APPENDIX B

Physical Hydrological, and Ecological Conditions Influencing Anadromous Salmonid Habitat in Policy Area Streams

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PHYSICAL, HYDROLOGICAL, AND ECOLOGICAL CONDITIONS INFLUENCING ANADROMOUS SALMONID HABITAT IN POLICY AREA STREAMS

This appendix describes certain prominent physical, hydrological, and ecological characteristics associated with the Policy area that can influence anadromous salmonid habitats within adjoining streams and rivers.

B.1 PHYSICAL CHARACTERISTICS

The Policy area covers about 5,000 square miles and is generally mountainous, except for about 550 square miles of relatively flat area (slopes < 4%), 45 percent of which lies in the Russian River basin and the remainder in the lower part of basins draining into San Pablo Bay (Figure 1-1). The Policy area lies wholly within the northern California Coast Ranges physiographic section (Fenneman 1931). The mountain rocks consist of consolidated rock, mostly sandstone and shale, composing the Franciscan Formation. Volcanic rocks overlie the Franciscan rocks in some areas. The Franciscan rocks and, to a lesser degree, the younger volcanics, have been folded, faulted, and eroded to form northwest-trending ridges and valleys.

Some valleys in the Policy area are broad and flat and contain thick sedimentary deposits (USGS 1967). Some gradient valleys contain thick deposits of gravel derived from erosion of surrounding mountains, and others are steep and narrow, actively eroding, and contain relatively little alluvial gravel. Many channels are incised in response to tectonic and erosion processes, from land use practices resulting in the loss of a stabilizing riparian zone, and/or from increased peak flows in urbanized settings (Haltiner et al. 1996). Valleys generally follow zones of brecciated rock along folding and fault lines, where hummocky topography and landslides are prominent features of the landscape (Rantz and Thompson 1967; Kondolf et al. 2001).

B.2 HYDROLOGICAL CHARACTERISTICS

Streams in the Policy area have distinct seasonal runoff patterns, reflecting limited precipitation from June through September. The climate is characterized as Mediterranean, with mild wet winters and cool dry summers along the coast. Summer temperatures are considerably warmer in inland valleys than in coastal basins. Rantz and Thompson (1967) estimated that about 80 percent of the total precipitation in the Policy area falls during five months, from November through March. Mountains in the Policy area are of relatively low elevation resulting in little snowmelt runoff. Mean annual precipitation increases from south to north along the coast, and from inland to the coast for basins draining into San Pablo Bay, ranging from around 20 inches in the Napa Valley to around 110 inches on the mountain divide of the Mattole River basin. Mean annual precipitation is strongly influenced by altitude and steepness of the coastal mountain slopes. About 80 percent of the total annual runoff occurs during the four months of December through March. Rains during November generally contribute little runoff, and are absorbed by the ground. The bulk of precipitation typically falls during several storms each year. In general, flows during the summer and early fall are low compared with the winter, and many small streams may go dry. Some streams flow throughout the dry season during wet years, maintain isolated pools in average years, and have no water in them in dry years (Opperman 2002). There is little lag between rainfall and runoff once antecedent conditions become wetter in November, reflecting low soil and surface rock permeability and a limited capacity for sub-surface storage (Rantz and Thompson 1967). This results in streams with relatively 'flashy' storm runoff hydrographs. Rantz and Thompson (1967) noted a close relationship exists between flow-duration curves and low flow frequency curves derived for streams in the region. Both types of curves were found to be influenced by basin characteristics. The strength of the relationship was thought to reflect the regional consistency of the seasonal pattern of precipitation. Characteristics of the flow duration curve were correspondingly found to be related to discharge, and the magnitude of floods of any given frequency could be related to both the size of the drainage area and mean annual basin-wide precipitation.

Because of the low infiltration capacity and permeability of the Franciscan and volcanic rocks, baseflows in streams are poorly maintained. Along the mountain drainages, baseflow that does occur is maintained by groundwater discharge emerging from fractures through springs and seeps. As a result, some streams may be composed of discontinuous wet reaches with pools sustained over summer by groundwater discharge. Some higher elevation streams may run dry from summer to late fall. In the valleys, groundwater occurs in the alluvial deposits. There, baseflow is maintained by groundwater discharge along reaches where the water table is higher than the adjacent stream. In the larger valley drainages, such as the Napa River, Sonoma Creek, Petaluma River, Russian River, Lagunitas Creek, groundwater discharge is large enough to sustain perennial flow.

Due to the low water yield of the Franciscan and volcanic rocks, groundwater development in the mountainous areas is limited. Well yields are low, typically on the order of a few gallons per minute, but in some locations sufficient for domestic, stock pond, or small-scale irrigation purposes. The vast majority of groundwater development occurs in the larger valley drainages, particularly the Napa and Russian Rivers, where urban water purveyors operate extensive wellfields. Some wells in these areas yield as much as 3,000 gallons per minute (DWR 1975). Pumping of groundwater can deplete stream flow by intercepting tributary groundwater that would otherwise discharge to a stream, or by direct withdrawal from the surface flow.

Streams in some regions of the Policy area have less demand for water placed on them for out-of-channel use than other streams. Most coastal rivers and streams north of the Russian River have been impacted more by timber harvest activities than by water use. In general, there is a gradual shift in impacts from timber harvest towards water diversion and grazing in a southerly direction. As such, the Navarro River, and to a lesser extent the Garcia River represent transition basins in that they have experienced varying levels of timber harvest, water use, and grazing impacts. Impacts in other northern coastal basins resulting from implementation of the Policy are expected to be less significant than elsewhere, as projected water demands are unlikely to exceed the diversion limitations placed by the Policy.

Following the stream ordering system of Strahler (1957), where a first order stream is the highest channel in the network, a second order stream extends downstream of the junction of two first order streams and so forth, most streams in the Policy area are of third order or smaller, as designated in the 1:100,NHD Plus geospatial data sets from Horizon Systems Corporation developed for the Environmental Protection Agency using the USGS National Hydrography Dataset (NHD) as base data, Horizon Systems (2006). There are 2,594 first order, 616 second order, 161 third order, and 31 fourth order streams delineated in the Policy area. Most first order streams have a drainage area less than 3 mi^2 and most second order streams have a drainage area less than 10 mi^2 (Figure B-1). This indicates that the Policy must be applicable to a wide range of stream sizes, including small first and second order streams.

B.3 ECOLOGICAL CHARACTERISTICS

Riparian communities in the coastal basins north of the Russian River tend to include an overstory consisting of mixed conifer and hardwood big leaf species, and various willows, vines, epiphytes, herbaceous, and other woody plants forming an understory. Willows are typical pioneers in disturbed areas. In redwood forests, the redwoods form the primary overstory species, with other tree species forming part of the understory. Most riparian systems in the region have been altered by timber harvest or fire. Many systems have gone through succession to relatively diverse second growth forests (Ray et al. 1984).

Riparian communities in the eastern and northern portions of the Policy area have been described as one of three broad types, headwater areas, mid-level areas, and broad valley floodplains (Roberts 1984). In headwaters areas, stream channels are often actively eroding close to or at bedrock. Riparian vegetation composition and density reflects in large part the ability of plants to find a foothold and nourishment in thin alluvial soils. The stream flow regime in most cases provides adequate year-round water if not diverted. In mid-level areas, most streams contain gravel bars and sand flats supporting riparian vegetation, often in narrow strips between the stream and bedrock hillslopes. The vegetation is relatively susceptible to scouring during floods, with recolonization depending on seed source proximity to the channel and dispersal mechanisms. Riparian groves are found in wider valleys with terraces. In the third community type, broad-valley floodplain areas, deposition of a thick sediment layer near abundant water is associated with riparian gallery forests. Colonization processes occur rapidly, although this community is influenced heavily by land use practices including clearing and grading (Roberts 1984).

The area and diversity of the riparian zone in the Russian River watershed has been reduced considerably from historic levels by a variety of land uses. Many of the areas which historically supported floodplain wetlands and riparian forests in a mature stage have been converted to agricultural lands. The construction of large dams on the East Fork of the Russian River and Dry Creek have influenced characteristic flow and sediment transport regimes, which in turn have likely influenced the extent and characteristics of the riparian zone as well. Most of the riparian community in the basin is dominated by hardwood species such as California bay laurel, white alder, and various oak and willow species. However, several invasive species including particularly giant reed are changing the riparian zone community structure at isolated locations in the basin (Florsheim et al. 1997; Opperman 2002; Opperman and Merenlender 2003).

Riparian zones in the Policy area serve a variety of functions for creating and maintaining anadromous salmonid habitat, including providing habitat structure and cover through input of large woody debris (LWD) and bank stability, water temperature control through shading, input of organic material for secondary production, and by insect drop as a juvenile food source. Of these, only the benefits and importance of LWD as a habitat element for anadromous salmonids in Policy area streams remain equivocal. LWD can be an important mechanism for creating spawning and rearing habitat for anadromous salmonids, especially in conifer forested streams on the North Coast and in the Pacific Northwest (e.g., Gregory et al. 2003). However, streams with hardwood dominated riparian zones can have a very low loading and geomorphic influence of LWD on channel form and fish habitat, although streams with relatively high hardwood LWD loading values can have some fish habitat associated with LWD-jams, but not individual pieces. This is because individual pieces of hardwood LWD are considerably smaller than LWD provided by mature conifers and can break down faster, and thus have less influence on channel form. In general, streams on private land may have significantly less LWD than streams in protected watersheds (Opperman 2002).

Anadromous salmonid habitat requirements during the winter diversion season include primarily passage, spawning, incubation, and winter rearing. In general, spawning habitats in Policy area streams tend to be more evenly distributed in lower gradient channels, while in higher gradient channels, spawning areas are sporadic and often limited to distinct patches or pockets, a result of gravel supply, transport, and deposition patterns. The ability of anadromous salmonids to use these spawning habitats and negotiate passage barriers in the Policy area is strongly dependent on flow magnitude and duration, gradient, and channel shape and size (Rantz 1964; MTTU 2000). In the smallest streams, passage may occur only during high water events. Spawning occurs in areas with suitable gravel quality and quantity, during freshets and/or base flows. Winter rearing generally requires deeper water and cover that can be provided in the form of large substrate, overhanging vegetation, or undercut banks. In Policy area streams, availability of rearing habitat is generally controlled by base flow. A more detailed description of anadromous salmonid habitat requirements, specifically as they are related to certain Policy elements is provided in Appendix D.

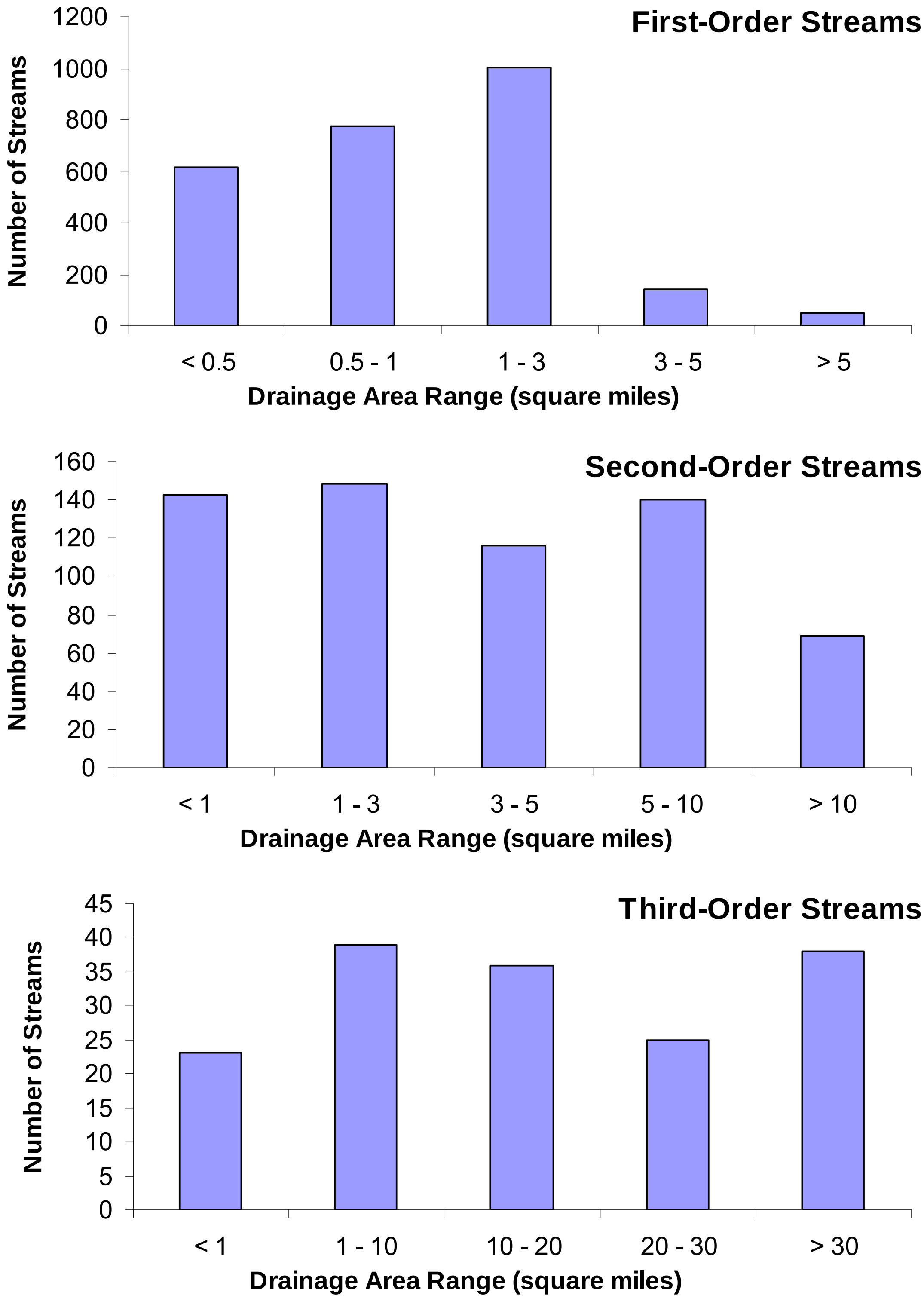

Figure B-1. Relative frequency of drainage basin areas, by Strahler stream order across the Policy area.