

Chapter 3

Hydrogeomorphic Setting

This chapter describes the physical setting of the inventory area and the four physiographic regions used to categorize the geomorphology of the inventory area. The overview presented in this chapter of the geologic, soil, climate, hydrologic, and geomorphic characteristics of the inventory area is important in understanding the location, extent, and functioning of the region's wetlands and aquatic resources.

3.1 Regional Physical Setting

3.1.1 Regional Geology

Elevations in the inventory area range from at or below sea level (marshes adjacent to the Sacramento–San Joaquin Delta [Delta] near Brentwood and Oakley) to the 3,849-foot peak of Mount Diablo, the highest point in the inventory area. The physiography of the inventory area is dominated by Mount Diablo and its surrounding hillslopes/valleys (which generally trend northwest/southeast according to local structure/faulting), lower valleys, and plains transitioning to the Bay/Delta zones.

Figure 3-1 shows a simplification of the regional geology to portray general rock types in the inventory area. Descending in age, materials include currently active and older Holocene alluvial deposits (stream channels, floodplain deposits, bay muds, basin materials, dune sands, older fan deposits, etc.). Wetlands in the inventory area are typically found in alluvium occupying valley floors and floodplains. Understanding the distribution, texture, and depth of the wetlands soils is important in characterizing and evaluating wetland functioning.

Several Tertiary sedimentary formations, which are older in the stratigraphic column than the Holocene alluvial deposits mentioned above, are also found in the inventory area. These formations include the Tulare Formation (Fm.) (Pliocene non-marine sandstones/conglomerates); Markly Fm. (Eocene sandstones/siltstones); and Meganos Fm. (Paleocene siltstones, shales, conglomerates). Differences in granular texture of the submember units of individual formations become important in understanding soil distributions and wetland support opportunities. For example, certain shale members of sedimentary rock may be more likely to support more clay-dominant soils that offer greater water impoundment through reduced porosity/permeability

(compared to sandier soils with better drainage). Older rocks in the inventory area include the sandstones, siltstones, and shale beds of the Great Valley Sequence and the basaltic/chert and sandstone mélangé of the Franciscan Complex observed on the higher portions of Mount Diablo.

3.1.2 Regional Soils

Soils in the inventory area are highly variable because of the complex geology, climate, topography, and hydrology in the area (Figure 3-2). The Contra Costa County general soils map (Soil Conservation Service 1977) identifies 14 soil associations (distinctive patterns of soils in defined proportions) in the county. The inventory area contains all these soil associations except the Joice-Reyes association, which consists of saline mucks and silty clays in saltwater marshes and tidal flats. Most of the soils in the inventory area formed from alluvial, sedimentary, and meta-sedimentary sources and have been formed in concert with the complex geologic history of the area.

Many areas on the lower terraces have been urbanized and/or altered to produce crops. As mentioned above in relation to regional geology, the spatial distribution of sands, clays, clay loams, and mucks (as shown in Figure 3-2) is a key parameter in distinguishing the location and extent of wetlands, their cause, and their functioning. Figure 3-2 shows the banding of higher infiltrating sandy soils compared to clays in the Sand, Deer, Dry, and Briones Creek subbasins of the central inventory area.

3.1.3 Regional Climate

The inventory area is located in a transitional zone between the San Francisco Bay Area and the San Joaquin Valley in eastern Contra Costa County. The inventory area is characterized by a Mediterranean climate, with varying degrees of maritime influence depending on proximity to the Bay. Precipitation in the inventory area falls mostly as rain during the late fall, winter, and early spring months, although the higher elevations can receive infrequent snowfalls during the winter months, with snow sometimes lasting for 2–3 days on Mount Diablo (Soil Conservation Service 1977). Total precipitation is variable from an average of 13 inches per year at Antioch to almost 23 inches at Mount Diablo (Figure 3-3). Variability in precipitation reflects elevational and aspect differences in relation to the Bay and Mount Diablo. In particular, a rain shadow effect on the lee, or eastern, side of the Diablo Range increases aridity east of the mountains towards the Delta lowlands.

The climate in the inventory area is strongly influenced by its location and topography. In the summer, a steady marine wind blows through the Golden Gate and up the Carquinez Strait. The eastern portion of the inventory area is not influenced by marine air to the same extent as the western portion.

Consequently, temperatures in the eastern part of the inventory area are generally

warmer than in the western part. The alluvial dune sand geology and soils in the northern areas of lower Marsh Creek subbasin are a product of these historically strong winds and a sand source to the north in the Bay and Delta.

3.1.4 Regional Hydrology and Land Use

The inventory area contains several streams that drain to Suisun Bay and the Delta (Figure 1-2). For the purposes of this study, these watersheds have been subdivided into 15 subbasin units (Figure 1-3). Because of the Mediterranean climate and its characteristic lack of rainfall during the summer months, ephemeral and intermittent streams are the dominant hydrologic features in the inventory area.

Surface flow in ephemeral streams is generally supplied by rainfall; these streams flow only during and immediately following rain events. Surface flow in intermittent or seasonal streams is supplied by a combination of rainfall runoff and groundwater; these streams generally flow throughout the rainy season and into the late spring or early summer. Perennial streams in the inventory area are also supported by rainfall runoff and groundwater, but unlike seasonal streams, they run year-round with major dry-season input from both natural and artificial sources (e.g., upwelling springs or fault/geologic contacts, and surface/subsurface flows from local irrigation, respectively).

Major perennial streams in the inventory area include portions of Upper Mount Diablo Creek and its tributaries, Upper and Lower Marsh Creek, Lower Sand Creek and Deer Creek, and Kirker Creek. Evidence suggests that the perennial reaches of Lower Marsh, Sand, and Deer Creeks were not historically perennial and that current hydrological conditions have been influenced by increased discharges from agricultural and urban sources (Natural Heritage Institute and Delta Science Center 2002). Marsh Creek drains the largest area of any stream originating in the inventory area. Figure 1-2 (Figure 1-2) shows major perennial and ephemeral streams in the inventory area. Except for a few small streams that drain west into San Francisco and San Pablo Bays, most streams drain into the San Joaquin River and Suisun Bay to the north and east.

Land use (Figure 3-4 and Table 5-0 in Chapter 5) and hydrology are discussed separately below for the four physiographic regions in the inventory area.

3.2 Geomorphic Regions

To assist in the hydrologic and geomorphic assessment of individual subbasins and their wetland features (documented in Chapter 5), the inventory area has been classified into four geomorphic regions with similar physiographic conditions: montane region, foothills/upper valley region, lower plain/valley region, and Sacramento–San Joaquin Delta region (Figure 3-5). This classification was based on general elevational/structural conditions, whereby

hillslope steepness and stream channel slopes are greatest in the montane zone and then decrease through the upper valleys, foothills, lower valleys, and plains, into the Delta zone.

The montane and foothills areas are source areas for sediment, groundwater, surface water, and water quality constituents to be transported downstream towards the upper valleys, lower valleys, and plains. However, while generally related to elevation and slope, this simple cascade of sediment/water downstream does not necessarily incorporate the opportunities for “sinks” (or storage) of water/sediment in several depositional areas throughout the system, such as floodplains, hollows, perches, terraces, mid-channel pools. These geomorphic features are often the most likely place for wetland occurrence. Thus, the classification of the four geomorphic regions was also based on a system that relates the basic physical processes of water/sediment transport to wetland occurrence/location.

Owing to topographic variability, individual subbasins in the inventory area cross more than one geomorphic region. For example, the Sand Creek subbasin is primarily characterized as a foothill/upper valley type of basin, but it originates in the montane region and continues downstream passing into the lower valley/plain region. For purposes of this report, individual subbasins are organized according to their principal geomorphic region as follows.

- Montane Region: Upper Mount Diablo Creek and Upper Marsh Creek.
- Foothills/Upper Valley Region: Willow Creek, Kirker Creek, West Antioch Creek, Deer Creek, Briones Creek, Sand Creek, Dry Creek, Brushy Creek, and Kellogg Creek.
- Lower Valley/Plain Region: East Antioch Creek, Oakley Creek, and Lower Marsh Creek.
- Sacramento–San Joaquin Delta Region: East County Delta Drainages (includes Indian, Rock, Sand Mound, Dutch, Piper, and Taylor Sloughs, as well as False River).

3.2.1 Montane Region

Most drainages in the montane region remain relatively natural and occupy at least a portion of their historic floodplains. This region plays an important role in providing high-quality habitat to riparian and wetlands species and is an important sediment source area for the rest of the inventory area. Most of the creeks in this area are ephemeral or intermittent and generally support narrow floodplains with limited riparian habitat. However, there are perennial, spring-fed reaches in this region as well. Stream gradients in this region are steep, and channels are frequently confined within narrow bedrock canyons.

3.2.2 Foothills/Upper Valley Region

Many of the drainages in the foothills/upper valley region have been affected by several decades of grazing. Under certain conditions and grazing regimes, livestock can be an effective means of controlling invasive species and maintaining a diverse native plant community. If stocking rates are too high, rotations are too long, and livestock access to aquatic resources is not properly regulated, grazing can reduce native plant cover, reduce overall vegetative cover, compact soils, contour hillslopes through the formation of terracettes, and destabilize streambanks.

In some areas, soil compaction and reduced vegetative cover due to overgrazing have increased storm runoff by reducing rainfall interception and soil infiltration. Increased surface runoff has led to increased stream flow in channels with unstable banks. These combined processes often result in eroded streams with severely incised reaches through valley bottom sections, higher sediment loads in the streams, and an increased alluviation/deposition at some point downstream where gradients are reduced. In general, channel erosion and incision has not been as severe in shallow hillslope tributaries as in valley bottoms, but native vegetation and overall vegetative cover has been severely reduced in these areas as well. Stream gradients in this geomorphic region are relatively steep in the foothills, and become much less steep on the valley floor.

3.2.3 Lower Valley/Plain Region

The lower valley/plain region of the inventory area has mostly been urbanized. In urban areas, hydrology and stream form has been altered for flood control or to convey irrigation water. Most streams have been disconnected from their historic floodplains by levees and channelization. Many of these streams are maintained as flood control channels that support little or no riparian vegetation. The terrain in this region is nearly level, with some low hills.

3.2.4 Sacramento–San Joaquin Delta Region

Most of the low-lying lands within the western Sacramento–San Joaquin Delta region (Delta region) have been reclaimed by protective dikes and converted to agricultural uses. As a result, little native vegetation remains in the area. The terrain in this region is nearly level, with very little topographic relief. Portions of the northeastern corner of the inventory area have substantially subsided and are currently at or below sea level. Sensitive channel systems have developed in this area because of blockage of natural flows by roads, culverts, and railroad lines. The drainages in the Delta region are treated here collectively as a single subbasin, the East County Delta Drainages. This subbasin includes Indian, Rock, Sand Mound, Dutch, Piper, and Taylor Sloughs, as well as False River.