/2) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; common fine roots; many very fine tubular pores; slightly effervescent; mildly alkaline; clear smooth boundary.

B22cag—25 to 35 inches; light olive brown (2.5Y 5/4) clay that has common medium prominent gray (2.5Y 6/1) and yellowish brown (10YR 5/6) mottles, very dark gray (N 3/0) moist; weak medium subangular blocky structure; hard, friable, sticky and plastic; few fine roots; many very fine tubular pores; strongly effervescent, soft masses of lime; moderately alkaline; gradual wavy boundary.

B23cag—35 to 52 inches; light olive brown (2.5Y 5/4) clay that has many coarse distinct gray (2.5Y 6/1) and light yellowish brown (2.5Y 6/4) mottles, dark gray (N 4/0) moist; weak medium and fine subangular blocky structure; hard, friable, sticky and plastic; very few fine roots; many fine tubular pores; strongly effervescent, soft masses of lime; moderately alkaline; gradual smooth boundary.

Cca—52 to 60 inches; light olive brown (2.5Y 5/4) silty clay loam that has few fine faint light olive brown (2.5Y 5/6) mottles, olive brown (2.5Y 4/4) moist; weak fine subangular blocky structure; hard, friable, slightly sticky and plastic; no roots; few fine tubular pores; strongly effervescent; moderately alkaline.

The A horizon is grayish brown, dark grayish brown, very dark grayish brown, gray, or dark gray (10YR 5/2, 4/2, 3/2, 5/1, 4/1). The B2 horizon is dark gray, grayish brown, and light olive brown (10YR 4/1, 5/2; 2.5Y 5/4). It is heavy silty clay loam, silty clay, or clay. The C horizon is light olive brown, olive brown, or olive yellow (2.5Y 5/4, 4/4, 6/6). It is silty clay loam or clay loam. In places, this horizon has thin strata of very fine sand.

Pescadero series

The Pescadero series consists of very deep, poorly drained soils that formed in alluvium that derived from sedimentary rock sources. These soils are on the basin rims. They have slopes of less than 2 percent. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Pescadero soils are similar to Clear Lake and Marvin soils, which do not have a natric horizon.

Typical pedon of Pescadero clay, drained, north of the city of Livermore, 150 feet south of Hartford Avenue and 0.7 mile east of the junction of North Livermore and Hartford Avenues (outside the survey area):

A2—0 to 2 inches; gray (10YR 5/1) clay loam, dark gray (10YR 4/1) moist; weak thin platy structure; hard, friable, sticky and plastic; common very fine roots; few fine tubular pores; slightly acid; clear wavy boundary.

B21t—2 to 12 inches; dark gray (N 4/0) clay, very dark gray (N 3/0) moist; few fine prominent olive (5Y 4/3) mottles; moderate medium prismatic structure; very hard, firm, slightly sticky and plastic; common very fine roots; many very fine tubular pores; few thin clay films on faces of peds; moderately alkaline; gradual wavy boundary.

B22t—12 to 20 inches; dark gray (10YR 4/1) clay, black (10YR 2/1) moist; common fine prominent very dark gray (5Y 3/1) mottles; moderate medium prismatic structure; very hard, firm, slightly sticky and plastic; few very fine roots; many very fine tubular pores; common moderately thick clay films on faces of peds; slightly effervescent; moderately alkaline; gradual wavy boundary.

B23tca—20 to 30 inches; light gray (5Y 7/1) clay, gray (5Y 5/1) moist; moderate medium prismatic structure; hard, firm, sticky and plastic; few very fine and fine roots; many very fine tubular pores; common moderately thick clay films on faces of peds; strongly effervescent; moderately alkaline; gradual wavy boundary.

C1ca—30 to 40 inches; gray (5Y 6/1) clay loam, gray (5Y 5/1) moist; massive; very hard, firm, slightly sticky and plastic; no roots; many very fine tubular pores; violently effervescent, soft masses of lime; moderately alkaline; gradual wavy boundary.

C2ca—40 to 58 inches; light olive gray (5Y 6/2) clay loam, olive gray (5Y 5/2) moist; massive; very hard, firm, slightly sticky and plastic; common very fine tubular pores; violently effervescent, soft masses of lime; moderately alkaline; gradual wavy boundary.

C3ca—58 to 72 inches; light gray (5Y 7/2) clay loam, olive gray (5Y 5/2) moist; massive; hard, firm, slightly sticky and plastic; few very fine tubular pores; violently effervescent, many soft masses of lime; moderately alkaline.

Drainage of the Pescadero soils has been improved by the use of deep drainage ditches and natural stream cutting. The water table is below a depth of 4 feet in most years. In winter, these soils are subject to ponding where surface drainage is not provided.

The A2 horizon is gray, light gray, or light brownish gray (10YR 5/1, 7/1, 6/2) loam or clay loam. It is dominantly slightly acid or moderately alkaline but is strongly alkaline in ponded areas. If present, the A1 horizon is dark gray or dark grayish brown (10YR 4/1, 4/2) clay loam or silty clay loam. The B2t horizon is moderately alkaline or strongly alkaline. Structure is columnar or prismatic. Content of saline and alkali salts increases with depth. In some pedons, gypsum is at a depth of 36 to 48 inches.

Pleasanton series

The Pleasanton series consists of very deep, well drained soils that formed on low terraces in alluvium that derived from sedimentary rock sources. The slopes range from 0 to 5 percent. The average annual precipitation is 16 inches. The mean annual temperature is 57 degrees F.

Pleasanton soils are similar to Rincon soils, which are more than 35 percent clay in the argillic horizon.

Typical pedon of Pleasanton gravelly loam, in the SE1/4NE1/4NE1/4 of sec. 24, T. 3 S., R. 2 E. (outside the survey area):

Ap—0 to 9 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and common fine and medium roots; common very fine and fine interstitial pores; 20 percent gravel; slightly acid; abrupt smooth boundary.

A12—9 to 21 inches; grayish brown (10YR 5/2) gravelly loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and common fine and medium roots; common very fine and fine interstitial pores; 20 percent gravel; neutral; clear smooth boundary.

B2t—21 to 48 inches; brown (10YR 4/3) gravelly sandy clay loam, dark brown (10YR 3/3) moist; moderate medium subangular blocky structure; very hard, friable, sticky and plastic; common very fine and fine roots; many very fine and fine and few medium tubular pores; common moderately thick clay films on faces of peds and lining pores; 20 percent gravel; neutral; gradual wavy boundary.

B3t—48 to 64 inches; brown (10YR 4/3) gravelly loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; very hard, friable, sticky and plastic; few very fine roots; many very fine and common fine pores; few thick and few thin clay films on faces of peds and lining pores; 20 percent gravel; neutral; gradual wavy boundary.

C—64 to 72 inches; yellowish brown (10YR 5/4) gravelly fine sandy loam, dark yellowish brown (10YR 4/4) moist; massive; hard, friable, sticky and slightly plastic; many very fine, common fine, and few medium pores; few thin clay films in pores; 25 percent gravel; mildly alkaline.

The A horizon is grayish brown, brown, or pale brown (10YR 5/2, 5/3, 6/3). The B2t horizon is dark brown or brown (10YR 4/3, 5/3). Reaction is neutral or mildly alkaline. The C horizon is gravelly silt loam, gravelly loam, or gravelly fine sandy loam. Gravel content ranges from 15 to 35 percent throughout. In some pedons, the C horizon is calcareous.

Reyes series

The Reyes series consists of very deep, very poorly drained soils on tidal flats. These soils formed in alluvium that derived from mixed sources. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Reyes soils are near Laugenour, Pescadero, and Willows soils. Laugenour soils are stratified sandy loam, fine sandy loam, and loam. Pescadero soils have a natric horizon. Willows soils have intersecting slickensides.

Typical pedon of Reyes clay, in the city of Hayward, 500 feet northeast of the end of the flood control road adjacent to the flood control channel, T. 4 S., R. 3 W. (This pedon is covered by water at high tide.)

A1—0 to 6 inches; olive gray (5Y 4/2) clay, dark olive gray (5Y 3/2) moist; massive; hard, friable, sticky and plastic; many fine, medium, and coarse roots; estimated 5 percent fibers; strongly alkaline; clear smooth boundary.

C1—6 to 18 inches; mottled dark greenish gray (5GY 4/1) and black (N 2/0) clay; massive; hard, friable, sticky and plastic; many fine, medium, and coarse roots; strong odor of hydrogen sulfide when treated with hydrochloric acid; strongly alkaline; clear smooth boundary.

C2—18 to 23 inches; mottled dark greenish gray (5GY 4/1) and black (N 2/0, 10YR 2/1) clay; massive; hard, friable, sticky and plastic; many fine roots; strong odor of hydrogen sulfide when treated with hydrochloric acid; strongly alkaline; clear smooth boundary.

C3—23 to 42 inches; mottled dark greenish gray (5GY 4/1) and black (N 2/0) clay; massive; hard, friable, sticky and plastic; no roots; strong odor of hydrogen sulfide when treated with hydrochloric acid; strongly alkaline; gradual smooth boundary.

C4—42 to 72 inches; dark greenish gray (5GY 4/1) silty clay; massive; hard, friable, sticky and plastic; strong odor of hydrogen sulfide when treated with hydrochloric acid; strongly alkaline.

Reyes soils are very poorly drained unless the drainage has been altered. This soil is covered with water at high tides. The A1 horizon is olive gray, dark gray, or dark grayish brown (5Y 5/2, 4/1, 2.5Y 4/2). The upper part of the C horizon has black (N 2/0), reddish brown, and yellowish brown (5YR 5/4, 10YR 5/6) mottles. The C horizon is strongly alkaline except where the water table has been lowered. Some pedons have jarosite in the C horizon, but most sulfides occur as black (N 2/0) mottling that becomes dark gray when exposed to air or when treated with dilute hydrochloric acid.

Rincon series

The Rincon series consists of very deep, well drained soils that formed in alluvium that derived from sedimentary rock sources. These soils are on low terraces. The slopes range from 0 to 2 percent. The average annual precipitation ranges from 14 to 20 inches. The mean annual temperature is 57 degrees F.

Rincon soils are associated with and are similar to Danville, Marvin, and Pleasanton soils. Danville soils have a mollic epipedon. Marvin soils are somewhat poorly drained. Pleasanton soils are less than 35 percent clay in the argillic horizon.

Typical pedon of Rincon clay loam, 150 feet west of Mountain House Road, between Mountain House School and an east-west dirt road in the SE1/4SE1/4SE1/4NW1/4 of sec. 6, T. 2 S., R. 4 E. (outside the survey area):

Ap—0 to 8 inches; grayish brown (10YR 5/2) clay loam, dark brown (10YR 3/3) moist; massive; very hard, friable, sticky and plastic; many fine and few medium and very fine roots; common fine and few very fine and medium tubular pores; neutral; abrupt smooth boundary.

A12—8 to 16 inches; dark grayish brown (10YR 4/2) clay loam, dark brown (10YR 3/3) moist; massive; very hard, friable, sticky and plastic; many fine and very fine roots; common fine and very fine tubular pores; neutral; abrupt smooth boundary.

B21t—16 to 28 inches; dark grayish brown (10YR 4/2) heavy clay loam, dark brown (10YR 3/3) moist; weak coarse blocky structure; very hard, friable, sticky and plastic; many fine and very fine roots; many fine and very fine tubular pores; few thin clay films on faces of peds and lining pores; neutral; gradual wavy boundary.

B22t—28 to 38 inches; brown (10YR 5/3) and grayish brown (10YR 5/2) clay, dark brown (10YR 4/3) and dark grayish brown (10YR 4/2) moist; moderate coarse blocky structure; extremely hard, firm, sticky and very plastic; few fine and many very fine roots; common fine and very fine tubular pores; common thin clay films on faces of peds and lining pores; neutral; gradual wavy boundary.

B3t—38 to 52 inches; brown (10YR 5/3) clay, dark brown (10YR 4/3) moist; moderate medium blocky structure; extremely hard, very firm, sticky and very plastic; few fine and very fine roots; common fine and very fine tubular pores; common thin and few moderately thick clay films on faces of peds and lining pores; mildly alkaline; gradual wavy boundary.

Cca—52 to 60 inches; yellowish brown (10YR 5/4) clay loam, dark yellowish brown (10YR 4/4) moist; massive; extremely hard, very firm, slightly sticky and very plastic; few very fine roots; common fine and very fine pores; moderately thick clay films lining pores; strongly effervescent, seams of lime; moderately alkaline.

The A horizon is grayish brown, dark grayish brown, or brown (10YR 5/2, 4/2, 4/3). It is slightly acid or neutral. The B2t horizon is dark grayish brown, brown, or dark yellowish brown (10YR 4/2, 5/3, 4/6). It is neutral to moderately alkaline. In a few pedons, the B2t horizon is slightly effervescent. The C horizon is yellowish brown or light yellowish brown (10YR 5/6, 6/4) loam, clay loam, or silty clay loam.

Sycamore series

The Sycamore series consists of very deep, poorly drained soils that formed in alluvium that derived from sedimentary rock sources. These soils are on flood plains. The slopes range from 0 to 2 percent. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Sycamore soils are associated with Laugenour and Yolo soils. Laugenour soils are less than 18 percent clay between depths of 10 and 40 inches. Yolo soils are well drained.

Typical pedon of Sycamore silt loam, 1,250 feet east of Hopyard Road, 50 feet north of Black Avenue, and 1/4 mile north of Pleasanton (outside the survey area):

Ap—0 to 7 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; weak medium granular structure; slightly hard, friable, sticky and slightly plastic; many fine roots; few fine tubular pores and common medium interstitial pores; moderately alkaline; gradual smooth boundary.

A12—7 to 18 inches; light brownish gray (2.5Y 6/2) silt loam, dark grayish brown (2.5Y 4/2) moist; massive; slightly hard, friable, sticky and slightly plastic; many fine roots; few fine tubular pores; moderately alkaline; gradual smooth boundary.

B21—18 to 30 inches; grayish brown (2.5Y 5/2) silt loam, dark grayish brown (2.5Y 4/2) moist; few fine prominent yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, sticky and slightly plastic; few fine roots; few fine tubular pores and few medium interstitial pores; slightly effervescent; moderately alkaline; gradual smooth boundary.

B22—30 to 44 inches; light olive gray (5Y 6/2) silt loam, olive gray (5Y 5/2) moist; common fine distinct dark yellowish brown (10YR 4/4) mottles; massive; slightly hard, friable, slightly sticky and slightly plastic; few fine roots; few and very few fine tubular pores; strongly effervescent, small soft whitish concretions and seams of lime; moderately alkaline; abrupt smooth boundary.

C—44 to 60 inches; light olive gray (5Y 6/2) heavy silt loam, olive gray (5Y 4/2) moist; common fine and medium distinct yellowish brown (10YR 5/6) mottles; massive; slightly hard, friable, sticky and plastic; few fine roots; very few fine tubular pores; strongly effervescent; small soft whitish nodules and seams of lime; moderately alkaline.

The A horizon is light brownish gray or grayish brown (2.5Y 6/2, 10YR 5/2). It is neutral to moderately alkaline. The B horizon is grayish brown, light brownish gray, or light olive gray (2.5Y 5/2, 6/2, 5Y 6/2). The C horizon is light olive gray or light olive brown (5Y 6/2, 2.5Y 5/4) heavy silt loam or clay.

Tierra series

The Tierra series consists of very deep, moderately well drained soils on dissected terraces and terrace remnants. These soils formed in weakly consolidated, stratified old alluvium interspersed with beds of sandstone. The slopes range from 0 to 30 percent. The average annual precipitation ranges from 15 to 20 inches. The mean annual temperature is 57 degrees F.

Tierra soils are associated with Azule soils and they are near Diablo and Danville soils. Azule soils do not have an abrupt boundary between the A and B horizons; they have a paralithic contact between depths of 20 and 40 inches. Diablo soils are more than 35 percent clay throughout the solum and have intersecting slickensides. Danville soils have a mollic epipedon.

Typical pedon of Tierra loam, 100 feet northeast of Paseo Padre Parkway, 1/8 mile northwest of the intersection of Washington Boulevard and Paseo Padre Parkway, and 1/8 mile southeast of Paseo Padre and Interstate 680 overpass, in the NE1/4NE1/4 of sec. 2, T. 5 S., R. 1 W. (projected):

Ap—0 to 6 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; slightly acid; clear smooth boundary.

A12—6 to 11 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, sticky and slightly plastic; slightly acid; clear smooth boundary.

A2—11 to 12 inches; gray (10YR 6/1) loam, dark gray (10YR 4/1) moist; weak thin platy structure; soft, friable, slightly sticky and slightly plastic; common very fine and fine horizontal roots; common very fine and fine tubular and interstitial pores; slightly acid; abrupt smooth boundary.

B21t—12 to 17 inches; very dark grayish brown (10YR 3/2) clay, dry or moist; strong coarse prismatic structure; very hard, firm, sticky and very plastic; few very fine and fine exped roots; common very fine and fine tubular pores; many thick clay films on faces of peds; neutral; clear wavy boundary.

B22t—17 to 24 inches; grayish brown (10YR 5/2) clay that has gray (10YR 5/1) stains on peds, dark grayish brown (10YR 4/2) moist; strong coarse prismatic structure; very hard, firm, sticky and very plastic; few very fine and fine exped roots; few very fine and fine tubular pores; many thick clay films on faces of peds; neutral; clear wavy boundary.

B3t—24 to 32 inches; brown (10YR 5/3) clay, dark brown (10YR 3/3) moist; moderate coarse angular blocky structure; very hard, firm, sticky and plastic; very few very fine interstitial and tubular pores; common thin clay films on faces of peds; neutral; clear wavy boundary.

C—32 to 60 inches; variegated yellowish brown (10YR 5/4) and brown (10YR 5/3) sandy clay loam, dark yellowish brown (10YR 4/4) moist; many medium distinct very pale brown (10YR 7/4) mottles; massive; very hard, firm, sticky and plastic; neutral.

The A1 horizon is dark grayish brown, grayish brown, or dark gray (10YR 4/2, 5/2, 4/1). Reaction is medium acid or slightly acid. The A2 horizon is also medium acid or slightly acid. It is sandy loam or loam. The B2t horizon is very dark brown, grayish brown, dark grayish brown, or very dark grayish brown (10YR 2/2, 4/2, 5/2, 3/2). The C horizon is sandy clay loam or clay loam.

Vallecitos series

The Vallecitos series consists of shallow, well drained soils that formed in residuum of metasedimentary rock. The slopes range from 30 to 50 percent. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Vallecitos soils are similar to Contra Costa soils, which have a lithic contact between depths of 20 to 40 inches.

Typical pedon of Vallecitos gravelly loam, in the SW1/4SW1/4 of sec. 9, T. 5 S., R. 4 E. (outside the survey area):

A11—0 to 1 1/2 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; moderate medium granular structure; soft, friable, slightly sticky and plastic; many very fine roots; many very fine pores; 20 percent gravel; neutral; clear smooth boundary.

A12—1 1/2 to 6 inches; brown (10YR 5/3) gravelly loam, dark brown (10YR 3/3) moist; massive; hard, friable, slightly sticky and plastic; many very fine roots; many very fine pores; 20 percent gravel; neutral; abrupt wavy boundary.

B21t—6 to 12 inches; reddish brown (5YR 4/3) heavy clay loam, dark reddish brown (5YR 3/3) moist; weak medium angular blocky structure; very hard, firm, slightly sticky and very plastic; many very fine roots; many very fine pores; thin continuous clay films lining pores and as bridges; 10 percent gravel; neutral; clear smooth boundary.

B22t—12 to 16 inches; brown (10YR 5/3) heavy clay loam, dark brown (10YR 4/3) moist; massive; very hard, firm, slightly sticky and very plastic; few very fine roots; common very fine pores; thin continuous clay films lining pores; slightly acid; abrupt irregular boundary.

R—16 inches; bluish gray (5B 5/1) fine-grained, metamorphosed sandstone that has calcite seams; clay films along cleavage planes.

The A1 horizon is brown or pale brown (10YR 5/3, 6/3). The B2t horizon is reddish brown or brown (5YR 4/3; 7.5YR 5/4; 10YR 5/3). Some pedons do not have a B2t horizon. Depth to bedrock ranges from 10 to 20 inches.

Willows series

The Willows series consists of very deep, poorly drained soils that formed in mixed alluvium that derived mainly from sedimentary rock sources. These soils are on the upper edge of the basin rim and have slopes ranging from 0 to 2 percent. The average annual precipitation ranges from 14 to 18 inches, and the mean annual temperature is 57 degrees F.

Willows soils are similar to Clear Lake soils and are near Danville and Omni soils. Clear Lake soils do not have excess salts. Danville and Omni soils have a mollic epipedon.

Typical pedon of Willows clay, in the city of Hayward, 200 feet southeast of Corporate Avenue, near the Eden Industrial Park, in the SE1/4SW1/4 of sec. 32, T. 3 S., R. 2 W. (projected):

A11—0 to 9 inches; black (N 2/0) clay, moist and dry; moderate very coarse prismatic structure; very hard, firm, sticky and very plastic; few medium and many very fine roots; common very fine tubular pores; moderately alkaline; clear smooth boundary.

A12—9 to 19 inches; black (5Y 2/1) clay, moist and dry; moderate very coarse prismatic structure that parts to moderate medium angular blocky; very hard, firm, sticky and very plastic; common very fine roots; many very fine tubular pores; many intersecting slickensides; moderately effervescent; moderately alkaline; gradual smooth boundary.

ACcs—19 to 29 inches; dark gray (5Y 4/1) clay, very dark gray (5Y 3/1) moist; many medium distinct dark grayish brown (10YR 4/2) mottles; many medium prominent yellowish brown (10YR 5/4) mottles; moderate very coarse prismatic structure that parts to moderate medium angular blocky; very hard, firm, sticky and plastic; few very fine roots; many very fine tubular pores; many large intersecting slickensides; many seams of gypsum; strongly effervescent; moderately alkaline; clear smooth boundary.

C1ca—29 to 48 inches; grayish brown (2.5Y 5/2) clay; dark grayish brown (2.5Y 4/2) moist; many medium faint grayish brown (10YR 5/2) and many medium prominent yellowish brown (10YR 5/4) mottles; weak coarse angular blocky structure; very hard, firm, sticky and plastic; few very fine roots; common very fine tubular pores; many slickensides; strongly effervescent; moderately alkaline; abrupt smooth boundary.

C2ca—48 to 72 inches; grayish brown (2.5Y 5/2) clay; dark grayish brown (2.5Y 4/2) moist; many fine distinct dark greenish gray (5GY 4/1) mottles; massive; very hard, firm, sticky and plastic; few very fine roots; few very fine tubular pores; many irregularly shaped hard lime concretions about 1/8 to 1/4 inch in diameter; violently effervescent; moderately alkaline.

These soils have cracks that are 1 to 2 inches wide at the surface (unless plowed) and extend to a depth of 30 to 40 inches. The A1 horizon is black (N 2/0) or very dark gray (N 3/0; 5Y 3/1, 2/1). Moist value is 2 or 3. Structure is granular, angular blocky, or prismatic. Reaction ranges from mildly alkaline to strongly alkaline. Secondary calcium carbonate occurs in most places at a depth of 14 to 40 inches. Soft masses of secondary calcium carbonate are common in the lower part of the AC horizon and in the C horizon. The C horizon has mottled colors with a matrix of grayish brown, light olive brown, or yellowish brown (2.5Y 5/2, 5/4; 10YR 5/4).

Yolo series

The Yolo series consists of very deep, well drained soils that formed in alluvium that derived from sedimentary rock sources. These soils are on alluvial fans and flood plains of the larger streams. The slopes are less than 2 percent. The average annual precipitation ranges from 14 to 18 inches. The mean annual temperature is 57 degrees F.

Yolo soils are associated with Sycamore soils, which are poorly drained and have distinct mottling in the B2 horizon.

Typical pedon of Yolo silt loam, in the city of Fremont, 500 feet northwest of Mowry Avenue and 100 feet northeast of Parkside Drive, in the SE1/4NW1/4, sec. 28, T. 4 S., R. 1 W. (projected):

Ap—0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; massive; hard, friable, sticky and plastic; many medium, fine, and very fine roots; few very fine and fine tubular pores; neutral; clear smooth boundary.

C1—8 to 18 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; common coarse, fine, and very fine roots; very few very fine and fine tubular pores; mildly alkaline; gradual smooth boundary.

C2—18 to 34 inches; brown (10YR 5/3) silt loam, dark brown (10YR 4/3) moist; massive; hard, friable, sticky and plastic; common fine and very fine roots; very few tubular pores; moderately alkaline; diffuse smooth boundary.

C3—34 to 60 inches; brown (10YR 5/3) silt loam, dry and moist; massive; hard, friable, sticky and plastic; common fine and very fine roots; many very fine tubular pores; moderately alkaline.

The A horizon is grayish brown or brown (10YR 5/2, 5/3). The C horizon is silt loam or silty clay loam and has thin strata of very fine sandy loam. It is brown, grayish brown, or pale brown (10YR 5/3, 5/2, or 6/3).

Formation of the soils

In this section, the factors that affect the formation of soils in the survey area are discussed and important processes in morphology are described.

Soil is a natural formation on the surface of the earth in which plants grow. It is composed of mineral and organic material. Soils differ in their appearance, composition, productivity, and management requirements in different localities and even within short distances. Five soil-forming factors cause soils to differ. They are parent material, relief, climate, plants and animals, and time. The relative effect of each of these factors varies from one soil to another.

The process of soil formation is quite complex. The influence of each soil-forming factor and the relationships among these factors are more easily described by relating soils within areas of a similar landform or geomorphic unit. In the paragraphs that follow, the landscape and climate are discussed. Then the soil-forming factors are considered in relation to the soils in each geomorphic unit.

Landscape

The survey area is bordered on the west by San Francisco Bay and on the east by ridges of the Coast Range.

The upland area of the Coast Range is hilly to very steep. Folding and faulting have formed a topography made up of nearly parallel, northwest-trending ridges that consist mainly of steeply dipping sedimentary rock. These ridges are at an elevation of about 500 to 2,000 feet. A few major streams in the area dissect the hills at approximately right angles to the ridges. The drainage pattern of most of the smaller streams has been altered by horizontal fault displacement at the foot slopes.

Terraces border the foothills in the northern half of the survey area and extend almost to the tidal areas. The bay plain extends from the foothills or terraces to the tidal flats of the bay. A few small but prominent hills are adjacent to the tidal areas and consist primarily of steeply dipping sedimentary rock and some basic intrusive rock.

Alameda County, Western Part, can be divided into three geomorphic units based on differences in landforms. The interaction of soil forming factors differs for each unit and the relationship among the soils in each unit is significantly different. These geomorphic units are (1) Hilly to very steep uplands of the coast ranges; (2) Flood plains, fans, and terraces of the bay plain; and (3) Tidal flats of the bay.

Climate

The climate is mild. It varies locally, but the overall differences in temperature and rainfall are not extreme. Winters are cool and moist. Summers are dry and, as a result of frequent sea breezes and early morning fog, they are cool.

The annual rainfall is about 14 inches near Newark and increases with elevation to about 25 inches near Hayward. Precipitation effectiveness is greater on north-facing slopes.

The soils are moist from late fall to early spring and dry the remainder of the time. There is about 2 to 11 inches of moisture in excess of evapotranspiration requirements of the natural vegetation. This surplus is not sufficient for active leaching in most areas. Very little leaching occurs in the deeper soils. The redistribution of carbonates and translocation of clays is slow. Most soils have a good supply of bases, and many do not have a prominent argillic horizon. There are a few small areas where the parent rock contains seams of jarosite or pyrite in extremely acid soils.

This warm climate promotes rapid decomposition of organic matter and retards the accumulation of organic material, especially when the soils are moist. The soils are rarely, if ever, frozen so that surface horizons are not broken up by frost action and are not well granulated. Many soils have a massive and hard surface layer and are relatively low in content of organic matter. Soils that have darker and softer surface horizons are commonly associated with the moister sites. Many of the soils are dry below a depth of 20 inches in summer and fall unless they are irrigated. During this dry period many biological and chemical processes are retarded. The alternate wet and dry cycle causes the soils high in montmorillonitic clays to shrink and swell. Large cracks develop in Altamont and Climara soils. Soil material from the surface layer sloughs into these cracks and mixes with the soil material in the lower horizons.

Geomorphic units

Hilly to very steep uplands of the coast ranges

The uplands of this area of the Coast Ranges consist mainly of sedimentary rock; there is some metamorphic and basic igneous rock. Many ridges are composed of interbedded shale, siltstone, sandstone, claystone, and conglomerate that have been folded and faulted. Some of these strata have volcanic material that was deposited in a marine environment. The shale, siltstone, mudstone, and argillaceous sandstone parent rock weather to silty or clayey material. The clays are mainly montmorillonitic. Most rock material is enriched with lime. Some has many seams of lime. These rocks are relatively soft and fractured, making them susceptible to rapid weathering.

Very steep slopes affect soil stability. Clayey material creeps and slides if slopes are excessive. As a result of landslides, slips, and slumps, soil erosion has kept pace with soil formation in many areas. Millsholm soils and other shallow soils are examples.

Altamont, Diablo, and Los Osos soils are moderately deep or deep soils. These soils formed in soft parent material that is more easily weathered. The Altamont and Diablo soils are expansive clay soils and are characterized by little horizon differentiation. The Los Osos soils are not so expansive as the Altamont, Climara, and Diablo soils and have a distinct argillic horizon. The Los Osos soils have a more permeable surface layer and are therefore less stable than the Altamont and Diablo soils. Some parent rock is less easily weathered, and the soils that formed in material derived from this kind of rock are shallow. The Montara soils, which formed in material that weathered from ultrabasic rock, are an example. These soils are also susceptible to erosion, which accounts in part for their shallowness.

The vegetation in much of this area of the Coast Ranges consists of annual grasses and scattered oak. Shrubs, dense stands of oak, bay leaf, and madrone are on moister sites. A few areas of coastal redwood, madrone, and ferns are in cooler, moister sites on steep, north-facing slopes.

The grasses furnish organic matter that darkens the A horizon to a depth of about 10 inches. Most of the soils that are associated with the grass cover are more than 1 percent organic matter. This percentage is highest on moister and cooler sites.

Livestock has grazed the hills of this area of the Coast Ranges since the establishment of the Spanish missions in the early 1800's. At times, the number of animals was so great that the grasslands were overgrazed and erosion was accelerated. Nearly contour trails or terracettes are on most steep, grassy slopes. Gulleys are prevalent in deeper soils along ravines and concave slopes. Man is altering the landscape near urban centers. Large areas of soils are cut and filled for urban structures. Machines are used to excavate the marine sediment and reshape the landscape. Erosion is often severe on cut and fill slopes. The hazards of landslide, slippage, and slumping are increased by manipulation of the soil material.

Flood plains, fans, and terraces of the bay plain

The bay plain lies between the tidal flats and the uplands of the Coast Range as part of the fault block of San Francisco Bay. The streams draining the surrounding hills are not large and stream gradients are slight upon reaching the valley. The valley fill material is medium to fine grained sediment eroded from the adjacent uplands. Soils are poorly drained in parts of the flood plains and basins and well drained on the fans and low terraces at slightly higher elevations.

Some valley flood plains have depressions or basins, which are ponded in wet periods. The Clear Lake soils formed in basinlike positions under poor drainage conditions. These soils have a thick, dark surface horizon and mottled, calcareous lower horizons. Stream entrenchment and diversion structures lower the water table so that the montmorillonitic clays shrink during dry periods. Shrinking and swelling in the surface horizon and lower horizons produce slickensides.

The Pescadero soils formed on basin rims where sodium was concentrated near the surface by capillary rise from the water table and lateral movement of ground water from higher areas. The exchangeable sodium dispersed clay particles, and columnar and prismatic structure formed in the subsurface horizons.

In areas cut by larger streams, deposition consists of medium-textured material. Much of this material has been deposited since settlement by man; erosion was accelerated by cultivation of the steeper areas of the watershed. The Sycamore soils formed under these conditions.

Nearly level to gently sloping soils of the bay plain are drained by small intermittent streams, and deposition is minimal. These soils have an argillic horizon. The Danville and Rincon soils are examples.

Old terraces are mainly in the central part of the survey area and extend from the uplands to the bay plain. They represent an older landscape which remained fairly stable during the formation of valleys and uplands. Thus, the soils that formed on terraces have had a longer time to form and to develop prominent morphological features associated mainly with translocation and accumulation of silicate clays. Tierra soils are the main soils on these terraces; they are characterized by a thin loamy A1 horizon, a light A2 horizon, and an abrupt boundary to a clay Bt horizon, which has a strong prismatic structure.

Near downtown Oakland and Alameda, the terrain is wind-blown. Prevailing winds reworked sandy beach deposits and moved the sandy sediment inland. The Baywood soils are an example. The accumulation of organic matter in the surface layer is the prominent pedogenic process.

Agricultural land is being converted to Urban land. The original soils are altered, mainly in the surface horizon, to meet the needs of urban works and structures. Soils on nearly level or gentle slopes are subject to less cutting and filling. In general, the degree of alteration is less in areas that were converted before heavy earth-moving equipment was available.

Tidal flats of the bay

Marshy tidal flats border San Francisco Bay. These tidal flats consist of unconsolidated sediment, mostly clay and silt from mixed sources, that is deposited in the shallow water around the perimeter of the bay by tidal action, currents, and waves. Cordgrass and pickleweed are salt-tolerant plants that grow on the flats and help trap additional sediment and prevent erosion. The bay mud is impregnated with salt from the brackish bay water and contains reduced sulfur compounds.

The Reyes soils formed on tidal flats. They consist of dark-colored, gleyed clays and are about 5 to 10 percent organic matter. They subside when drained, forming large cracks that remain after rewetting. These soils become strongly acid if exposed to air. A yellow efflorescence or jarosite is in drained areas of Reyes soils.

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Glossary

Aeration, soil. The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly aerated soil is considerably higher in carbon dioxide and lower in oxygen.

Alkali (sodic) soil. A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

Alkaline soil. Any soil that has a pH greater than 7.3. (See Reaction, soil.)

Alluvium. Material, such as sand, silt, or clay, deposited on land by streams.

Amendment. Any material that is worked into the soil to make it more productive. Lime, gypsum, sawdust, or synthetic conditioners are examples. Fertilizers constitute a special group of soil amendments.

Anaerobic. The absence of molecular oxygen. Growing in the absence of molecular oxygen (anaerobic bacteria).

Available water capacity (available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as—

	Inches
Very low	0 to 2.5
Low	2.5 to 5.0
Moderate	5.0 to 7.5
High	More than 7.5

Base saturation. The degree to which material having base exchange properties is saturated with exchangeable bases (sum of Ca, Mg, Na, K), expressed as a percentage of the exchange capacity.

Bedrock. The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

Bottom land. The normal flood plain of a stream, subject to frequent flooding.

Buried soil. A developed soil that was once exposed but is now overlain by a more recently formed soil.

Calcareous soil. A soil containing enough calcium carbonate (commonly with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid. A soil having measurable amounts of calcium carbonate or magnesium carbonate.

Cat clay. Wet clay soils that are high in content of reduced forms of sulfur. If drained, these soils become extremely acid because of the oxidation of sulfur compounds.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coat, clay skin.

Claypan. A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

Coarse fragments. Mineral or rock particles up to 3 inches (2 millimeters to 7.5 centimeters) in diameter.

Coarse textured (light textured) soil. Sand or loamy sand.

Complex, soil. A map unit of two or more kinds of soil occurring in such an intricate pattern that they cannot be shown separately on a soil map at the selected scale of mapping and publication.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard; little affected by moistening.

Corrosive. High risk of corrosion to uncoated steel or deterioration of concrete.

Cover crop. A close-growing crop grown primarily to improve and protect the soil between periods of regular crop production, or a crop grown between trees and vines in orchards and vineyards.

Cutbanks cave. Unstable walls of cuts made by earthmoving equipment. The soil sloughs easily.

Depth to rock. Bedrock at a depth that adversely affects the specified use.

Diversion (or diversion terrace). A ridge of earth, generally a terrace, built to protect downslope areas by diverting runoff from its natural course.

Drainage class (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

Excessively drained.—Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

Somewhat excessively drained.—Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

Well drained.—Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

Moderately well drained.—Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

Somewhat poorly drained.—Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

Poorly drained.—Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

Very poorly drained.—Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients, as for example in "hillpeats" and "climatic moors."

Drainage, surface. Runoff, or surface flow of water, from an area.

Eolian soil material. Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

Erosion. The wearing away of the land surface by running water, wind, ice, or other geologic agents and by such processes as gravitational creep.

Erosion (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

Erosion (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes a bare surface.

Excess salts. Excess water soluble salts. Excessive salts restrict the growth of most plants.

Fertility, soil. The quality that enables a soil to provide plant nutrients, in adequate amounts and in proper balance, for the growth of specified plants when light, moisture, temperature, tilth, and other growth factors are favorable.

Field moisture capacity. The moisture content of a soil, expressed as a percentage of the ovendry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called *normal field capacity, normal moisture capacity,* or *capillary capacity*.

Fine textured (heavy textured) soil. Sandy clay, silty clay, and clay.

Flooding. The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent. *None* means that flooding is not probable; *rare* that it is unlikely but possible under unusual weather conditions; *occasional* that it occurs on an average of once or less in 2 years; and *frequent* that it occurs on an average of more than once in 2 years. Duration is expressed as *very brief* if less than 2 days, *brief* if 2 to 7 days, and *long* if more than 7 days. Probable dates are expressed in months; *November-May*, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

Flood plain. A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

Foot slope. The inclined surface at the base of a hill.

Forb. Any herbaceous plant not a grass or a sedge.

Genesis, soil. The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

Gleyed soil. A soil having one or more neutral gray horizons as a result of waterlogging and lack of oxygen. The term "gleyed" also designates gray horizons and horizons having yellow and gray mottles as a result of intermittent waterlogging.

Grassed waterway. A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

Gravel. Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

Gravelly soil material. Material from 15 to 35 percent, by volume, rounded or angular rock fragments, not predominantly flattened, up to 3 inches (7.5 centimeters) in diameter.

Ground water (geology). Water filling all the unblocked pores of underlying material below the water table, which is the upper limit of saturation.

Gully. A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

Gypsum. Hydrous calcium sulphate.

Habitat. The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

Horizon, soil. A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

O horizon.—An organic layer, fresh and decaying plant residue, at the surface of a mineral soil.

A horizon.—The mineral horizon, formed or forming at or near the surface, in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon most of which was originally part of a B horizon.

A2 horizon.—A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or a combination of these; (2) by prismatic or blocky structure; (3) by redder or browner colors than those in the A horizon; or (4) by a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that from which the solum is presumed to have formed. If the material is known to differ from that in the solum the Roman numeral II precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

Hummocky. Refers to a landscape of hillocks, separated by low sags, having sharply rounded tops and steep sides. Hummocky relief resembles rolling or undulating relief, but the tops of ridges are narrower and the sides are shorter and less even.

Humus. The well decomposed, more or less stable part of the organic matter in mineral soils.

Hydrologic soil groups. Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

Infiltration. The downward entry of water into the immediate surface of soil or other material, as contrasted with percolation, which is movement of water through soil layers or material.

Irrigation. Application of water to soils to assist in production of crops. Methods of irrigation are—

Drip.—Applying water at a very slow rate of about 30 drops per minute or by using specially designed commercial sprinkler heads for drip or trickle irrigation.

Furrow.—Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

Sprinkler.—Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

Landslide. The rapid downhill movement of a mass of soil and loose rock generally when wet or saturated.

The speed and distance of movement, as well as the amount of soil and rock material, vary greatly.

Leaching. The removal of soluble material from soil or other material by percolating water.

Light textured soil. Sand and loamy sand.

Liquid limit. The moisture content at which the soil passes from a plastic to a liquid state.

Loam. Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

Low strength. Inadequate strength for supporting loads.

Medium textured soil. Very fine sandy loam, loam, silt loam, or silt.

Metamorphic rock. Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

Minimum tillage. Only the tillage essential to crop production and prevention of soil damage.

Moderately coarse textured (moderately light textured) soil. Sandy loam and fine sandy loam.

Moderately fine textured (moderately heavy textured) soil. Clay loam, sandy clay loam, and silty clay loam.

Montmorillonite. A fine, platy, alumino-silicate clay mineral that expands and contracts with the absorption and loss of water. It has a high cation-exchange capacity and is plastic and sticky when moist.

Morphology, soil. The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

Mottling, soil. Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance—*few, common,* and *many*; size—*fine, medium,* and *coarse*; and contrast—*faint, distinct,* and *prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

Munsell notation. A designation of color by degrees of the three single variables—hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

Neutral soil. A soil having a pH value between 6.6 and 7.3.

Nutrient, plant. Any element taken in by a plant, essential to its growth, and used by it in the production of food and tissue. Plant nutrients are nitrogen, phosphorus, potassium, calcium, magnesium, sulfur, iron, manganese, copper, boron, zinc, and perhaps other elements obtained from the soil; and carbon, hydrogen, and oxygen obtained largely from the air and water.

Parent material. The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

Ped. An individual natural soil aggregate, such as a granule, a prism, or a block.

Pedon. The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

Percolation. The downward movement of water through the soil.

Percs slowly. The slow movement of water through the soil adversely affecting the specified use.

Permeability. The quality that enables the soil to transmit water or air, measured as the number of inches per hour that water moves through the soil. Terms describing permeability are *very slow* (less than 0.06 inch), *slow* (0.06 to 0.20 inch), *moderately slow* (0.2 to 0.6 inch), *moderate* (0.6 to 2.0 inches), *moderately rapid* (2.0 to 6.0 inches), *rapid* (6.0 to 20 inches), and *very rapid* (more than 20 inches).

Phase, soil. A subdivision of a soil series or other unit in the soil classification system based on differences in the soil that affect its management. A soil series, for example, may be divided into phases on the bases of differences in slope, stoniness, thickness, or some other characteristic that affects management. These differences are too small to justify separate series.

pH value. (See Reaction, soil). A numerical designation of acidity and alkalinity in soil.

Piping. Moving water of subsurface tunnels or pipelike cavities in the soil.

Plasticity index. The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

Plastic limit. The moisture content at which a soil changes from a semisolid to a plastic state.

Poorly graded. Refers to soil material consisting mainly of particles of nearly the same size. Because there is little difference in size of the particles, density can be increased only slightly by compaction.

Poor outlets. Surface or subsurface drainage outlets difficult or expensive to install.

Productivity (soil). The capability of a soil for producing a specified plant or sequence of plants under a specified system of management. Productivity is measured in terms of output, or harvest, in relation to input.

Profile, soil. A vertical section of the soil extending through all its horizons and into the parent material.

Range (or rangeland). Land that, for the most part, produces native plants suitable for grazing by livestock; includes land supporting some forest trees.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as—

	pH
Extremely acid	Below 4.5
Very strongly acid	4.5 to 5.0
Strongly acid	5.1 to 5.5
Medium acid	5.6 to 6.0
Slightly acid	6.1 to 6.5
Neutral	6.6 to 7.3
Mildly alkaline	7.4 to 7.8
Moderately alkaline	7.9 to 8.4
Strongly alkaline	8.5 to 9.0
Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Rock fragments. Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

Rooting depth. Shallow root zone. The soil is shallow over a layer that greatly restricts roots. See Root zone.

Root zone. The part of the soil that can be penetrated by plant roots.

Runoff. The precipitation discharged in stream channels from a drainage area. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Saline-alkali soil. A soil that contains a harmful concentration of salts and exchangeable sodium; contains harmful salts and is strongly alkaline; or contains harmful salts and exchangeable sodium and is very strongly alkaline. The salts, exchangeable sodium, and alkaline reaction are in the soil in such location that growth of most crop plants is less than normal.

Saline soil. A soil containing soluble salts in an amount that impairs growth of plants. A saline soil does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

Sandstone. Sedimentary rock containing dominantly sand-size particles.

Sedimentary rock. Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

Seepage. The rapid movement of water through the soil. Seepage adversely affects the specified use.

Series, soil. A group of soils, formed from a particular type of parent material, having horizons that, except for the texture of the A or surface horizon, are similar in all profile characteristics and in arrangement in the soil profile. Among these characteristics are color, texture, structure, reaction, consistence, and mineralogical and chemical composition.

Shale. Sedimentary rock formed by the hardening of a clay deposit.

Sheet erosion. The removal of a fairly uniform layer of soil material from the land surface by the action of rainfall and runoff water.

Shrink-swell. The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

Silt. As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slickensides. Polished and grooved surfaces produced by one mass sliding past another. In soils, slickensides may occur at the bases of slip surfaces on the steeper slopes; on faces of blocks, prisms, and columns; and in swelling clayey soils, where there is marked change in moisture content.

Slope. The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

Slow intake. The slow movement of water into the soil.

Small stones. Rock fragments 3 to 10 inches (7.5 to 25 centimeters) in diameter. Small stones adversely affect the specified use.

Soil. A natural, three-dimensional body at the earth's surface that is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *very coarse sand* (2.0 millimeters to 1.0 millimeter); *coarse sand* (1.0 to 0.5 millimeter); *medium sand* (0.5 to 0.25 millimeter); *fine sand* (0.25 to 0.10 millimeter); *very fine sand* (0.10 to 0.05 millimeter); *silt* (0.005 to 0.002 millimeter); and *clay* (less than 0.002 millimeter).

Solum. The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in mature soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristics of the soil are largely confined to the solum.

Stones. Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

Stratified. Arranged in strata, or layers. The term refers to geologic material. Layers in soils that result from the processes of soil formation are called horizons; those inherited from the parent material are called strata.

Structure, soil. The arrangement of primary soil particles into compound particles or aggregates that are separated from adjoining aggregates. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are either *single grained* (each grain by itself. as in dune sand) or *massive* (the particles adhering without any regular cleavage, as in many hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. The part of the soil below the solum.

Subsurface layer. Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

Taxadjuncts. Soils that cannot be classified in a series recognized in the classification system. Such soils are named for a series they strongly resemble and are designated as taxadjuncts to that series because they differ in ways too small to be of consequence in interpreting their use or management.

Terrace (geologic). An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea. A stream terrace is frequently called a second bottom, in contrast with a flood plain, and is seldom subject to overflow. A marine terrace, generally wide, was deposited by the sea.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or " very fine."

Thin layer. Otherwise suitable soil material too thin for the specified use.

Tilth, soil. The condition of the soil, especially the soil structure, as related to the growth of plants. Good tilth refers to the friable state and is associated with high noncapillary porosity and stable structure. A soil in poor tilth is nonfriable, hard, nonaggregated, and difficult to till.

Topsoil (engineering). Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

Trace elements. The chemical elements in soils, in only extremely small amounts, essential to plant growth. Examples are zinc, cobalt, manganese, copper, and iron.

Unstable fill. Risk of caving or sloughing in banks of fill material.

Upland (geology). Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the lowlands along streams.

Valley fill. In glaciated regions, material deposited in stream valleys by glacial melt water. In nonglaciated regions, alluvium deposited by heavily loaded streams emerging from hills or mountains and spreading sediments onto the lowland as a series of adjacent alluvial fans.

Variant, soil. A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

Variegation. Refers to patterns of contrasting colors assumed to be inherited from the parent material rather than to be the result of poor drainage.

Water table. The upper limit of the soil or underlying rock material that is wholly saturated with water.

Water table, apparent. A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

Water table, perched. A water table standing above an unsaturated zone. In places, an upper, or perched water table is separated from a lower one by a dry zone.

Weathering. All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

Well graded. Refers to a soil or soil material consisting of particles well distributed over a wide range in size or diameter. Such a soil normally can be easily increased in density and bearing properties by compaction. Contrasts with poorly graded soil.

Wilting point (or permanent wilting point). The moisture content of soil, on an ovendry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.

TABLES

TABLE 1.--TEMPERATURE DATA FROM FIVE WEATHER STATIONS

ALVARADO, CALIFORNIA

Month	Temperature				
	Highest	Mean maximum	Mean	Mean minimum	Lowest
	°F	°F	°F	°F	°F
January	74	58.4	49.8	41.3	23
February	76	60.7	52.5	44.2	33
March	83	65.0	55.8	46.7	35
April	87	66.9	57.6	48.3	35
May	96	70.5	61.1	51.7	38
June	96	72.5	63.2	53.9	42
July	99	73.7	64.6	55.4	43
August	92	73.4	64.3	55.3	45
September	109	75.7	65.1	54.5	45
October	96	72.8	61.9	51.0	38
November	91	66.7	55.5	44.4	30
December	79	60.2	50.9	41.6	23
Annual	109	67.5	58.5	49.0	23
HAYWARD, CALIFORNIA					
January	71	55.9	47.6	39.2	22
February	77	58.9	50.0	41.2	28
March	84	61.9	52.4	42.9	30
April	86	65.4	55.7	46.0	33
May	94	68.5	59.0	49.4	36
June	104	71.6	62.2	52.8	40
July	99	74.3	64.4	54.4	40
August	98	73.4	64.1	54.8	40
September	99	75.4	64.8	54.1	42
October	94	71.1	60.3	49.5	35
November	85	63.8	53.7	43.6	30
December	78	57.7	49.4	41.0	23
Annual	104	66.5	57.0	47.4	22

TABLE 1.--TEMPERATURE DATA FROM FIVE WEATHER STATIONS--Continued

NEWARK, CALIFORNIA

Month	Temperature				
	Highest	Mean maximum	Mean	Mean minimum	Lowest
	°F	°F	°F	°F	°F
January	75	59.6	45.4	33.8	22
February	78	59.7	48.8	38.0	25
March	79	62.6	51.7	40.7	29
April	87	68.2	56.0	43.7	32
May	97	70.4	59.1	47.7	35
June	99	74.6	63.0	51.4	41
July	97	76.7	64.9	53.1	41
August	99	77.0	64.8	52.6	41
September	101	78.3	64.5	50.7	40
October	88	72.6	59.7	46.8	33
November	84	64.6	52.8	41.0	26
December	75	59.4	49.1	38.9	26
Annual	101	68.4	56.7	44.9	22
OAKLAND AIRPORT, CALIFORNIA					
January	72	56.0	47.2	38.4	24
February	82	60.0	50.7	41.3	25
March	85	63.4	53.4	43.3	32
April	88	65.9	55.6	45.3	31
May	94	65.8	58.4	48.3	36
June	107	71.6	61.6	51.6	41
July	102	72.0	62.7	53.4	46
August	95	72.0	62.9	53.7	47
September	102	74.0	63.3	52.6	41
October	94	71.0	60.0	48.9	34
November	86	64.3	53.8	43.2	27
December	74	57.3	48.6	39.8	23
Annual	107	66.3	56.5	46.7	23

TABLE 1.--TEMPERATURE DATA FROM FIVE WEATHER STATIONS--Continued

OAKLAND (CHABOT), CALIFORNIA

Month	Temperature				
	Highest	Mean maximum	Mean	Mean minimum	Lowest
	°F	°F	°F	°F	°F
January	73	54.3	47.8	41.2	24
February	75	57.3	50.4	43.3	28
March	87	61.4	53.3	45.3	32
April	88	64.9	56.1	47.4	36
May	97	68.3	59.2	50.1	38
June	97	71.2	62.2	53.1	41
July	98	73.0	63.9	54.8	48
August	99	73.4	63.9	54.5	47
September	103	74.6	64.6	54.6	44
October	98	70.6	61.3	52.0	36
November	83	63.4	55.3	47.1	32
December	69	55.9	49.5	43.2	25
Annual	103	65.0	56.7	48.9	24

TABLE 2.--AVERAGE MONTHLY AND ANNUAL PRECIPITATION DATA

Month	Station							
	Alvarado (near)	Alviso	Hayward High School	Hayward (near)	Newark	Niles	Oakland	Sunol
	In	In	In	In	In	In	In	In
January	3.54	2.41	4.08	5.13	1.86	3.69	3.30	3.98
February	3.47	1.71	3.84	4.05	2.57	3.07	3.51	3.89
March	2.32	1.90	2.70	3.68	2.47	2.94	2.31	2.56
April	1.13	0.92	1.54	2.31	0.85	1.40	1.46	1.40
May	0.43	0.42	0.86	1.12	0.46	0.74	0.61	0.70
June	0.11	0.12	0.19	0.16	0.11	0.19	0.15	0.15
July	0	0.01	0.01	0.03	0.03	0	0.01	0
August	0.03	0.01	0.04	0.04	0.01	0.03	0.02	0.02
September	0.11	0.21	0.32	0.31	0.03	0.29	0.09	0.40
October	0.68	0.50	0.92	1.34	0.99	1.01	0.91	0.95
November	0.94	1.46	1.89	2.03	1.89	2.08	1.95	1.77
December	3.30	2.69	3.99	5.22	2.37	3.35	3.42	3.72
Annual	16.06	12.36	20.38	25.42	13.64	18.79	17.74	19.54

TABLE 3.--ACREAGE AND PROPORTIONATE EXTENT OF THE SOILS

Map symbol	Soil name	Acres	Percent
100	Altamont clay, 5 to 15 percent slopes	100	0.1
101	Altamont clay, 15 to 30 percent slopes	215	0.1
102	Altamont clay, 30 to 50 percent slopes	355	0.2
103	Azule clay loam, 9 to 30 percent slopes	1,290	0.9
104	Azule clay loam, 30 to 50 percent slopes	170	0.1
105	Baywood Variant, sand	220	0.2
106	Botella loam, 0 to 2 percent slopes	4,625	3.2
107	Clear Lake clay, 0 to 2 percent slopes, drained	8,140	5.6
108	Clear Lake clay, 2 to 9 percent slopes, drained	1,710	1.2
109	Climara clay, 30 to 50 percent slopes	370	0.3
110	Contra Costa clay loam, 30 to 50 percent slopes	320	0.2
111	Danville silty clay loam, 0 to 2 percent slopes	10,660	7.4
112	Danville silty clay loam, 2 to 9 percent slopes	725	0.5
113	Diablo clay, 9 to 15 percent slopes	890	0.6
114	Diablo clay, 15 to 30 percent slopes	325	0.2
115	Diablo clay, 30 to 50 percent slopes	65	*
116	Gaviota-Rock outcrop complex, 15 to 50 percent slopes	215	0.1
117	Laugenour loam, drained	760	0.5
118	Los Gatos-Los Osos complex, 30 to 50 percent slopes	130	0.1
119	Los Gatos-Los Osos complex, 50 to 75 percent slopes	545	0.4
120	Los Osos silty clay loam, 9 to 30 percent slopes	305	0.2
121	Los Osos silty clay loam, 30 to 50 percent slopes	270	0.2
122	Los Osos-Millsholm complex, 9 to 30 percent slopes	1,675	1.2
123	Los Osos-Millsholm complex, 30 to 50 percent slopes	945	0.7
124	Los Osos-Millsholm complex, 50 to 75 percent slopes	265	0.2
125	Marvin silt loam, saline-alkali	3,115	2.2
126	Maymen loam, 30 to 75 percent slopes	3,790	2.6
127	Maymen-Los Gatos complex, 30 to 75 percent slopes	1,845	1.3
128	Millsholm silt loam, 30 to 50 percent slopes	1,565	1.1
129	Millsholm silt loam, 50 to 75 percent slopes	965	0.7
130	Montara-Rock outcrop complex, 30 to 75 percent slopes	525	0.4
131	Omni silty clay loam, drained	4,800	3.3
132	Omni silty clay loam, strongly saline	125	0.1
133	Pescadero clay, drained	1,940	1.3
134	Pescadero clay, ponded	1,050	0.7
135	Pits, gravel	685	0.5
136	Pleasanton gravelly loam, 0 to 5 percent slopes	145	0.1
137	Reyes clay	3,830	2.7
138	Reyes clay, ponded	15,700	10.9
139	Reyes clay, drained	3,560	2.5
140	Rincon clay loam, 0 to 2 percent slopes	2,665	1.8
141	Riverwash	190	0.1
142	Quarry	150	0.1
143	Sycamore silt loam, drained	5,100	3.5
144	Sycamore silt loam, clay substratum	3,255	2.3
145	Tierra loam, 0 to 5 percent slopes	340	0.2
146	Urban land	8,460	5.9
147	Urban land-Baywood complex	4,025	2.8
148	Urban land-Clear Lake complex	5,620	3.9
149	Urban land-Danville complex	2,560	1.8
150	Urban land-Tierra complex, 2 to 5 percent slopes	4,435	3.1
151	Urban land-Tierra complex, 5 to 15 percent slopes	2,630	1.8
152	Urban land-Tierra complex, 15 to 30 percent slopes	1,920	1.3
153	Vallecitos-Rock outcrop complex, 30 to 50 percent slopes	170	0.1
154	Willows clay, drained	2,225	1.5
155	Xerorthents, clayey	1,060	0.7
156	Xeropsamments, fill	6,115	4.2
157	Xerorthents-Altamont complex, 30 to 50 percent slopes	1,120	0.8
158	Xerorthents-Los Osos complex, 30 to 50 percent slopes	3,465	2.4
159	Xerorthents-Millsholm complex, 30 to 50 percent slopes	3,135	2.2
160	Xerorthents-Millsholm complex, 50 to 75 percent slopes	595	0.4
161	Yolo silt loam, 0 to 2 percent slopes	5,955	4.1
	Total	144,120	100.0

* Less than 0.1 percent.

TABLE 4.--BUILDING SITE DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
100 Altamont	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength.
101, 102 Altamont	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
103, 104 Azule	Severe: slope, too clayey.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
105 Baywood Variant	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
106 Botella	Moderate: too clayey.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Severe: low strength.
107 Clear Lake	Severe: too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, low strength.	Severe: shrink-swell, low strength.
108 Clear Lake	Severe: too clayey.	Severe: shrink-swell, low strength, floods.	Severe: shrink-swell, low strength, floods.	Severe: shrink-swell, floods, low strength.	Severe: shrink-swell, low strength.
109 Climara	Severe: slope, depth to rock, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, depth to rock, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
110 Contra Costa	Severe: slope, depth to rock, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
111, 112 Danville	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
113 Diablo	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength.
114, 115 Diablo	Severe: too clayey, slope.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, slope, low strength.	Severe: shrink-swell, low strength, slope.
116*: Gaviota	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.	Severe: slope, depth to rock.
Rock outcrop.					

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
117---------------- Laugenour	Slight-----------	Moderate: low strength, shrink-swell.	Moderate: shrink-swell, low strength, wetness.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.
118*, 119*:					
Los Gatos--------	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, low strength.
Los Osos---------	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
120, 121---------- Los Osos	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
122*, 123*, 124*:					
Los Osos---------	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
Millsholm--------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
125---------------- Marvin	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength.
126---------------- Maymen	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
127*:					
Maymen-----------	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.
Los Gatos--------	Severe: depth to rock, slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, low strength.
128, 129---------- Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
130*:					
Montara----------	Severe: depth to rock, slope.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, low strength.
Rock outcrop.					
131---------------- Omni	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
132---------------- Omni	Severe: floods, too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: floods, low strength, shrink-swell.

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
133-----Pescadero	Severe: too clayey.	Severe: low strength, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
134-----Pescadero	Severe: floods, too clayey, wetness.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, wetness, low strength.	Severe: floods, shrink-swell, low strength.
135*. Pits					
136-----Pleasanton	Moderate: too clayey.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell.	Moderate: shrink-swell, low strength.
137-----Reyes	Severe: too clayey, floods, wetness.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, shrink-swell, floods.	Severe: wetness, floods, low strength.
138-----Reyes	Severe: floods, wetness, too clayey.	Severe: floods, shrink-swell, wetness.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, shrink-swell.	Severe: floods, wetness, low strength.
139-----Reyes	Severe: too clayey, wetness.	Severe: shrink-swell, low strength.	Severe: wetness, shrink-swell.	Severe: shrink-swell, low strength.	Severe: low strength, shrink-swell.
140-----Rincon	Moderate: too clayey.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.	Severe: low strength, shrink-swell.
141*. Riverwash					
142*. Quarry					
143-----Sycamore	Slight-----	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.
144-----Sycamore	Severe: too clayey.	Moderate: low strength.	Severe: low strength, shrink-swell.	Moderate: low strength.	Moderate: low strength.
145-----Tierra	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
146*. Urban land					
147*: Urban land.					
Baywood-----	Severe: cutbanks cave.	Slight-----	Slight-----	Moderate: slope.	Slight.
148*: Urban land.					

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
148*:					
Clear Lake	Severe: too clayey.	Severe: floods, shrink-swell, low strength.	Severe: floods, wetness, shrink-swell.	Severe: floods, shrink-swell, low strength.	Severe: shrink-swell, low strength.
149*:					
Urban land.					
Danville	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
150*:					
Urban land.					
Tierra	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: shrink-swell, low strength.	Severe: shrink-swell, low strength.
151*:					
Urban land.					
Tierra	Severe: too clayey.	Severe: shrink-swell, low strength.	Severe: shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength.
152*:					
Urban land.					
Tierra	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.
Azule	Severe: slope, too clayey.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.	Severe: slope, low strength, shrink-swell.
153*:					
Vallecitos	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, low strength.
Rock outcrop.					
154 Willows	Severe: too clayey.	Severe: floods, shrink-swell, low strength.	Severe: shrink-swell, low strength.	Severe: floods, shrink-swell, low strength.	Severe: low strength, shrink-swell.
155* Xerorthents	Severe: slope, too clayey, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
156* Xeropsamments	Severe: cutbanks cave, wetness.	Moderate: wetness.	Severe: wetness.	Moderate: wetness.	Moderate: wetness.
157*:					
Xerorthents	Severe: slope, too clayey, depth to rock.	Severe: slope, shrink-swell, low strength.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.
Altamont	Severe: too clayey, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.	Severe: shrink-swell, low strength, slope.

See footnote at end of table.

TABLE 4.--BUILDING SITE DEVELOPMENT--Continued

Soil name and map symbol	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets
158*:					
Xerorthents	Severe: slope, depth to rock.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Severe: slope.
Los Osos	Severe: slope, too clayey.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, shrink-swell, low strength.	Severe: slope, low strength, shrink-swell.
159*, 160*:					
Xerorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock, slope.
161 Yolo	Slight	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.	Moderate: low strength, shrink-swell.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 5.--SANITARY FACILITIES

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," "good," and "fair." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
100 Altamont	Severe: percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Moderate: slope.	Poor: too clayey.
101 Altamont	Severe: percs slowly, depth to rock, slope.	Severe: slope.	Severe: too clayey, depth to rock.	Severe: slope.	Poor: too clayey, slope.
102 Altamont	Severe: percs slowly, depth to rock, slope.	Severe: slope.	Severe: too clayey, depth to rock, slope.	Severe: slope.	Poor: too clayey, slope.
103 Azule	Severe: slope, percs slowly, depth to rock.	Severe: slope.	Severe: too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
104 Azule	Severe: slope, percs slowly, depth to rock.	Severe: slope.	Severe: slope, too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
105 Baywood Variant	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy.
106 Botella	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
107 Clear Lake	Severe: wetness, percs slowly.	Moderate: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey.
108 Clear Lake	Severe: percs slowly.	Slight	Severe: too clayey.	Moderate: floods.	Poor: too clayey.
109 Climara	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey, area reclaim.
110 Contra Costa	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, too clayey, depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
111 Danville	Severe: percs slowly.	Slight	Severe: too clayey.	Slight	Poor: too clayey.
112 Danville	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
113 Diablo	Severe: percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Moderate: slope.	Poor: too clayey.
114 Diablo	Severe: slope, percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
115: Diablo	Severe: slope, percs slowly.	Severe: slope.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey.
116*:					
Gaviota	Severe: slope, depth to rock.	Severe: seepage, depth to rock, slope.	Severe: slope, depth to rock, seepage.	Severe: slope, seepage.	Poor: slope, thin layer, area reclaim.
Rock outcrop.					
117: Laugenour	Severe: percs slowly, wetness.	Severe: seepage.	Severe: wetness.	Severe: seepage.	Good.
118*, 119*:					
Los Gatos	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
120: Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
121: Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
122*:					
Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
123*, 124*:					
Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
125: Marvin	Severe: percs slowly, wetness.	Moderate: wetness.	Severe: too clayey, wetness.	Moderate: wetness.	Poor: too clayey.
126: Maymen	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
127*:					
Maymen	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Los Gatos	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
128, 129 Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
130*:					
Montara	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: depth to rock, slope.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Rock outcrop.					
131, 132 Omni	Severe: percs slowly.	Slight	Severe: too clayey, wetness.	Slight	Poor: too clayey.
133 Pescadero	Severe: percs slowly.	Slight	Severe: wetness, too clayey.	Slight	Poor: too clayey.
134 Pescadero	Severe: floods, percs slowly, wetness.	Severe: floods, wetness.	Severe: floods, too clayey, wetness.	Severe: floods, wetness.	Poor: wetness, too clayey.
135*. Pits					
136 Pleasanton	Severe: percs slowly.	Moderate: slope, seepage.	Slight	Slight	Fair: small stones.
137 Reyes	Severe: percs slowly, floods, wetness.	Severe: floods, wetness.	Severe: wetness, too clayey, floods.	Severe: floods, wetness.	Poor: too clayey, wetness.
138 Reyes	Severe: floods, wetness, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness, too clayey.	Severe: floods, wetness.	Poor: wetness, too clayey.
139 Reyes	Severe: wetness, percs slowly.	Severe: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey.
140 Rincon	Severe: percs slowly.	Slight	Moderate: too clayey.	Slight	Fair: too clayey.
141*. Riverwash					
142*. Quarry					
143 Sycamore	Severe: percs slowly.	Severe: seepage.	Severe: seepage.	Slight	Good.

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
144 Sycamore	Severe: percs slowly.	Moderate: seepage.	Slight	Slight	Fair: thin layer.
145 Tierra	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
146*. Urban land					
147*: Urban land.					
Baywood	Slight	Severe: seepage.	Severe: seepage.	Severe: seepage.	Fair: too sandy.
148*: Urban land.					
Clear Lake	Severe: wetness, percs slowly.	Moderate: wetness.	Severe: wetness, too clayey.	Severe: wetness.	Poor: too clayey.
149*: Urban land.					
Danville	Severe: percs slowly.	Moderate: slope.	Severe: too clayey.	Slight	Poor: too clayey.
150*: Urban land.					
Tierra	Severe: percs slowly.	Moderate: slope.	Moderate: too clayey.	Slight	Fair: too clayey.
151*: Urban land.					
Tierra	Severe: percs slowly.	Severe: slope.	Moderate: too clayey.	Moderate: slope.	Fair: too clayey.
152*: Urban land.					
Tierra	Severe: slope, percs slowly.	Severe: slope.	Moderate: slope, too clayey.	Severe: slope.	Poor: slope, too clayey.
Azule	Severe: slope, percs slowly, depth to rock.	Severe: slope.	Severe: depth to rock.	Severe: slope.	Poor: slope, too clayey, area reclaim.
153*: Vallecitos	Severe: slope, depth to rock, percs slowly.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
Rock outcrop.					
154 Willows	Severe: percs slowly.	Slight	Severe: wetness, too clayey.	Slight	Poor: too clayey.
155* Xerorthents	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, too clayey.

See footnote at end of table.

TABLE 5.--SANITARY FACILITIES--Continued

Soil name and map symbol	Septic tank absorption fields	Sewage lagoon areas	Trench sanitary landfill	Area sanitary landfill	Daily cover for landfill
156*: Xeropsamments	Severe: wetness.	Severe: wetness, seepage.	Severe: wetness, seepage.	Severe: wetness, seepage.	Poor: too sandy, seepage.
157*:					
Xerorthents	Severe: slope, percs slowly, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: slope, too clayey.
Altamont	Severe: percs slowly, depth to rock, slope.	Severe: slope.	Severe: too clayey, depth to rock, slope.	Severe: slope.	Poor: too clayey, slope.
158*:					
Xerorthents	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer.
Los Osos	Severe: slope, depth to rock, percs slowly.	Severe: slope.	Severe: slope, depth to rock, too clayey.	Severe: slope.	Poor: area reclaim, slope, too clayey.
159*, 160*:					
Xerorthents	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope.
Millsholm	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope, depth to rock.	Severe: slope.	Poor: slope, thin layer, area reclaim.
161: Yolo	Moderate: percs slowly.	Moderate: seepage.	Moderate: too clayey.	Slight	Fair: too clayey.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 6.--WATER MANAGEMENT

[Some terms that describe restrictive soil features are defined in the Glossary. Absence of an entry indicates that the soil was not evaluated]

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
100, 101, 102: Altamont	Slope, depth to rock.	Low strength, hard to pack.	Slope, percs slowly, depth to rock.	Slope, slow intake, percs slowly.	Slope, percs slowly.
103, 104: Azule	Slope, depth to rock.	Low strength, hard to pack.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, erodes easily, depth to rock.
105: Baywood Variant	Wetness, seepage.	Piping, seepage.	Favorable	Droughty, seepage, wetness.	Droughty.
106: Botella	Favorable	Favorable	Favorable	Favorable	Erodes easily.
107: Clear Lake	Favorable	Low strength, hard to pack.	Percs slowly, floods.	Slow intake, percs slowly.	Percs slowly.
108: Clear Lake	Favorable	Low strength, hard to pack.	Percs slowly, slope.	Percs slowly, slow intake, slope.	Percs slowly.
109: Climara	Slope, depth to rock.	Low strength, hard to pack, thin layer.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, depth to rock, percs slowly.
110: Contra Costa	Slope, depth to rock.	Low strength, hard to pack.	Slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, percs slowly, depth to rock.
111: Danville	Favorable	Hard to pack	Percs slowly	Percs slowly	Percs slowly.
112: Danville	Favorable	Hard to pack	Percs slowly, slope.	Percs slowly, slope.	Percs slowly.
113, 114, 115: Diablo	Slope	Low strength, hard to pack.	Percs slowly, slope.	Slope, slow intake, percs slowly.	Slope, percs slowly.
116*:					
Gaviota	Slope, depth to rock.	Thin layer, piping.			Slope, depth to rock, erodes easily.
Rock outcrop.					
117: Laugenour	Seepage	Piping, seepage.	Favorable	Favorable	Erodes easily.
118*, 119*:					
Los Gatos	Slope, depth to rock.	Thin layer	Slope, depth to rock.	Slope, rooting depth.	Slope, erodes easily, depth to rock.
Los Osos	Slope, depth to rock.	Hard to pack, thin layer.	Complex slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, erodes easily, depth to rock.
120, 121: Los Osos	Slope, depth to rock.	Hard to pack, thin layer.	Complex slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, erodes easily, depth to rock.

See footnote at end of table.

TABLE 6.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
122*, 123*, 124*:					
Los Osos	Slope, depth to rock.	Hard to pack, thin layer.	Complex slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, erodes easily, depth to rock.
Millsholm	Slope, depth to rock.	Thin layer	Slope, depth to rock.		Slope, rooting depth, erodes easily.
125 Marvin	Favorable	Hard to pack	Percs slowly, excess salt.	Percs slowly, excess salt, erodes easily.	Percs slowly, excess salt, erodes easily.
126 Maymen	Slope, depth to rock.	Thin layer, low strength.	Slope, depth to rock.	Slope, droughty, rooting depth.	Slope, rooting depth, droughty.
127*:					
Maymen	Slope, depth to rock.	Thin layer, low strength.	Slope, depth to rock.	Slope, droughty, rooting depth.	Slope, rooting depth, droughty.
Los Gatos	Slope, depth to rock.	Thin layer	Slope, depth to rock.	Slope, rooting depth.	Slope, erodes easily, depth to rock.
128, 129 Millsholm	Slope, depth to rock.	Thin layer	Slope, depth to rock.		Slope, rooting depth, erodes easily.
130*:					
Montara	Slope, depth to rock.	Thin layer			Slope, depth to rock.
Rock outcrop.					
131, 132 Omni	Favorable	Hard to pack	Percs slowly, poor outlets.	Percs slowly, erodes easily.	Percs slowly, erodes easily.
133 Pescadero	Favorable	Low strength, hard to pack.	Excess sodium, excess salt, percs slowly.		Excess sodium, excess salt, percs slowly.
134 Pescadero	Favorable	Low strength, compressible.	Excess salt, percs slowly, excess sodium.	Excess salt, excess sodium, percs slowly.	Excess salt, wetness, percs slowly.
135*. Pits					
136 Pleasanton	Seepage	Favorable	Slope	Droughty	Droughty.
137 Reyes	Favorable	Hard to pack, piping, wetness.	Excess salt, percs slowly, floods.	Floods, slow intake, wetness.	Excess salt, percs slowly, wetness.
138 Reyes	Favorable	Hard to pack, wetness, piping.	Percs slowly, excess salt, floods.	Wetness, excess salt, slow intake.	Excess salt, excess sodium, wetness.
139 Reyes	Favorable	Hard to pack, excess salt.	Excess salt, percs slowly, poor outlets.	Wetness, excess salt, slow intake.	Excess salt, percs slowly, droughty.
140 Rincon	Favorable	Hard to pack	Percs slowly	Percs slowly	Erodes easily, percs slowly.

See footnote at end of table.

TABLE 6.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
141*. Riverwash					
142*. Quarry					
143 Sycamore	Seepage	Piping	Favorable	Favorable	Erodes easily.
144 Sycamore	Favorable	Thin layer, piping.	Percs slowly	Percs slowly	Percs slowly, erodes easily.
145 Tierra	Favorable	Hard to pack	Slope, percs slowly.	Percs slowly	Percs slowly, erodes easily.
146*. Urban land					
147*: Urban land.					
Baywood	Seepage	Piping, seepage.	Slope, cutbanks cave.	Droughty, fast intake.	Droughty.
148*: Urban land.					
Clear Lake	Favorable	Low strength, hard to pack.	Percs slowly, floods.	Slow intake, percs slowly.	Percs slowly.
149*: Urban land.					
Danville	Favorable	Hard to pack	Percs slowly, slope.	Percs slowly, slope.	Percs slowly.
150*: Urban land.					
Tierra	Favorable	Hard to pack	Slope, percs slowly.	Percs slowly, slope.	Percs slowly, erodes easily.
151*: Urban land.					
Tierra	Slope	Hard to pack	Slope, percs slowly.	Percs slowly, slope.	Slope, erodes easily, percs slowly.
152*: Urban land.					
Tierra	Slope	Hard to pack	Slope, percs slowly.	Slope, percs slowly.	Slope, erodes easily, percs slowly.
Azule	Slope, depth to rock.	Low strength, hard to pack.	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, erodes easily, depth to rock.
153*: Vallecitos	Slope, depth to rock.	Thin layer			Slope, rooting depth, percs slowly.
Rock outcrop.					
154 Willows	Favorable	Hard to pack, piping, excess salt.	Percs slowly, poor outlets.	Slow intake, percs slowly, droughty.	Excess salt, excess sodium, droughty.

See footnote at end of table.

TABLE 6.--WATER MANAGEMENT--Continued

Soil name and map symbol	Pond reservoir areas	Embankments, dikes, and levees	Drainage	Irrigation	Grassed waterways
155*: Xerorthents	Slope, depth to rock.	Low strength, thin layer.	Percs slowly, poor outlets.	Percs slowly, slow intake.	Slope, percs slowly.
156*: Xeropsamments	Seepage	Seepage	Favorable	Wetness, droughty.	Droughty.
157*:					
Xerorthents	Slope, depth to rock.	Low strength, thin layer.	Percs slowly, slope, depth to rock.	Percs slowly, slope, rooting depth.	Slope, percs slowly.
Altamont	Slope, depth to rock.	Low strength, hard to pack.	Slope, percs slowly, depth to rock.	Slope, slow intake, percs slowly.	Slope, percs slowly.
158*:					
Xerorthents	Slope	Thin layer	Slope, percs slowly, depth to rock.	Slope, percs slowly, rooting depth.	Slope, thin layer.
Los Osos	Slope, depth to rock.	Hard to pack, thin layer.	Complex slope, depth to rock, percs slowly.	Slope, rooting depth, percs slowly.	Slope, erodes easily, depth to rock.
159*, 160*:					
Xerorthents	Slope	Piping, low strength.	Slope, depth to rock.	Slope, rooting depth.	Slope.
Millsholm	Slope, depth to rock.	Thin layer	Slope, depth to rock.	Slope, rooting depth.	Slope, rooting depth, erodes easily.
161: Yolo	Seepage	Favorable	Favorable	Favorable	Erodes easily.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 7.--RECREATIONAL DEVELOPMENT

[Some terms that describe restrictive soil features are defined in the Glossary. See text for definitions of "slight," "moderate," and "severe." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
100 Altamont	Moderate: too clayey, slope.	Moderate: too clayey, slope.	Severe: too clayey, slope.	Moderate: too clayey.
101 Altamont	Severe: slope.	Severe: too clayey, slope.	Severe: too clayey, slope.	Moderate: too clayey, slope.
102 Altamont	Severe: slope.	Severe: too clayey, slope.	Severe: too clayey, slope.	Severe: too clayey, slope.
103 Azule	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
104 Azule	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
105 Baywood Variant	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
106 Botella	Slight	Slight	Moderate: small stones.	Slight.
107, 108 Clear Lake	Severe: floods.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
109 Climara	Severe: slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.
110 Contra Costa	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
111 Danville	Slight	Slight	Moderate: too clayey.	Slight.
112 Danville	Slight	Slight	Moderate: slope, too clayey.	Slight.
113 Diablo	Moderate: slope, too clayey.	Moderate: slope, too clayey.	Severe: slope, too clayey.	Moderate: too clayey.
114 Diablo	Severe: slope.	Severe: slope.	Severe: slope, too clayey.	Moderate: too clayey, slope.
115 Diablo	Severe: slope.	Severe: slope.	Severe: slope, too clayey.	Severe: slope.
116*:				
Gaviota	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop.				
117 Laugenour	Moderate: percs slowly.	Slight	Moderate: percs slowly.	Slight.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
118*, 119*:				
Los Gatos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
120 Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
121 Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
122*:				
Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
Millsholm	Severe: slope.	Severe: slope.	Moderate: slope.	
123*, 124*:				
Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Millsholm	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
125 Marvin	Moderate: percs slowly.	Slight	Moderate: percs slowly.	
126 Maymen	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.
127*:				
Maymen	Severe: slope.	Severe: slope.		Severe: slope.
Los Gatos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
128, 129 Millsholm	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
130*:				
Montara	Severe: slope, depth to rock.	Severe: slope.	Severe: depth to rock, slope.	Severe: slope.
Rock outcrop.				
131 Omni	Moderate: percs slowly, too clayey.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
132 Omni	Severe: floods.	Severe: floods.	Severe: floods.	Moderate: too clayey.
133 Pescadero	Moderate: too clayey, percs slowly.	Slight	Moderate: too clayey.	Slight.
134 Pescadero	Severe: floods, percs slowly.	Severe: floods, wetness.	Severe: floods, wetness.	Severe: floods, wetness.

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
135*. Pits				
136 Pleasanton	Moderate: small stones.	Moderate: small stones.	Severe: small stones.	Moderate: small stones.
137 Reyes	Severe: floods, percs slowly, wetness.	Severe: wetness.	Severe: floods, wetness, too clayey.	Severe: wetness.
138 Reyes	Severe: floods, wetness, percs slowly.	Severe: wetness.	Severe: wetness, floods, too clayey.	Severe: wetness.
139 Reyes	Severe: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey, percs slowly.	Moderate: too clayey.
140 Rincon	Slight	Slight	Moderate: too clayey.	Slight.
141*. Riverwash				
142*. Quarry				
143, 144 Sycamore	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.	Moderate: dusty.
145 Tierra	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
146*. Urban land				
147*: Urban land.				
Baywood	Moderate: too sandy, soil blowing.	Moderate: too sandy, soil blowing.	Severe: too sandy, soil blowing.	Moderate: too sandy, soil blowing.
148*: Urban land.				
Clear Lake	Severe: floods.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
149*: Urban land.				
Danville	Slight	Slight	Moderate: slope, too clayey.	Slight.
150*: Urban land.				
Tierra	Moderate: percs slowly.	Slight	Moderate: percs slowly, slope.	Slight.
151*: Urban land.				

See footnote at end of table.

TABLE 7.--RECREATIONAL DEVELOPMENT--Continued

Soil name and map symbol	Camp areas	Picnic areas	Playgrounds	Paths and trails
151*:				
Tierra	Moderate: percs slowly, slope.	Moderate: slope.	Severe: slope, percs slowly.	Slight.
152*: Urban land.				
Tierra	Severe: slope.	Severe: slope.	Severe: slope, percs slowly.	Moderate: slope.
Azule	Severe: slope.	Severe: slope.	Severe: slope.	Moderate: slope.
153*:				
Vallecitos	Severe: slope.	Severe: slope.	Severe: slope, depth to rock.	Severe: slope.
Rock outcrop.				
154 Willows	Moderate: too clayey, percs slowly.	Moderate: too clayey.	Severe: too clayey.	Moderate: too clayey.
155* Xerorthents	Severe: too clayey, slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.
156* Xeropsamments	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.	Severe: too sandy.
157*:				
Xerorthents	Severe: too clayey, slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.
Altamont	Severe: slope.	Severe: slope.	Severe: too clayey, slope.	Severe: slope.
158*:				
Xerorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Los Osos	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
159*, 160*:				
Xerorthents	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
Millsholm	Severe: slope.	Severe: slope.	Severe: slope.	Severe: slope.
161 Yolo	Slight	Slight	Slight	Slight.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 8.--WILDLIFE HABITAT POTENTIALS

[See text for definitions of "good," "fair," "poor," and "very poor." Absence of an entry indicates that the soil was not rated]

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
100 Altamont	Fair	Good	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
101 Altamont	Fair	Fair	Good	Poor	Poor	Very poor	Fair	Very poor	Fair.
102 Altamont	Poor	Fair	Good	Poor	Poor	Very poor	Poor	Very poor	Fair.
103 Azule	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
104 Azule	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
105 Baywood Variant	Fair	Fair	Fair	Fair	Poor	Very poor	Fair	Very poor	Fair.
106 Botella	Good	Good	Good	Good	Fair	Fair	Good	Fair	Good.
107 Clear Lake	Fair	Good	Poor	Poor	Poor	Good	Fair	Fair	Poor.
108 Clear Lake	Good	Good	Fair	Poor	Poor	Very poor	Good	Very poor	Fair.
109 Climara	Poor	Fair	Good	Poor	Very poor	Very poor	Poor	Very poor	Fair.
110 Contra Costa	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
111 Danville	Good	Good	Good	Good	Good	Fair	Good	Fair	Good.
112 Danville	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
113, 114 Diablo	Fair	Good	Poor	Poor	Very poor	Very poor	Fair	Very poor	Poor.
115 Diablo	Poor	Fair	Poor	Poor	Very poor	Very poor	Poor	Very poor	Poor.
116*:									
Gaviota	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Poor.
Rock outcrop.									
117 Laugenour	Good	Good	Good	Good	Poor	Good	Good	Fair	Good.
118*:									
Los Gatos	Poor	Poor	Good	Good	Very poor	Very poor	Poor	Very poor	---
Los Osos	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
119*:									
Los Gatos	Very poor	Very poor	Good	Good	Very poor	Very poor	Very poor	Very poor	---
Los Osos	Very poor	Very poor	Good	Good	Very poor	Very poor	Poor	Very poor	Good.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
120. Los Osos	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
121. Los Osos	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
122*:									
Los Osos	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
Millsholm	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
123*:									
Los Osos	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
Millsholm	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
124*:									
Los Osos	Very poor	Very poor	Good	Good	Very poor	Very poor	Poor	Very poor	Good.
Millsholm	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
125. Marvin	Fair	Fair	Poor	Fair	Good	Good	Fair	Good	Fair.
126. Maymen	Very poor	Very poor	Poor	Good	Very poor	Very poor	Fair	Very poor	---
127*:									
Maymen	Very poor	Very poor	Poor	Good	Very poor	Very poor	Fair	Very poor	---
Los Gatos	Very poor	Very poor	Good	Good	Very poor	Very poor	Very poor	Very poor	---
128. Millsholm	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
129. Millsholm	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
130*:									
Montara	Very poor	Very poor	Poor	Fair	Very poor	Very poor	Very poor	Very poor	Poor.
Rock outcrop.									
131. Omni	Good	Good	Good	Poor	Poor	Poor	Good	Poor	Fair.
132. Omni	Poor	Poor	Poor	Poor	Fair	Fair	Poor	Fair	---
133. Pescadero	Poor	Fair	Very poor	Very poor	Good	Fair	Poor	Fair	Very poor.
134. Pescadero	Very poor	Very poor	Poor	Poor	Poor	Poor	Very poor	Poor	---
135*. Pits									
136. Pleasanton	Good	Good	Good	Good	Poor	Very poor	Good	Very poor	Good.
137. Reyes	Poor	Fair	Good	Good	Poor	Fair	Fair	Fair	Good.
138. Reyes	Very poor	Very poor	Very poor	Very poor	Poor	Good	Very poor	Fair	Very poor.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
139 Reyes	Poor	Fair	Poor	Poor	Fair	Good	Poor	Fair	Poor.
140 Rincon	Fair	Good	Fair	Good	Poor	Poor	Good	Poor	Fair.
141*. Riverwash									
142*. Quarry									
143 Sycamore	Good	Good	Good	Good	Poor	Poor	Good	Poor	Good.
144 Sycamore	Good	Good	Good	Good	Fair	Fair	Good	Fair	---
145 Tierra	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
146*. Urban land									
147*: Urban land.									
Baywood	Fair	Good	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
148*: Urban land.									
Clear Lake	Fair	Good	Poor	Poor	Poor	Good	Fair	Fair	Poor.
149*: Urban land.									
Danville	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.
150*, 151*: Urban land.									
Tierra	Fair	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
152*: Urban land.									
Tierra	Poor	Fair	Fair	Fair	Very poor	Very poor	Fair	Very poor	Fair.
Azule	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
153*: Vallecitos	Very poor	Very poor	Fair	Fair	Very poor	Very poor	Poor	Very poor	Fair.
Rock outcrop.									
154 Willows	Good	Good	Poor	Poor	Good	Good	Fair	Good	Poor.
155* Xerorthents	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
156* Xeropsamments	Very poor	Very poor	Very poor	Very poor	Poor	Very poor	Very poor	Poor	Very poor.
157*: Xerorthents	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
Altamont	Poor	Fair	Good	Poor	Poor	Very poor	Poor	Very poor	Fair.

See footnote at end of table.

TABLE 8.--WILDLIFE HABITAT POTENTIALS--Continued

Soil name and map symbol	Potential for habitat elements						Potential as habitat for--		
	Grain and seed crops	Grasses and legumes	Wild herba-ceous plants	Shrubs	Wetland plants	Shallow water areas	Openland wildlife	Wetland wildlife	Rangeland wildlife
158*:									
Xerorthents	Very poor	Very poor	Good	Good	Very poor	Very poor	Very poor	Very poor	Good.
Los Osos	Poor	Fair	Good	Good	Very poor	Very poor	Fair	Very poor	Good.
159*:									
Xerorthents	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Millsholm	Very poor	Poor	Fair	Poor	Very poor	Very poor	Poor	Very poor	Poor.
160*:									
Xerorthents	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Very poor.
Millsholm	Very poor	Very poor	Poor	Poor	Very poor	Very poor	Very poor	Very poor	Poor.
161 Yolo	Fair	Good	Good	Good	Very poor	Very poor	Good	Very poor	Good.

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 9.--ENGINEERING PROPERTIES AND CLASSIFICATIONS

[The symbol > means more than. Absence of an entry indicates that data were not estimated]

Soil name and map symbol	Depth	USDA texture	Classification		Fragments > 3 inches	Percentage passing sieve number--				Liquid limit	Plasticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
100, 101, 102------ Altamont	0-28	Clay-------------	CH, CL	A-7	0	100	95-100	95-100	75-95	40-60	20-35
	28-50	Clay, silty clay, clay loam.	CH, CL	A-7	0	100	95-100	95-100	75-95	40-60	20-35
	50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
103, 104----------- Azule	0-6	Clay loam--------	CL	A-6	0	80-100	75-100	70-100	60-95	30-40	10-20
	6-25	Clay, sandy clay	CL, CH	A-7	0	80-100	75-100	70-100	50-95	45-60	25-40
	25	Weathered bedrock.	---	---	---	---	---	---	---	---	---
105---------------- Baywood Variant	0-60	Sand-------------	SM, SP-SM	A-2, A-3	0	100	100	50-75	5-15	---	NP
106---------------- Botella	0-9	Loam-------------	CL-ML, CL	A-4, A-6	0	80-100	75-100	65-95	50-70	25-35	5-15
	9-33	Silty clay loam, clay loam.	CL	A-6, A-7	0	90-100	85-100	70-95	60-80	35-45	15-25
	33-60	Sandy clay loam, clay loam, silt loam.	SC, CL	A-6	0	90-100	85-100	70-90	35-65	30-40	10-20
107, 108----------- Clear Lake	0-26	Clay-------------	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-30
	26-60	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-30
109---------------- Climara	0-27	Clay-------------	CL, CH	A-7	0-10	95-100	75-95	80-90	70-85	40-60	20-30
	27-33	Gravelly clay, clay.	CL, CH	A-7	0-10	70-100	60-95	60-90	50-75	40-60	20-30
	33	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
110---------------- Contra Costa	0-24	Clay loam--------	CL	A-6	0	75-100	75-100	75-100	60-80	20-40	10-25
	24-30	Clay, clay loam	CL, CH	A-7, A-6	0	85-100	85-100	80-100	75-95	35-60	15-35
	30-35	Gravelly clay, gravelly clay loam.	CL, CH	A-7	5-15	85-100	60-75	50-70	50-70	40-60	25-35
	35	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
111, 112----------- Danville	0-21	Silty clay loam	CL	A-6	0	90-100	80-100	70-85	55-70	25-40	15-25
	21-53	Clay, silty clay, silty clay loam.	CL, CH	A-7	0	100	95-100	70-85	55-70	40-60	20-30
	53-80	Clay loam, silty clay loam.	CL	A-6	0	85-100	75-90	65-90	50-75	20-40	10-25
113, 114, 115------ Diablo	0-15	Clay-------------	CL, CH	A-7	0	100	95-100	95-100	85-95	45-70	20-40
	15-42	Silty clay, clay, clay loam.	CL, CH	A-7	0	100	95-100	95-100	85-95	45-70	20-40
	42-50	Silty clay, silty clay loam, clay.	CL, CH	A-7, A-6	0	90-100	85-100	85-100	75-95	35-70	15-40
	50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
116*:											
Gaviota-----------	0-11	Sandy loam------	SM	A-4, A-2	0-5	75-100	75-100	55-70	30-50	20-30	NP-5
	11	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 9.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
117-----------------	0-8	Loam------------	ML, CL-ML	A-4	0	100	100	85-95	60-75	20-30	NP-10
Laugenour	8-23	Fine sandy loam	SM	A-4	0	100	100	75-85	40-50	15-25	NP-5
	23-40	Loam------------	CL-ML, ML	A-4	0	100	100	80-90	50-60	15-25	NP-10
	40-60	Silty clay loam	CL	A-7, A-6	0	100	100	95-100	85-95	35-45	15-25
118*, 119*:											
Los Gatos---------	0-19	Loam------------	CL	A-6	0-5	90-100	80-100	75-85	60-75	25-40	10-20
	19-40	Clay loam, loam	CL	A-6	0-5	80-100	75-100	60-80	50-65	30-40	15-20
	40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Los Osos----------	0-8	Silty clay loam	CL	A-6, A-7	0	95-100	90-100	80-100	70-95	30-50	10-20
	8-30	Silty clay loam, clay loam, clay.	CL, CH	A-7	0	95-100	90-100	75-100	55-90	45-60	20-30
	30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
120, 121-----------	0-8	Silty clay loam	CL	A-6, A-7	0	95-100	90-100	80-100	70-95	30-50	10-20
Los Osos	8-30	Silty clay loam, clay loam, clay.	CL, CH	A-7	0	95-100	90-100	75-100	55-90	45-60	20-30
	30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
122*, 123*, 124*:											
Los Osos----------	0-8	Silty clay loam	CL	A-6, A-7	0	95-100	90-100	80-100	70-95	30-50	10-20
	8-30	Silty clay loam, clay loam, clay.	CL, CH	A-7	0	95-100	90-100	75-100	55-90	45-60	20-30
	30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
Millsholm---------	0-20	Silt loam-------	ML, CL-ML	A-4	0	80-100	80-100	70-100	50-75	25-35	NP-10
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
125-----------------	0-4	Silt loam-------	CL, CL-ML	A-4	0	100	100	85-95	70-90	25-30	5-10
Marvin	4-36	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	40-60	20-35
	36-60	Silty clay loam, clay loam.	CL, CL-ML	A-6	0	100	100	95-100	75-95	30-40	10-20
126-----------------	0-19	Loam------------	SM, ML	A-4, A-2	0	100	95-100	55-85	30-70	15-25	NP-5
Maymen	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
127*:											
Maymen------------	0-19	Loam------------	SM, ML	A-4, A-2	0	100	95-100	55-85	30-70	15-25	NP-5
	19	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Los Gatos---------	0-19	Loam------------	CL	A-6	0-5	90-100	80-95	75-85	60-75	25-40	10-20
	19-40	Clay loam, loam	CL	A-6	0-5	75-95	70-95	60-80	50-65	30-40	15-20
	40	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
128, 129-----------	0-20	Silt loam-------	ML, CL-ML	A-4	0	80-100	80-100	70-100	50-75	25-35	NP-10
Millsholm	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
130*:											
Montara-----------	0-14	Clay loam-------	CL	A-6, A-7	0-5	90-100	75-100	75-90	70-80	30-50	10-25
	14	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											

See footnote at end of table.

TABLE 9.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
131, 132----------- Omni	0-6	Silty clay loam	CL, ML	A-6, A-7	0	100	100	90-100	70-90	35-45	10-20
	6-52	Silty clay, clay	CL, CH	A-7	0	100	100	90-100	75-95	45-70	20-45
	52-60	Stratified clay loam to silty clay.	CL, CH	A-7	0	100	100	90-100	75-95	45-60	20-40
133---------------- Pescadero	0-2	Clay loam-------	CH	A-7	0	100	100	95-100	85-95	50-60	30-45
	2-30	Clay, silty clay	CH	A-7	0	100	100	95-100	85-95	50-60	30-45
	30-60	Clay loam, silty clay loam.	CL	A-7	0	95-100	95-100	90-100	80-95	40-50	15-25
134---------------- Pescadero	0-2	Clay loam-------	CL	A-7, A-6	0	100	100	90-100	70-80	30-60	10-45
	2-30	Clay------------	CH, CL	A-7, A-6	0	100	100	90-100	75-95	35-60	20-45
	30-60	Clay loam-------	CL	A-7, A-6	0	100	100	90-100	70-80	30-45	10-20
135*. Pits											
136---------------- Pleasanton	0-21	Gravelly loam---	GC, SC	A-6	0-5	55-80	50-75	45-70	35-50	30-40	10-20
	21-64	Gravelly loam, gravelly sandy clay loam, gravelly clay loam.	GC, SC, CL	A-6	0-10	55-80	50-75	40-70	35-55	25-40	10-20
	64-72	Gravelly fine sandy loam, gravelly loam, gravelly sandy clay loam.	GM, GC, GM-GC	A-4, A-6, A-2, A-1	0-10	55-75	50-75	45-65	20-50	15-35	NP-15
137, 138, 139------ Reyes	0-6	Clay------------	MH	A-7	0	100	100	90-100	80-95	50-70	20-30
	6-72	Clay, silty clay, silty clay loam.	ML, MH	A-7	0	100	100	85-100	85-95	45-70	15-30
140---------------- Rincon	0-16	Clay loam-------	CL	A-6, A-7	0	100	95-100	90-100	80-90	30-40	10-20
	16-52	Sandy clay, clay, clay loam.	CL, CH	A-7	0	100	95-100	90-100	75-90	40-60	25-35
	52-60	Stratified sandy loam to clay loam.	SC, CL	A-6	0	90-100	85-100	80-90	35-70	20-40	10-25
141*. Riverwash											
142*. Quarry											
143---------------- Sycamore	0-18	Silt loam-------	ML	A-4	0	100	100	90-100	75-90	20-35	NP-10
	18-60	Silt loam, loam	ML	A-4	0	100	100	85-100	60-90	20-35	NP-10
144---------------- Sycamore	0-44	Silt loam-------	ML, CL-ML	A-4	0	100	100	90-100	70-90	25-35	5-10
	44-60	Clay------------	CL, CH	A-7	0	100	100	90-100	75-95	40-60	20-35
145---------------- Tierra	0-12	Loam------------	CL, CL-ML	A-4, A-6	0	95-100	80-100	70-95	50-65	20-35	5-15
	12-32	Clay, clay loam, sandy clay.	CH, CL	A-6, A-7	0	100	85-100	70-100	50-95	35-55	15-30
	32-60	Clay loam, sandy clay loam.	CL, SC	A-6	0	95-100	80-100	70-95	45-75	25-40	10-20
146*. Urban land.											
147*: Urban land.											
Baywood-----------	0-16	Loamy sand------	SM	A-2	0	100	100	50-90	15-35	---	NP
	16-60	Loamy sand, loamy fine sand.	SM	A-2	0	100	100	50-95	15-35	---	NP

See footnote at end of table.

TABLE 9.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
148*: Urban land.											
Clear Lake	0-26	Clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-30
	26-60	Clay, silty clay	CH, CL	A-7	0	100	100	95-100	85-95	40-60	20-30
149*: Urban land.											
Danville	0-21	Clay loam	CL	A-6	0	90-100	80-100	70-85	55-70	25-40	15-25
	21-53	Clay, sandy clay, silty clay.	CL, CH	A-7	0	100	95-100	70-85	55-70	40-60	20-30
	53-80	Clay loam, silty clay loam.	CL	A-6	0	85-100	75-90	65-90	50-75	20-40	10-25
150*, 151*: Urban land.											
Tierra	0-12	Loam	CL, CL-ML	A-4, A-6	0	95-100	80-100	70-95	50-65	20-35	5-15
	12-32	Clay, clay loam, sandy clay.	CH, CL	A-6, A-7	0	100	85-100	70-100	50-95	35-55	15-30
	32-60	Clay loam, sandy clay loam.	CL, SC	A-6	0	95-100	80-100	70-95	45-75	25-40	10-20
152*: Urban land.											
Tierra	0-12	Loam	CL, CL-ML	A-4, A-6	0	95-100	80-100	70-95	50-65	20-35	5-15
	12-32	Clay	CH, CL	A-6, A-7	0	100	85-100	70-100	50-95	35-55	15-30
	32-60	Sandy clay loam	CL, SC	A-6	0	95-100	80-100	70-95	45-75	25-40	10-20
Azule	0-6	Clay loam	CL	A-6	0	80-100	75-100	70-100	60-95	30-40	10-20
	6-25	Clay	CL, CH	A-7	0	80-100	75-100	70-100	50-95	45-60	25-40
	25	Weathered bedrock.	---	---	---	---	---	---	---	---	---
153*: Vallecitos	0-6	Gravelly loam	SC, SM-SC	A-2	0-5	70-80	60-70	50-60	25-35	25-35	5-15
	6-16	Clay loam	CL	A-7, A-6	0	90-100	80-90	65-75	55-75	35-45	15-20
	16	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Rock outcrop.											
154 Willows	0-19	Clay	CH	A-7	0	100	100	90-100	85-95	50-70	25-40
	19-72	Clay, silty clay	CH	A-7	0	100	100	90-100	85-95	50-70	25-40
155* Xerorthents	0-60	Clay	CL, CH	A-7	0-20	80-100	80-100	75-100	65-95	40-60	20-35
156* Xeropsamments	0-60	Sand	SM, SP-SM	A-2, A-3	0	100	100	50-75	5-15	---	NP
157*: Xerorthents	0-24	Clay	CL, CH	A-7	0-20	80-100	80-100	75-100	65-95	40-60	20-35
	24	Weathered bedrock.	---	---	---	---	---	---	---	---	---
157*: Altamont	0-28	Clay	CH, CL	A-7	0	100	95-100	95-100	75-95	40-60	20-35
	28-50	Clay, silty clay, clay loam.	CH, CL	A-7	0	100	95-100	95-100	75-95	40-60	20-35
	50	Weathered bedrock.	---	---	---	---	---	---	---	---	---
158*: Xerorthents	0-60		---	---	---	---	---	---	---	---	---

See footnote at end of table.

TABLE 9.--ENGINEERING PROPERTIES AND CLASSIFICATIONS--Continued

Soil name and map symbol	Depth	USDA texture	Classification		Frag- ments > 3 inches	Percentage passing sieve number--				Liquid limit	Plas- ticity index
			Unified	AASHTO		4	10	40	200		
	In				Pct					Pct	
158*:											
Los Osos	0-10	Clay loam	CL	A-6, A-7	0	95-100	90-100	80-100	70-95	30-50	10-20
	10-30	Silty clay loam, clay loam, clay.	CL, CH	A-7	0	95-100	90-100	75-100	55-90	45-60	20-30
	30	Weathered bedrock.	---	---	---	---	---	---	---	---	---
159*:											
Xerorthents	0-60	Silt loam	CL-ML	A-4	0-35	80-100	75-100	65-80	50-70	20-30	5-10
	60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Millsholm	0-20	Silt loam	ML, CL-ML	A-4	0	80-100	80-100	70-100	50-75	25-35	NP-10
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
160*:											
Xerorthents	0-60	Loam	CL-ML	A-4	0-35	80-100	75-100	65-80	50-70	20-30	5-10
	60	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
Millsholm	0-20	Silt loam	ML, CL-ML	A-4	0	80-100	80-100	70-100	50-75	25-35	NP-10
	20	Unweathered bedrock.	---	---	---	---	---	---	---	---	---
161 Yolo	0-8	Silt loam	ML, CL-ML	A-4	0	100	100	85-100	70-85	20-30	NP-10
	8-60	Silt loam, silty clay loam.	CL	A-6, A-4	0	100	100	85-100	70-95	25-40	5-20

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS

[The symbol < means less than; > means more than. Entries under "Erosion factors--T" apply to the entire profile. Absence of an entry indicates that data were not available or were not estimated]

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T
	In	In/hr	In/in	pH	Mmhos/cm			
100, 101, 102 Altamont	0-28	0.06-0.2	0.12-0.16	6.1-7.8	<2	High	0.24	3
	28-50	0.06-0.2	0.12-0.16	7.4-8.4	<2	High	0.24	
	50	---	---	---	---	---	---	
103, 104 Azule	0-6	0.2-0.6	0.15-0.18	5.6-7.3	<2	Moderate	0.43	2
	6-25	0.06-0.2	0.15-0.18	5.6-7.3	<2	High	0.20	
	25	---	---	---	---	---	---	
105 Baywood Variant	0-60	6.0-20	0.05-0.08	6.6-8.4	<2	Low	0.15	5
106 Botella	0-9	0.6-2.0	0.14-0.16	6.6-7.8	<2	Moderate	0.43	5
	9-33	0.2-0.6	0.16-0.19	6.6-7.8	<2	Moderate	0.32	
	33-60	0.2-0.6	0.15-0.18	7.4-8.4	<2	Moderate	0.32	
107 Clear Lake	0-26	0.06-0.2	0.12-0.16	6.1-8.4	<2	High	0.24	5
	26-60	0.06-0.2	0.12-0.16	7.4-8.4	<4	High	0.24	
108 Clear Lake	0-26	0.06-0.2	0.12-0.16	6.1-8.4	<2	High	0.24	5
	26-60	0.06-0.2	0.12-0.16	7.4-8.4	<4	High	0.24	
109 Climara	0-27	0.06-0.2	0.12-0.15	6.6-8.4	<2	High	0.24	2
	27-33	0.06-0.2	0.10-0.14	7.4-8.4	<2	High	0.17	
	33	---	---	---	---	---	---	
110 Contra Costa	0-24	0.6-2.0	0.15-0.19	6.1-7.3	<2	Moderate	0.24	3
	24-30	0.06-0.2	0.15-0.19	5.6-7.3	<2	High	0.24	
	30-35	0.06-0.2	0.13-0.16	5.6-7.3	<2	High	0.24	
	35	---	---	---	---	---	---	
111, 112 Danville	0-21	0.2-0.6	0.16-0.19	6.1-7.3	<2	Moderate	0.32	5
	21-53	0.06-0.2	0.12-0.16	6.1-7.3	<2	High	0.24	
	53-80	0.2-0.6	0.15-0.18	6.6-8.4	<2	Moderate	0.28	
113, 114, 115 Diablo	0-15	0.06-0.2	0.12-0.15	6.1-7.8	<2	High	0.24	3
	15-42	0.06-0.2	0.14-0.19	7.4-8.4	<2	High	0.24	
	42-50	0.06-0.2	0.14-0.19	7.9-8.4	<8	High	0.24	
	50	---	---	---	---	---	---	
116*:								
Gaviota	0-11	2.0-6.0	0.07-0.12	5.6-7.3	<2	Low	0.43	1
	11	---	---	---	---	---	---	
Rock outcrop.								
117 Laugenour	0-8	0.6-2.0	0.14-0.16	7.9-8.4	<2	Low	0.37	5
	8-23	2.0-6.0	0.10-0.12	7.9-8.4	<2	Low	0.32	
	23-40	2.0-6.0	0.14-0.16	7.9-8.4	<2	Moderate	0.37	
	40-60	0.2-0.6	0.16-0.18	7.9-8.4	<2	Moderate	0.32	
118*, 119*:								
Los Gatos	0-19	0.6-2.0	0.15-0.20	5.6-7.3	<2	Moderate	0.32	2
	19-40	0.2-0.6	0.14-0.20	5.6-7.3	<2	Moderate	0.37	
	40	---	---	---	---	---	---	
Los Osos	0-8	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	0.32	2
	8-30	0.06-0.2	0.12-0.16	5.6-7.3	<2	High	0.28	
	30	---	---	---	---	---	---	
120, 121 Los Osos	0-8	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	0.32	2
	8-30	0.06-0.2	0.12-0.16	5.6-7.3	<2	High	0.28	
	30	---	---	---	---	---	---	

See footnote at end of table.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T
	In	In/hr	In/in	pH	Mmhos/cm			
122*, 123*, 124*:								
Los Osos--------	0-8	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	0.32	2
	8-30	0.06-0.2	0.12-0.16	5.6-7.3	<2	High------	0.28	
	30	---	---	---	---	----------	---	
Millsholm-------	0-20	0.6-2.0	0.14-0.17	5.6-6.5	<2	Low-------	0.43	1
	20	---	---	---	---	----------	---	
125-------------- Marvin	0-4	0.06-0.2	0.15-0.17	6.6-7.8	<4	Moderate	0.43	5
	4-36	0.06-0.2	0.15-0.17	7.9-8.4	4-8	High------	0.24	
	36-60	0.06-0.2	0.19-0.21	7.9-8.4	4-8	High------	0.37	
126-------------- Maymen	0-19	0.6-2.0	0.12-0.14	4.5-6.5	<2	Low-------	0.17	1
	19	---	---	---	---	----------	---	
127*:								
Maymen----------	0-19	0.6-2.0	0.12-0.14	4.5-6.5	<2	Low-------	0.17	1
	19	---	---	---	---	----------	---	
Los Gatos-------	0-19	0.6-2.0	0.15-0.20	5.6-7.3	<2	Moderate	0.32	2
	19-40	0.2-0.6	0.14-0.20	5.6-7.3	<2	Moderate	0.37	
	40	---	---	---	---	----------	---	
128, 129--------- Millsholm	0-20	0.6-2.0	0.14-0.17	5.6-6.5	<2	Low-------	0.43	1
	20	---	---	---	---	----------	---	
130*:								
Montara---------	0-14	0.2-0.6	0.17-0.20	6.6-8.4	<2	Moderate	0.32	1
	14	---	---	---	---	----------	---	
Rock outcrop.								
131-------------- Omni	0-6	0.2-0.6	0.14-0.19	7.4-8.4	<2	Moderate	0.43	5
	6-52	0.06-0.2	0.12-0.16	7.9-8.4	<2	High------	0.37	
	52-60	0.06-0.2	0.12-0.18	7.9-8.4	<2	High------	0.37	
132-------------- Omni	0-6	0.2-0.6	0.12-0.16	8.5-9.0	>8	Moderate	0.43	5
	6-52	0.06-0.2	0.06-0.10	8.5-9.0	>8	High------	0.37	
	52-60	0.06-0.2	0.06-0.10	8.5-9.0	>8	High------	0.37	
133-------------- Pescadero	0-2	0.2-0.6	0.14-0.16	6.1-8.4	4-8	High------	0.28	5
	2-30	<0.06	0.05-0.10	7.9-9.0	8-16	High------	0.28	
	30-60	0.06-0.2	0.05-0.10	7.9-9.0	8-16	Moderate	0.32	
134-------------- Pescadero	0-2	0.06-0.2	0.02-0.05	8.5-9.0	>16	Moderate	0.28	5
	2-30	<0.06	0.02-0.05	8.5-9.0	>16	High------	0.17	
	30-60	0.06-0.2	0.02-0.05	8.5-9.0	>16	Moderate	0.28	
135*. Pits								
136-------------- Pleasanton	0-21	0.6-2.0	0.07-0.11	5.6-7.3	<2	Low-------	0.28	5
	21-64	0.2-0.6	0.10-0.14	6.6-7.8	<2	Moderate	0.37	
	64-72	0.6-2.0	0.08-0.11	6.6-7.8	<2	Low-------	0.37	
137-------------- Reyes	0-6	0.06-0.2	0.06-0.10	6.6-8.4	>8	High------	0.15	5
	6-72	<0.06	0.03-0.05	6.6-8.4	>16	High------	0.28	
138-------------- Reyes	0-6	<0.06	0.-0.03	7.9-9.0	>16	High------	0.15	5
	6-72	<0.06	0.-0.03	7.9-9.0	>16	High------	0.28	
139-------------- Reyes	0-6	<0.06	0.06-0.14	6.1-8.4	4-8	High------	0.15	5
	6-72	<0.06	0.03-0.05	3.6-6.0	>16	High------	0.28	
140-------------- Rincon	0-16	0.2-0.6	0.17-0.19	6.1-7.3	<2	Moderate	0.37	4
	16-52	0.06-0.2	0.12-0.15	6.6-8.4	<2	High------	0.43	
	52-60	0.2-0.6	0.13-0.17	7.4-8.4	<2	Moderate	0.37	

See footnote at end of table.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors K	Erosion factors T
	In	In/hr	In/in	pH	Mmhos/cm			
141*. Riverwash								
142*. Quarry								
143------------- Sycamore	0-18	0.6-2.0	0.13-0.15	6.6-8.4	<2	Moderate	0.49	5
	18-60	0.6-2.0	0.13-0.18	6.6-8.4	<2	Moderate	0.49	
144------------- Sycamore	0-40	0.6-2.0	0.14-0.18	6.6-8.4	<2	Low-------	0.49	5
	40-60	0.06-0.2	0.12-0.14	7.4-8.4	<2	High------	0.24	
145------------- Tierra	0-12	0.6-2.0	0.13-0.16	5.6-6.5	<2	Low-------	0.37	1
	12-32	<0.06	0.02-0.04	5.6-7.3	<2	High------	0.28	
	32-60	0.06-0.2	0.15-0.18	5.6-8.4	<2	Moderate	0.37	
146*. Urban land								
147*: Urban land.								
Baywood---------	0-16	6.0-20	0.07-0.10	5.1-7.3	<2	Low-------	0.15	5
	16-60	6.0-20	0.06-0.09	5.1-7.3	<2	Low-------	0.15	
148*: Urban land.								
Clear Lake------	0-26	0.06-0.2	0.12-0.16	6.1-8.4	<2	High------	0.24	5
	26-60	0.06-0.2	0.12-0.16	7.4-8.4	<4	High------	0.24	
149*: Urban land.								
Danville--------	0-21	0.2-0.6	0.16-0.19	6.1-7.3	<2	Moderate	0.32	5
	21-53	0.06-0.2	0.12-0.16	6.1-7.3	<2	High------	0.24	
	53-80	0.2-0.6	0.15-0.18	6.6-8.4	<2	Moderate	0.28	
150*, 151*: Urban land.								
Tierra----------	0-12	0.6-2.0	0.13-0.16	5.6-6.5	<2	Low-------	0.37	1
	12-32	<0.06	0.02-0.04	5.6-7.3	<2	High------	0.28	
	32-60	0.06-0.2	0.15-0.18	5.6-8.4	<2	Moderate	0.37	
152*: Urban land.								
Tierra----------	0-12	0.6-2.0	0.13-0.16	5.6-6.5	<2	Low-------	0.37	1
	12-32	<0.06	0.02-0.04	5.6-7.3	<2	High------	0.28	
	32-60	0.06-0.2	0.15-0.18	5.6-8.4	<2	Moderate	0.37	
Azule-----------	0-6	0.2-0.6	0.15-0.18	5.6-7.3	<2	Moderate	0.43	2
	6-25	0.06-0.2	0.15-0.18	5.6-7.3	<2	High------	0.20	
	25	---	---	---	---	----------	---	
153*: Vallecitos------	0-6	0.6-2.0	0.11-0.13	6.1-6.5	<2	Low-------	0.37	1
	6-16	0.06-0.2	0.14-0.16	6.6-7.3	<2	Moderate	0.24	
	16	---	---	---	---	----------	---	
Rock outcrop.								
154------------- Willows	0-19	<0.06	0.10-0.12	7.4-9.0	2-8	High------	0.28	2
	19-72	<0.06	0.05-0.10	8.5-9.0	>4	High------	0.28	
155*------------ Xerorthents	0-60	<0.2	0.10-0.12	6.1-8.4	<2	High------	0.28	1
156*------------ Xeropsamments	0-60	6.0-20	0.05-0.07	6.6-8.4	<4	Low-------	0.24	5

See footnote at end of table.

TABLE 10.--PHYSICAL AND CHEMICAL PROPERTIES OF SOILS--Continued

Soil name and map symbol	Depth	Permeability	Available water capacity	Soil reaction	Salinity	Shrink-swell potential	Erosion factors	
							K	T
	In	In/hr	In/in	pH	Mmhos/cm			
157*:								
Xerorthents-----	0-24	<0.2	0.10-0.12	6.1-8.4	<2	High------	0.28	1
	24	---	---	---	---	----------	---	
Altamont--------	0-28	0.06-0.2	0.12-0.16	6.1-7.8	<2	High------	0.24	3
	28-50	0.06-0.2	0.12-0.16	7.4-8.4	<2	High------	0.24	
	50	---	---	---	---	----------	---	
158*:								
Xerorthents-----	0-60	---	---	---	---	----------	---	---
Los Osos--------	0-10	0.2-0.6	0.17-0.19	5.6-6.5	<2	Moderate	0.32	2
	10-30	0.06-0.2	0.12-0.16	5.6-7.3	<2	High------	0.28	
	30	---	---	---	---	----------	---	
159*, 160*:								
Xerorthents-----	0-60	0.6-2.0	0.12-0.16	5.6-7.8	<2	Low-------	0.32	1
	60	---	---	---	---	----------	---	
Millsholm-------	0-20	0.6-2.0	0.14-0.17	5.6-6.5	<2	Low-------	0.43	1
	20	---	---	---	---	----------	---	
161-------------- Yolo	0-8	0.6-2.0	0.14-0.17	6.1-7.3	<2	Moderate	0.37	5
	8-60	0.6-2.0	0.16-0.19	6.1-8.4	<2	Moderate	0.37	

* See description of the map unit for composition and behavior characteristics of the map unit.

TABLE 11.--SOIL AND WATER FEATURES

[The definitions of "flooding" and "water table" in the Glossary explain terms such as "rare," "brief," "apparent," and "perched." The symbol > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
100, 101, 102----- Altamont	D	None---------	---	---	>6.0	---	---	40-60	Rippable
103, 104---------- Azule	C	None---------	---	---	>6.0	---	---	24-40	Rippable
105--------------- Baywood Variant	B	None---------	---	---	3.0-5.0	Apparent	Jan-Dec	>60	---
106--------------- Botella	B	None---------	---	---	>6.0	---	---	>60	---
107--------------- Clear Lake	D	Rare---------	Brief-----	Nov-Mar	3.0-6.0	Apparent	Dec-Mar	>60	---
108--------------- Clear Lake	D	None to rare	---	---	>6.0	---	---	>60	---
109--------------- Climara	D	None---------	---	---	>6.0	---	---	20-40	Hard
110--------------- Contra Costa	C	None---------	---	---	>6.0	---	---	20-40	Rippable
111, 112---------- Danville	C	None---------	---	---	>6.0	---	---	>60	---
113, 114, 115----- Diablo	D	None---------	---	---	>6.0	---	---	40-60	Rippable
116*:									
Gaviota-----------	D	None---------	---	---	>6.0	---	---	10-20	Hard
Rock outcrop.									
117--------------- Laugenour	B	None---------	---	---	3.5-6.0	Apparent	Jan-Dec	>60	---
118*, 119*:									
Los Gatos---------	C	None---------	---	---	>6.0	---	---	24-40	Hard
Los Osos----------	C	None---------	---	---	>6.0	---	---	24-40	Rippable
120, 121---------- Los Osos	C	None---------	---	---	>6.0	---	---	24-40	Rippable
122*, 123*, 124*:									
Los Osos----------	C	None---------	---	---	>6.0	---	---	24-40	Rippable
Millsholm---------	D	None---------	---	---	>6.0	---	---	10-20	Hard
125--------------- Marvin	C	None---------	---	---	3.5-6.0	Perched	Dec-Jul	>60	---
126--------------- Maymen	D	None---------	---	---	>6.0	---	---	10-20	Hard
127*:									
Maymen------------	D	None---------	---	---	>6.0	---	---	10-20	Hard
Los Gatos---------	C	None---------	---	---	>6.0	---	---	24-40	Hard

See footnotes at end of table.

TABLE 11.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
128, 129---------- Millsholm	D	None--------	---	---	>6.0	---	---	10-20	Hard
130*: Montara----------	D	None--------	---	---	>6.0	---	---	10-20	Hard
Rock outcrop.									
131--------------- Omni	D	None--------	---	---	>5.0	Apparent	Jan-Dec	>60	---
132--------------- Omni	D	None--------	---	---	>4.0	Apparent	Jan-Dec	>60	---
133--------------- Pescadero	C	------------	---	---	4.0-6.0	Apparent	Jan-Dec	>60	---
134--------------- Pescadero	D	Common------	Very long	Jan-Dec	1.5-3.0	Apparent	Jan-Dec	>60	---
135*. Pits									
136--------------- Pleasanton	B	None--------	---	---	>6.0	---	---	>60	---
137--------------- Reyes	C/D	Frequent----	Very brief	Jan-Dec	0-2.0	Apparent	Jan-Dec	>60	---
138**------------- Reyes	D	Frequent----	Very long	Jan-Dec	+2-0.0	Apparent	Jan-Dec	>60	---
139--------------- Reyes	D	Frequent----	Very brief	Jan-Dec	2.0-4.0	Apparent	Jan-Dec	>60	---
140--------------- Rincon	C	None--------	---	---	>6.0	---	---	>60	---
141*. Riverwash									
142*. Quarry									
143, 144---------- Sycamore	B	None--------	---	---	>6.0	---	---	>60	---
145--------------- Tierra	D	None--------	---	---	>6.0	---	---	>60	---
146*. Urban land									
147*: Urban land.									
Baywood----------	A	None--------	---	---	>6.0	---	---	>60	---
148*: Urban land.									
Clear Lake-------	D	Rare--------	Brief-----	Nov-Mar	4.0-5.0	Apparent	Dec-Mar	>60	---
149*: Urban land.									
Danville---------	C	None--------	---	---	>6.0	---	---	>60	---
150*, 151*: Urban land.									

See footnotes at end of table.

TABLE 11.--SOIL AND WATER FEATURES--Continued

Soil name and map symbol	Hydrologic group	Flooding			High water table			Bedrock	
		Frequency	Duration	Months	Depth	Kind	Months	Depth	Hardness
					Ft			In	
150*, 151*:									
Tierra	D	None	---	---	>6.0	---	---	>60	---
152*:									
Urban land.									
Tierra	D	None	---	---	>6.0	---	---	>60	---
Azule	C	None	---	---	>6.0	---	---	24-40	Rippable
153*:									
Vallecitos	D	None	---	---	>6.0	---	---	10-20	Hard
Rock outcrop.									
154 Willows	D	None to rare	---	---	5.0-6.0	Apparent	Jan-Dec	>60	---
155* Xerorthents	D	None	---	---	>6.0	---	---	>60	---
156* Xeropsamments	D	None	---	---	3.5-6.0	Apparent	Jan-Dec	>60	---
157*:									
Xerorthents	D	None	---	---	>6.0	---	---	>24	Rippable
Altamont	D	None	---	---	>6.0	---	---	40-60	Rippable
158*:									
Xerorthents	C	None	---	---	>6.0	---	---	10-60	Hard
Los Osos	C	None	---	---	>6.0	---	---	24-40	Rippable
159*, 160*:									
Xerorthents	B	None	---	---	>6.0	---	---	>20	Rippable
Millsholm	D	None	---	---	>6.0	---	---	10-20	Hard
161 Yolo	B	None	---	---	>6.0	---	---	>60	---

* See description of the map unit for composition and behavior characteristics of the map unit.
**In the "High water table--Depth" column, a plus sign preceding the range in depth indicates that the water table is above the surface of the soil. The first numeral in the range indicates how high the water rises above the surface. The second numeral indicates the depth below the surface.

TABLE 12.--CLASSIFICATION OF THE SOILS

Soil name	Family or higher taxonomic class
Altamont	Fine, montmorillonitic, thermic Typic Chromoxererts
Azule	Fine, montmorillonitic, thermic Mollic Haploxeralfs
Baywood	Sandy, mixed, thermic Entic Haploxerolls
Baywood Variant	Sandy, mixed, thermic Aquic Haploxerolls
Botella*	Fine-loamy, mixed, thermic Pachic Argixerolls
Clear Lake	Fine, montmorillonitic, thermic Typic Pelloxererts
Climara	Fine, montmorillonitic, thermic Chromic Pelloxererts
Contra Costa	Fine, mixed, thermic Mollic Haploxeralfs
Danville	Fine, montmorillonitic, thermic Pachic Argixerolls
Diablo	Fine, montmorillonitic, thermic Chromic Pelloxererts
Gaviota	Loamy, mixed, nonacid, thermic Lithic Xerorthents
Laugenour	Coarse-loamy, mixed (calcareous), thermic Aeric Fluvaquents
Los Gatos	Fine-loamy, mixed, mesic Typic Argixerolls
Los Osos	Fine, montmorillonitic, thermic Typic Argixerolls
Marvin	Fine, montmorillonitic, thermic Aquic Haploxeralfs
Maymen	Loamy, mixed, mesic Dystric Lithic Xerochrepts
Millsholm	Loamy, mixed, thermic Lithic Xerochrepts
Montara	Loamy, serpentinitic, thermic Lithic Haploxerolls
Omni	Fine, montmorillonitic (calcareous), thermic Fluvaquentic Haplaquolls
Pescadero	Fine, montmorillonitic, thermic Aquic Natrixeralfs
Pleasanton	Fine-loamy, mixed, thermic Mollic Haploxeralfs
Reyes	Fine, mixed, acid, thermic Sulfic Haplaquepts
Rincon	Fine, montmorillonitic, thermic Mollic Haploxeralfs
Sycamore	Fine-silty, mixed, nonacid, thermic Aeric Haplaquepts
Tierra	Fine, montmorillonitic, thermic Mollic Palexeralfs
Vallecitos	Clayey, montmorillonitic, thermic Lithic Ruptic-Xerochreptic Haploxeralfs
Willows	Fine, montmorillonitic, thermic Typic Pelloxererts
Xeropsamments	Xeropsaments
Xerorthents	Xerorthents
Yolo	Fine-silty, mixed, nonacid, thermic Typic Xerorthents

*This soil is a taxadjunct to the series. See text for a description of those characteristics of the soil that are outside the range of the series.

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WETS Table

WETS Station: OAKLAND METROPOLITAN INTL AP, CA								
Requested years: 1948 - 2018								
Month	Avg Max Temp	Avg Min Temp	Avg Mean Temp	Avg Precip	30% chance precip less than	30% chance precip more than	Avg number days precip 0.10 or more	Avg Snowfall
Jan	56.2	41.9	49.0	3.38	1.51	4.07	6	0.0
Feb	59.5	44.8	52.1	2.84	1.29	3.46	6	0.0
Mar	62.0	46.6	54.3	2.48	1.16	3.03	6	0.0
Apr	64.4	48.6	56.5	1.48	0.49	1.74	3	0.0
May	67.1	51.8	59.4	0.39	0.11	0.35	1	0.0
Jun	70.1	54.4	62.3	0.14	0.00	0.10	0	0.0
Jul	71.1	56.2	63.6	0.03	0.00	0.01	0	0.0
Aug	71.7	56.8	64.2	0.03	0.00	0.03	0	0.0
Sep	73.8	56.2	65.0	0.20	0.00	0.13	0	0.0
Oct	70.3	52.5	61.4	1.10	0.25	1.15	2	0.0
Nov	63.0	47.0	55.0	2.27	1.03	2.74	5	0.0
Dec	56.6	42.6	49.6	3.57	1.55	4.35	6	0.0
Annual:					14.41	20.42		
Average	65.5	49.9	57.7	-	-	-	-	-
Total	-	-	-	17.91			37	0.0

GROWING SEASON DATES			
Years with missing data:	24 deg = 15	28 deg = 16	32 deg = 17
Years with no occurrence:	24 deg = 56	28 deg = 54	32 deg = 28
Data years used:	24 deg = 56	28 deg = 55	32 deg = 54
Probability	24 F or higher	28 F or higher	32 F or higher
50 percent *	No occurrence	No occurrence	No occurrence
70 percent *	No occurrence	No occurrence	No occurrence
* Percent chance of the growing season occurring between the Beginning and Ending dates.			

STATS TABLE - total precipitation (inches)													
Yr	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annl
1948	0.77	1.74	2.66	3.48	0.84	0.02	0.02	T	0.01	0.53	0.43	4.02	14.52
1949	1.67	3.43	4.78	T	0.45	T	0.03	0.10	T	0.25	1.74	2.53	14.98
1950	7.96	2.02	2.19	1.45	0.71	0.02	T	T	0.01	1.80	4.64	5.36	26.16
1951	4.34	2.46	1.46	0.95	0.67	0.01	T	0.19	T	0.54	3.22	8.36	22.20
1952	7.47	1.55	4.46	1.23	0.16	0.23	T	T	T	0.01	1.31	5.81	22.23
1953	2.04	0.02	1.72	2.55	0.42	0.53	T	0.09	T	0.35	1.74	0.41	9.87
1954	2.85	1.93	2.69	1.67	0.11	0.11	T	0.08	0.01	0.06	1.69	4.33	15.53
1955	4.14	1.05	0.41	1.40	0.35	T	T	T	T	0.07	2.10	11.29	20.81
1956	7.60	1.65	0.04	1.26	0.92	T	T	T	0.32	1.02	0.04	0.29	13.14
1957	2.82	3.12	2.16	0.94	3.42	0.04	T	0.00	0.67	2.62	0.52	3.26	19.57

1958	4.87	8.53	5.69	4.58	0.36	0.20	0.01	T	0.07	0.22	0.09	1.49	26.11
1959	3.96	3.95	0.33	0.02	T	0.00	0.00	0.03	3.27	T	T	1.46	13.02
1960	3.42	2.99	1.24	0.70	0.63	T	T	T	T	0.11	4.24	0.68	14.01
1961	2.63	0.88	2.47	0.96	0.59	T	T	0.09	0.32	0.07	3.96	1.90	13.87
1962	1.03	7.30	1.99	0.27	T	T	T	0.05	0.19	8.56	0.61	2.47	22.47
1963	2.68	2.64	3.31	4.60	0.51	0.03	T	0.01	0.28	1.44	3.19	0.42	19.11
1964	3.90	0.23	1.94	0.03	0.24	0.43	0.03	0.03	0.00	1.46	3.23	5.31	16.83
1965	2.95	0.82	1.95	2.54	T	T	0.01	0.06	T	0.07	4.29	3.63	16.32
1966	2.15	2.12	0.49	0.39	0.25	0.05	0.14	0.06	0.09	T	3.86	3.51	13.11
1967	8.90	0.27	4.62	4.46	0.12	1.05	0.00	T	0.01	0.53	1.32	2.70	23.98
1968	5.05	1.82	3.07	0.83	0.45	T	T	0.03	T	0.29	2.44	3.21	17.19
1969	6.90	8.85	0.98	1.82	T	0.05	T	0.00	T	2.06	0.71	4.33	25.70
1970	7.78	1.69	1.24	0.02	T	0.73	T	T	0.00	0.77	7.07	6.01	25.31
1971	1.30	0.57	2.59	0.63	0.17	T	0.00	T	0.12	0.07	1.66	3.50	10.61
1972	1.04	1.31	0.25	0.96	0.05	0.25	T	T	0.77	3.89	5.24	2.51	16.27
1973	7.37	5.94	2.78	0.05	0.05	T	T	0.00	0.42	1.35	7.42	3.99	29.37
1974	3.38	1.90	4.19	3.21	T	0.08	0.80	T	0.00	0.74	0.64	1.93	16.87
1975	1.96	3.24	5.08	1.78	T	0.08	0.13	0.10	T	4.40	0.49	0.28	17.54
1976	0.29	2.00	0.96	1.00	T	0.11	T	0.74	0.52	0.42	0.90	1.70	8.64
1977	1.06	0.81	1.83	0.10	1.12	T	0.07	0.02	0.56	0.28	1.97	3.88	11.70
1978	7.24	3.81	5.37	3.74	T	T	T	T	0.19	T	1.76	0.46	22.57
1979	6.65	4.79	2.64	0.58	0.18	T	0.06	T	0.00	2.06	2.04	4.79	23.79
1980	3.16	5.56	1.71	0.93	0.21	0.01	0.23	T	T	0.11	0.15	1.51	13.58
1981													
1982													
1983							0.00	0.02	0.49	0.46	6.39	5.70	13.06
1984	0.26	2.20	1.74	0.76	0.04	0.36	T	0.06	0.08	3.04	5.96	1.53	16.03
1985	0.48	1.44	3.46	0.08	0.02	0.14	M0.10	T	0.30	0.62	2.98		9.62
1986													
1987													
1988													
1989													
1990													
1991													
1992													
1993													
1994													
1995													
1996													
1997													

1998													
1999													
2000	5.66	7.63	1.84	0.81	1.12	0.19	0.02	M0.03	M0.17	M2.31	0.55	0.76	21.09
2001	2.49	6.22	M1.21	1.16	T	0.07	T	0.02	0.33	0.34	3.12	7.88	22.84
2002	1.29	1.63	3.24	0.37	M0.83	0.01	T	T	0.02	M0.02	2.68	9.03	19.12
2003	1.01	1.34	1.00	3.76	0.69	T	0.03	T	T	0.08	0.77	2.69	11.37
2004	M0.28	1.80	0.44	0.01	0.05	T	0.00	T	0.08	3.44	M1.57	5.30	12.97
2005	3.51	4.39	4.29	1.80	1.64	0.62	0.01	0.03	0.04	0.35	1.87	8.82	27.37
2006	3.13	1.85	7.13	3.59	0.65	T	M0.00	0.00	0.01	0.65	2.25	3.53	22.79
2007	0.75	4.74	0.33	1.33	0.10	T	T	T	0.17	1.55	0.87	2.95	12.79
2008	6.79	1.84	0.24	0.23	T	0.00	T	0.01	0.02	0.47	1.80	2.46	13.86
2009	1.03	5.94	1.99	0.34	0.58	0.03	0.01	0.01	0.22	3.22	0.21	M0.99	14.57
2010	3.73	2.39	2.57	2.55	1.16	0.01	T	T	0.01	0.70	2.92	6.63	22.67
2011	0.89	3.75	5.08	0.24	1.15	1.88	T	T	T	1.69	1.27	0.11	16.06
2012	2.17	M0.81	5.88	2.98	0.01	0.09	0.03	T	T	0.80	4.34	5.82	22.93
2013	0.29	0.52	0.49	1.33	0.02	0.17	T	T	0.61	0.01	1.17	M0.28	4.89
2014	0.04	3.66	2.65	1.60	T	T	0.01	T	0.44	0.57	1.79	8.86	19.62
2015	T	2.00	0.09	1.08	T	0.18	0.01	T	T	T	1.11	4.11	8.58
2016	5.22	0.30	4.80	1.00	M0.02	T	T	T	0.00	2.89	1.40	4.14	19.77
2017	7.53	7.34	2.69	2.46	T	0.03	0.00	T	0.07	M0.13	3.00	0.09	23.34
2018	4.59	0.34	3.65	3.18	T	T	T	T	T	M0.07			11.83

Notes: Data missing in any month have an "M" flag. A "T" indicates a trace of precipitation.

Data missing for all days in a month or year is blank.

Creation date: 2016-07-22