3

AFFECTED ENVIRONMENT

Photo by: Robert Campbell

3

AFFECTED ENVIRONMENT

INTRODUCTION

The "Affected Environment" chapter describes the Drakes Estero environment; relevant physical and biological processes within Drakes Estero; and the existing conditions for those elements of the natural, cultural, and social environment that could be affected by the implementation of the actions considered in this EIS. The impact topics addressed in this EIS include wetlands, eelgrass, wildlife and wildlife habitat, special-status species, coastal flood zones, water quality, soundscapes, wilderness, visitor experience and recreation, socioeconomic resources, and NPS operations. Impacts for these impact topics are analyzed in "Chapter 4: Environmental Consequences."

DRAKES ESTERO SETTING AND PROCESSES

PACIFIC COASTAL SHELF/NEARSHORE ENVIRONMENT

Drakes Estero is a shallow estuary characterized by terrestrial (land-derived) and oceanic influences. Sediment and nutrient cycling within Drakes Estero are driven primarily by tidal influence from the ocean, with minimal freshwater input. The open Pacific waters off the Point Reyes coast near the mouth of Drakes Estero are known as Drakes Bay, a component of the larger Gulf of the Farallones (see figure 1-2). This portion of the nearshore environment lies within the Gulf of the Farallones National Marine Sanctuary, an area encompassing nearly 1,300 square miles of coastal ocean habitat. Marine sanctuaries are federally designated areas protected under the Marine Sanctuaries Act in recognition of their significance. The continental shelf off the coast of the Seashore extends 25 miles from the coast to the continental shelf break, at which point the ocean floor drops abruptly into the deeper Pacific waters. NPS owns the submerged land and manages the marine environment from the mean high tide line to 0.25 mile out over the continental shelf. The Pacific waters at this location along the California coast are at a transition zone between the Californian and Oregonian marine provinces (i.e., oceanographic zones with specific physical characteristics) (Valentine 1966). This interface creates a condition where warm-temperate species from the Californian province coexist with cold-temperate species from the Oregonian province, resulting in a relatively high diversity of marine organisms on the continental shelf and nearshore environment at Point Reyes.

The coastal ocean waters adjacent to the mouth of Drakes Estero are subject to “upwelling” (Morgan 2001), a Pacific coast phenomenon in which prevailing winds blow surface waters away from the coast, allowing colder, nutrient-rich water to be pulled up from deeper ocean reserves (Kozloff 1983). The California coast is one of only five oceanic eastern boundary coastal upwelling areas in the world, and the only one in North America (Ryther 1969; Hill et al. 1998). Because of the upwelled nutrients, productivity from phytoplankton is high, serving as the foundation for the multiple trophic levels (i.e., feeding levels) of the diverse marine organisms found here (Kozloff 1983). The central California coastline also is susceptible to changes related to climate change and sea level rise, which are expected to bring increases in mean sea level of approximately 3 to 4.5 feet by the year 2100 (Heberger et al. 2009).

The continental shelf water column at Point Reyes is a dynamic medium for ocean life, owing to multiple currents driven by winds, tides, density gradients, topography, and the rotation of the earth (Denny and Wethey 2001). For example, nearshore currents often create microhabitats in the water column that trap organisms such as zooplankton, resulting in localized “hot spots” where predators such as fish, seabirds, and mammals are attracted to feed (Airamé, Gaines, and Caldow 2003). In addition, water rich in nutrients and organic material from estuaries such as Drakes Estero, Tomales Bay, and the nearby San Francisco Bay contribute to the abundant and diverse species in the Gulf of the Farallones National Marine Sanctuary off the Point Reyes Peninsula. This phenomenon is referred to as “outwelling” (Teal 1962; Canuel et al. 1995) and is based on the net export of carbon and nutrients from high-productivity estuaries to adjacent open ocean waters.

The coastal marine environment is generally divided into benthic (bottom), pelagic (open water), subtidal (coastal areas below low tide), and intertidal (coastal areas between high and low tide) zones based on water depth, distance from shore, bathymetric gradient (contour of the bottom), and tidal exposure (how often, if at all, the substrate is exposed at low tide) (Bertness, Gaines, and Hay 2001). The biological community of each zone is distinctive. For example, in the pelagic zone, phytoplankton (small or microscopic free-floating plants) is the predominant source of primary productivity via photosynthesis. Primary productivity is the creation of plant tissue from solar energy, and photosynthesis is the process that occurs within plants to turn solar energy into plant tissue. In the subtidal zone, various species of kelp are dominant, and in the intertidal zone, algae capable of withstanding periods of exposure and drying are the dominant sources of primary productivity (Kozloff 1983).

In addition, the substrate across these habitat zones can range from soft-bottomed mud or sand to coarse gravel to rocky outcrops and benches, which affects the types and distribution of benthic organisms (those associated with the seafloor). Many species of fishes, invertebrates, and other marine life inhabit the soft sediments, either on the surface of the seafloor or burrowing in the seabed (Lenihan and Micheli 2001). These animals have adapted to the continuous shifting of sediments by ocean currents. Species that thrive in this environment include Dungeness crabs, sea pens, clams, and flatfishes such as California halibut and English sole. The complexity of rocky, hard-bottom areas provides very different habitats in comparison with soft-bottom communities. Species such as rockfish, kelp, soft corals, sponges, and anemones are common in rocky subtidal habitats, reflecting the high species diversity that can often accompany this habitat type (Witman and Dayton 2001). This abundance of benthic life on the continental shelf attracts predators that typically inhabit the pelagic zone, including a diversity of fish, seabirds, and marine mammals.

Intertidal rocky shore habitats are common along coastal areas surrounding the Point Reyes Headland, which is identified by the State of California as an Area of Special Biological Significance. Areas of Special Biological Significance are stringently monitored by the California State Water Resources Control Board for water quality and discharges of storm and wastewater from watersheds feeding the Areas of Special Biological Significance. Habitat zones in rocky intertidal areas respond to horizontal and vertical gradients caused by stressful conditions such as wave energy, salinity, and exposure to air (Menge and Branch 2001). The uppermost zone, also known as the splash zone, is rarely submerged; as a result, diversity in this stressful habitat is low, but species such as periwinkle snails, barnacles, and some types of green algae have adapted to live there. The mid zone, which is periodically exposed to air, harbors an abundance of organisms dwelling within the spaces between the rocks. Examples include mussels, limpets, crabs, anemones, chitons, black turban snails, and several species of algae (Barry et al. 1995). In the lower rocky intertidal zone, exposure to air is infrequent, so species inhabiting this zone are more adapted to withstand the physical stress of wave energy. Here, species such as sea urchins, sea stars, sea palms, and filamentous algae are common.

Sandy beach habitat, such as Drakes Beach near the mouth of Drakes Estero, is found in several locations along the Point Reyes Peninsula shoreline. Though these habitats appear biologically poor due to the lack of vegetation cover and visible wildlife, the beach is a biologically rich habitat with many burrowing animals that also serve as food for fish, mammals, and migratory birds (Kozloff 1983; Hubbard and Dugan 2003). Examples include sand crabs, Pismo clams, razor clams, and sand fleas. Because plants and algae cannot root in the sandy substrate, primary productivity on sandy beaches is typically provided by drift kelp and other seaweeds that wash ashore during normal tidal cycles or storm events (Kozloff 1983; Dugan et al. 2003). This “wrack line” is an important source of algae, food, and cover for many smaller animals, such as amphipods and isopods (small crustaceans), that live on the beach. These organisms in turn serve as a food source for higher-order predators living on or migrating across the California coast.

GEOLOGICAL SETTING

The geologic and geographic character of the Point Reyes Peninsula has been largely influenced by the nearby San Andreas Fault. The San Andreas Fault Zone approximates the eastern border of the Seashore from Bolinas Lagoon through the Olema Valley north to Tomales Bay (Clark and Brabb 1997) (see figure 1-2). This zone is an active tectonic boundary between the Pacific plate and the continental North American plate (Niemi and Hall 1992; Stoffer 2002). “Tectonic” refers to the field of geology that is concerned with the study of large-scale movements of the Earth’s crust, which is of interest in this region because tectonic plate boundaries like the San Andreas Fault System tend to have higher occurrences of catastrophic earthquakes. Because the Point Reyes Peninsula is on the Pacific plate side (west side) of the fault zone, much of the land area within the Seashore is of different geologic composition than the "mainland" portions of Marin County, which is on the North American plate, east of the fault zone (Clark and Brabb 1997). On the east side, the major formations originated from ocean-derived rocks that have been reworked over geologic time by tectonic activity. On the west side, the Point Reyes Peninsula is essentially an uplifted block of granite overlain by recent sedimentary rocks of terrestrial and marine origin (Galloway 1977).

The land immediately surrounding Drakes Estero, also known as the Point Reyes Plain, owes its moderately sloping topography to the underlying mudstone and siltstone rocks that were formed during the Pliocene Epoch (circa 5 million to 2 million years ago). This moderate terrain stands in contrast to the Inverness Ridge, a prominent, granite-based ridgeline at the eastern end of the Seashore that is much older in geologic origin (Upper Cretaceous Period, circa 100 million to 65 million years ago). Flanking the western edge of the San Andreas Fault Zone, the Inverness Ridge is evidence of the tectonic forces at work along this major plate boundary over geologic time. Uplift and folding of rocks along the ridgeline have created a western slope characterized by short, steep valleys. Small tributary streams flow through these valleys and contribute freshwater to coastal lagoons such as Drakes Estero that lie immediately to the west (Galloway 1977).

INTERNAL GEOMETRY AND SEDIMENTS

The internal geometry of Drakes Estero and the nearby continental shelf reflect the prehistoric stream channel that conveyed surface water across the shelf during the last glacial period (Galloway 1977; Press 2005). The shallow, nearly level character of the Drakes Estero floor, outside of the main channel, is considered a remnant of a marsh system that flanked this former stream system. Because of its shallow nature, the distribution of sediments in Drakes Estero is largely controlled by tidal flushing rather than streamflow. Evidence for this phenomenon is provided by the sand, soft mud, and silt-laden substrate that dominates the Drakes Estero floor both at the surface and at depth (Anima 1990[i]; Press 2005). Studies of sediment distribution in Drakes Estero have found that coarser-textured sediments (medium- to fine-grained sand and silt) are more common in the main tidal channels, and that sediment near the mouth of Drakes Estero is composed of medium- to fine-, well-sorted sands. Sediments in the mid to upper portions of Drakes Estero, including the upper tidal branches, are predominantly composed of mud and silt. This is evident on the tidal flats as well as in the upper channels, which begin to lose their definition as they fill up with fine sediment over time (Anima 1991[ii]). One exception is the channel of Schooner Bay, which is artificially maintained by boat traffic scouring (disturbance of sediments) from the ongoing commercial shellfish operations (Anima 1991[iii]).

The basin floor in Drakes Estero is an aggrading substrate, which means there has been a net accumulation of sediment over time. Using pollen core analysis, Mudie and Byrne (1980) estimated that sediment accumulated at a rate of approximately 20 inches (50 centimeters) per 100 years during the mid-

1800s, dropping to approximately 6 inches (15 centimeters) per 100 years afterward. Using a variety of sampling methods, Anima (1990[iv], 1991[v]) estimated similar sedimentation rates based on sample cores taken from various locations throughout Drakes Estero. The results from this study were highly variable, but overall average sedimentation rates were reported in the range of 5 to 12 inches (12 to 30 centimeters) per 100 years. Sediment accumulation was highest near the mouth (24 inches, or 60 centimeters, per 100 years), presumably due to ocean currents depositing sediments from the adjacent nearshore Pacific shelf. In certain locations, such as adjacent to the existing commercial shellfish operation's facility, high sedimentation rates and/or active mixing of sediments from boat traffic prevented accurate estimation. Anima's review (1990[vi]) also suggests that approximately 100 feet (30 meters) of sediment has filled the valley at the mouth of Drakes Estero over recent geologic time, and that the onset of filling was approximately 8,000 years ago. The predominantly soft-sediment substrate of Drakes Estero described above is due in part to this infilling process. As a result, Drakes Estero is nearly lacking in hard substrate, with only a few minor locations where bedrock is exposed on the estuary floor (NAS 2009).

HYDRODYNAMICS

Drakes Estero is a shallow estuary encompassing approximately 3.5 square miles of tidal surface waters. It was formed during the last major glacial retreat as a system of drowned valleys extending north into the adjacent landscape (Galloway 1977). Drakes Estero has minimal freshwater input (Press 2005), and by its basin morphometry (shape and internal geometry) is characterized as a shallow, open embayment, with an average subtidal depth of around 6.5 feet, although deeper water is found in the mainstem portion in a central channel that is maintained by boat traffic, with the deepest measurements near the mouth (23 to 26 feet) (CCC 2007a). Because of the open character of the lagoon and the low freshwater input, most of Drakes Estero is flushed by a semidiurnal (twice-daily) tidal cycle with a tidal range of around 6 feet, with seawater approaching coastal Pacific salinities (around 34 parts per thousand) (NOAA 2010). The tidal cycle has two unequal highs and two unequal lows (Kozloff 1983).

Drakes Estero is partially protected from the open ocean by Limantour Spit, a narrow, sandy ridge at the mouth of the embayment. Limantour Spit is a dynamic landform, as evidenced by the highly variable position of the Drakes Estero inlet, which has shifted location in historic and recent times (Anima 1990[vii]). Variations in the position and depth of the inlet have influenced sediment dynamics and distribution within Drakes Estero.

Drakes Estero as a whole is a system of five branching bays, from west to east: Barries Bay (86 acres), Creamery Bay (133 acres), Schooner Bay (390 acres), Home Bay (190 acres), and Estero de Limantour (225 acres) (see figure 1-2). Nearly half of Drakes Estero's surface area consists of mud- and sand flats that are exposed at low tide (Press 2005). Because of the shallow character of the bay and its tendency to flush completely within a normal tidal cycle, currents in the mainstem and secondary channels are relatively strong. Further, the high width-to-depth ratio combined with this large exchange of water volume per tidal cycle ensures that Drakes Estero is well mixed, with no density layering in the water column (Wechsler 2004[viii]).

BIOGEOCHEMICAL CYCLING

Biogeochemical cycling refers to the chemical interactions that exist between biological organisms and the abiotic (nonliving) components of the environment such as air, water, and soil. In estuaries, biogeochemical cycling can be controlled by a variety of physical forces and by the diversity of organisms that inhabit these rich coastal habitats. Regardless of the physical forces at work, estuaries are generally highly productive habitats due to the potential for organic and inorganic nutrients to cycle in all four of the above compartments (biota, air, water, soil), and due to the dynamic nature of the transitional environment that estuaries embody (Nixon et al. 1976). These transitions are related to environmental gradients such as saltwater to freshwater, open ocean to rivers, water to land, tidal flux to river flow, and deep water to shallow water (MacCready 1999). Further, estuaries receive nutrients, sediment, and detritus (dead organic material) from their contributing watersheds, as well as nutrients and sediments from open-ocean sources via tidal influx. As a result, estuaries support a diversity of life, from free-swimming organisms to benthic fauna and seagrasses to microbes and detritus feeders (Costanza, Kemp, and Boynton 1997). In addition, primary productivity (the formation of new organic material through biological processes, particularly photosynthesis) is typically high in estuaries, due to the various photosynthetic organisms that can inhabit these environments, such as seagrasses, algae, and phytoplankton (Williams and Heck 2001).

Because Drakes Estero is a shallow coastal lagoon system with minimal freshwater input, it shares several features that affect biogeochemical cycling with other west coast estuaries, such as high sediment nutrient concentrations, extensive tidal flushing, and proximity to nutrient-rich upwelling zones along the coast. In other estuarine systems, such as those found on the east coast of North America and in Europe, filter-feeding organisms, such as bivalves, have been shown to play an important role in nutrient cycles and stimulation of primary productivity (Reusch, Chapman, and Gröger 1994; Peterson and Heck 1999, 2001; Newell and Koch 2004). However, as Dumbauld, Ruesink, and Rumrill (2009) indicate, the nutrients provided by coastal upwelling in these west coast lagoon systems control summer primary productivity, a condition on which filter-feeding bivalves would have limited influence. In systems like Drakes Estero where bivalves are grown commercially, nutrient cycling functions provided by commercially grown bivalves are likely to be restricted to areas under or immediately adjacent to shellfish beds/structures.

In a study of ecosystem effects of shellfish mariculture, Everett, Ruiz, and Carlton (1995) noted that bivalve culture in nearby Coos Bay, Oregon, caused significant erosion or sedimentation, depending on the method used (rack versus stake culture). Under such conditions, the density of submerged aquatic vegetation was negatively affected by the changes brought about by mariculture-induced modification of the sediments (Everett, Ruiz, and Carlton 1995).

Research on biogeochemistry in Drakes Estero is limited, but there have been a few studies documenting chemical and physical characteristics of the Estero's sediments and water column. For example, in a research project that looked at the effects of oyster mariculture on benthic invertebrates, sediment and water samples were collected in and around oyster racks and analyzed for chemical constituents and physical properties. From this research, the following observations were made: surface sediments in all samples were well oxygenated, percent organic matter was not different between oyster racks and nearby samples, and percent silt and percent sand were different between oyster racks and nearby samples. Harbin-Ireland attributed the organic content in the sediments under and adjacent to racks to the availability of seagrass-based detritus, which was plentiful in the area of the study, and also suggested that the oxygen content of surface sediments was due to tidal mixing and seagrass root oxidation (Harbin-Ireland 2004[ix]). Further, Harbin-Ireland detected a significant difference in sediment texture between racks and nearby samples, suggesting that erosion was taking place around the racks (2004[x]), as discussed above (Everett, Ruiz, and Carlton 1995). Finally, research on nutrient inputs from the watershed above Drakes Estero suggested that excess nutrient loading was not likely to occur in Drakes Estero due to the high rate of tidal flushing relative to stream inputs (NAS 2009).

PRIMARY PRODUCTIVITY

In estuarine environments, the predominant sources of primary productivity are submerged aquatic vegetation, algae, and phytoplankton (Williams and Heck 2001). In Drakes Estero, eelgrass (*Zostera marina*) is the dominant form of submerged aquatic vegetation and is present throughout Drakes Estero in dense beds (Wechsler 2004[xi]). Eelgrass is described in more detail under the “Eelgrass” section of this chapter.

As with submerged aquatic vegetation, phytoplankton and epiphytes can represent a significant component of the overall primary productivity in estuaries (Cole and Cloern 1987; Carr, Boyer, and Brooks 2010). Phytoplankton is composed of microscopic, photosynthetic, free-floating organisms in the water column; epiphytes are photosynthetic algae that attach to submerged aquatic vegetation for support, usually seen as coatings on seagrass blades. Though there has been no scientific research on phytoplankton production in Drakes Estero, studies in nearby estuaries such as San Francisco Bay have demonstrated that productivity is controlled by light availability in the water column, which is adversely affected by water turbidity (high levels of suspended sediment in the water column) (Cloern 1987; Cole and Cloern 1987). Given that water quality in Drakes Estero is relatively high (NAS 2009), it is likely that phytoplankton productivity is also high relative to other embayments within the region. However, epiphytes are expected to represent a minor component of the overall primary productivity in this region, as Carr, Boyer, and Brooks (2010) have noted for San Francisco Bay. This reemphasizes the dominant role that eelgrass, and to a lesser extent, phytoplankton, play in the overall primary productivity within Drakes Estero.

Finally, intertidal flats in Drakes Estero are frequently colonized by macroalgal mats, which are “blooms” of green marine algae that become encrusted on the sediment surface (Press 2005). This observation is consistent with studies in other Pacific coastal habitats (Josselyn and West 1985; Everett 1991, 1994). Based on the research of Press on the ecology of macroalgal mats in Drakes Estero, these features are not a major source of primary production in Drakes Estero, but may function as important habitat for benthic invertebrates and may also contribute to nutrient cycles in the sediments (Press 2005).

TERRESTRIAL SETTING

Terrestrial habitat types within the Seashore are characterized by multiple vegetation cover types, ranging from low-elevation coastal dune communities to pine-dominated forests high along the Inverness Ridge. This variability reflects the character of the underlying geologic and soil formations, as well as the influence of the maritime climate and coastal watershed processes (Galloway 1977). In addition, the range and type of vegetation communities have been shaped by the past land uses of early human populations. Thousands of years ago, the Coast Miwoks used vegetation and land for both food and shelter (Slaymaker 1982). From the mid-19th century to present, land uses related to agriculture and commercial activities (land clearing, road building, livestock grazing, etc.) have had a dramatic effect on the landscape.

Terrestrial Vegetation

Terrestrial plant life on the Point Reyes Peninsula is both abundant and diverse, with 910 observed plant species within the Seashore. Vegetation cover types within the Drakes Estero watershed include wetlands, coastal dune, coastal scrub, grassland, pasture, and riparian woodland. Wetlands are discussed as a separate impact topic later in this chapter, because they occur in the project area and there is the potential for these resources to be impacted by the alternatives considered in this EIS.

Coastal Dune. This vegetation cover type includes active coastal dunes, northern foredunes, northern foredune grasslands, and northern dune scrub communities (Holland 1986). Coastal dunes are not found within the project area, but occur at the mouth of Drakes Estero. Active dunes are highly mobile sand formations often found near sandy beaches in the absence of coastal headlands. Generally barren of stabilizing vegetation, the shape and size of coastal dunes frequently change based on wind direction, speed, topography, sand source, and sand grain size. In foredune areas, stabilizing vegetation increases in density, forming patches of native plants within a greater dune habitat dominated by nonnative species. However, coverage of vegetation is usually low, and patches of bare sand are common. Dense, nonnative monocultures (areas dominated by one species) are commonly found dominated by European beachgrass (*Ammophila arenaria*) or ice plant (*Carpobrotus edulis*). Native plants are usually limited to remnant patches comprised of dune sagebrush (*Artemisia pycnocephala*), coast buckwheat (*Eriogonum latifolium*), dune lupine (*Lupinus chamissonis*), and goldenbush (*Ericameria ericoides*). Nonnative species are commonly interspersed within native plant communities of this vegetation cover type.

Coastal Scrub. This vegetation cover type is characterized by woody shrub species from 3 to 7 feet tall. Coastal scrub is fairly widespread and includes most shrub-dominated lands within the Seashore. Shrubs are defined as woody perennials with multiple stems growing from the base. Most California shrublands have an abundance of xerophytes (species adapted to arid conditions) (McMinn 1939). In coastal areas, shrubs often form low-growing stands mixed with grasses. Coastal scrub is usually located inland of foredunes, where decreased wind and salt spray allow better stabilization and increased plant height. Other species associated with coastal scrub include coyote brush (*Baccharis pilularis*), California blackberry (*Rubus ursinus*), sedges, rushes, poison oak (*Toxicodendron diversilobum*), coffeeberry (*Rhamnus californica*), thimbleberry (*Rubus parviflorus*), and California sagebrush (*Artemisia californica*) (McMinn 1939; Holland 1986). Within the study area, the coastal scrub vegetation cover type is present around the DBOC onshore facility and along the main access road (see figure 3-2 in the "Wetlands" section below); however, impacts to this vegetation cover type would be negligible.

Grassland. California coastal prairie, a type of grassland, is the dominant vegetation cover type within the Seashore. Nonnative annual grasses from the Mediterranean region have replaced native species to become the dominant species in California grasslands (Jackson 1985). Nonnative velvet grass (*Holcus lanatus*) often dominates grasslands, while small communities of remaining native plant species are comprised of Pacific reedgrass (*Calamagrostis nutkaensis*), tufted hairgrass (*Deschampsia cespitosa*), California oatgrass (*Danthonia californica*), meadow barley (*Hordeum brachyantherum*), and California brome (*Bromus carinatus*) (Sawyer and Keeler-Wolf 1995). The most common of these, Pacific reedgrass, is sometimes intermingled with sedges and rushes (within wetland cover types) and nonnative species.

Pasture. Pasturelands are distinct cover types in which land is specifically used to graze cattle or is managed to produce silage for cattle. Pasture vegetation is comprised of perennial grasses and legumes (species in the bean family) that usually provide up to 100 percent canopy closure. According to season and livestock stocking levels, height of vegetation varies from a few inches to 2 or more feet on fertile soils before grazing. The mix of grasses and legumes varies according to management practices such as seed mixture, fertilization, soil type, irrigation, weed control, and the type of livestock on the pasture (Mayer and Laudenslayer 1988). Plant species within pastures vary with the geographic area. Species documented in pastures in Point Reyes Peninsula include nonnative species such as Italian ryegrass (*Lolium multiflorum*), velvet grass, and tall fescue (*Festuca arundinacea*), as well as several species of native and nonnative clovers (*Trifolium* spp.).

Riparian Woodland. Riparian woodland includes both forests and scrublands found in areas directly adjacent to streams and their associated water resources (wetlands). They are often dominated by deciduous trees and shrubs such as red alder (*Alnus rubra*) and willows (*Salix* spp.) (Sawyer and Keeler-Wolf 1995). Herbaceous associate species include multiple berry species (*Rubus* spp.), hedgenettle (*Stachys ajugoides*), sedges, rushes, small-fruited bulrush (*Scirpus microcarpus*), sword fern (*Polystichum munitum*), and lady fern (*Athyrium filix-femina*) (Holland 1986).

Terrestrial Wildlife

The diversity of animals within the terrestrial habitats surrounding Drakes Estero has been estimated based on known observations of species and habitats present. In general, the Seashore supports 27 species of reptiles and amphibians, countless invertebrates, 65 species of mammals, and nearly 500 species of birds. The discussion below provides a general overview of the animals found within the area surrounding Drakes Estero. Those species that occur in the immediate project area and have the potential to be impacted by the alternatives considered in this EIS are discussed as separate impact topics (under "Wildlife and Wildlife Habitat") in this chapter. In addition, many animal species at the Seashore are protected by the federal or state endangered species acts (see the impact topic discussion under "Special-status Species"; see also appendix E).

Mammals. Terrestrial mammal species commonly observed within the Seashore include dusky-footed woodrat (*Neotoma fuscipes monochroura*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), black-tailed deer (*Odocoileus hemionus columbianus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), black-tailed hare (*Lepus californicus californicus*), brush rabbit (*Sylvilagus bachmani ubericolor*), pocket gopher (*Thomomys bottae*), and many species of bats, shrews, mice, and moles. Mountain lion (*Felis concolor*) are present although rarely seen, and coyotes (*Canis latrans*) are widespread. Additionally, tule elk (*Cervus elaphus nannodes*), once extirpated from the Point Reyes Peninsula, have been successfully reintroduced and are observed regularly in several park areas, including Drakes Estero and Estero de Limantour.

Amphibians and Reptiles. Common amphibians found in the Seashore include California newts (*Taricha torosa*), Pacific chorus frog (*Pseudacris regilla*), roughskinned newts (*Taricha granulosa*), and nonnative bullfrogs (*Rana catesbeiana*). The Pacific giant salamander (*Dicamptodon ensatus*) can be found near streams. The federally threatened California red-legged frog (*Rana aurora draytonii*) also occurs within the Seashore (see "Special-status Species"). Common reptiles include western fence lizard (*Sceloporus occidentalis*), northern alligator lizard (*Gerrhonotus coeruleus*), Pacific gopher snake (*Pituophis melanoleucus*), Western terrestrial garter snake (*Thamnophis elegans*), and western pond turtle (*Clemmys marmorata*).

Birds. The Seashore is also well known for its bird populations. The Point Reyes Peninsula provides habitat for many resident and migratory birds. Approximately 490 bird species, including landbirds, seabirds, and shorebirds, have been documented within the Seashore boundaries. This large number of observed species (approximately 45 percent of the total number of species observed in the United States) is attributed to the unique geographic setting, abundant and diverse habitat availability, and maritime climate. Geographically**,** the United States Pacific coast and its adjacent interior valleys provide winter destinations for seabirds and shorebirds that breed in the Arctic and temperate zones of eastern Siberia, Alaska, and Canada, and migrate along the Pacific flyway (the migration corridor from Alaska to Patagonia). Additionally, the east–west orientation of the Point Reyes Peninsula attracts many of these migratory species, by presenting unique habitat types within the transitions between pelagic, subtidal, intertidal, and terrestrial environments.

Landbirds, which occupy terrestrial habitats for most of their life cycle, are abundant on Point Reyes Peninsula. Like other types of birds, landbirds can include year-round residents, short-term migrants, and long-term migrants (Rich et al. 2004). Nesting grounds and wintering grounds are found within the large variety of terrestrial habitat types on Point Reyes Peninsula, including coastal dune, coastal scrub, riparian woodland, (including coniferous and hardwood forest), grassland, and headwater wetlands. General categories of landbirds include songbirds, birds of prey, and upland gamebirds. A species of particular note is the northern spotted owl (*Strix occidentalis caurina*), which is a federally threatened species protected under the ESA.

Nonnative Terrestrial Animals. Nonnative animals also occur in the terrestrial portions of the Seashore. Axis deer (*Axis axis*) and fallow deer (*Dama dama*) were released by a local landowner for hunting but have been substantially reduced through recent park programs. Nonnative animals include red fox (*Vulpes vulpes*), Norway rat (*Rattus norvegicus*), Virginia opossum (*Didelphis virginiana*), and common house cats (*Felis domesticus*). Nonnative bird species include house sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), and wild turkeys (*Meleagris gallopavo*).

IMPACT TOPIC: WETLANDS

The identification of wetlands within the project area is necessary to ensure their protection in accordance with federal laws (section 404 of the CWA and the Rivers and Harbors Act of 1899) and state laws (the California Coastal Act of 1976 and the California Environmental Quality Act). At the federal level, EPA and USACE define wetlands as follows:

> Areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. (33 CFR 328.3[b]; 40 CFR 230.3[t])

Using this definition, a wetland requires the presence of three parameters: hydric soil, a dominance of hydrophytic vegetation, and hydrology at or above the ground surface. Alternatively, USFWS defines wetlands as follows:

> Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification, wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year. (Cowardin et al. 1979)

The USFWS definition is more comprehensive than the EPA/USACE definition, recognizing that physical or chemical conditions such as wave action, currents, or high salinity may prevent development of hydric soils or hydrophytic vegetation in some wetland types. Therefore, some unvegetated and/or nonhydric soil sites, such as mudflats or high-energy shorelines, may not exhibit all three attributes but are still classified as wetlands. Nonetheless, unvegetated mudflats and shorelines below the ordinary high tide elevation are regulated as waters of the United States by USACE.

In 1977, President Carter issued Executive Order 11990, "Protection of Wetlands," for all federal agencies. As a result, NPS issued *Director's Order 77-1: Wetland Protection* to establish "NPS policies, requirements, and standards for implementing Executive Order 11990" (NPS 2002a). This order instructs NPS to use the USFWS determination as the standard for defining, classifying, and inventorying wetlands and determining when NPS actions have the potential to adversely impact wetlands. Based on the Cowardin definition, a wetland must have two of the three attributes listed above.

DRAKES ESTERO WETLANDS

Drakes Estero is a shallow, coastal marine lagoon approximately 3.5 square miles in surface area at high tide. Water depths range from approximately 26 feet near the mouth of Drakes Bay to less than 7 feet across much of the lagoon (Anima 1991[xii]). The mean tidal range of Drakes Estero is approximately 6.2 feet (Pendleton et al. 2005). Drakes Estero consists of five narrow bays: Barries Bay, Creamery Bay, Schooner Bay, Home Bay, and Estero de Limantour. Anima (1991[xiii]) describes Drakes Estero (all five bays) as having approximately 1.8 square miles (1,152 acres) of intertidal flats exposed during low tide. Six perennial and four ephemeral freshwater streams flow into Drakes Estero and originate from a 31-square-mile watershed, including Drakes Estero itself (Baltan 2006).

This section describes the wetland systems above the mean low tide elevation up to and including areas 100 feet landward of the high tide line within the four westernmost bays using the Cowardin wetland classification system (Cowardin et al. 1979). The areas below the low tide elevation (subtidal wetlands) are primarily dominated by eelgrass and are described in the "Eelgrass" section of this chapter. Estero de Limantour, because it falls very near the mouth of Drakes Bay, is disassociated with and outside the study area and is not considered in this EIS.

A qualitative inventory of wetlands is summarized based on data collected by NPS staff with references such as the NPS wetlands GIS database, the *National Wetlands Inventory* established by the USFWS (USFWS 1985a), local soil survey information (Natural Resources Conservation Service 2011), and aerial photographic interpretation. The Seashore's GIS database relies on soil and *National Wetlands Inventory* information but also includes NPS field-verification of wetlands surrounding Creamery and Schooner bays.

The total area of Drakes Estero, excluding Estero de Limantour, below the high tide line (an area that includes both subtidal and intertidal areas) is approximately 1,958 acres (NPS 2011n). Wetlands within the study area occur as estuarine intertidal or palustrine systems. At low tide, much of the Drakes Estero bottom is exposed as intertidal wetlands, most of which contain no vegetation (i.e., the sandy shorelines, sandbars, and mudflats) (Anima 1991[xiv]). The intertidal sand and mudflat wetland types are the most common wetlands within the study area. Intertidal vegetated marshes (E2EM1 systems) can be found within the upper, shallow-water reaches of each of the bays interlaced by shallow tidal creeks (E2SB systems). Palustrine systems occur landward of the tidal zone dominated by freshwater marshes (PEM) with pockets of scrub-shrub (PSS) in low-lying guts and valleys along streams and/or groundwater seeps.

In the immediate vicinity of the onshore developed area, estuarine wetlands (E2EM and E2UB3) occur along the northern boundary of the developed area and extend eastward, where wetlands transition into a freshwater marsh (PEM) and scrub-shrub (PSS) habitat type.

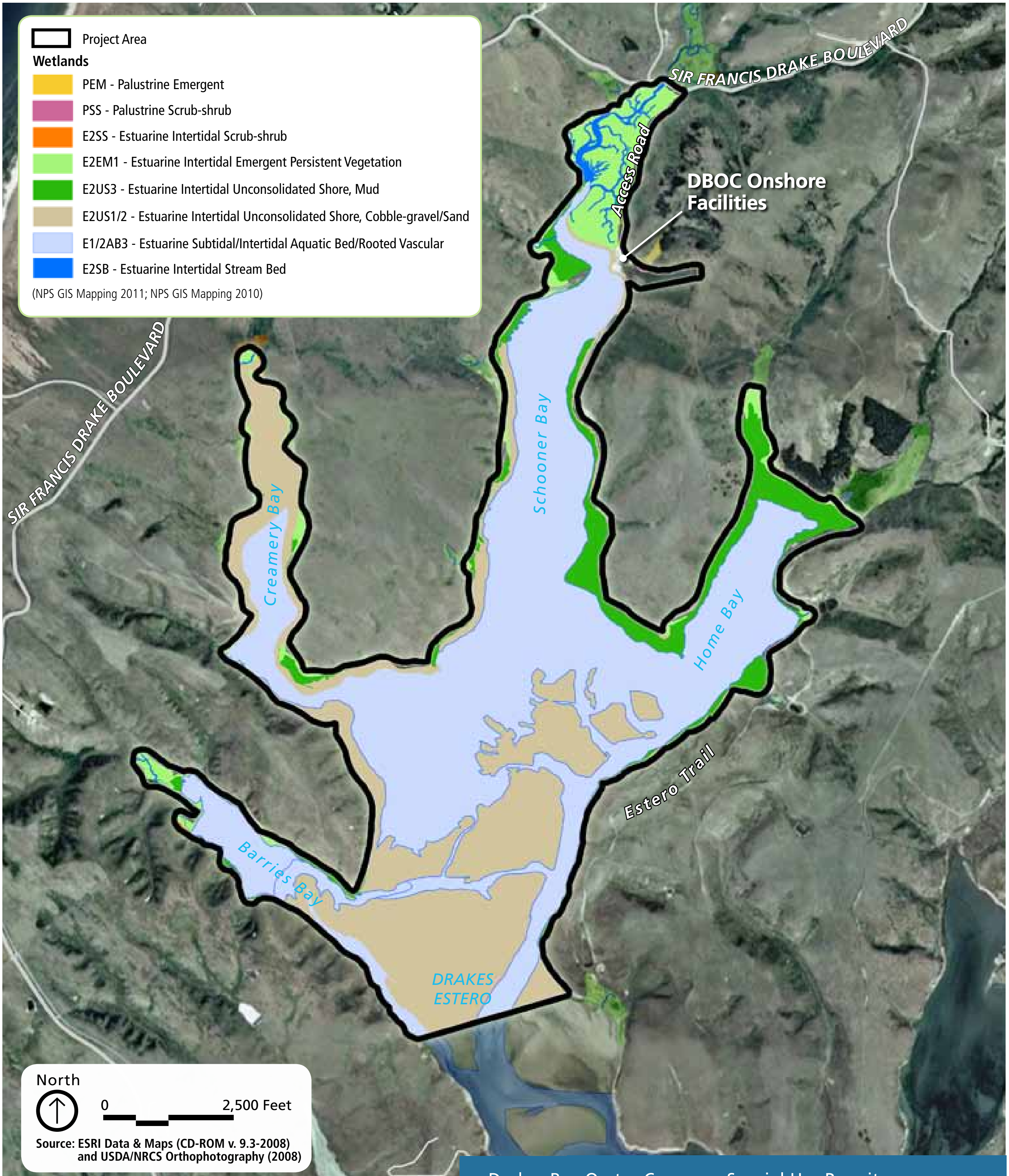
A list of wetland types present within the project area is provided in table 3-1. Figures 3-1 and 3-2 provide a general representation of the wetland types in the project area.

TABLE 3-1. WETLAND TYPES IN THE PROJECT AREA

Wetland Type	Classification Code	Description
Estuarine intertidal, unconsolidated shore, cobble/gravel, sand	E2US1/2	Gravel and sandy beaches and exposed tidal sandbars formed by accretion/deposition in shallows and along shorelines.
Estuarine intertidal, unconsolidated shore, mud	E2US3	Occurs primarily in the upper reaches of the bays as unvegetated mudflats.
Estuarine intertidal, emergent, persistent vegetation	E2EM1	Tidal marshes dominated by emergent vegetation. Plant species include glasswort (*Salicornia virginica*), saltgrass (*Distichlis spicata*), and salt marsh daisy (*Jaumea carnosa*).
Estuarine intertidal, scrub-shrub	E2SS	Shrub wetlands that occur behind the DBOC onshore operations center and at the headwaters of Creamery Bay.
Estuarine intertidal, streambed	E2SB	Intertidal creeks at the northernmost ends of various bays.
Palustrine, emergent	PEM	Nontidal marshes and slough dominated by sedges (*Carex* spp.) and rushes (*Juncus* spp.).
Palustrine, scrub-shrub	PSS	Small patch of freshwater scrub-shrub wetlands located behind (east of) DBOC onshore facilities.
Estuarine subtidal/intertidal, aquatic bed/rooted vascular	E1/2AB3	Generally consistent with areas defined as eelgrass beds. See "Impact Topic: Eelgrass" for description.

Note: Wetlands classified using the Cowardin system (Cowardin et al. 1979).

Characteristic species within the intertidal wetland communities include saltgrass (*Distichlis spicata*), glasswort (*Salicornia virginica*), pickleweed (*Salicornia pacifica*), Pacific cordgrass (*Spartina foliosa*), salt marsh daisy (*Jaumea carnosa*), gumweed (*Grindelia* spp.), and goose tongue (*Plantago maritima*). Freshwater herbaceous wetlands are often dominated by canary reedgrass (*Phalaris arundinacea*), slough sedge (*Carex obnupta*), grasses (e.g., *Calamagrostis* spp.), rushes (*Juncus* spp.), scirpoid sedges (*Scirpus* spp.), and cattails (*Typha* spp.) (Holland 1986; NPS 2011n).



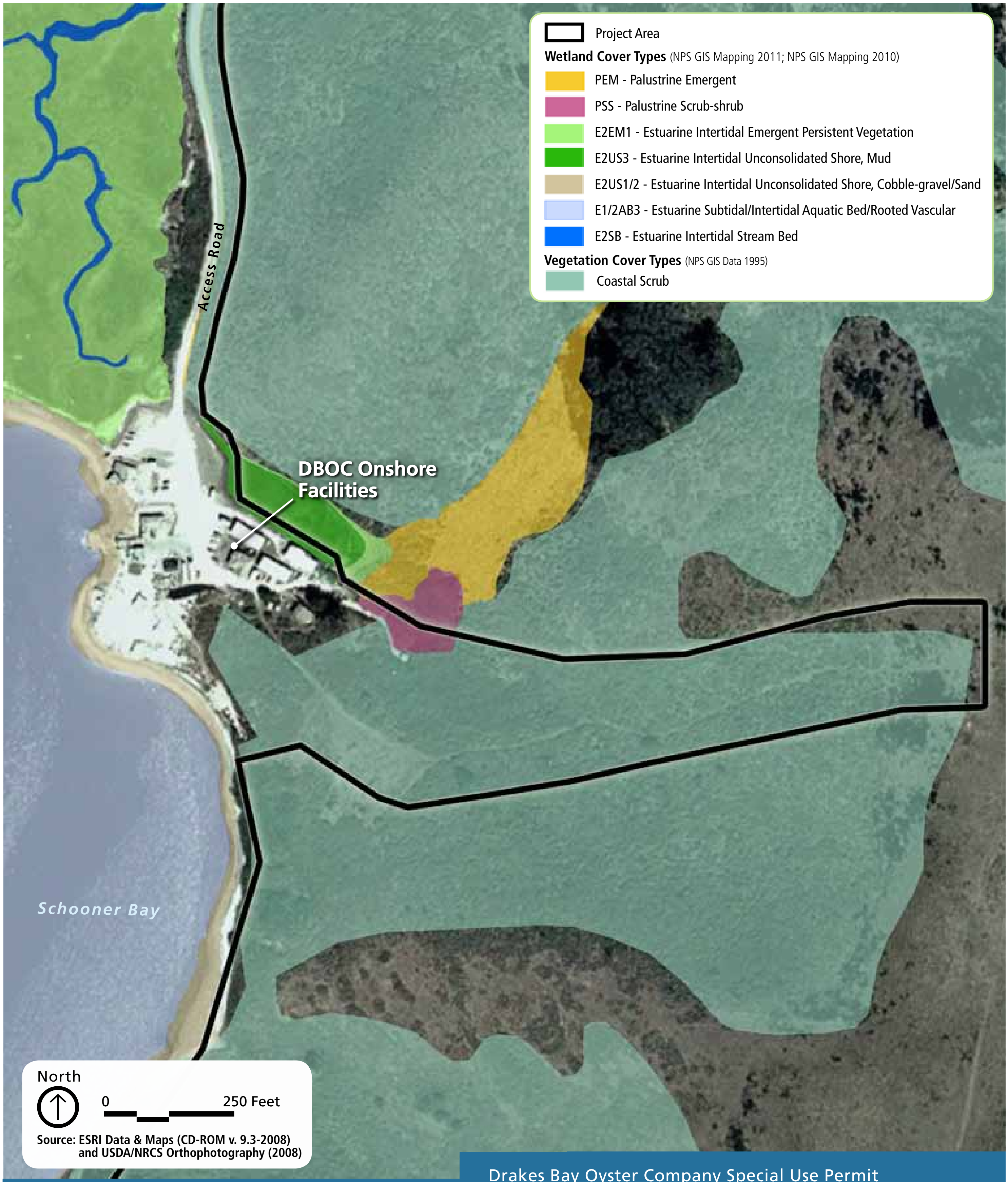
Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-1

Wetlands



Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-2

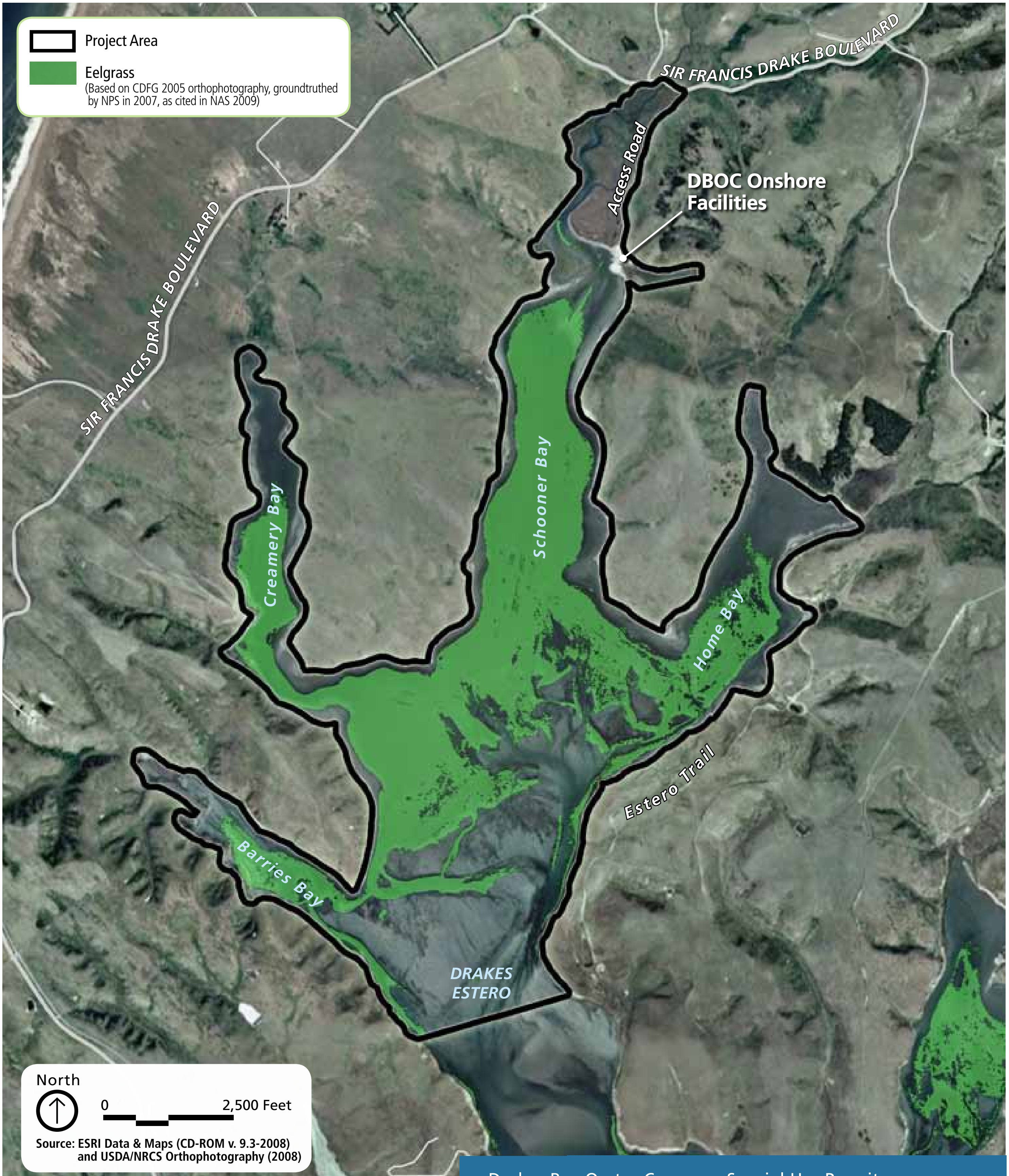
Onshore Vegetation and Wetland Cover Types

The wetlands within the project area, which are located within the coastal zone, are exposed to the effects of sea-level rise due to climatic changes. Based on the recent California Climate Change Center report (Heberger et al. 2009), and as described in the “Impact Topic: Floodplains” section of this chapter, the California coastal zone may experience an increase in mean sea level of approximately 3 to 4.5 feet by 2100. At this rate, sea-level rise, on average, could reach approximately 5.9 inches within the next 10 years. Under such changes, much of the wetland area described above would be under water for the duration of the tidal cycle, effectively changing the character of the wetland and shifting the prevailing hydrologic regime inland. In terms of land area, the potential effect of such changes is unknown; however, for most of the California coast, thousands of wetland acres are expected to experience dynamic changes in hydrology and ecosystem function over the time trajectory described above (Heberger et al. 2009).

IMPACT TOPIC: EELGRASS

In Drakes Estero, eelgrass is the dominant form of submerged aquatic vegetation and is present throughout Drakes Estero in dense beds (figure 3-3). As Press (2005) describes it: “The eelgrass *Zostera marina* dominates the subtidal zone, with extensive beds present everywhere except the exposed intertidal zones, the deepest channels, and the dynamic area surrounding the Estero’s opening.” In addition to eelgrass, Wechsler (2004[xv]) noted other photosynthetic organisms such as giant kelp (*Macrocystis pyrifera*) and big-leaf algae (*Ulva* spp.) present in Drakes Estero, but these were minor in distribution compared to eelgrass. Wechsler also observed that eelgrass beds were an important foraging and breeding ground for many aquatic organisms, including juvenile fish (2004[xvi]). Eelgrass beds form the base of the food web (the “web” of relationships between organisms and their primary food sources) in many coastal habitats, particularly those such as Drakes Estero where eelgrass is the most abundant photosynthetic organism in the system (see discussion under “Primary Productivity”). In addition, eelgrass provides important habitat for fish, invertebrates, and other aquatic organisms, as well as foraging grounds for many types of waterbirds and shorebirds, such as the black brant. Further, eelgrass beds can perform important environmental functions, such as trapping sediment, taking up excess nutrients, and protecting shorelines from erosion by decreasing wave energy (Williams and Heck 2001).

Eelgrass beds are classified as a type of “special aquatic site,” a category of waters of the United States afforded additional consideration under the CWA section 404(b)(1) guidelines developed by the EPA. USACE uses these guidelines as the environmental standards by which to evaluate dredge and fill activities regulated under section 404 of the CWA. The guidelines are also used to establish mitigation requirements for impacts to such resources. Under the 404(b)(1) guidelines, special aquatic sites are subject to greater protection because of their significant contribution to the overall environment. Special aquatic sites possess unique characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These sites are generally recognized as significantly influencing or positively contributing to the overall environmental health or vitality of the entire ecosystem of a region.



Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-3

Eelgrass Cover

Eelgrass beds such as those found in Drakes Estero would be considered "vegetated shallows" under the possible special aquatic sites described in the Federal Register (40 CFR 230, section 404[b][1]).

Seagrasses are included within habitat areas of particular concern for fish species within the Pacific Groundfish Fishery Management Plan (Groundfish Plan; PFMC 2008) under the federal Marine Sanctuaries Act of 1972 (16 U.S.C. 1431) and are considered essential fish habitat under the Magnuson-Stevens Fishery Conservation and Management Act of 1976. The act defines essential fish habitat as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." According to essential fish habitat guidelines, "waters" includes aquatic areas and their associated physical, biological, and chemical properties that are used by fish, and may include aquatic areas historically used by fish. "Substrate" includes sediment, hard bottom, structures underlying waters, and associated biological communities (NMFS 2011b).

Additionally, estuaries, canopy kelp, seagrass, and rocky reefs are designated as habitat areas of particular concern for several fish species within the Groundfish Plan (PFMC 2008). Habitat areas of particular concern are subsets of essential fish habitat that are rare, particularly susceptible to human-induced habitat degradation, especially ecologically important, or located in an environmentally stressed area. Areas designated as habitat areas of particular concern under these provisions are given additional scrutiny when projects are reviewed under the consultation process of the Marine Sanctuaries Act, which is administered by NOAA.

When reviewed under the consultation process of the Marine Sanctuaries Act, additional scrutiny is given to projects in areas designated as habitat areas of particular concern. In recognizing the importance of maintaining healthy populations of eelgrass for habitat and ecosystem functions, the Southern California eelgrass mitigation policy has been adopted by regulatory agencies. The policy is a set of guidelines and requirements for eelgrass mitigation in the coastal zone of Southern California (NOAA 2005). Similar guidelines for Northern California are currently in development, and those guidelines will draw from the Southern California model. For coastal projects requiring review by NMFS, USFWS, and/or CDFG, this policy provides the standardized interagency guidance on mitigating adverse impacts to eelgrass resources.

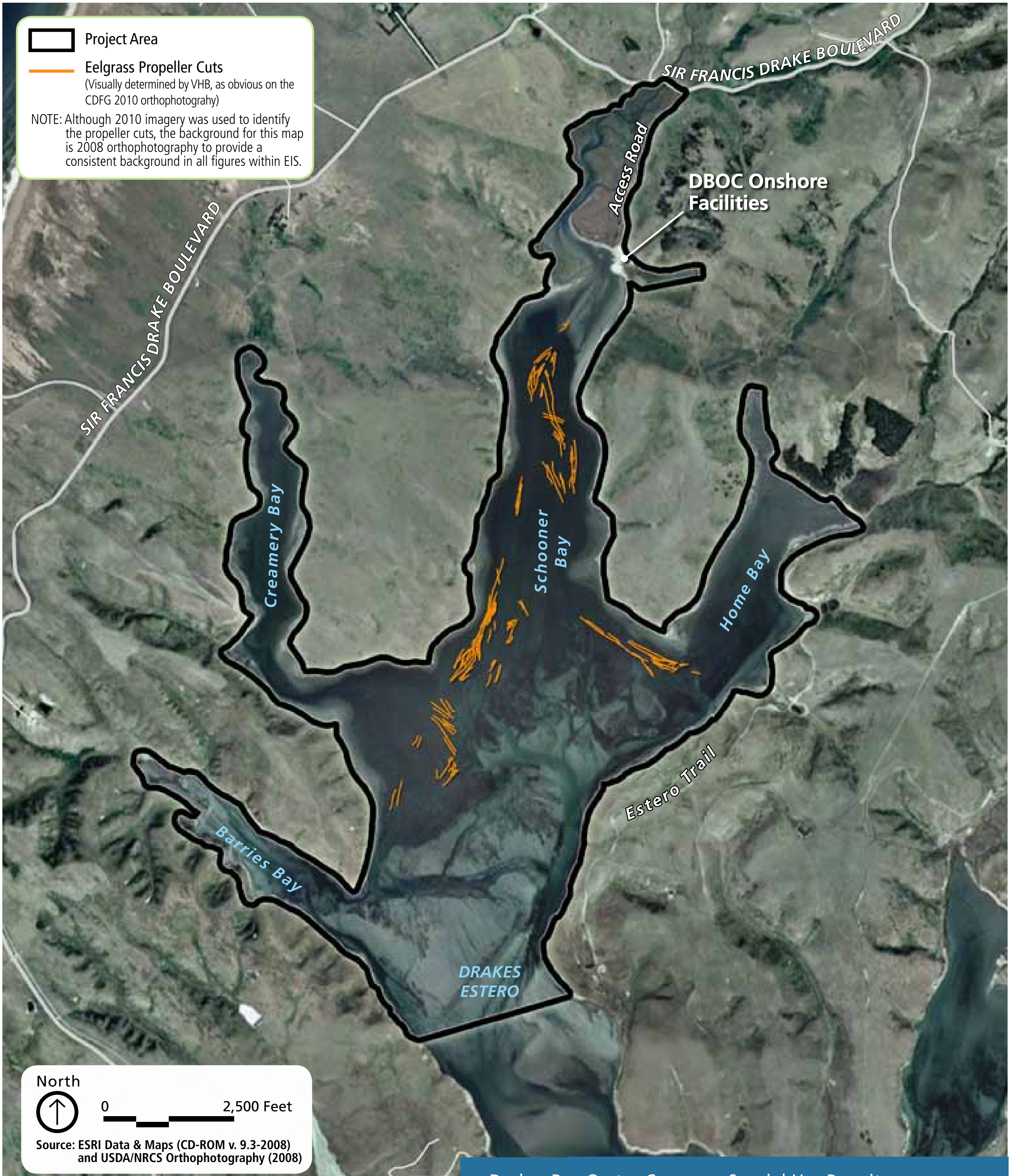
Total coverage of eelgrass is difficult to measure because eelgrass grows at different densities throughout Drakes Estero. A convenient method for estimating coverage is to separate eelgrass into different cover classes that can be interpreted based on aerial photography; for example, 90 to 100 percent cover (percentage of area covered by eelgrass) and 30 to 90 percent cover. Based on CDFG mapping from 2007, eelgrass coverage in Drakes Estero is estimated at approximately 353 acres (90 to 100 percent coverage) and 384 acres (30 to 90 percent coverage) (figure 3-3). The effects of propeller scars can easily be observed as linear, dark signatures through seagrass beds on high-resolution aerial photography (Zieman 1976). In their review of shellfish mariculture impacts on eelgrass in Drakes Estero, the NAS (2009) cites an estimated 50 acres of eelgrass habitat that was impacted by propeller damage based on review of 2007 aerial photography, but qualifies the estimate by saying that it was "loosely quantified" due to the resolution of the imagery used. This 50-acre quantity was based on an area drawn around all sections of Drakes Estero with propeller scars. In an effort to provide a more detailed and current assessment of propeller damage to eelgrass, recent (2010) high-resolution aerial photography of Drakes Estero was evaluated using GIS technology. This evaluation showed that 8.5 miles (45,031 linear feet) of propeller scars through eelgrass are readily seen on the aerial images. Due to the large variability among the widths of scars, this analysis method was not suited for calculating a comparable quantity for comparison with the 50-acre quantity reported by NAS (2009). Interpretation of propeller scarring on the 2010 aerial photographs was limited to areas that were clearly identifiable as scars (Zieman 1976); therefore, the 8.5-mile total is likely an underestimate. Scarring observed in algae was not included in the analysis (figure 3-4).

IMPACT TOPIC: WILDLIFE AND WILDLIFE HABITAT

BENTHIC FAUNA

The term “benthic fauna” refers to species of animals that live on or in the substrate (bottom dwellers). Examples of benthic fauna include, but are not limited to, crabs, shrimps, snails, clams, and oysters. In estuaries, benthic organisms are often regarded as significant components of the food web, providing resources for a variety of predators and performing important ecological functions (Trianni 1995; Bruno and Bertness 2001; Dumbauld, Brooks, and Posey 2001; Welsh 2003). Benthic invertebrates are also known to show rapid and measurable responses to changes in the environment; for this reason, the benthos (the community of benthic organisms) is often cited as an indicator of habitat degradation or, conversely, habitat integrity, depending on the composition and relative abundance of the species present (Weston 1990; Woodin 1991; Simenstad and Fresh 1995; Bruno and Bertness 2001).

In soft-sediment estuaries like Drakes Estero, ecological functions of benthic organisms can include oxygenating sediments by burrowing, consuming and reworking detritus (nonliving organic matter) into forms usable for other species, irrigating sediment and promoting structural complexity within the soft substrate, resuspending sediments and nutrients through bioturbation (the stirring or mixing of sediment by living organisms), and influencing nutrient cycles (Trianni 1995; Dumbauld 1997; Bruno and Bertness 2001; Welsh 2003; Ferraro and Cole 2007). Studies on benthic fauna in west coast estuaries have shown that the ecosystem functions of the benthic community can be adversely affected by disturbances related to organic enrichment (Weston 1990; Dumbauld, Ruesink, and Rumrill 2009); use of pesticides (such as carbaryl used to control burrowing shrimp) or other activities related to shellfish mariculture (Simenstad and Fresh 1995; Trianni 1995; Dumbauld, Brooks, and Posey 2001); and physical disturbance due to dredging, diking, boat traffic, or the introduction of invasive species (Ferraro and Cole 2007; Thompson 2005; Dumbauld, Ruesink, and Rumrill 2009).



Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-4

Eelgrass Propeller Cuts

Dominant native filter feeders include bivalves such as *Nutricola* spp., Washington clams (*Saxidomus nuttalli*), and gaper clams (*Tresus capax*). In addition, macoma clams are found in the outer, sandy tidal flats of Drakes Estero. Other dominant benthic species include tanaid crustaceans (*Leptochelia dubia*), cumaceans (*Cumella vulgaris*), phoronids (*Phoronopsis viridis*), shore crabs (*Hemigrapsus oregonensis*), gammarid amphipods, polychaete worms, and ostracods (Press 2005).

Bivalves

Bivalves, such as native clams, represent a major component of the benthic faunal community in Drakes Estero. Press (2005) noted eight different species of clams (*Clinocardium nuttallii*, *Macoma nasuta*, *M. petalum*, *M. secta*, *Nutricola confusa*, *Protothaca staminea*, *Gemma gemma*, *Rochefortia tumida*) and one species of mussel (*Musculista senhousia*) in his plots at the mouth of Barries Bay. Likewise, native marine clams were prevalent in the study plots of Harbin-Ireland (2004[xvii]) in Schooner Bay. Nonnative species, such as the Pacific oyster (*Crassostrea gigas*), introduced by the commercial shellfish operations, also represent a large component of the bivalve population in Drakes Estero (see discussion below).

Bivalves are filter feeders, with the capacity to contribute to the cycling of nutrients and organic matter between the bottom substrate (benthic system) and the overlying water column (pelagic system) (Dame 1996). With respect to bivalves, the concept relates to the manner in which these filter feeders remove particulate organic and inorganic matter (including plankton) from the water column and, through the process of digestion and excretion, convert that material into forms that are more readily available for uptake by other organisms inhabiting the bottom substrate (Lenihan and Micheli 2001). In various ecosystems, nutrient cycling influenced by filter-feeding bivalves has been shown to provide ecological benefits such as reduced turbidity (Newell and Koch 2004), depression of harmful algal blooms (Dame and Prins 1998; Smaal, van Stralen, and Schuiling 2001), and stimulation of primary productivity through nutrient enrichment of nearby sediments where algae and/or submerged aquatic vegetation may be growing (Reusch, Chapman, and Gröger 1994; Peterson and Heck 1999, 2001; Newell and Koch 2004). However, as Dumbauld, Ruesink, and Rumrill (2009) suggest, west coast estuaries like Drakes Estero are unlikely to experience these ecosystem influences from bivalves to any large degree due to factors such as extensive tidal flushing, high nutrient content in the sediments, and proximity to nutrient-rich upwelling zones along the coast. Dumbauld, Ruesink, and Rumrill (2009) suggest that the abundant nutrient supply from upwelling controls summer primary productivity in west coast embayments like Drakes Estero, and that filter-feeding bivalves would have limited influence under these circumstances.

The history of the decline of the native Olympia oyster within its original range is believed to be one of overexploitation. By the early 1900s, populations of this species were so depleted due to overfishing that the fishery was abandoned altogether following the successful introduction of the nonnative Pacific oyster. Olympia oysters that remain are limited in distribution throughout their range, resulting in its designation as a special status species. A recent study shows that the native Olympia oyster suffers ecological displacement from the Pacific oyster, a much more successful competitor (Trimble, Ruesink, and Dumbauld 2009). Based on this study, the failure of the Olympia oyster to become established on Pacific oyster reefs is related to post-recruitment failure (i.e., inability to grow once affixed to the hard shell substrate). Post-recruitment failure is apparently induced by several factors: (1) dessication (the aquaculture reefs created for oyster fisheries are much higher in elevation than native subtidal reefs, such that colonizing Olympia oysters run the risk of overexposure to air); (2) competition from fouling organisms such as colonial tunicates, which are introduced via commercial shellfish vectors and can quickly smother habitat; (3) preference to colonize Pacific oyster habitat, thereby being subjected to competition from the successful Pacific oyster. In a 1935 survey of the California oyster industry, Bonnot (1935) stated regarding Drakes Estero: “No oysters were found growing there. Several small plants of Japanese seed oysters were made in 1932.”

Recent data suggest that the California coast is undergoing sea-level rise from climate change (Heberger et al. 2009). In addition to changes in sea level, climatic warming has also been linked to changes in ocean circulation patterns and water chemistry. Scientists have recently documented changes in ocean pH levels, indicating that ocean acidification is a process that is currently occurring and can be measured in coastal marine and estuarine habitats (Kerr 2010; Feely et al. 2008). Ocean acidification (a condition in which seawater becomes more acidic) can have adverse effects on organisms that build shells or skeletons from calcium carbonate, such as marine bivalves (Kerr 2010). The more acidic conditions can cause reduced rates of calcification (effectively lowering shell-building potential), and eventually can begin to dissolve shell material (Feely et al. 2008; Kerr 2010).

Nonnative, Invasive, and Commercial Shellfish Species

The Pacific oyster, which is the species of oyster cultivated by DBOC, is not native to the west coast of North America (Trimble, Ruesink, and Dumbauld 2009). As such, there is potential for this species to develop naturally breeding populations in Drakes Estero, which would directly compete for food and space with native species. DBOC has recently introduced the nonnative Manila clam to its stock of cultured bivalves (NAS 2009). Current best management practices in commercial shellfish operations, such as use of triploid stock (effectively sterile stock, with three sets of chromosomes rather than two) to inhibit establishment of reproductively active colonies, along with importation of cultchless juveniles (young molluscs without large shells), are current measures used in other areas of the country to deter colonies of nonnative shellfish (NAS 2004). Based on reports submitted to CDFG, DBOC records indicate average production levels of nearly 5.34 million Pacific oysters (approximately 454,036 pounds) harvested annually between 2007 and 2009. Annual production has ranged from approximately 4.15 million Pacific oysters (352,960 pounds) harvested in 2006 to approximately 6.89 million Pacific oysters (585,277 pounds) and 20,520 Manila clams (684 pounds) in 2010.

European flat oysters, native to Europe, have been included in the commercial shellfish operations lease since 1979 and are permitted in the 2008 SUP. DBOC does not currently cultivate this species. According to records submitted by DBOC to CDFG, DBOC has never sold or planted European flat oysters. The last record of European flat oysters being sold at the site is from April 1968 (CDFG 2011c). Small numbers of this species still existed within Drakes Estero as of January 2008. DBOC has advised that these are remnants of prior plantings by JOC (DBOC 2008b[xviii]).

NAS (2009, 2010) points out that historic importation of the Pacific oyster on cultch has resulted in the introduction of other nonnative species to the region (see also Foss et al. 2007), such as the pathogen *Haplosporidium nelsoni* (which causes MSX-multinucleated sphere unknown) (Friedman 1996; Burreson and Ford 2004), herpes-like viruses (Burge et al. 2005; Burge, Griffin, and Friedman 2006; Friedman 1996), and particularly the invasive colonial tunicate *Didemnum vexillum*(commonly referred to as *Didemnum*) (Lambert 2009; Foss et al. 2007). This tunicate is an aggressive colonizer of hard substrates like oyster culture sites, and has been observed overgrowing habitats such as piers, pilings, rocky surfaces, and the types of structures used in oyster mariculture (racks, bags, etc.). This type of aggressive growth can cause serious ecological consequences for invertebrate fauna (Osman and Whitlatch 2007; Mercer, Whitlatch, and Osman 2009). Further, the ability of *Didemnum* to regenerate after being fragmented increases its dispersal capabilities (Bullard, Sedlack, et al. 2007), which can be exacerbated by maintenance of oyster bags and racks (NAS 2009). In Drakes Estero as well as nearby Tomales Bay, this tunicate has been observed growing on eelgrass blades (NAS 2009; Grosholz 2011b). This tunicate overgrowth can have detrimental effects on eelgrass by inhibiting its ability to photosynthesize (Carman and Grunden 2010).

Didemnum growing on eelgrass, as observed in Tomales Bay. (Photo courtesy of NPS.)

Didemnum at Bull Point, along the shore of Drakes Estero. (Photo courtesy of NPS.)

Byers (1999) studied the invasion of the mud snail *Batillaria attramentaria* with specific reference to its introduction by commercial shellfish operations in Drakes Estero, where this species was found to be potentially detrimental to native snail populations. In addition, shell remains from an exotic soft shell clam (*Mya arenaria*) were observed by archeologists and marine biologists on the surface of archeology site MRN-296 near DBOC onshore facilities, located in an area formerly used as a shell dumping site for JOC (Konzak and Praetzellis 2011). Finally, Heiman (2006) looked at the potential effects of human-made hard substrates (piers, jetties, bridges) on nonnative invertebrate and algae introductions in nearby Elkhorn

Slough, California, drawing a connection between oyster culture as a mode of introduction for nonnative species and increased availability of hard substrates for nonnative species to become established.

FISH

Based on studies in other U.S. Pacific estuaries and coastal lagoons, Drakes Estero likely supports a wide diversity of fish species. For example, common species found in Pacific estuaries include starry flounder (*Platichthys stellatus*), English sole (*Parophrys vetulus*), herring (*Clupea pallasii*), anchovy (*Engraulis mordax*), speckled sand dab (*Citharichthys stigmaeus*), surf smelt (*Hypomesus pretiosus*), American shad (*Alosa sapidissima*), staghorn sculpin (*Leptocottus armatus*), shiner surfperch (*Cymatogaster aggregata*), and free-swimming arthropods such as the Dungeness crab (*Cancer magister*) (Pinnix et al. 2005; Blackmon, Wyllie-Echeverria, and Shafer 2006; Williamson 2006). In addition, two federally listed species—Coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*)—have critical habitat in the Drakes Estero watershed. Steelhead trout are present and use most watersheds on the Point Reyes Peninsula, whereas Coho salmon have not been documented on the Point Reyes outer coast, but potential habitat for this species exists.

Though a comprehensive study of the fish community within Drakes Estero has not been undertaken, Wechsler (2004[xix]) sampled fish in Schooner Bay and Estero de Limantour to evaluate potential effects of oyster mariculture on Drakes Estero fish populations. Among the 35 species observed, the 5 most prevalent species were topsmelt (*Atherinopsis affinis*), three-spined stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), bay pipefish (*Syngnathus leptorhynchus*), and kelp surfperch (*Brachyistius frenatus*).

An aspect of wildlife habitat management that pertains to the Seashore is areas designated as essential fish habitat. The Magnuson-Stevens Fishery Conservation and Management Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), is the law that governs U.S. marine fisheries management. It requires regional management councils to maintain fishery management plans that, among other things, describe essential fish habitat and protection measures. The topic of essential fish habitat was discussed under the “Impact Topic: Eelgrass” section above. Drakes Estero has been identified as essential fish habitat for fish species managed under several fishery management plans maintained by the Pacific Fishery Management Council (PFMC 2008). Species included under these fishery management plans include various rockfishes, flatfishes, and sharks (Groundfish Plan), the Coho and Chinook salmon (Pacific Coast Salmon Fishery Management Plan), and northern anchovy, mackerel, and squid (Coastal Pelagic Fishery Management Plan) (PFMC 1998).

HARBOR SEALS

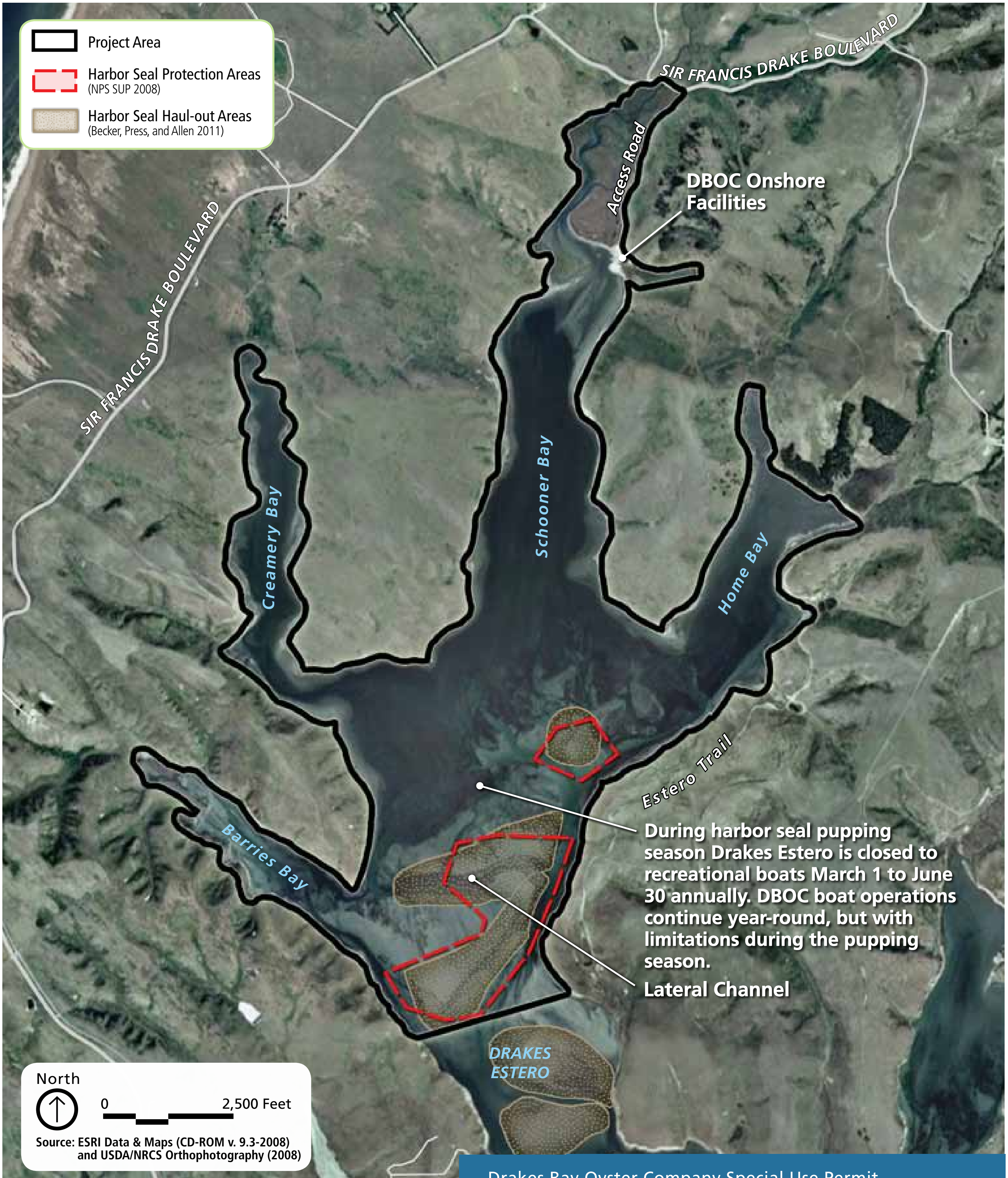
Drakes Estero supports a large breeding population of Pacific harbor seals (*Phoca vitulina richardsi*) due in part to the diversity and availability of exposed substrates such as intertidal sandbars, mudflats, and beaches, which are favorable locations for seal haul-out sites (NAS 2009; Becker, Press, and Allen 2011) (figure 3-5). Drakes Estero is one of the largest harbor seal colonies in the state (Lowry, Carretta, and Forney 2008), the largest in Marin County, and accounts for around 20 percent of pups produced in Central California from Sonoma to San Mateo Counties (Codde et al. 2011).

The Pacific harbor seal is the only year-round resident pinniped (seal or seal-like mammal) in the San Francisco Bay Area (Sydeman and Allen 1999; Truchinski et al. 2008). Seals use terrestrial sites (called haul out sites) during the breeding season (March 1 to June 30) to give birth and suckle their young, and during the nonbreeding season for rest and to molt their fur (NAS 2009). Figure 3-5 shows the sandbar areas in Drakes Estero used by harbor seals, as well as the boundaries of the current zones designed to protect common haul-out sites. Drakes Estero is a site of ongoing seal monitoring studies conducted by NPS (e.g., NPS 2006c; Adams et al. 2009; Codde et al. 2011).

Monitoring objectives have often included detection of changes to population size, evaluating reproductive success, and identifying anthropogenic or environmental factors that affect the existing population. Population size and reproductive success of harbor seals can be attributed to a number of factors, one of which is the availability of high quality breeding habitat. The results of the 2010 NPS study of harbor seals in multiple Marin County survey locations indicated that the largest seal population, based on observed numbers of hauled-out adults (610) and pups born (223), is within Drakes Estero (Codde et al. 2011).

Harbor seals reside almost exclusively in coastal habitats, spending approximately 33 to 55 percent of their time at onshore terrestrial sites depending on the season (Yochem et al.1987; Burns 2002; NAS 2009). Seal abundance at haul-outs is influenced by multiple factors, including time of day, tide level, current direction, weather, season, year, disease outbreaks, disturbances from other wildlife, and human activities (Yochem et al. 1987; Suryan and Harvey 1999; Thompson, Van Parijs, and Kovacs 2001; Grigg et al. 2004; Hayward et al. 2005; Seuront and Prinzivalli 2005; NAS 2009).

Environmental factors such as El Niño–Southern Oscillation events can affect attendance and reproduction (Trillmich and Ono 1991; Sydeman and Allen 1999) due to the changes in weather patterns and ocean temperatures that usually accompany this Pacific Ocean phenomenon. Other factors include density-dependence (Jeffries et al. 2003), interspecific competition (competition with other species) (Bowen et al. 2003), predation (Lucas and Stobo 2000), and disease (Thompson, Van Parijs, and Kovacs 2001). Human activities can disturb seals at haul-out sites, causing changes in seal abundance, distribution, and behavior, and can even cause abandonment (Suryan and Harvey 1999; Grigg et al. 2002; Seuront and Prinzivalli 2005; Johnson and Acevedo-Gutierrez 2007).



Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-5

Harbor Seal Protection Areas and Haul-out Areas

Haul-out sites in Drakes Estero and adjacent Estero de Limantour have been subdivided into eight subsites based on habitat conditions. These subsites arise from a complex of eight sandbar sites where seals haul out at various times over the year. During a single day, seals can move from one subsite to another when crowding occurs or when rising tides limit the amount of available space. Seals also may float over submerged subsites during high tides, awaiting the reemergence of the sandbar when the tide recedes. The eight subsites in Drakes Estero and Estero de Limantour are used during breeding and molting seasons, and some also are used year-round. Females with pups frequent sand bars located in the upper and middle portions of Drakes Estero during low tide, apparently conferring the advantage of isolation from the mainland, as well as from humans and predators. Limantour Spit at the mouth of Drakes Estero is predominantly used by non-breeding seals during the breeding season (Becker, Press, and Allen 2011).

In July 2009, the Marine Mammal Commission (MMC) initiated a review of the potential effects of human activities, including aquaculture operations, on harbor seals in Drakes Estero. The document is under internal review by MMC. This report will be reviewed and considered as part of the NEPA process for this EIS when it becomes available.

Between spring 2007 and 2010, more than 250,000 digital photographs were taken from remotely deployed cameras overlooking harbor seal haul-out sites in Drakes Estero. The photographs were taken in one minute intervals. Because the collection of these photos was not based on documented protocols and procedures, the body of photographs does not meet the Department’s standards for a scientific product. As a result, the photographs have not been relied upon in this EIS. These photographs are posted and available for review on the NPS website at http://www.nps.gov/pore/parkmgmt/planning_reading_room_photographs_videos.htm.

BIRDS

The region surrounding Point Reyes Peninsula is host to one of the most diverse and abundant bird population centers in the world (Shuford et al. 1989). In particular, the Seashore is a well known location for abundant waterbird and shorebird populations, which include a large variety of species that rely on its coastal and estuarine habitats. There are several reasons for such high diversity, including coastal upwelling, which provides for rich, nearshore feeding grounds with abundant zooplankton and small fishes; the physiographic character of the landscape, which provides exceptional nesting habitat for many species; the position of the region as a stop-off point for migrating birds from temperate areas such as Chile, New Zealand, Hawaii, and other locations; and the proximity of deep water close to the shoals near Cordell Bank, which creates unique conditions for high productivity and optimal foraging for waterbirds and shorebirds (Shuford et al. 1989; Press 2005).

While Drakes Estero is not a significant breeding site for most of the birds found there, it is a major foraging (or feeding) and resting location for nearly all species of resident (year-round) and nonresident (migratory) birds known to use the project area. Foraging is an important aspect of a bird’s biological activity, involving energy expenditure related to finding food and energy gained from successful feeding activity. Suitable foraging habitat areas serve as "staging sites" which are used by migratory birds to restore depleted fat reserves after long periods of flight (Myers 1983), to minimize energy expenditure by resting, and allow them to successfully arrive at migratory destinations. Staging also builds energy reserves required for breeding activity that commences upon arrival at a bird's migratory destination (Harrington and Perry 1995). The use of Drakes Estero as a staging site is further enhanced by the presence of sandspits and sandbars, which in addition to serving as foraging habitat, provide isolated roosting and resting habitat.

Drakes Estero's foraging and resting habitats also provide benefits to many other bird species that overwinter in the estuary. Due to their relative isolation from onshore habitats and capacity to hold large quantities of birds, the threat of predation is greatly reduced. The physical isolation from onshore habitats prevents ground predators from accessing potential prey. In addition, birds rely heavily on auditory cues (e.g., the call of a raptor) during biological activities and for detection of predator alerts or warning signals from other nearby birds (Francis, Ortega, and Cruz 2009). Since more birds are attracted to isolated foraging and resting habitat, predators are more likely to be detected and avoided with alerts and warning signals.

Due to the large number of migratory species using Drakes Estero, populations vary depending on the time of year that they migrate (usually spring or fall) (Evens 2008). Shuford et al. (1989) used the following categories to describe seasonal occurrence of birds visiting or inhabiting the Seashore, including Drakes Estero: "resident," which includes species present continuously through the nonmigratory period; "transient," a species passing through the area during migration; "dispersant," which includes species that arrive after long-distance dispersal from some other breeding site; and "visitant," a species occurring occasionally because it is at the edge of its normal range.

The primary bird occurrences in the project area result from high frequency of resident and overwintering (transient) species using Drakes Estero as foraging habitat, staging habitat, and habitat to rest before and after migration. This is due to an abundance of protected resting habitat and the diversity of foraging habitat found in Drakes Estero, including intertidal beaches, intertidal flats, brackish marshland, and open subtidal waters. The abundant resident and overwintering bird populations in Drakes Estero include a high diversity of species, including waterbirds and shorebirds (Shuford et al. 1989).

Waterbirds and shorebirds are large categories of species that can be further characterized by where they forage. They include seabirds (foraging in the open ocean), coastal waterbirds (foraging along the interface between land and salt/freshwater), wading birds (foraging by wading in fresh and brackish water), marsh birds (foraging primarily in freshwater), and true shorebirds (foraging primarily along shorelines and estuarine mudflats). Waterfowl (ducks, geese, and swans) are also a large component of Drakes Estero's resident and transient bird populations (Shuford et al. 1989).

While transient, dispersant, and visitant bird species use Drakes Estero to temporarily stop and forage during migration, many also overwinter (stay and forage throughout the winter season) before continuing to their final migratory destination. For some species, Drakes Estero is their migratory destination. The invertebrate species living year-round on intertidal flats in Drakes Estero are available prey for the overwintering bird species, as well as those species that visit during the spring and fall migrations. In addition, other abundant prey species which live and seek cover in eelgrass beds (e.g., fish and crustaceans) provide foraging opportunities for the abundant bird population. The abundance and diversity of birds that overwinter is reflected by the inventories conducted in Drakes Estero by White (1999), in which 58 bird species were recorded in Home Bay from November to March. In addition, the study recorded bird inventories during the same period in other Drakes Estero locations, revealing 51 species in Schooner Bay, 47 species in Creamery Bay, and 41 species in Barries Bay.

The combined inventories from each location totaled approximately 73 different migratory species during the mid-winter count (White 1999). The highest abundance included the American wigeon (*Anas americana*), bufflehead (*Bucephala albeola*), ruddy duck (*Oxyura jamaicensis*), willet (*Catoptrophorus semipalmatus*), western sandpiper (*Calidris mauri*), least sandpiper (*C. minutilla*), and dunlin (*C. alpina*). This is reiterated in Press (2005) which notes the identification of nearly 50 waterbird and shorebird species that commonly winter in Drakes Estero, with records of Buffleheads, Ruddy Ducks, Western Sandpipers, Least Sandpipers, and Dunlin each totaling over 1000 individuals (Page and White 1999). In addition, approximately 102 species of migratory waterbirds, shorebirds, and waterfowl have been recorded in the Drakes Estero and Estero de Limantour complex (Evens 2008).

Some bird species within the Seashore have special conservation status due to population size and known threats to survival of the species. The Point Reyes Peninsula has potential habitat for federally listed shorebird species, including western snowy plover (*Charadrius alexandrinus nivosus*) and California least tern (*Sternula antillarum browni*) (Hickey et al. 2003; Robinson-Nilsen, Demers, and Strong 2009) (see "Special-status Species" section in this chapter). Drakes Estero serves as a major staging area for spring-migrating black brant geese (*Branta bernicla*), which graze by the hundreds on the abundant eelgrass beds before continuing migration between Mexico and Alaska (Shuford et al. 1989; Ganter 2000; Moore et al. 2004; Evens 2008). Eelgrass is the primary food for the black brant, and the bird is considered by CDFG as a species of special concern due to decreasing abundance within their historic range (Davis and Deuel 2008). While observations of black brant in Drakes Estero from 1985 indicate over 2,000 individuals counted on a single day, significantly less brant were observed in the following years (NPS 1991).

The American white pelican (*Pelecanus erythrorhynchos*) is also found in Drakes Estero during summer and winter months (Evens 2008). This pelican species is also a CDFG species of special concern but only within its current breeding range (which is outside Drakes Estero) (Shuford 2008). Drakes Estero provides rich foraging habitat preferred by overwintering white pelicans, which can utilize the estuary during the non-breeding period of migration (Evens 2008; Shuford 2010).

Drakes Estero also provides habitat for several species recently removed from the Federal List of Endangered and Threatened Wildlife, including the brown pelican (*Pelecanus occidentalis*), peregrine falcon (*Falco peregrinus*), and bald eagle (*Haliaeetus luecocephalus*). Abundant numbers (ranging from hundreds to thousands) of brown pelicans forage and roost in Drakes Estero, especially during runs of anchovies and sardines (Evens 2008). Peregrine falcons residing in nearby cliffs also hunt prey in Drakes Estero, likely due to the availability of abundant avian prey species, which is most of the falcon's diet (Evens 2008). Unlike the peregrine, Bald eagles are not known to nest near Drakes Estero, but can occasionally forage in its waters for fish and other birds.

Other notable species that frequent Drakes Estero include osprey (*Pandion haliaetus*), great blue heron (*Ardea herodias*), great egret (*Ardea alba*), snowy egret (*Egretta thula*), and black-crowned night heron (*Nycticorax nycticorax*). Osprey are raptors attracted to Drakes Estero's abundant fish population, which are the osprey's preferred prey, and can select nesting sites in nearby trees and cliffs (Evens 2008). Herons and egrets are types of colonial waterbirds, species which gather into large assemblages during nesting season and obtain their food by foraging in nearby aquatic habitat. Studies conducted between 1999 and 2005 by Kelly et al (2006) present data from an active colony of great blue herons and great egrets, located on the west shore of Drakes Estero. Earlier inventories of Marin County colonial waterbirds found great blue heron colonies near the south finger of Home Bay, and on the east and west shore of Schooner Bay near the former Johnson Oyster Company (Pratt 1983).

The 2003 Southern Pacific Shorebird Conservation Plan designates Drakes Estero, in combination with Estero de Limantour, as a wetland of importance. It states, "Each regularly holds thousands of shorebirds with combined totals sometimes reaching nearly 20,000 individuals in winter" (Hickey et al. 2003). The conservation plan also notes the Drakes Estero and Estero de Limantour system as a Site of Regional Importance to shorebird conservation by the Western Hemisphere Shorebird Reserve Network (Hickey et al. 2003), a status based on having at least 20,000 shorebirds annually. The system's proximity to the San Francisco Bay, which is a Western Hemisphere Shorebird Reserve Network Site of Hemispheric Importance (i.e., greater than 500,000 annual shorebirds), and other recognized wetland habitats (Bolinas Lagoon, Tomales Bay, Abbott's Lagoon, San Antonio Estero, and San Americano Estero) connects it to a network of interrelated coastal wetlands (Page and White1999). This connectivity of habitats hosts more waterbirds and shorebirds in all seasons than any other wetland along the U.S. Pacific coast (Stenzel et al. 2002). The known movements of migratory birds within the greater Bay Area wetland complex are noted in Shuford et al. (1989), also indicating the connectivity of each site within the network of wetlands.

The North American Waterbird Conservation Plan Waterbird Initiative includes the Seashore as an Important Bird Area (Kushlan et al. 2002). Since this designation, the California chapter of the North American Waterbird Conservation Plan Waterbird Initiative has elevated three divisions of coastal Marin County to independent Important Bird Area status, including Tomales Bay and Outer Point Reyes (the latter inclusive of Drakes Estero and Estero de Limantour). Further, the Seashore was recognized in 2001 by the American Bird Conservancy as one of the 100 Globally Important Bird Areas.

IMPACT TOPIC: SPECIAL-STATUS SPECIES

Special-status species include plant and animal species that have regulatory protection under current federal and state laws. Federal protection is afforded through the ESA, which is administered by the USFWS and NMFS. In California, state protection is afforded through the California ESA, which is administered by the CDFG.

The USFWS and NMFS may list a species as either endangered or threatened, and critical habitat areas may be established for currently listed species as an additional conservation measure. By definition, an "endangered" species is in danger of extinction throughout all or a significant portion of its range (NMFS 2011b). A "threatened" species is one that is likely to become endangered in the foreseeable future (NMFS 2011b). Critical habitat is defined as: (1) specific areas within the geographical area occupied by the species at the time of listing, on which are found those physical or biological features that are essential to the conservation of the listed species and that may require special management considerations or protection, and (2) specific areas outside the geographical area occupied by the species at the time of listing that are essential to the conservation of a listed species (16 U.S.C. 1532). The CDFG may list a species as threatened, endangered, or rare. State-listed species with threatened or endangered designations can also be listed federally by USFWS or NMFS and have similar conservation needs. The rare designation describes certain plants in California, not animals, using the California Rare Plant Rank system created by the California Native Plant Society (CNPS). The system ranks the highest conservation priorities for state and federally listed plants, and incrementally lower conservation priorities for unlisted plants (which may still have conservation value but lack sufficient species information or have limited distribution). The CNPS Rare Plant Program operates under a Memorandum of Understanding with CDFG, which formalizes and outlines their cooperation in rare plant assessment and protection.

Pursuant to section 7 of the ESA, NPS requested a species list from the USFWS to determine whether federally listed threatened or endangered species occur within the project area (appendix E). The USFWS Sacramento Fish and Wildlife Office provided a list of threatened and endangered species for the Drakes Bay U.S. Geological Survey 7.5 Minute Quadrangle Map dated 1976 (USFWS 2010). NOAA's NMFS Southwest Regional Office provided additional comments and recommendations regarding marine resources in Drakes Estero (NMFS 2010c). In addition, NPS reviewed formal consultations from the USFWS (NMFS 2009; USFWS 2004, 2008) for recent NPS projects that have relevant natural resources and are located near Drakes Estero.

To identify potential special-status species specific to the project area of this EIS, NPS reviewed the USFWS results by species and associated habitat. NPS determined that no federally listed plant species and seven federally listed animal species or their critical habitat are likely to exist within the project area. Additional data provided by the CDFG and CNPS reveal other potential special-status species, including state-listed or other rare species. Federally listed species are described in the sections below; however, state-listed and other unlisted rare species are excluded because their habitat would be unaffected by proposed actions in the project area (see appendix E).

Species described in this section do not comprise all species that are considered to be at risk. “Species of Special Concern” (SSC) are animals that are not listed under state or federal law. The purpose of SSC designation is to focus attention on species that require special management consideration and to help avoid the need for listing under the federal and state endangered species laws. Since these SSC are not listed by USFWS, NMFS, or CDFG, these species are described in the Wildlife and Wildlife Habitat section.

FEDERALLY LISTED ANIMAL SPECIES

Of the 19 federally listed animal species revealed in the USFWS searches (appendix E), 7 species are potentially affected by proposed actions in the project area: Myrtle’s silverspot butterfly, California red-legged frog, central California Coho salmon, central California steelhead, leatherback sea turtle, western snowy plover, and California least tern. These federally listed species are described below.

Myrtle’s Silverspot Butterfly (*Speyeria zerene myrtleae*)

Myrtle’s silverspot butterfly was federally listed as endangered in 1992 (USFWS 1992). Its habitat includes coastal dune–grassland communities to inland sagebrush and forest communities. The historic range of the butterfly in California is believed to have extended from the mouth of the Russian River in Sonoma County to Point Año Nuevo in San Mateo County (Launer et al. 1992).

In the Seashore, suitable habitat includes several vegetation cover types, such as coastal dune, coastal prairie, and coastal scrub, at elevations ranging from sea level to approximately 985 feet above sea level, and 3 miles inland (Launer et al. 1992). Plant species known to attract adult Myrtle’s silverspot butterfly include western dog violet (*Viola adunca*), curly-leaved monardella (*Monardella undulata*), yellow sand-verbena (*Abronia latifolia*), seaside daisy (*Erigeron glaucus*), bull thistle (*Cirsium vulgare*), gum plant (*Grindelia* spp.), and mule ears (*Wyethia* spp.). Brownie thistle (*Cirsium quercetorum*) and groundsel (*Senecio* spp.) are also food sources. Many of these nectar-producing species are common to the Seashore, including the dog violet, which is a main nectar source for the butterfly (USFWS 2009).

Threats to the species include urban and agricultural development, changes in natural fire patterns, reduced availability of host plants, invasive nonnative plants, livestock grazing, overcollecting, and other human-caused impacts (USFWS 1998, 2009). The complex habitat needs of breeding Myrtle’s silverspot butterfly may be the species’ limiting factor. Due to the lack of historic data prior to the 1990s, it is not known whether the silverspot has historically declined within the Seashore. Surveys of Myrtle’s silverspot butterfly populations at the Seashore between 1993 and1997 found that the Tomales Point Tule Elk Reserve population remained stable, whereas the central Point Reyes population declined sharply (USFWS 1998).

As of 1980, the only remaining healthy populations of the Myrtle's silverspot butterfly are believed to exist within the Seashore. Butterflies have been found in association with land surrounding Drakes Estero, which is bordered by coastal scrub communities suitable for butterfly habitat. A 1997 survey of points within the Point Reyes Peninsula estimated populations of approximately 250 to 500 butterflies. Surveys completed in 2003 observed three separate populations of the species, located near Drakes Estero, Drakes Beach, and several Seashore trailheads (USFWS 1998, 2009). Due to the known population information and potential Myrtle's silverspot butterfly habitat surrounding Drakes Estero, this project has the potential to impact the species.

California Red-legged Frog (*Rana aurora draytonii*)

The California red-legged frog was listed as federally threatened in 1996 (USFWS 1996). In addition, revised critical habitat was designated for the red-legged frog in 2010 (USFWS 2010). The frog requires a variety of habitats, including aquatic breeding areas, riparian habitat, and upland dispersal habitats. Aquatic habitats used for breeding include pools and backwaters within streams and creeks, ponds, marshes, springs, sag ponds, dune ponds, and lagoons. Additionally, California red-legged frogs frequently breed in artificial impoundments, such as stock ponds (USFWS 2002b). Historically, the frog has been observed at elevations ranging from sea level to 5,200 feet above sea level, but it has been extirpated (eliminated) in 70 percent of its former range. Potential threats to the species include elimination or degradation of habitat from land development and land use activities, and predation from introduced species such as bullfrogs and crayfish.

Since 1993, the U.S. Geological Survey Biological Resources Division has conducted surveys of aquatic amphibian habitat in the Seashore. Field data collected during these surveys includes habitat type (permanent or seasonal, natural or created), water characteristics (depth, flow, turbidity, etc.), vegetation (emergent, floating, and surrounding the site), disturbance (including current grazing), and the age and physical condition of amphibians found. The surveys have identified more than 120 California red-legged frog breeding sites within the Seashore, supporting a total adult population of several thousand frogs (NPS 2007a). Approximately two-thirds of the breeding sites are on ranch lands, with a large proportion occurring at stock ponds used by farmers.

The central peninsula alone has roughly 75 stock ponds in an area extending from the Kehoe Ranch near Pierce Point south to Point Reyes itself, and east to Tomales Bay, Mount Vision, and the Laguna Ranch (now the Clem Miller Environmental Education Center). Approximately 50 of these ponds are located on land currently used for ranching, with most of the remaining 25 on former ranch lands on Inverness Ridge and above Estero de Limantour. Most of these ponds retain water at least 20 inches deep well into the summer, and a number are perennial in typical rainfall years. Evidence of red-legged frog breeding has been observed in many of these ponds.

The creation of stock ponds and other small impoundments on ranches over the past 100 years has likely resulted in increased numbers of these frogs and an expansion in range for red-legged frogs in the Seashore area. Frogs appear to move readily between such ponds during periods when the ground is moist, which is prolonged due to the climatic conditions that occur along the Point Reyes Peninsula. Numerous wet swales, seasonal springs, and ephemeral pools within the Seashore provide dispersed travel and feeding habitats.

Based on survey data, important habitat for red-legged frogs also includes streams with relatively low gradients that have late-season water flow or water retention in pools. On Point Reyes Peninsula, such creeks support relatively few of the documented occurrences of the frogs, but may serve as important connectors to other breeding and refuge habitats. Examples of Seashore streams with this habitat are found in the Drakes Estero watershed, and California red-legged frogs are documented in East Schooner, Home Ranch, Limantour, Glenbrook, Muddy Hollow, and Laguna creeks.

The 2010 California red-legged frog critical habitat designation specifically includes the Point Reyes Peninsula, due to the presence of habitat features that are essential to the conservation of the species. The critical habitat designation states that the peninsula contains high-quality aquatic habitats suitable for breeding and upland areas for dispersal, shelter, and food. The Point Reyes Peninsula critical habitat also provides connectivity to red-legged frog populations both north and inland of the peninsula. As a result, the project has potential to impact populations of California red-legged frog and its critical habitat.

Central California Coho Salmon (*Oncorhynchus kisutch*)

The central California Coho salmon was originally listed as federally threatened in 1996 (NOAA 1996) and then changed to federally endangered in 2005 (NMFS 2005b). The salmon was also state-listed as endangered in 2001 (CDFG 2004c). In addition, critical habitat was designated for the Coho salmon in 1999 (NOAA 1999). The Coho salmon is an anadromous species, spending a portion of its life cycle in marine waters (including estuaries) and a portion—specifically spawning and rearing—in fresh waters. Coho salmon adults migrate from their marine environment into the freshwater streams and rivers where they were born, in order to mate and spawn (the release of eggs and sperm after mating). This process occurs once in the Coho salmon’s life cycle, with death occurring after spawning. Upon successful reproduction, young salmon remain in fresh waters for rearing and then migrate to estuarine and marine waters to forage and mature to adulthood (NMFS 2011a).

The threats to the California Coho salmon are numerous. West coast populations have experienced dramatic declines in abundance in the past several decades due to both human-induced and natural factors. Loss of habitat and habitat modification, two primary threats, occur when natural watershed flow regimes are altered by human-induced factors such as diversions for agriculture, flood control, and hydropower, among others. In addition, human land use, such as logging, road construction, and urbanization, causes detrimental habitat modification within the watershed. Recreational and commercial fisheries also threaten the species by altering stock populations. Other threats result from increased predator populations in habitat where modification has caused shifts in nonnative species and predator abundance. Natural threats can include predation from piscivorous birds and pinnipeds, as well as environmental conditions such as flooding and climatic change that can intensify problems associated with riverine and estuarine habitat (NMFS 2011c).

In 2004, the *Recovery Strategy for California Coho Salmon* developed a guide for recovering Coho salmon populations on the north and central coasts of California (CDFG 2004c). For each Coho salmon Evolutionarily Significant Unit (including the central California Coho salmon), several smaller recovery units were created based on the characteristics of smaller drainages within watersheds. The Seashore is included in the Bodega-Marin Coastal Recovery Unit, which is further divided into seven hydrologic areas. Hydrologic areas within the Seashore include Tomales Bay, Point Reyes (which includes Drakes Estero), and Bolinas. Based on the 2004 report, the CDFG determined that the Point Reyes hydrologic area does not have Coho salmon present, nor are Coho salmon suspected to be present. The other hydrologic areas within the Seashore have both historical and recently documented occurrences of the species (CDFG 2004c).

However, in association with the federally threatened listing in 1996, NMFS designated critical habitat for central California coast Coho salmon to include all accessible reaches of rivers, including estuarine areas and their tributaries, between Punta Gorda in northern California and the San Lorenzo River in central California (NOAA 1999). This critical habitat designation includes the Seashore, Drakes Estero, and its tributaries. Through this designation, NMFS considers the following requirements of the species: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring; and (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species (NOAA 1999). The designation recognizes species' use of diverse habitats and accentuates the need to account for all of the species' freshwater and estuarine life stages, including small freshwater streams and estuarine rearing areas (NOAA 1999).

Central California Steelhead (*Oncorhynchus mykiss*)

The central California steelhead was listed as federally threatened in 1996 (NOAA 1996). In addition, critical habitat was designated for the steelhead in 2005 (NMFS 2005a). Similar to the Coho salmon, the California steelhead is an anadromous fish species. They swim from freshwater habitat, through estuaries, and into the ocean where they may spend several years before returning to spawn. Monitoring data indicate that steelhead juveniles may reside within freshwater environments for 18 months to 3 years. The steelhead may make several spawning migrations in its lifetime (NMFS 2011e).

The threats to the California steelhead are numerous, and west coast populations have experienced dramatic declines in abundance in the past several decades (NMFS 2011e). Loss of habitat and habitat modification, two primary threats, occur when natural watershed flow regimes are altered by human-induced factors such as diversions for agriculture, flood control, and hydropower, among others (NMFS 2011c). In addition, human land use, such as logging, road construction, and urbanization, causes detrimental habitat modification within the watershed (Avocet Research Associates 2002). In addition, recreational and commercial fisheries also threaten the species by altering stock populations. Other threats result from increased predator populations in habitat where modification has caused shifts in nonnative species and predator abundance (NMFS 2011c).

Within the Seashore, the California steelhead occurs in the Olema, Lagunitas, Pine Gulch Creek, Tomales Bay, Drakes Estero, and Bolinas watersheds. Data on steelhead populations have been gathered as part of the NPS *Coho and Steelhead Monitoring Program* (NPS 2001a), and since the mid-1990s, monitoring efforts show that populations of steelhead are generally stable. Within the Drakes Estero watershed, which also is recognized by the NMFS as potential steelhead habitat, creeks known to support California steelhead include East and North Schooner, Glenbrook, Muddy Hollow, Home Ranch, and Laguna. During the 2008 Drakes Estero Coastal Watershed Restoration Project conducted by NPS, sites within the Drakes Estero watershed were identified for restoration of anadromous fish passage habitat (NPS 2009a).

In association with the federally threatened listing in 1997, NOAA designated critical habitat for central California coast steelhead in 2005 (NMFS 2005a). The critical habitat area includes portions of Marin County, the Seashore, and the Drakes Estero watershed. Drakes Estero itself is not included in the critical habitat designation; however, several tributary creeks feeding Drakes Estero have segments of critical habitat in the vicinity on the project area. These creeks include Creamery Bay, East Schooner, Home Ranch, Laguna, and Muddy Hollow creeks (NMFS 2005a). While the designated critical habitat in these creeks is close to Drakes Estero, location coordinates of the upstream and downstream limits provided by NMFS show that they are not included in the project area (NMFS 2005a).

Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback sea turtle was listed as federally endangered in 1970 (USFWS 1970). Since the turtle inhabits both land and marine environments, a joint agreement was established between the USFWS and NMFS, where the USFWS has jurisdiction over sea turtles on land and the NMFS has jurisdiction over sea turtles in the marine environment. Land habitat of the leatherback sea turtle includes the sandy, tropical and subtropical beaches where female leatherbacks typically nest. Marine habitat is largely pelagic (within open oceans and seas) and used as foraging habitat. Leatherbacks migrate long distances from nesting to foraging habitat; however, migratory routes are not entirely known and the turtle’s distribution within its range is considered highly variable (NMFS 2010a).

The turtles have the most extensive range of any living reptile and have been reported throughout oceans around the world. Studies indicate that leatherback sea turtles arrive in marine waters along the eastern Pacific coast of North America during summer and fall months after migrating across the Pacific Ocean from nesting grounds along the western Pacific coasts (e.g., Indonesia). This arrival coincides with formation of large aggregations of gelatinous zooplankton (i.e., jellyfish), one of the primary prey species on which leatherbacks forage. Leatherbacks also forage on pelagic tunicates, another type of gelatinous zooplankton, but to a lesser degree (NMFS 2010a).

The presence of the leatherback sea turtles near Drakes Estero and the Seashore is not well documented and leatherback occurrences have not been recorded within the project area. Based on its nesting and foraging habitat requirements, it is unlikely that the turtles would use the shallow estuarine or land habitats associated with Drakes Estero. However, the 2010 NMFS proposal to revise the designated critical habitat of the leatherback could expand the turtle's current critical habitat area to include potential habitat areas along the Pacific coast, including Drakes Estero. In general, the expansion would include an offshore area within the Pacific Ocean (encompassing the Seashore), which would extend landward to the to the shoreline and then follow the line of the mean lower low water (north to Point Arena and south Point Sur) (NMFS 2010a).

The NMFS proposal to revise the current designated critical habitat included five physical or biological features essential for conservation: 1) space for individual and population growth, and for normal behavior; 2) food, water, air, light, minerals, or other nutritional or physiological requirements; 3) cover or shelter; 4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and 5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distribution of a species (NMFS 2010a).

If the proposed revision to the leatherback's critical habitat is accepted, based on the definition of the proposed boundary, portions of Drakes Estero below (i.e., seaward) the mean lower low water line would be included in the turtle's critical habitat. This portion of Drakes Estero is comprised of intertidal and subtidal habitats (described in the "Impact Topic: Wetlands" section above) that do not exhibit typical nesting or foraging habitat features required by the leatherback.

Western Snowy Plover (*Charadrius alexandrinus nivosus*)

The western snowy plover was listed as federally threatened in 1993 (USFWS 1993). Habitat for the western snowy plover includes beaches, dry mudflats, dry salt flats, and sandy shores. The plover nests on the ground in broad open spaces with sparse clumps of vegetation that allow protective cover for chicks. Nests also occur beside or under protective objects (Page et al. 2009). The western snowy plover's diet includes insects, small crustaceans, and other minute vertebrates (Terres 1980).

The primary threat to western snowy plover survival is habitat loss and degradation due to human disturbance, urban development, encroachment from nonnative beach grasses, and increases in predator abundance (USFWS 2007). Human activity such as running, walking, biking, and vehicle use are also noted as key factors in the decline of breeding sites and populations. The snowy plover nesting season (March through September) coincides with the greatest periods of human use of west coast beaches.

Intensive use by humans can result in nest abandonment, decreased nest density, and reduced nesting success (USFWS 2011b).

The western snowy plover uses the Point Reyes Peninsula as wintering and nesting habitat. During the 1980s, nesting took place along the entire Great Beach, on the far east end of Drakes Beach near the mouth of Drakes Estero, and at Limantour Spit. In recent years, erosion along the southern portion of Great Beach has diminished the upper beach area such that the entire beach can be washed by waves. Nesting is occurring on the northern portion of this beach, between the North Beach parking area and Kehoe Beach, which is backed by extensive dunes. Between 2001 and 2005, snowy plover nests were observed on this northern portion of Great Beach. Plovers also nest along the western edge of Abbotts Lagoon. Limantour Spit, the point at which Drakes Estero meets Drakes Bay, has historically been used as nesting habitat by plovers; however, no nests have been observed there since 2000 (Peterlein 2009).

In 2005, the USFWS designated 12,145 acres of critical habitat for western snowy plover, including portions of Marin County. Based on federal reassessment of conservation needs proposed, updates to western snowy plover critical habitat were recommended in 2010, increasing the total acres of critical habitat to 28,261. The proposal includes 68 critical habitat units, 51 of which are designated in California. The nearest current areas of critical habitat include Limantour Spit, located at the mouth of Drakes Estero, and all the Seashore beaches lining the northwest shore of the Point Reyes Peninsula (USFWS 2011a). Due to the proximity of nesting habitat and critical habitat, and the presence of potential foraging habitat in Drakes Estero, the project has the potential to impact the western snowy plover.

California Least Tern (*Sternula antillarum browni*)

The California least tern was listed as federally endangered in 1970 and state-listed as endangered in 1971 (USFWS 1985b). Least terns nest in loose colonies on relatively open beaches with no vegetation, along lagoon or estuary margins. Foraging habitat includes shallow estuaries or lagoons with abundant populations of small fish or other small prey. Terns usually dive for their prey, and rest or loaf on sandy beaches and mudflats. Much of the California least tern’s behavior, including foraging, nesting, roosting, and migrating, is conducted in colonies (NatureServe 2011).

The California least tern’s range extends down the Pacific Coast from San Francisco to Baja California. Adult terns fly south with their young from California, stopping to feed and rest at staging sites along the coast (Thompson et al. 1997). While no least terns are known in the Seashore, suitable habitat is present within some estuaries and lagoons, like Drakes Estero and Estero de Limantour. Clusters of populations are located as near as San Francisco Bay.

The primary threat to the California least tern is destruction or disturbance of breeding habitat because of urban development. Predation is also a threat to the tern, mainly because of increased vulnerability due to colonial nesting behavior. Common predators include ravens, American kestrels, feral cats, dogs, and raccoons (USFWS 1985b). While critical habitat has yet to be designated for the California least tern, essential nesting and foraging habitat features exist within the Seashore. As a result, the project has the potential to impact the California least tern.

Animal Species of Concern

Several federal species of concern and state-listed rare, threatened, or endangered species have been identified within the Seashore. These include 9 invertebrate, 3 fish, 1 reptile, 19 bird, and 8 mammal species (appendix E). In the federal system, species of concern are those for which the USFWS is collecting additional information to determine whether they warrant consideration for future listing as threatened or endangered under the ESA. Due to lack of appropriate habitat, none of these species is likely to occur within the project area.

IMPACT TOPIC: COASTAL FLOOD ZONES

Executive Order 11988, “Floodplain Management,” provides for the protection of floodplain values, while the NPS *Procedural Manual 77-2: Floodplain Management* provides requirements for implementing the Executive Order (NPS 2003a). Floodplains, in the truest sense, are fluvial lands formed from freshwater streams and rivers that receive floodwaters once the water has overtopped the bank of the main channel. This is typically the result of a higher than normal influx of upstream water supplies (water moving from higher elevations to lower elevations). Floodplains are important resources in the storage and filtering of these floodwaters. Construction and development within a floodplain can result in long-term direct impacts such as decreased flood storage volumes, the restriction of natural flow patterns, and the exacerbation of catastrophic flooding in downstream areas.

Flood zones are geographic areas that are defined by the Federal Emergency Management Agency (FEMA) based on flood risks. Each zone reflects the severity or type of flooding in the area. FEMA identifies flood zones as Special Flood Hazard Areas, areas where floodplain management must be enforced (FEMA 2009). These areas can be subject to the risk of flooding by any natural means, whether by water cresting the banks of channels (fluvial floodplain) or by tidal surges and tsunamis.

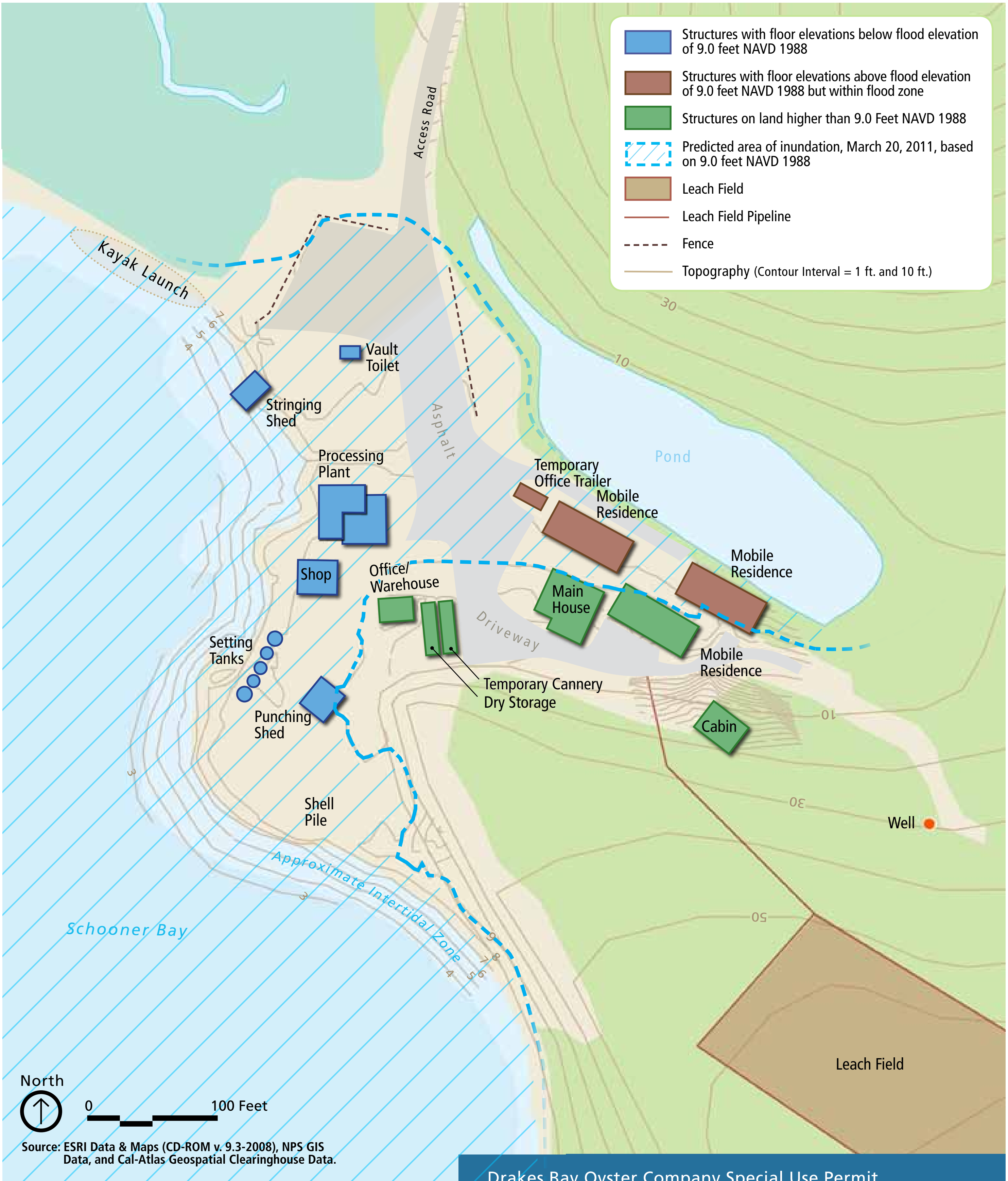
A flood insurance study that evaluated the flood risk of the numerous streams and bays in Marin County was prepared by FEMA in 2009. The FEMA study included researching numerous written accounts of flood events in the county. The principal sources of catastrophic flooding affecting coastal areas, including Drakes Estero, are tidal storm surges and tsunamis. Tidal storm surges occur when water is pushed by high winds and exceptionally high tides from a low elevation to a higher elevation because of coastal storms and hurricanes. Tsunamis are large sea waves created by oceanic earthquakes, submarine landslides, or volcanic eruptions. NOAA identifies regions subject to potential tsunami inundation. Drakes Estero falls with this tsunami inundation zone (State of California Emergency Management Agency 2009).

No gauge data or modeling results are available that specify the 100-year and 500-year flood elevations specifically for Drakes Estero. The closest coastal site evaluated by FEMA is Bolinas Bay/Stinson Beach, which is approximately 17 miles southeast of Drakes Estero. Bolinas Bay maintains unrestricted connectivity with the Pacific Ocean. The FEMA study concluded that a 100-year flood event (an event that has a 1 percent chance of occurring in any given year) would flood the immediate shoreline of Bolinas Bay to an elevation of 8.2 feet (North American Vertical Datum of 1988 [NAVD–88]). The 500-year flood event would flood the shoreline to an elevation of 8.5 feet (NAVD–88). While the FEMA analysis for Bolinas Bay provides a quantifiable flood level resulting from the potential 100-year and 500-year storm events, a direct correlation is not fully assumed between Bolinas Bay and Drakes Estero. Nevertheless, the FEMA flood zone elevations for Bolinas Bay provide potential benchmark data helpful in understanding the potential for flooding in Drakes Estero.

A topographic survey was performed at the onshore facilities based on NAVD–88 (figure 3-6). The purpose of the survey was to verify the topographic elevations of the onshore features and correlate those elevations associated with flood events. Ground elevations and floor elevations of buildings, ground elevations of wrack lines, and the elevation of the high tide line on the day of the survey (May 5, 2011) were measured and mapped. A large majority of the onshore facilities occur on land with a topographic elevation between 7 and 9 feet. The stringing shed and processing plant were found to have finished floor elevations below 8 feet, while the NPS vault toilet, DBOC shop, and punching shed have finished floor elevations between 8 and 9 feet. All other structures have finished floor elevations above 10 feet.

The high tide water line on May 5, 2011, was measured at 3.9 feet NAVD–88 at 3:40 p.m. When correlating this tide elevation with the NOAA tidal gauge station near the Point Reyes Light Station (Gauge 9415020), the gauge reading was found to be the same elevation for the same high tide event at 2:08 p.m. This suggests that the readings at Gauge 9415020 are reflective of the same tide elevations in Drakes Estero, with a tidal correction of approximately 92 minutes.

Since the Point Reyes Light Station tidal gauge appears to reflect the same tidal elevation as Drakes Estero, the gauge data was used to extrapolate the flood results in Drakes Estero from a known storm. The most recent storm event, on March 20, 2011, was chosen for this evaluation. A gauge reading of 8.12 feet was measured during this storm, just shy of the 100-year flood elevation of 8.2 feet determined by FEMA for Bolinas Bay. This measurement was compared to the surveyed elevation of four debris wrack lines at the onshore facilities originating from the March 20, 2011, flood event. One wrack line was located east (landward) of three setting tanks, another debris wrack line was found immediately south of the setting tanks, and the two other wrack lines were surveyed at the toe of shell piles. Each wrack line was measured at topographic elevations ranging between 8.7 feet to 9.2 feet NAVD–88, higher than the 8.12-foot gauge elevation at the light station. The 0.6- to 1.0-foot positive differential implies that the wrack deposition elevations are a function of wave runup at the time of the 8.12-foot crest. Thus, the flood from the March 20, 2011, event is believed to have reached more nearly an elevation of 9.0 feet, taking into consideration the gauge reading of 8.12 and wave runup of an additional 0.88 feet.



Source: ESRI Data & Maps (CD-ROM v. 9.3-2008), NPS GIS Data, and Cal-Atlas Geospatial Clearinghouse Data.

Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-6

Potential Flood Zone

If the FEMA 100-year flood elevation for Bolinas Bay of 8.20 feet is applied to Drakes Estero, adding 0.88 feet for wave runup would result in a flood elevation of 9.08 feet. Thus, an elevation of 9.0 feet appears to be a reasonable estimate of the 100-year flood elevation for purposes of this EIS. Figure 3-6 depicts the approximate area of inundation at the onshore facilities based on the 9-foot contour line covering approximately 2.44 acres of the project area (approximately 0.86 acres within NPS facilities and 1.58 acres of DBOC facilities). At this elevation, the kayak launch parking lot, NPS vault toilet, DBOC driveway, DBOC stringing shed, conveyor foundation, processing plant, shop, and punching shed would have been inundated by a few inches. Available ground photographs after the storm event show that shifting of the setting tanks caused by wave action had occurred. Additionally, water would have inundated land underneath the temporary office trailer and the two mobile homes abutting the pond, although water did not reach their floor elevations (11 feet). Situated above the 9-foot contour, the office warehouse, cannery storage trailers, main house, mobile home adjacent to the main house, and cabin remained dry during the March 20, 2011, event.

Currently, offshore structures incur daily flooding as part of their normal function, and a 100-year flood event would be no different in that regard. However, severe flood events are typically associated with high winds and waves that have historically caused portions of offshore structures to dislodge and wash ashore. It is the responsibility of DBOC to monitor the offshore structures and clean up dislodged materials found floating or along the shoreline.

Of importance to future floodplain and resource management, currently documented rates of sea-level rise due to climatic warming trends predict increases in mean sea level of approximately 3 to 4.6 feet by the year 2100 (Cayan et al. 2009; Heberger et al. 2009). This equates to water levels rising as much as 0.59 inch on average per year. Over the next 10-year period under consideration in this EIS, this could mean a potential rise in sea level of 5 inches. A rise of this magnitude could cause a change in the 100-year flood elevation from the FEMA-reported 8.2 feet to 8.6 feet NAVD–88. Taking into consideration an estimated wave runup of approximately 0.88 feet, the inundation elevation could reach 9.48 feet due to sea level rise in 10 years.

IMPACT TOPIC: WATER QUALITY

Drakes Estero is a shallow-water lagoon with small levels of contributing freshwater sources within its watershed. A single, open-water passage to Drakes Bay occurs at the mouth of Drakes Estero that allows two tidal exchanges each day with Drakes Bay. This exchange effectively cycles oceanic water at a volume equal to that contained in Drakes Estero on a daily basis (NAS 2009), thus maintaining salinity levels at approximately 33 to 37 parts per thousand (Anima 1991[xx]) and water temperature at that of the oceanic source. The daily tidal exchange coupled with the relatively low level of anthropogenic watershed disturbances are contributing factors to the good water quality of Drakes Estero (Baltan 2006; Zubkousky 2010; NAS 2009).

The Seashore initiated a study of the water quality of Drakes Estero that served to investigate possible pollution from pesticides/herbicides and sediment inputs. Sediment rates were found to fluctuate between 12 and 30 centimeters per 100 years over the last 120 to 150 years (Anima 1990[xxi]). This study also concluded that sedimentation rates have increased in the last 150 years, possibly attributable to an increase in land uses such as trail and roads (Anima 1990[xxii]). The increase in sediments due to cattle operations, however, is "very difficult to substantiate based on the change in population and overall land use of the area over the last 150 years." Anima found that the sedimentation rates of Drakes Estero closely resemble sedimentation rates calculated by other researchers working in similar environments. In summary, he concludes:

> Drakes Estero is a slowly filling system that is being supplied with sediment from the open marine environment, streams, aeolian deposition, biological reworking, and erosion of the surrounding bedrock. Tidal action is playing the dominant role in sediment distribution, erosion of surrounding bedrock and overall flushing of the system.

Anima also collected sediment samples across Drakes Estero to perform laboratory analyses of pesticide/herbicide concentrations. The conclusion reached was that the levels observed were "near or below the detection limits of the analytical methods used." In his 1991 paper, Anima went further to state that the levels of pesticides/herbicides in the sediment of Drakes Estero were found to be "below the level of limits for ingestion by organisms as set by the National Academy of Sciences and the Environmental Protection Agency."

The CDPH maintains regulations on water quality affecting the safe use of public waters. Water quality standards differ depending on the particular use. For instance, California's minimum bacteriological standards for recreational use based on a single sample are a count of either 10,000 total coliform bacteria per 100 milliliters (/100 ml), 400 fecal coliform bacteria/100 ml, or 104 enterococcus bacteria/100 ml. Fecal coliform standards for shellfish harvesting in Drakes Estero are much more stringent, at 14 most probable number (MPN)/100 ml or 43 MPN/100 ml when combined with a declining trend in fecal coliform levels at the sampling station or in surrounding areas (CDPH 2010).

The CDPH Division of Drinking Water and Environmental Management Preharvest Sanitation Unit is tasked with conducting sanitary surveys of shellfish harvesting areas as part of the National Shellfish Sanitation Program. Under a site-specific management plan for commercial shellfishing, shellfish harvesting areas are classified as *approved*, *conditionally approved*, or *prohibited* based on the water quality sampling and mollusc sampling results. The program is designed to restrict mariculture harvesting during periods when fecal coliform or marine biotoxin levels may temporarily exceed existing standards.

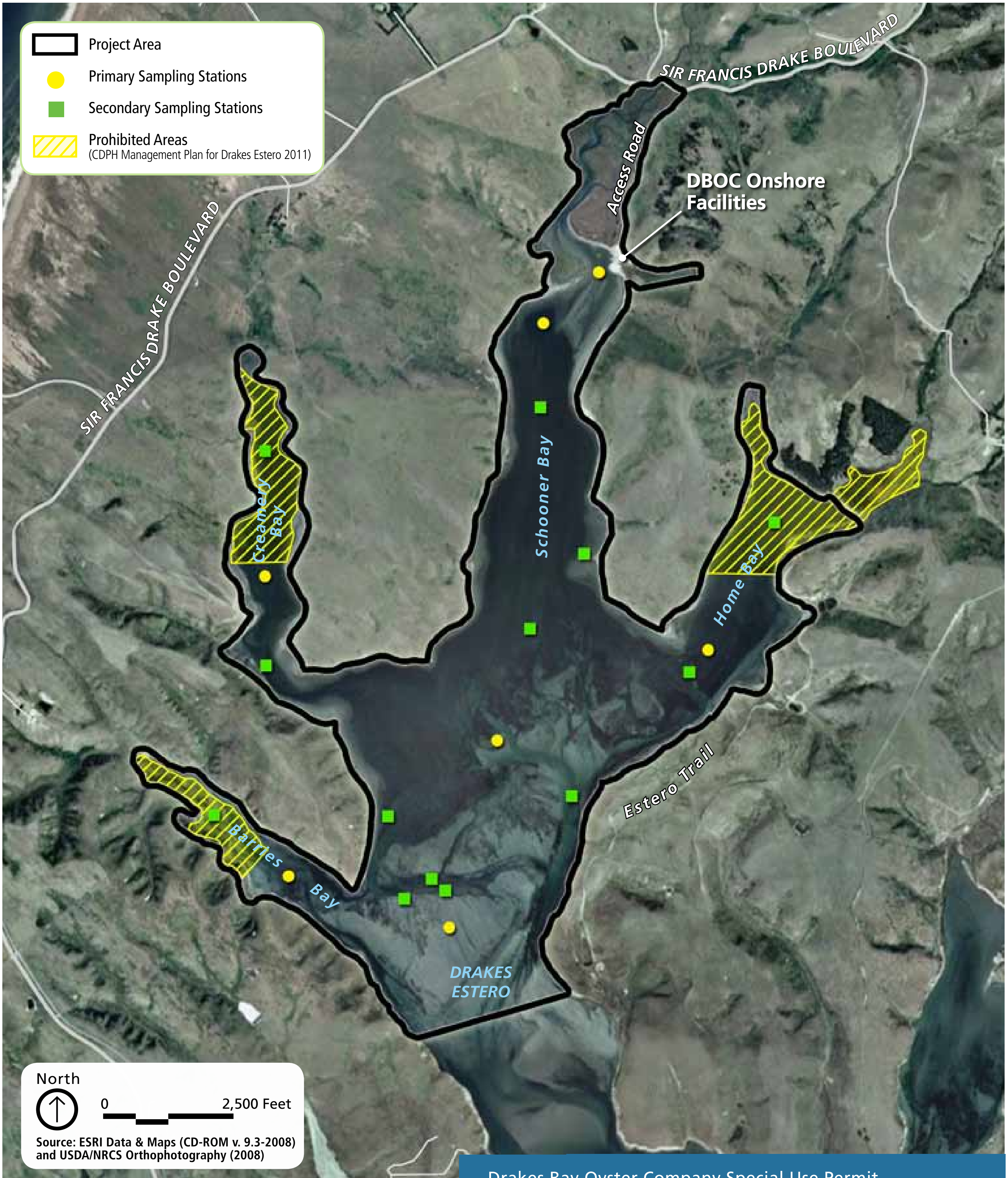
The CDPH has prepared the 2010 *Management Plan for Commercial Shellfishing in Drakes Estero, California* (management plan). The purpose of the plan is to "define the criteria and procedures used by the state shellfish authority for determining when bivalve shellfish can be harvested for marketing from a shellfish growing area classified as *Conditionally Approved*" (CDPH 2010). Harvest restrictions are tied to specific water quality standards for fecal coliform and marine biotoxins. Standards for fecal coliform vary depending on whether the pollution derives from point sources or non-point sources.

Between 2003 and 2006, water quality samples in Drakes Estero were analyzed and reported in a California Department of Health Services sanitary survey report (Baltan 2006). The survey report evaluated all environmental factors to identify actual and potential pollution sources affecting water quality within Drakes Estero. Annual updates to the report have been conducted, and the latest report was completed by Zubkousky (2010). The 2006 report recognizes Drakes Estero as "one of the most pristine estuaries on the west coast," and concludes that the entire body of Drakes Estero has very good water quality. However, both Baltan (2006) and Zubkousky (2010) list five source types of bacterial pollution potentially affecting the water quality of Drakes Estero. These sources include cattle operations, septic systems, industrial waste, wildlife, and watercraft. The primary source of pollution is from cattle waste originating from the six cattle ranches within the watershed. In 1991, Anima cites these ranches as having a total of 1,185 head of cattle (Anima 1991[xxiii]), whereas Press (2005) refers to 700 head of cattle. Bacterial pollution derived from wildlife and boaters was too difficult to measure, but was presumed to be limited (Zubkousky 2010).

Fecal coliform levels in most of Drakes Estero have been shown to intermittently rise after rain events associated with runoff from pastures within the watershed (Baltan 2006; Zubkousky 2010). Leased cattle ranches surrounding Drakes Estero allow cattle to graze within close proximity to the shoreline. Areas with the highest concentrations of animal waste in Drakes Estero include the upper reaches of Barries, Creamery, and Home bays. Those areas are classified as *prohibited* for shellfish harvesting due to the high risk of contamination. Likewise, the 2011 management plan states, "because of the residential units, company buildings, and the on-site septic system, a small *Prohibited* area has been established at the upper end of Schooner Bay. This area extends approximately 50 feet outward in all directions from the shellfish plant." Figure 3-7 depicts the CDPH sampling sites in Drakes Estero, as well as the prohibited areas.

The 2011 management plan classifies most of the other licensed areas as *conditionally approved*, and establishes standards and procedures for closing harvesting when fecal coliform levels are predictably elevated after rainfall events. Shellfish harvesting closures of 7 days are required at Inner Schooner Bay when a single rainfall event exceeds 0.7 inch during any 24-hour period. The remaining *conditionally approved* areas require a minimum closure period of 3 days following a rainfall event exceeding 0.75 inch during any 24-hour period. For all areas, immediate closure of shellfish harvesting is required when rainfall in excess of 2.5 inches occurs over a 7-day period.

Zubkousky (2010) reports that rainfall-driven closures during the 2009–2010 monitoring year amounted to 54 days for Inner Schooner Bay, 77 days for all other *conditionally approved* areas, and 14 days for the *approved* areas. Zubkousky (2010) reports that DBOC has complied with all required closures during the 2009–2010 monitoring year.



Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-7
Water Quality

The management plan calls for self-monitoring of water quality to protect against contamination events not linked to rainfall, such as emergency sewage spills. Any water quality sample having a fecal coliform measurement greater than 43 MPN/100 ml will cause the area represented by that sample to be immediately closed for harvesting. For the growing area to be reopened to harvesting, the sampling result for fecal coliform must be equal to or lower than 14 MPN/100 ml (Zubkousky 2010). Actual water quality samples in Drakes Estero detected low levels of fecal coliform during the latest monitoring period (Zubkousky 2010). The geometric mean for all stations ranged between a low of 2.0 MPN/100 ml to a high of 2.8 MPN/100 ml, and no spills were detected.

In the 2006 sanitary survey report, Baltan stated that the only source of commercial wastewater entering Drakes Estero comes from the shellfish washing operations. This water is simply recycled water originating from Drakes Estero to clean harvested oysters at an outdoor spraying station. The water from the spraying station is allowed to return to Drakes Estero via surface sheet flow. The washing station removes attached sediments and fouling organisms from the oysters before the oysters are sent to the processing plant. No chemicals are added to the water for the washing operations. Water from the washing operations was found to be nonhazardous (Baltan 2006).

The 2006 sanitary survey report also cited the septic system at the DBOC plant as being in poor condition prior to the mid 1990s. In 1998, a newer and larger septic system with a 27-bedroom capacity replaced the older system. Currently, there are five homes containing a total of 14 bedrooms at DBOC; thus, the septic system has sufficient capacity to treat the wastewater produced by DBOC residents. Another septic system was installed at DBOC in 2005 to treat commercial wastewater originating from the shucking building, the plant, and a retail area (Baltan 2006). Both systems use 1,500-gallon underground storage tanks located near the facilities that temporarily store wastewater until it is pumped to two leach fields located upslope approximately 450 and 1,300 feet east/southeast from the main facilities. Marin County Environmental Health Services regulates septic systems in the county. DBOC has entered into an agreement with Marin County Environmental Health Services that includes quarterly monitoring and an annual inspection by a Marin County Environmental Health Services–registered engineer and sanitarian. No septic failures are known to have occurred, although Zubkousky (2010) recognizes the “potential” pollution from area septic systems, but with no quantifiable data.

The 2011 management plan for Drakes Estero requires collective shellfish sampling for marine biotoxins. The two primary biotoxins include paralytic shellfish poisoning and domoic acid. Paralytic shellfish poisoning is an acute form of food poisoning derived from shellfish that have fed on the toxin-producing dinoflagellate *Alexandrium catenella*. Toxic concentrations between 200 and 500 micrograms per 100 grams of shellfish tissue when ingested by humans will cause minor symptoms of sickness. Levels between 500 and 2,000 micrograms will cause moderate symptoms, and ingestion of over 2,000 micrograms can be lethal (Langlois 2009). The federal alert level for paralytic shellfish poisoning is 80 micrograms. Domoic acid is a biotoxin that originates from the diatom *Pseudo-nitzschia australis* (Langlois 2009). Ingestion rates between 27 and 75 micrograms per gram of tissue may lead to mild to moderate symptoms of sickness, while concentrations greater than 450 micrograms per gram may result in severe neurological symptoms and/or death. The alert level for domoic acid is 20 micrograms per gram.

The CDPH performs a monthly analysis of shellfish samples submitted by statewide mariculturalists. DBOC sample results are reported in monthly reports and summarized in an annual report. *The Marine Biotoxin Monitoring Program Annual Report 2009* (Langlois 2009) states that paralytic shellfish poisoning levels reached their highest in August of the monitoring year, with a reading of 966 micrograms per 100 grams taken from a sample of sentinel sea mussels. Domoic acid toxicity levels oscillate across the entire California coast. While two peaks occurred in 2009—one in the spring and another during the fall—Drakes Estero samples were not reported to be included in the peak readings (Langlois 2009).

GROUNDWATER

The Marin County Community Development Agency oversees and regulates the drinking water supplies in the county to ensure "the water shall meet the physical, chemical, and bacteriological standards of the California State Department of Public Health and the U.S. Environmental Protection Agency." Potable water within the Drakes Estero watershed is provided via groundwater wells at the farm residences and within the pasturelands to supply water to cattle watering tanks. Additionally, a drinking well at the DBOC plant supplies potable water for the workers and residents. Water samples from this well are submitted weekly by DBOC to the CDPH Drinking Water Unit (Latham and Watkins 2010) to be tested for contaminants. In a letter dated August 3, 2009, from the park to DBOC, the Seashore recognized a

> . . . drilled well located on the slope above the residences, a hydropneumatic tank, iron removal, and distribution piping. The well is reported to have a sanitary seal, and there are no apparent sources of contamination within a 50-foot radius. Chlorination of the water is not done. Periodic bacteriological testing is reportedly done weekly, with no positive results reported. (NPS 2009b)

A report was produced by the CDPH in 2002 that assessed the vulnerability that source well water at the onshore facilities could be contaminated by any possible contaminating activities (PCA) (CDPH 2002). The only PCA in the area cited in the report was the septic drain field. The report did not indicate any contaminants in the DBOC well water.

IMPACT TOPIC: SOUNDSCAPES

The Seashore's natural soundscape encompasses all the natural sounds that occur in the Seashore and the natural conditions for perceiving those sounds. This includes sounds that are part of the biological or other physical resource components of the Seashore, such as birds singing, waves crashing, or wind blowing through trees. Section 4.9 of NPS *Management Policies 2006* directs NPS to preserve, to the greatest extent possible, the natural soundscapes of units of the national park system. Additionally, NPS will restore to the natural condition wherever possible those soundscapes that have become degraded by noise. *Director's Order 47: Soundscape Preservation and Noise Management* further guides toward the maintenance and restoration of natural soundscapes. Director's Order 47 states that "nearly as many visitors come to national parks to enjoy the natural soundscape (91 percent) as come to view the scenery (93 percent)" (NPS 2000).

According to NPS, "Although noise has been used as a synonym for sound, it is essentially the negative evaluation of sound by people and is extraneous or undesired. Humans perceive sound as an auditory sensation created by pressure variations that move through a medium such as water or air and is measured in terms of amplitude and frequency" (NPS 2011j). Sources of noise within national parks are dependent on the particular park and may include vehicular sources (cars, buses, or other vehicles) used for tours and access to trails and campgrounds; aircraft overflights from planes, helicopters, and military jets along with airport development; snowmobiles and watercraft; park operations; and energy development (NPS 2009f).

Sound consists of pressure variations that move through a medium such as water or air, which are measured in terms of amplitude and frequency. The magnitude of noise is usually described by its sound pressure level. The range of sound pressure varies greatly, so a logarithmic scale in decibels (dBA) is used to relate sound pressures to a reference standard (20 microPascals in air, 1 microPascal in water). Sound pressure levels are often defined in terms of frequency-weighted scales (A, B, C, or D). The A-weighted decibel scale is used most commonly; it reflects the varying frequency sensitivity of the human ear to low level sounds (low level meaning 40 dBA above the human threshold of hearing at 1 kilohertz [kHz]). All of the sound level measurements in this document represent 1 second A-weighted average level measurements, or L_{Aeq},1s in the standard terminology of the American National Standards Institute (ANSI 1994). However, for simplicity and conformance with many other public documents, all sound level values will be denoted by "dBA," a more common term for the same measurement. Table 3-2 provides a reference list of sound levels for comparison.

SOUND LEVELS AT DRAKES ESTERO

Data were collected at the Seashore in 2009 to establish ambient sound levels in several areas of distinct vegetation, topography, elevation, and climate. Drakes Estero was identified as being a unique area within the Seashore, and measurements were taken at a bluff on the eastern shore of Drakes Estero over the course of 30 days in July/August of 2009. This site is located approximately 2 miles from the onshore DBOC operations. The measurement from this report that is used to roughly characterize the acoustic environment is the L_{50} measurement. L is a standard variable for sound measurements, and the L_{50} represents the sound level (in A-weighted decibels) that is exceeded 50 percent of the time. In other words, it is the median sound measurement. The daytime L_{50} for this site was 34 dBA, although daily L_{50} values varied between 44 dBA and 25 dBA (John A. Volpe National Transportation Systems Center [Volpe] 2011). These measured levels included noise from DBOC operations and other human activities, and they included natural sound energy from portions of the audio spectrum well above the noise energy generated by DBOC. Thus, these values overstate the natural background sound level in Drakes Estero relative to DBOC noise; however, it is the best available data and is a reasonable measurement of the existing soundscape against which comparisons can be made.

TABLE 3-2. INDOOR AND OUTDOOR SOUND LEVELS

Outdoor Sound Levels	Sound Level (dBA)	Indoor Sound Levels
	110	Rock band at 5 meters
Jet overflight at 300 meters	105	
	100	Inside New York subway train
Gas lawnmower at 1 meter	95	
	90	Food blender at 1 meter
Diesel truck at 15 meters	85	
Noisy urban area—daytime	80	Garbage disposal at 1 meter
	75	Shouting at 1 meter
Gas lawnmower at 30 meters	70	Vacuum cleaner at 3 meters
Suburban commercial area	65	Normal speech at 1 meter
	60	
Quiet urban area—daytime	55	Quiet conversation at 1 meter
	50	Dishwasher next room
Quiet urban area—nighttime	45	
	40	Empty theater or library
Quiet suburb—nighttime	35	
	30	Quiet bedroom at night
Quiet rural area—nighttime	25	Empty concert hall
Rustling leaves	20	
	15	Broadcast and recording studios
	10	
	5	
Reference pressure level	0	Threshold of hearing at 1 kHz

Source: Federal Highway Administration (FHWA) 1980.

Noise sources at DBOC are summarized in table 3-3. At 50 feet from the receptors, DBOC operations contribute between 71 and 85 dBA of noise to the natural soundscape within the study area. These dBA levels can be expressed in terms of NPS regulations regarding audio disturbances. The limit specified by NPS regulation is 60 dBA at 50 feet (36 CFR 2.12). A 71 dBA source (at 50 feet) has the same effect as more than 12 sources at the limit specified by NPS regulation. Additional perspective on how this sound is perceived and how it alters the soundscape of an area is discussed below.

The actual sound levels that would be experienced by a specific receptor would depend on the distance between that receptor and the noise source and the path noise would have to travel between the two points. In most environments, sound levels fall off with the square of distance from the source (spherical spreading loss), in addition to absorption and scattering losses that are directly proportional to distance. Spherical spreading loss alone causes a 20 dBA reduction in level with every tenfold increase in distance, or an approximate 6 dBA reduction for every doubling of distance. Therefore, if a motorboat is measured to produce 71 dBA at 50 feet, a kayaker would experience approximately 51 dBA at a 500 foot distance. Note that the temperature inversions may form when the water of Drakes Estero is substantially colder than the ambient air. Under these conditions, sounds can travel much farther over water than would be predicted by spherical spreading loss.

TABLE 3-3. NOISE GENERATORS AT DBOC

Equipment	Description†	Frequency of Use (Weather Permitting)†	Representative Sound Level at 50 Feet (dBA)[a]
Motorboat	20 HP, 4-cycle engine	Up to 12 40-minute trips/day	71*
Motorboat	40 HP, 4-cycle engine	Up to 12 40-minute trips/day	71*
Forklift	60 HP diesel engine	2 to 4 hours/day	79**
Pneumatic drills	Handheld hydraulic drills	Approximately 2 hours/day	85**
Oyster tumbler	Tube for sorting oysters by size, run by electric motor	Approximately 2 hours/day	79**

Sources: †DBOC [Lunny], pers. comm., 2011h; *Noise Unlimited, Inc, 1995; **FHWA 2006.

[a] Hourly values

Topography can affect sound transmission through air. Steep topography such as the bluffs around some of Drakes Estero can block sound transmission. Because the 2009 sound measurements used in this EIS were taken on a bluff well above Drakes Estero, the measurements may have recorded limited mariculture-related noises.

Wind conditions also have the potential to impact noise levels. Wind can increase the natural background sound level. Wind also can cause sound to bend away from the ground in the upwind direction and towards the ground in the downwind direction. Therefore, sounds may carry farther downwind than would be predicted by spherical spreading and may carry less far upwind. Strong winds inhibit formation of the temperature inversions discussed in the previous paragraph. Because the project area is located near the ocean it is likely to experience frequent winds, capable of carrying sounds greater distances downwind and dissipating them in other directions.

The closest weather station to the project area is at the Point Reyes Light Station. Average wind speeds over the past year have ranged between 9 miles per hour on April 1, 2010, and 22 miles per hour on March 30, 2011. Over the course of the year, over 30 percent of days experienced an average wind speed of 10 miles per hour. This area is exposed along the coastline and is subject to high winds, with maximum wind gusts of 79 miles per hour on March 19, 2011 (Western Regional Climate Center 2011). Because of its exposed location, this weather station may experience more windy conditions than are experienced within the relatively sheltered Drakes Estero.

The hourly wind speed recorded at the bluff above Drakes Estero during the July/August 2009 sound monitoring varied between 1 and 9 miles per hour (Volpe 2011). For the sake of comparison, daily average wind speed at the Point Reyes Light Station during the same period ranged between 2 and 25 miles per hour, with maximum gusts between 11 and 52 miles per hour (Western Regional Climate Center 2011). The actual sound levels at a particular receptor would be calculated based upon reference sound level data, the noise paths between the source and the receptor location, and the attenuation of sound levels over distance (FTA 2006). For instance, hikers along the Estero Trail would be unlikely to hear any of the noises associated with DBOC operations because of the noise attenuation associated with distance, wind, and topography.

Underwater sound levels at Drakes Estero have not been monitored by NPS, but several qualitative factors suggest that its natural sound levels would be unusually low. First, the relatively small expanse of Drakes Estero prevents generation of any substantial waves by wind. Second, this area is free from underwater sounds of breaking surf. Third, the narrow entrance and shallow bottom of Drakes Estero will prevent most sound originating outside of the system from intruding. Underwater soundscapes are generally more heavily affected by motorized boats than the above water environment. This is due to the capacity of sound to travel much farther in water than in air, the underwater exhaust systems of most boat engines, and the noise generated by cavitation from the propellers.

HUMAN AND WILDLIFE RESPONSE TO NOISE

The contribution of human-caused noise to the natural soundscape has the potential to impact wildlife and visitor use of the project area as well as the wilderness values of Drakes Estero. Noise has similar adverse effects on humans and wildlife. Noise interferes with sleep and communication, and it can present distraction or interference for other activities. Noise also interferes with hearing, preventing wildlife and humans from perceiving sounds they otherwise would have heard. Noise also causes physiological responses, and chronic exposure has been shown to elevate the risk of hypertension and stroke in humans (Jarup et al. 2008). Noise has been shown to annoy humans, though the degree of annoyance is idiosyncratic. Humans vary in their sensitivity to noise. Subjective responses to noise also depend upon the context. In the context of park noise management, it is important to characterize the resources and activities that are essential to the park's purpose (NPS 2000).

In the context of community noise management, some agencies have utilized laboratory studies of perceived loudness to interpret the effects of elevated levels of background sound. This practice has produced the generalization that a 10 dBA increase is perceived as roughly twice as loud. This subjective interpretation has several problems that discourage its application in national park settings. To illustrate its most serious defect, consider that a 10 dBA increase in noise exposure is produced when the number of noise sources is increased ten-fold. The subjective loudness interpretation asserts that ten times as many sources sound twice as loud, and one hundred times as many sources sound four times as loud. These assertions cannot be supported by science or everyday experience. In the dose-response studies where sound level is related to annoyance, the fraction of the community expressing annoyance roughly doubles with every 6 dBA of increase in noise level (ANSI 2008; ISO 2003).

Table 3-4 below provides reference points for how different sound levels can affect the ability for humans to communicate vocally. A normal speaking voice is approximately 65 dBA.

TABLE 3-4. EFFECTIVE COMMUNICATION DISTANCES

Sound Level (dBA)	Approximate Distance at which Vocal Communication Becomes Difficult (feet)
30 dBA	64
40 dBA	16
50 dBA	10
60 dBA	5
70 dBA	3
80 dBA	2

Source: EPA 1981

Given the wilderness context for evaluating effects in Drakes Estero, more appropriate measures of acoustical environmental quality address the capacity to hear natural sounds, or the capacity for park visitors to communicate without raising their voices. One useful index is the change in the maximum distance at which a sound can be detected (Barber, Crooks, and Fristrup 2010). By this measure, a 10 dBA increase in background sound levels reduces detection (or communication) distance to $1/\sqrt{(10)}$ of its original value, a 68 percent reduction. The area in which this sound could be heard is correspondingly reduced by 90 percent. This metric may be applied to wildlife and human perception of natural events, as well as to speech communication by park visitors. The only qualification applied to this metric is that the animal's hearing threshold must be lower than the natural ambient sound levels. This is true for many wildlife species, and all humans with normal hearing.

Wilderness areas are valuable for their undeveloped character, where humans are visitors and do not remain. Wilderness areas are also valuable as an opportunity for solitude. These values are articulated in the Wilderness Act (PL 88-577) and reiterated in related policies such as NPS *Management Policies 2006* and *Director's Order 41: Wilderness Stewardship* (NPS 2006d, 2011b). The noise from DBOC operations can detract from these values. The sounds serve as evidence of man's imprint on the natural landscape and can disrupt opportunities for solitude. Similarly, visitors wishing to enjoy a natural experience within the congressionally designated potential wilderness of Drakes Estero may not welcome these disturbances; noise may reduce visitor enjoyment of recreational use of the project area. For additional background on wilderness qualities, please see the "Impact Topic: Wilderness" section.

Wildlife also is very sensitive to sound, as animals often depend on auditory cues for hunting, predator awareness, sexual communication, defense of territory, and habitat quality assessment (Barber, Crooks, and Fristrup 2010). High ambient sound levels from human voices, and sound events associated with human activities (e.g., driving cars, hiking), have been observed to have negative population-level, behavioral, and habitat-use consequences in many species (Frid and Dill 2002; Landon et al. 2003; Habib, Bayne, and Boutin 2007). Human activities can disturb seals at haul-out sites, causing changes in seal abundance, distribution, and behavior, and can even cause abandonment (Suryan and Harvey 1999; Grigg et al. 2002; Seuront and Prinzivalli 2005; Johnson and Acevedo-Gutierrez 2007). The impacts of underwater noise on marine mammals have been widely documented during the past 40 years, and have been the subject of three reports by the NAS (NAS 2003).

The effects of noise on birds have been studied extensively, because of their prominent acoustical displays to attract mates, maintain bonds with mates and offspring, and alert others to predators (Francis, Ortega, and Cruz 2009). Similar to physical degradation of the habitat caused by development or other human activities, the low-frequency, high-amplitude, nearly omnipresent sound produced by roads, vehicles, airports, and mechanical equipment has been found to cause a decline in species diversity, abundance, and breeding success (Rheindt 2003). Additional detail on the ways in which sound levels impact wildlife can be found in the separate impact topic sections on wildlife and wildlife habitat.

IMPACT TOPIC: WILDERNESS

Point Reyes National Seashore is one of 46 units within the national park system that includes congressionally designated wilderness areas. The Wilderness Act (PL 88-577) was passed on September 3, 1964, to establish a national wilderness preservation system made up of designated wilderness areas.

Wilderness areas are defined, in part, as follows:

> An area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain. . . . An area of undeveloped Federal land retaining its primeval character and influence, without permanent improvements or human habitation. (PL 88-577)

Section 3(c) of the Wilderness Act required that the Secretary of the Interior review “every roadless area of five thousand contiguous acres or more” within the national park system and report to the president his recommendation as to the suitability of these areas for preservation as wilderness. The president is then to advise Congress of his recommendation with respect to the designation of each area. A presidential recommendation for designation as wilderness becomes effective only if so provided by an act of Congress (PL 88-577).

In 1972, the Seashore published its initial wilderness recommendation for an area of about 5,150 acres for the purpose of preservation of wilderness areas. As required by the Wilderness Act, a public hearing was held on the preliminary wilderness proposal for the Seashore at the Marin County Civic Center in San Rafael, California, on September 23, 1971. A total of 211 people attended, and a total of 4,658 responses to the proposal were received (NPS 1972b). Public comments received were varied. Several nationwide conservation groups (such as the Sierra Club and the National Parks Conservation Association [NPCA]) felt that the wilderness acreage proposed was not large enough. Seven organizations, mainly equestrian groups, supported the initial 5,150-acre proposal (NPS 1974).

Following the 1972 wilderness recommendation, the Seashore developed a final environmental statement (FES) on 10,600 acres of proposed wilderness. The alternatives analyzed in this environmental statement include no wilderness, less wilderness, and more wilderness (NPS 1974). The FES was published in 1974.

In 1976, Congress designated over 33,000 acres, including 25,370 acres as wilderness and another 8,003 acres of land and water as potential wilderness (PL 95-544, October 18, 1976, 90 Stat. 2515 and PL 94-567, October 20, 1976, 90 Stat. 2695). While the legislative language clearly articulates the acreage above in section 1, the map filed with the committee as required under section 2 of the legislation calculated that the actual acreage of those lands and waters are 24,200 acres of wilderness and 8,530 acres of potential wilderness. The wilderness area was named the Philip Burton Wilderness in 1985 (PL 99-68). The areas were designated as potential wilderness at the time due to nonconforming Wilderness Act uses in those areas. Nonconforming uses are described as prohibited by section 4(c) of the Wilderness Act.

Congress established the process whereby potential wilderness within the Seashore would convert to designated wilderness in section 3 of PL 94-567. This process requires publication in the Federal Register of a notice that all nonconforming uses have ceased. On November 18, 1999, in accordance with this process, a notice was published in the Federal Register that nonconforming uses of the lands located in the Muddy Hollow, Abbotts Lagoon, and Limantour (including southern Drakes Estero) areas had ceased. For instance, following the Mount Vision fire, power lines were removed from the Muddy Hollow corridor and power is now provided to the Limantour area by underground power lines located outside congressionally designated wilderness (along Limantour Road). As a result, 1,752 acres of the potential wilderness designated in 1976, including the waters of Estero de Limantour and the offshore waters off Limantour Spit, were converted to wilderness, bringing the total area of designated wilderness within the Seashore to 27,122 acres (NPS 1999a). The Philip Burton Wilderness Area is unique in that it is the only wilderness area between Canada and Mexico that includes marine waters (wilderness.net 2011).

The waters of Drakes Estero are included in the Philip Burton Wilderness at Point Reyes National Seashore. Approximately 1,363 acres of waters north of Sunset Point remain potential wilderness due to the presence of commercial shellfish operations (figure 3-8). These operations are referred to as nonconforming uses and prevent areas designated by Congress as potential wilderness from attaining full wilderness status and allowing NPS managers to best preserve the wilderness qualities of the area.

The Interagency Wilderness Character Monitoring Team, which represents the Bureau of Land Management, USFWS, NPS, U.S. Geological Survey, and the U.S. Forest Service, offers an interagency strategy to monitor trends in wilderness character across the national wilderness preservation system in the handbook *Keeping It Wild: An Interagency Strategy to Monitor Trends in Wilderness Character across the National Wilderness Preservation System*.

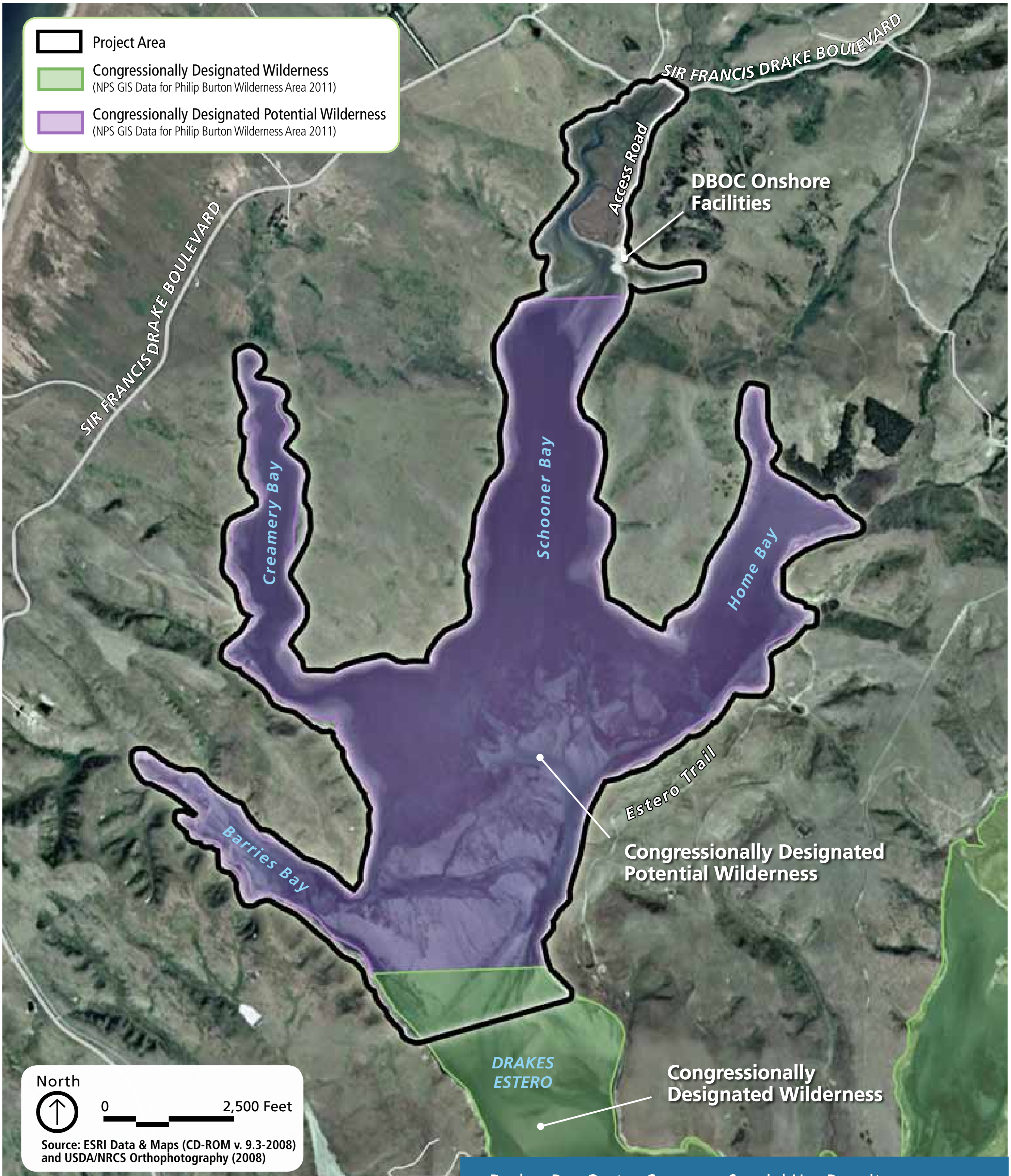


FIGURE 3-8

Phillip Burton Wilderness

The interagency team outlines four qualities of wilderness from the statutory language of the Wilderness Act that should be used in wilderness planning, stewardship, and monitoring:

- **Untrammeled**—Wilderness is essentially unhindered and free from modern human control or manipulation
- **Natural—**Wilderness ecological systems are substantially free from the effects of modern civilization
- **Undeveloped—**Wilderness retains its primeval character and influence, and is essentially without permanent improvement or modern human occupation
- **Solitude or a primitive and unconfined type of recreation**—Wilderness provides outstanding opportunities for solitude or primitive and unconfined recreation (NPS 2011b; Landres et al. 2008)

Nonconforming uses such as shellfish mariculture activities do not preclude the possibility of future conversion from congressionally designated potential wilderness to congressionally designated wilderness. Existing mariculture activities within Drakes Estero affect the wilderness qualities of Drakes Estero and prevent conversion while the activities are ongoing. A total of 95 wooden racks (approximately 5 miles when laid end to end) are currently installed in the Drakes Estero bottom and protrude from water's surface, especially during low tide. These items are evidence of the presence of modern human control or development within congressionally designated potential wilderness. The presence of mariculture-related structures and shellfish also alter the natural ecological systems of Drakes Estero. While some shellfish may occur within Drakes Estero naturally, the species and numbers being grown and the methods being used to grow them are dictated by human control and would not occur naturally. The mariculture infrastructure and the shellfish provide hard surface substrate in much greater abundance than would occur naturally. Furthermore, the predominant shellfish being produced is the Pacific oyster, a nonnative species in Drakes Estero. Table 3-5 lists the nonconforming structures and uses in Drakes Estero.

The congressionally designated potential wilderness of Drakes Estero also offers Seashore visitors an outstanding opportunity for solitude, although use of noise-generating boats and other equipment and activities by DBOC staff interrupts this experience. For instance, DBOC intermittently operates motor boats up to 8 hours a day within Drakes Estero. Additional detail on noise generation is contained within the "Impact Topic: Soundscapes" section, and additional detail on visitor experience is contained within the "Impact Topic: Visitor Experience and Recreation" section.

NPS infrequently requires the use of motorboats within the congressionally designated potential wilderness of Drakes Estero for management of park resources. These activities are subject to minimum use requirements, which minimize impacts on wilderness areas.

TABLE 3-5. NONCONFORMING STRUCTURES AND USES AFFECTING WILDERNESS QUALITIES IN DRAKES ESTERO

Nonconforming Structures or Uses	Wilderness Qualities Affected
Shellfish growing racks	Undeveloped (racks are evidence of modern human occupation)
Anchors into substrate and lines to hold culture bags, including floating bags and bags placed on sandbars	Untrammeled (anchors and lines manipulate natural substrate)
Overnight anchorage of barges in potential wilderness	Undeveloped (barges are evidence of human occupation)
Placement of trays and other culture materials for grow out of larvae	Natural (trays and other culture material affect the natural ecosystem)
Import and placement of nonnative or nonlocal species of private cultured species within Drakes Estero	Natural (presence of cultured species, particularly nonnative species, affects the natural ecosystem)
Placement and manipulation of culture bags containing pacific oyster and Manila clams on sandbars and mudflats in Drakes Estero	Untrammeled and natural (bags cause human manipulation of natural sediment dynamics) Undeveloped (bags are evidence of human occupation)
Motorized boat operations for mariculture operations	Natural (eelgrass damage and sediment disturbance from boat operations disrupt natural processes) Solitude (sound generated by motor boats distracts from opportunities for solitude)
Transmission of noise from production facility down Schooner Bay	Solitude (sound generated by pneumatic drills distracts from opportunities for solitude)

Drakes Estero does provide an outstanding opportunity for solitude and primitive, unconfined recreation. Hikers on Bull Point, Estero, and Sunset Beach trails enjoy expansive views of Drakes Estero, and kayaking is a popular recreational use of Drakes Estero. In compliance with the Wilderness Act, NPS does not allow any motorized boat traffic in Drakes Estero, with the exception of DBOC boats. DBOC boats are estimated to make up to 12 round trips into Drakes Estero per day (DBOC [Lunny], pers. comm., 2011h). Motorboats in Drakes Estero and other human-related sound sources, such as pneumatic drills, contribute noise levels between 71 and 85 dBA (based on equipment summaries provided by Kevin Lunny during a February 16, 2011, site visit and FHWA estimates for similar equipment) to an otherwise natural soundscape with background sound levels at approximately 34 dBA (Volpe 2011). Soundscapes are discussed in further detail under that impact topic. This results in an intrusion upon the solitude that is otherwise experienced by recreational visitors to Drakes Estero.

Should the nonconforming uses within Drakes Estero be removed, the process laid out in section 3 of PL 94-567 would be carried out in order to convert the congressionally designated potential wilderness to congressionally designated wilderness through the following process:

> All lands which represent potential wilderness additions, upon publication in the Federal Register of a notice by the Secretary of the Interior that all uses thereon prohibited by the Wilderness Act have ceased, shall thereby be designed wilderness. (PL 94-567, section 3)

Onshore facilities are currently located approximately 760 feet from the northern boundary of congressionally designated potential wilderness in Drakes Estero and approximately 2.5 miles north of the existing boundary between congressionally designated potential wilderness in the northern 1,363 acres of Drakes Estero and the congressionally designated wilderness at the southern mouth of Drakes Estero. The onshore DBOC facilities above the intertidal zone do not directly affect the Philip Burton Wilderness because the designation applies only to the waters and tidelands of Drakes Estero in the project area; however, sounds emanating from onshore activities may affect the undeveloped nature of Drakes Estero and disrupt the opportunity for solitude by disrupting the natural soundscape. This is discussed in additional detail under the impact topic of soundscapes.

IMPACT TOPIC: VISITOR EXPERIENCE AND RECREATION

Point Reyes National Seashore is located within 40 miles of the San Francisco metropolitan area, a major urban population center. The Seashore hosts more than 2 million visitors annually (NPS 2011m[xxiv]). According to visitor surveys conducted by Sonoma State University (Ferry and LaFayette 1997; Fungi 1999), most Seashore visitors spend two to six hours engaging in a variety of activities, depending on the season. Common activities range from whale watching and kayaking to hiking and bird-watching. Some visitors travel to the Seashore to visit DBOC, either as the sole reason for visiting or in conjunction with other recreational activities within the Seashore (Ferry and LaFayette 1997; Fungi 1999).

Pursuant to NPS *Management Policies 2006* (NPS 2006d) in general, preferred forms of visitor enjoyment are those that are uniquely suited to the superlative natural and cultural resources found in the parks. These preferred forms of use contribute to the personal growth and well-being of visitors by taking advantage of the inherent educational value of parks. Equally important, many appropriate uses also contribute to the health and personal fitness of park visitors. These are the types of uses that NPS will actively promote, in accordance with the NPS Organic Act.

Visitor services are different from the overall visitor experience in that they provide public accommodations, facilities and services that are necessary and appropriate for public use and enjoyment of the unit of the National Park System in which they are located. Visitor services also are consistent, to the highest practicable degree, with the preservation and conservation of the resources and values of the unit (16 U.S.C. 5951(b), 5952; 36 C.F.R. 51.3) (definition of "visitor service"). Visitor services within the Seashore include three visitor centers which offer a variety of ranger-lead programs, such as hikes and presentations; parking areas which provide access to beaches, trailheads, and other points of interest; the Point Reyes Bird Observatory, four backcountry campgrounds; and the Point Reyes Lighthouse. In contrast, the primary focus of DBOC is the commercial operation for the sale of shellfish to restaurants and the wholesale shellfish market outside the park. These are not services being offered to the visiting public to further the public's use and enjoyment of the park. As such, although DBOC may be considered to provide an experience for some visitors, it does not provide a visitor service. Pursuant to NPS

Management Policies 2006 (NPS 2006d), concession contracts may only be awarded for certain, defined types of commercial operations which do not, and cannot, include commercial shellfish operations. Concession contracts are limited, as a matter of law, to visitor services, which DBOC does not provide.

Visitors to the area use Drakes Estero and its environs for recreational activities such as kayaking and hiking. Drakes Estero is open annually to kayakers from July 1 to February 28. Closures are in place from March 1 to June 30 to protect harbor seals during pupping season. Visitors wishing to kayak in Drakes Estero may park in the NPS-maintained gravel parking lot adjacent to the DBOC facilities. This lot is relatively small, generally serving only a few vehicles at a time, with a maximum capacity of about 15 vehicles in unmarked spaces. The lot provides access to a sandy beach at the headwaters of Schooner Bay where visitors launch their kayaks.

In addition to individual kayakers, approximately 10 operators currently hold commercial use authorizations from the Seashore to offer kayak equipment rentals and/or guided tours within the Seashore. In 2010, three of the authorized kayak operators reported providing tours in Drakes Estero. In total, 221 visitors were accommodated on these tours during the 8-month period Drakes Estero is open to kayakers. Drakes Estero, which is congressionally designated potential wilderness, offers kayakers an outstanding opportunity for solitude while enjoying primitive and unconfined recreation. This is a hallmark quality of a designated wilderness area. Such a wilderness experience, however, is currently subject to interruption by motorized boat traffic, handheld pneumatic drills, and other generators of noise associated with DBOC operations. A more in-depth description of the soundscapes within the project area can be found in the “Soundscapes” section of this chapter. Additional background on wilderness qualities can be found in the “Impact Topic: Wilderness” section.

Several Seashore trails provide expansive views of Drakes Estero for hikers. The Bull Point Trail is 1.8 miles long and skirts Creamery Bay on its way to a terminal overlooking the main body of Drakes Estero. The Estero Trail travels 9.4 miles through open grassland. It offers outstanding views of Drakes Estero and Estero de Limantour and of the locally rich bird life (NPS 2011k). More than 35,000 visitors a year use this trail (NPS 2011k). Sunset Beach Trail branches off the Estero Trail to follow the bluffs bordering the eastern shores of Drakes Estero to Sunset Point. During low tide, the presence of oyster racks, bags, and motorized boats associated with DBOC operations are readily apparent to those visitors viewing Drakes Estero from these trails.

In 2003, 418 residents of Marin, Sonoma, Alameda, Contra Costa, and San Francisco County were randomly surveyed to gather information about the Seashore, from the perspective of local residents. When asked to identify the why a national park is important, the respondents felt that protection of wildlife, protection of rare species of plants and animals, and preservation of native ecosystems were most important to national parks (PRNSA 2003). Although they felt the ability to kayak, horseback ride, and bicycle within the Seashore were equally important, 92 percent reported recreational activities, in general, are an important component of national parks (58 percent felt it was very important) (PRNSA

2003). Additionally, 82 percent of those who had visited the Seashore felt it would be very important to maintain the wilderness experience for future visitors to the Seashore (PRNSA 2003).

DBOC estimates that 50,000 people visit their commercial operation each year (DBOC 2010n[xxv]). This is approximately 2.5 percent of the annual visitation to the Seashore. These people may be visiting DBOC to purchase shellfish directly at the on-site retail facility, be part of an educational tour, or simply out of curiosity in passing. DBOC sells their oysters both wholesale and at a retail facility on site. They also sell other "seafood and complementary food items," as authorized in the RUO.

The front of the DBOC building generally known as the processing plant provides retail and interpretive space. (Photo courtesy of VHB.)

IMPACT TOPIC: SOCIOECONOMIC RESOURCES

The social and economic environment of a region is characterized by its demographic composition, the structure and size of its economy, and the types and levels of public services available to its citizens. The socioeconomic study area for this EIS is Marin County, except for data related to shellfish production. Shellfish production is discussed in terms of statewide totals because such data are not readily available at the county level. In particular, production data provided by the CDFG, the Pacific Coast Shellfish Grower's Association, and an independent survey of the bivalve shellfish industry in California, which are compared to DBOC production levels in this section, are reported at the state level. Marin County includes Muir Beach, Stinson Beach, Bolinas, Olema, Inverness, Point Reyes, Marshall, and Tomales. As the nearest municipality to the project area, socioeconomic data from Inverness Census Designated Place (Inverness CDP) best reflects the conditions within the project area and offers an appropriate comparison to overall Marin County data. Socioeconomic data specific to Inverness CDP is called out as appropriate, as a representation of conditions within the project area, and for comparison to the overall county data. Inverness CDP is located along the northeastern boundary of the Seashore, adjacent to Tomales Bay (see figures 1-5 and 3-9). Seashore operations support the regional and state economy through the hiring of staff, purchase of goods and services, contracting with concessioners to provide visitor services (such as kayak tours of Drakes Estero), and operating its campgrounds (NPS 2006a). In addition, the more than 2 million annual visitors to the Seashore contribute to the regional economy by spending money at local establishments such as hotels, restaurants, and retail shops (NPS 2011a; NAS 2009). This section analyzes impacts to socioeconomic resources, focusing on operations related to DBOC.

GENERAL SOCIOECONOMIC RESOURCES

Marin County occupies approximately 828 square miles, including 308 square miles of tide and submerged lands, just north of the San Francisco Bay in California. Much of Marin County's population resides in the eastern portion of the county (figure 3-9). Western Marin County is primarily rural, with scattered, small, unincorporated towns that serve tourism, agriculture, and local residents. Point Reyes National Seashore is in western Marin County. Inverness CDP occupies approximately 6.4 square miles including 0.4 square miles of tide and submerged lands.

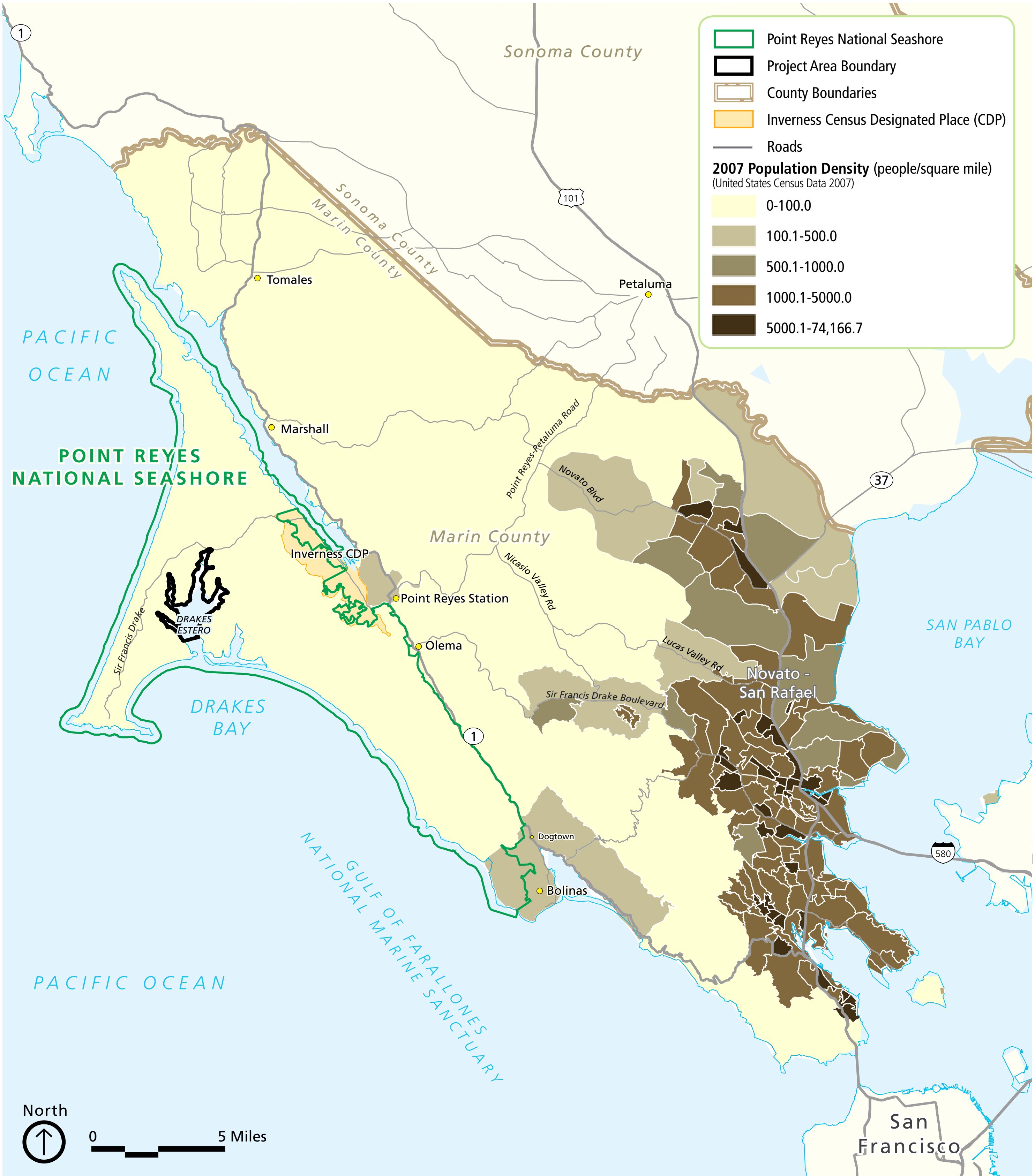
Demographics

Much of the data presented in this section are from the U.S. Census Bureau, which places people according to "usual residence" guidelines, meaning where they live most of the year. Based on 2009 U.S. Census Bureau data, Marin County had an estimated 246,711 residents and a population density of approximately 474 people per square mile (U.S. Census Bureau 2005–2009). In contrast, the population of Inverness CDP was estimated at 1,076 residents with a population density of 179 people per square mile, representing 0.4 percent of the overall county population.

Between 1990 and 2009 Marin County experienced a growth rate of 9 percent (Indiana Business Research Center 2009), while the population of Inverness CDP declined by approximately 24 percent (U.S. Census Bureau 2005–2009). In 2009, approximately 97 percent of the county population reported only one race, with approximately 81 percent reporting "white." The ethnicities of the remaining 19 percent are summarized in table 3-6 and compared to the population of the State of California. As shown in the table, minority concentrations within Marin County are below statewide averages both as a whole and for each individual race. The entire population of Inverness CDP reported their race as white in 2009.

TABLE 3-6. MINORITY POPULATIONS WITHIN MARIN COUNTY AND THE STATE OF CALIFORNIA

Race	Percent of Marin County Population	Percent of California Population[a]
Black	3.2	6.2
American Indian and Alaska Native	0.4	0.8
Asian	5.7	12.3
Native Hawaiian and other Pacific Islander	0.2	0.4
Some other race	6.9	15.5
Two or more races	2.2	3.5
Total minority	18.6	38.7



Source: ESRI Data & Maps (CD-ROM v. 9.3-2008)
and United States Census Data (2007)

Drakes Bay Oyster Company Special Use Permit
Environmental Impact Statement

National Park Service
U.S. Department of the Interior

Point Reyes National Seashore

FIGURE 3-9

Marin County Population Distribution

Approximately 82 percent of the people living in Marin County are native to the United States, with 48 percent born in the State of California. In comparison, 98 percent of the Inverness CDP population is native to the United States, and 62 percent is native to California. Neighborhoods (represented as block groups) in the eastern portion of Marin County are the most densely populated regions in the county.

Employment

As noted above, western Marin County is primarily rural. Much of the employment in western Marin County, in particular, caters to tourists visiting the area. In December 2009, the unemployment rate in Marin County was 7.9 percent, well below the statewide average of 11.3 percent (U.S. Department of Labor 2011; U.S. Census Bureau 2005–2009). In 2009, Inverness CDP reported zero unemployment (U.S. Census Bureau 2005–2009).

In 2009, the labor force in Marin County was concentrated in educational services, health care, and social assistance (20 percent); professional, scientific, management, administrative services, and waste management (19 percent); finance, insurance, real estate and rental leasing (11 percent); and retail trade (10 percent). Together, these sectors accounted for approximately 60 percent of the labor force within the county. Similarly, in Inverness CDP, the top four employment sectors in 2009 were educational services, health care, and social assistance (23 percent); construction industry (14 percent); retail trade (11 percent); and finance and insurance and real estate and rental leasing (10 percent). The heavy concentration of retail trade, construction, and real estate and rental leasing jobs reflects a local economy that is dependent on tourism. Agricultural jobs (agriculture, forestry, fishing, hunting and mining), which include jobs related to commercial shellfish operations, accounted for less than 1 percent of the labor force in Marin County and approximately 2 percent of the labor force in Inverness CDP (U.S. Census Bureau 2005-2009).

The median wage in Marin County in 2009 was $44,000, compared to $42,000 for Inverness CDP. From 1999 to 2009 the county's per capita income grew by approximately 16 percent, slightly lower than the statewide increase of approximately 22 percent. Similarly, the per capita income of Inverness CDP increased by approximately 17 percent between 1999 and 2009 (U.S. Census Bureau 2005–2009, 2000).

Tourism Contributions to the Economy

The economic benefits associated with the national park system are an indicator of tourism's contribution to the economy. In 2009, visitor spending within the national park system supported an estimated 247,000 jobs, approximately $9.2 billion in labor income, and approximately $15.6 billion in value added[1].

[1] Value added is the sum of labor income, profits and rents, and indirect business taxes. It can also be defined as total sales net of the costs of all non-labor inputs. Value added is the preferred economic measure of the contribution of an industry or activity to the economy.

Additionally in 2009 visitor spending was estimated at nearly $11.9 billion in local gateway regions around national parks (within a 60 mile radius of the parks and excluding park entry fees) (NPS 2011d). Approximately 90 percent of the total visitor spending ($10.8 billion) was contributed by non-local visitors (NPS 2011d). NPS employees also contribute to the local economies because they typically live and spend money in the vicinity of the parks at which they work. In 2009, NPS employed over 26,000 staff with a combined labor income of approximately $2.3 billion (NPS 2011d). This labor income equated to approximately $2.5 billion in value added to the regions around the parks (NPS 2011d).

The Seashore is a large contributor to the economy of Marin County (NPS 2006a; NAS 2009). Specifically, in 2005, the Seashore generated $5.3 million in tax revenue for Marin and Sonoma counties and $2.9 million in tax revenue for the State of California (NPS 2006a). In 2009, the approximately 2 million recreational visitors to the Seashore contributed nearly $86 million in local spending, $78 million of which was spent by non-local visitors (greater than 60 miles from the Seashore) (NPS 2011d). The non-local spending supported 966 jobs, approximately $39.3 million in labor income, and approximately $66.0 million in total value added for the local region (within 60 miles of the Seashore) (NPS 2011d). NPS payroll at the Seashore supported a total of 160 private sector and NPS staff in 2009 (129 NPS jobs). Maintaining these jobs resulted in approximately $10 million in labor income and approximately $13 million in value added for the region (NPS 2011d).

An example of a tourism-related business that operates within the project area is commercial kayak tours. Approximately 10 operators currently have commercial use authorization from the Seashore to offer kayak equipment rental and/or guided kayak tours within the Seashore. Three of the authorized operators offered kayak tours of Drakes Estero in 2010. DBOC’s contributions to the economy are described in the “Drakes Bay Oyster Company” section below.

Housing

In 2009 there were approximately 108,200 housing units in Marin County, 1,000 of which were located in Inverness CDP. Approximately 101,100 of the housing units in the county (93 percent) were occupied. In contrast, approximately 41 percent of the housing units within Inverness CDP were reported to be vacant, suggesting that several of the housing units within Inverness CDP are for seasonal, recreational, or other occasional use (U.S. Census Bureau 2005–2009). This is consistent with Inverness CDP’s location within the Seashore, a tourist destination.

Between 2005 and 2009, Marin County homes had an estimated median value of $880,000. Median home values within Inverness CDP were consistent with those in the county, and were reported to be $805,800 during the same period. The county had an estimated median monthly owner cost of $3,285 for those with a mortgage and $623 for those without a mortgage. The median gross rent was $1,487 per month for the county as a whole, while rents in Inverness CDP were slightly higher, at $1,547 per month (U.S. Census Bureau 2005–2009).

COMMERCIAL SHELLFISH OPERATIONS IN CALIFORNIA

There are approximately 30 marine aquaculture operations within the state (CDFG [Ramey], pers. comm., 2011d). Some are located on state-owned tidelands and submerged lands while others are located on tidelands and submerged lands under the jurisdiction of other governmental entities or private parties. State management by the CDFG of these operations differs based on the operation's location. The 2007 Census of Agriculture reported that, in 2007, 23 mariculture operations in California (operating on a combination of state-owned, granted, and private tide and submerged lands) produced and sold molluscs, such as abalone, clams, mussels, and oysters (USDA 2009). These operations accounted for over $11.7 million in product sales. Four mariculture operations were reported to produce and sell shellfish in Marin County in 2007, comprising approximately $2.3 million in product sales (USDA 2009). The sales reported in the Census of Agriculture include the value of aquaculture distributed for restoration, conservation, or recreational purposes (USDA 2009). A 2009 independent evaluation of bivalve/mollusk culture (not including abalone) indicated that 15 active shellfish companies operated in California in 2007/2008 and sold $16.5 million in live products (Kuiper 2009). According to the 2009 survey, these bivalve farms accounted for 208 jobs and $1.7 million in government fees, licenses, state and federal taxes (Kuiper 2009). "For every one dollar generated in profit by these farms, one dollar was paid to the government" (Kuiper 2009). Data provided by the Pacific Coast Shellfish Grower's Association indicated that in 2008 California oyster and clam sales totaled approximately $12.4 million and $830,000, respectively (PCSGA 2009).

In California, CDFG manages 18 leases for 9 mariculture operations, including the 2 leases at DBOC. With the exception of DBOC, these operations are located on state-owned tidelands. CFGC issues state water bottom leases pursuant to the Fish and Game Code, on state owned tidelands. CDFG then administers the leases for the CFGC and collects revenues from the leaseholder. Lessees pay an annual per acre rental fee and a privilege use tax ($0.04 per gallon for oyster, $0.0125 per pound for other shellfish) to the CDFG. These leaseholders also maintain an aquaculture registration with CDFG.

There are approximately 19 aquaculture operations in the state on granted or private tide and submerged lands not owned by the State of California (CDFG [Ramey], pers. comm., 2011d). Ten of these mariculture operations are on granted tidelands and 9 of the operations are on private tidelands. With the exception of Drakes Estero, the CFGC does not issue leases for aquaculture operations located on granted or private tidelands and the CDFG does not collect lease fees or privilege use taxes from these operators. Rather, these operators make payments to the entity that holds title to the tidelands and submerged lands on which they operate. These operators maintain an aquaculture registration with the CDFG; however, they do not pay other fees or taxes to the CDFG.

One example of the type of regulatory oversight that exists for aquaculture operations on granted tidelands is found with the Humboldt Bay Harbor, Recreation, and Conservation District (Harbor District). The Harbor District was established in 1970. The State of California granted all its tidelands and submerged lands to the Harbor District in 1970, reserving to the state “the right to fish in the waters on said lands with the right of convenient access to said water over said lands for said purpose.” The Harbor District owns the tidelands upon which operations take place and the District, not the CDFG, issues leases to the aquaculture businesses. The Harbor District collects lease payments (typically per acre) and a per gallon tax similar to the use tax collected by the CDFG for CDFG-managed leases. Approximately 60,000-80,000 gallon of oysters are produced in Humboldt Bay annually to be shucked, canned, and/or sold in the half shell. Approximately 450,000 individual oysters also are produced in Humboldt Bay each year for distribution in the shell (Molina 2011). According to the “Made in Humboldt Bay” website, 70 percent of the fresh oysters consumed in California are produced in Humboldt Bay (Humboldtmade.com 2011). Coast Seafoods, the largest shellfish operation in Humboldt Bay produces an estimated 60,000 gallons (each gallon contains 100-200 oysters) of oysters annually (Poor 2011). Coast Seafoods produces both Pacific and Kumamoto oysters.). In the case of Drakes Estero, the CFGC has issued, and CDFG administers, state water bottom leases to DBOC despite the fact that the underlying tidelands and submerged lands have been owned by the United States since 1965.The NPS has identified that because DBOC operations are on tidelands and submerged lands that were granted in fee to the United States, the NPS, as the landowner, is the proper leasing authority for the DBOC operation. Therefore, should the Secretary issue a permit to DBOC under section 124, as a condition of receiving that permit, DBOC would be required to surrender its state water bottom lease to the CFGC prior to issuance of a new SUP by the NPS. DBOC would thereafter operate under the terms of the NPS permit. The CDFG would no longer collect per acre fees or a privilege use tax from DBOC, but it would retain, through an agreement with NPS, oversight related to stocking of aquatic organisms, brood stock acquisitions, disease control, and the importation of aquatic animals. The CDFG coordinates disease and health certifications for shellfish with other agencies.

DRAKES BAY OYSTER COMPANY

Between 1980 and 2010, Pacific oyster production within Drakes Estero averaged 430,100 pounds (excluding 2004 production, for which data was not available) (CDFG 2011c[xxvi]). Table 2-1 Shellfish Species Production By Year (1980-2010) provides a complete list of shellfish produced within Drakes Estero during that timeframe. In 2005, production rates did not meet harvest requirements (180,030 pounds for M-438-01) due to the transfer of the lease from JOC to DBOC. Since that time, Pacific oyster production has increased. Between 2007 and 2009, annual Pacific oyster production averaged 454,036 pounds, and peaked in 2010 at greater than 585,000 pounds (nearly 6.9 million Pacific oysters). The 2010 levels of production represent an approximately 30 percent increase over production rates between 2007 and 2009 (CDFG 2011c). In 2009, in addition to Pacific oysters, the DBOC produced 458 pounds of Manila clams (13,740 clams). In 2010, Manila clam production at DBOC increased nearly 50 percent to 684 pounds (20,520 clams) (CDFG 2011c).

Gross revenue has been commensurate with oyster production levels; however, due to fluctuations in direct and overhead expenses between 2005 and 2009, net revenues have been variable. According to

DBOC, both the gross and net revenue projected for 2010 were expected to be greater than any year since 2005 (DBOC 2010i). Specifically, DBOC's November 15, 2010, letter to NPS regarding the oyster company's business plan states, "DBOC's financial projection is that income and expenses will approximate the income and expenses over the past 2 years" (DBOC 2010i). Revenue data for 2010 were not available at the time of report preparation; however, based on the quantity of Pacific oysters produced, 2010 revenue is anticipated to be greater than the annual revenue generated between 2005 and 2009. Revenue data prior to 2005 (associated with JOC) were not readily available.

DBOC states that its Pacific oyster products (and clams) are only distributed within an approximately 100-mile radius from its facility, and primarily to the San Francisco Bay Area and north (DBOC [Lunny], pers. comm., 2011h). Manila clams are currently sold on site and to select local restaurants only due to their limited production (DBOC [Lunny], pers. comm., 2011h). Of the shellfish produced at DBOC, DBOC reports that approximately 80 to 90 percent is sold to local restaurants and markets and approximately 5 percent is sold to seafood wholesalers and distributors (DBOC [Lunny], pers. comm., 2011h). The remaining 5 to 15 percent is sold on site. Other oyster companies close to DBOC that also contribute local oysters to the San Francisco Bay Area include Hog Island Oyster Farm, Tomales Bay Oyster Company, and Morro Bay Oyster Company.

Employment

As of November 2010, the DBOC staff was comprised of 31 full-time employees and 1 part-time (seasonal) employee (total of 32 employees), 15 of whom live with their families in company-owned housing (DBOC 2010j[xxvii]). These housing units are located within the onshore portion of the project area. DBOC maintains five housing units (with a total of 14 bedrooms) for its staff in the form of three double-wide mobile homes and two permanent houses (DBOC 2010k[xxviii]). Twenty-seven of the DBOC staff live within Marin County. The remaining 5 employees reside in Sonoma County.

DBOC Contributions to the Economy

DBOC operates the only on-site oyster cannery in the State of California; and according to DBOC, produces 100 percent of the state's shucked and packed oysters (DBOC 2010n[xxix]). It should be noted that many oysters harvested from Humboldt Bay are shucked and packed by Coast Seafoods, but their facilities for shucking and packing are not in the state. Shellfish production at DBOC has been compared to statewide oyster production levels, based on data provided by CDFG. However, the CDFG has acknowledged that their statewide production summaries do not accurately represent the total annual shellfish production in California. The available CDFG data are not inclusive of all statewide oyster production because some operations on private or granted tidelands are not accounted for in the totals as they are not required to report production data to the CDFG. As discussed previously, the CDFG manages 18 leases for 9 mariculture operations in California (out of a total of approximately 30 mariculture operations in the state). As such, DBOC contributions to the statewide Pacific oyster and total oyster markets are likely lower than the percentages presented in this document.

Additionally, production numbers for aquaculture operations under state-managed leases (approximately half of the operations in the state) are reported to the CDFG in total numbers for most areas in California and that data gets converted into a weight in pounds. In Drakes Estero, total numbers have been converted by CDFG into weight using a conversion of 100 oysters per gallon. In other areas of the state, the total number of oysters has been converted by CDFG to weight using 140 oysters per gallon. As a result, direct comparison of DBOC production with other areas may result in a 40 percent overestimate of production from Drakes Estero. In areas where production is not on state-managed leases, there are no standard reporting methods. CDFG has requested production information from those operations, but reporting is sporadic. In past years, CDFG used estimates of production. More recently, CDFG has only used reported production. As a result, reported production in Southern California has been reduced substantially (by 60,000 pounds of Pacific oyster and 500,000 pounds of mussels because previous estimates cannot be confirmed and there is no reported information for that location) (CDFG [Ramey], pers. comm., 2011d). In the case of Humboldt Bay, the largest producer has provided CDFG with production information by weight, without providing the total number of shellfish produced. CDFG has extrapolated total oyster production using the conversions of 100 oysters per gallon and 8.5 pounds per gallon, but has not inquired as to the method that the Humboldt Bay producers use. In the 2009 producer survey (Kuiper 2009), Ted Kuiper, who also was a shellfish producer in Humboldt Bay, assumed 180 oysters per gallon. For their analysis of statewide production CDFG has used the following assumptions:

For Tomales Bay:

- Pacific oyster/140 per gallon x 8.6 = pounds
- European flat oyster/140 per gallon x 8.5 = pounds
- Eastern oyster/300 per gallon x 8.5 = pounds
- Kumamoto oyster/300 per gallon x 8.5 = pounds
- Olympia oyster/400 per gallon x 8.5 = pounds

For Drakes Estero:

- Pacific oyster/100 per gallon x 8.5 = pounds

For Southern CA:

- Pacific oyster/140 per gallon x 8.6 = pounds

In Humboldt Bay, all information reported to CDFG has been in pounds. CDFG has converted to total shellfish using conversions of 100 oysters per gallon (regardless of species) and 8.5 pounds per gallon (CDFG [Ramey], pers. comm., 2011d). These conversions have not been confirmed with Humboldt Bay operators.

As described above, CDFG estimates of statewide shellfish production, including oyster production data, are not calculated consistently and are not inclusive of all statewide oyster production. Table 3-7 compares the shellfish production (2007/2008) within Drakes Estero to statewide shellfish production using three different sources: CDFG, an independent survey of California shellfish production by Ted Kuiper, and the Pacific Coast Shellfish Growers' Association.

According to CDFG records, between 2007 and 2009, Pacific oysters produced within Drakes Estero accounted for an average of 39 percent of the Pacific oysters produced in California, approximately 37 percent of the overall oyster market for the state, and 28 percent of the shellfish produced in the state, based on weight. Based on the number of individual oysters produced; however, DBOC accounted for 37 percent of the Pacific oysters, 34 percent of the total oysters, and 16 percent of the total shellfish produced in California between 2007 and 2009.CDFG records indicate nearly 1.17 million pounds of Pacific oysters and 1.24 million pounds of total oysters were produced annually in California between 2007 and 2009 (CDFG 2011a, 2011c). In 2010, DBOC produced 585,277 pounds of shucked oyster meat (6.89 million oysters), a 28 percent increase over 2009 production levels. Based on weight, and according to CDFG reports, Pacific oysters produced at DBOC in 2010 comprised 43 percent of the Pacific oysters, 40 percent of the total oysters, and 37 percent of the shellfish produced in California in that year (CDFG 2011a, 2011c). In contrast, based on the total number of individuals produced, DBOC produced 39 percent of the Pacific oysters, 36 percent of the total oysters, and 17 percent of the total shellfish produced in the state in 2010. As described above, the CDFG data are not calculated consistently and are not inclusive of all statewide oyster production. Additionally, 70 percent of the fresh oysters consumed in California are from Humboldt Bay (Humboldtmade.com 2011). Therefore, it is assumed that DBOC's contribution to the overall California oyster market between 2007 and 2010 is lower than that reported by CDFG.

According to CDFG data, in both 2009 and 2010, the total number of individual oysters produced in Drakes Estero was similar to production rates in Tomales Bay (CDFG 2011e). Additionally, although Humboldt Bay reports to be the largest producer of oysters within California, CDFG data indicates that Humboldt Bay oyster production (in 2009 and 2010) is less than that of Drakes Estero and Tomales Bay (CDFG 2011e). Shellfish operations within Humboldt Bay do not have state water bottom leases; therefore, are not required to report production to CDFG. As such, the Humboldt Bay data reported to CDFG has been in pounds and has not provided a conversion factor that can be used to convert to total oysters as described above.

According to data from state-owned tidelands (and DBOC) provided by CDFG, Manila clams harvested at DBOC in 2009 and 2010 represented only 1 percent and 0.04 percent, respectively, of the total Manila clams harvested in California those years. Manila clams were the only clams harvested in California in 2009 and 2010 (CDFG 2011a). Manila clam production at DBOC also is factored into the total shellfish percentages calculated for 2009 and 2010.

In addition to estimates provided by CDFG, statewide shellfish production data is available (for 2007 or 2008) from the Pacific Coast Shellfish Growers Association and within an independent survey of California's shellfish industry, prepared by Ted Kuiper (PCSGA 2009; Kuiper 2009). Table 3-7 summarizes the data available from these sources, and compares them to DBOC production and the shellfish production estimates reported by CDFG. As shown in the table, depending on the source and metric (individuals, weight, or value) used DBOC accounts for between 16 and 36 percent of the oysters and between 13 and 28 percent of the shellfish produced in California. The data from the Kuiper survey was calculated using the following conversion factors:

- 180 oysters comprise a gallon
- One gallon of oyster meat weighs 8.5 pounds
- Twenty mussels weigh 1 pound
- Thirty clams weigh 1 pound

In addition, the Kuiper survey considers imported oysters and clams; however, imported shellfish were removed from the calculations presented in table 3-7.

TABLE 3-7. CALIFORNIA SHELLFISH PRODUCTION, 2007/2008[1]

	DBOC[1]	CDFG[1]	Percent DBOC contribution	Kuiper survey[2]	Percent DBOC contribution	Pacific Coast Shellfish Growers Association	Percent DBOC contribution
Individuals							
Total Individual Oysters	5,314,005	15,412,180	34%	32,500,000	16%	N/A	N/A
Total Shellfish (individuals harvested)	5,314,005	32,200,219	17%	40,030,000	13%	N/A	N/A
Weight (lbs)							
Total Weight of Oysters (lbs)	451,691	1,258,952	36%	1,539,983	29%	N/A	N/A
Total Weight of Shellfish (lbs)	451,691	1,817,476	25%	1,895,983	24%	N/A	N/A
Value (Dollars)							
Total Value of Oysters	$2,484,301	$7,773,402	32%	N/A	N/A	$12,361,326	20%
Total Value of Shellfish	$2,484,301	$8,850,642	28%	N/A	N/A	$14,136,326	18%

Sources: CDFG 2011a, 2011c, 2011e; Kuiper 2009; and PCSGA 2009.
N/A: not applicable; data not available
Note: In 2007 and 2008, DBOC produced only Pacific oyster.
1 – Data shown is an average of production reported for 2007 and 2008.
2 – Data shown is based on a combination of 2007 and 2008 production levels, depending on the year reported by each operation surveyed.

DBOC reports that annual visitation for the oyster company is approximately 50,000 (DBOC 2010n[xxx]), approximately 2.5 percent of Seashore visitors (NPS 2011a). Specific data regarding the percentage of DBOC visitors that travel to the Seashore solely to visit the oyster company were not available at the time of report preparation; however, it is likely that at least a portion of the annual visitors to the oyster company also visit other areas of the Seashore during their trip. Visitors to DBOC also are likely to spend their money locally at establishments such as restaurants, retail shops, and lodging facilities. This spending further contributes to the local and regional economy and increases the demand on local goods and services. The sales tax within Marin County currently ranges from 9 to 9.5 percent, and is 9 percent in the vicinity of the Seashore. Of this total, 7.25 percent is allocated to the state and the remaining 1.75 percent is dedicated to local funds. Information pertaining to the current impact of this spending on the local and regional economies was not readily available at the time of report preparation.

DBOC also donates large oyster shells to native oyster restoration projects. As part of these efforts, DBOC recently donated an estimated $10,000 worth of shells to the San Francisco Bay Bird Observatory (DBOC 2010n[xxxi]). The oyster shells donated by DBOC have been used in wildlife habitat enhancement projects, to test, for example, whether predation of plover nests can be reduced by enhancing nesting habitat with oyster shells. Specific research efforts supported by DBOC, though the donation of oyster shells include, the San Francisco Bay Bird Observatory and the Berkeley Native Oyster Reef Project.

Due to the varying approaches used to estimate statewide oyster production rates and value in California, DBOC's share of the oyster and shellfish market is presented as a range in this document. In 2007/2008, shellfish harvested from DBOC comprised between 16 and 34 percent of the oysters and between 13 and 28 of the shellfish produced in California. These ranges are applied, as appropriate, throughout this document. However, because Manila clams were not harvested at DBOC until 2009 and CDFG is the only available statewide data for that year, DBOC's share of the statewide Manila clam market was estimated in comparison to CDFG data only.

IMPACT TOPIC: NPS OPERATIONS

Currently at Point Reyes (2010), there are approximately 120 FTE (full-time equivalent, or one person for a full year), including more than 90 permanent staff. During peak summer months, park staff increases to about 160 staff members, including Youth Conservation Corps enrollees who provide assistance in a number of ways. This work force is supplemented by 30,000 hours of Volunteers-in-Parks, Student Conservation Assistants, and AmeriCorps service.

The Seashore maintains the necessary infrastructure to support annual park visitation of 2.25 million people and provides offices, support structures, and limited housing for the permanent and seasonal park staff. Park structures include the following:

- 3 visitor centers
- 2 environmental education centers
- 3 research and education centers
- 30 restroom complexes
- 4 backcountry campgrounds
- 2 beach campgrounds
- 1 volunteer campground at Bear Valley
- 27 water systems
- 147 miles of trails
- Over 100 miles of roads
- Over 100 public and administrative structures
- 55 sewage treatment systems
- 34 housing units

The Seashore also manages and protects park cultural resources, including the following:

- 361 historic structures
- 124 recorded archeological sites
- 39 identified cultural landscapes
- 516,074 museum objects

Financial resources available to achieve the Seashore's annual goals include a base operating budget of approximately $7.8 million for 2010. In addition, the Seashore receives supplemental support for fire operations, routine maintenance, special natural resource projects, and repair and rehabilitation of structures. The management of Seashore programs, operations, and activities are categorized into one of several park divisions, grouped into the following function areas: facilities management, administration, visitor resource protection, natural resource management, science, cultural resource management, and interpretation and education.

Seashore-managed facilities in the vicinity of DBOC include an unpaved parking lot and associated fence, the DBOC access road, a sign/interpretive kiosk, and a vault toilet. The parking lot is immediately north of the DBOC facilities and provides parking for the adjacent beach, which serves as a boat/kayak launch for visitors. This lot is relatively small, with a maximum capacity of approximately 15 vehicles in unmarked spaces. The north and west sides of the lot are delineated by a split-rail wooden fence.

Road maintenance, sign development and installation, and custodial maintenance of the vault toilet are conducted by Seashore staff. The DBOC access road is inspected regularly by NPS facilities management staff. DBOC has been asked to notify the facilities management division when any issues arise with the road. Grading is conducted on an as-needed basis—since 2007, approximately annually. NPS maintains a vault toilet installed in 2008 adjacent to and southeast of the beach parking lot. NPS conducts regular custodial maintenance of the vault toilet, totaling more than 100 labor hours annually. NPS maintains signs for the access road to be consistent with NPS sign policy. In addition, within the Seashore, NPS conducts trash removal on a weekly basis. DBOC pays NPS for the trash removal services.

Management and administration staff members at the Seashore have a variety of responsibilities related to DBOC management, including negotiation, management, oversight, and compliance for the DBOC SUP. In conjunction with the 2008 SUP, DBOC and NPS signed a statement of principles that, among other things, indicates that NPS will cover costs associated with NEPA compliance required for the permit.

Over the past 5 years, management and administration costs for NPS have increased considerably because of Freedom of Information Act (FOIA) requests, heightened congressional and media interest, and local regional and national interest in the issues surrounding Drakes Estero. Internal coordination associated with these requests has been managed by existing staff.

Law enforcement and visitor resource protection staff are responsible for oversight of the RUO and SUP as well as enforcing all applicable regulations, including those related to species management and visitor protection. Duties related to DBOC management include regular check in, worker housing inspections, and response to calls as appropriate. Seashore staff are responsible for ensuring that closure policies within Drakes Estero are adhered to during harbor seal pupping season. Harbor seal pupping season occurs within Drakes Estero between March 1 and June 30. During this period, all recreational nonmotorized boats, including kayaks, are prohibited from entering Drakes Estero.

In addition to species-related law enforcement, Seashore staff are, in part, responsible for ensuring that DBOC housing conditions meet applicable standards. Annually, Seashore staff accompany the U.S. Department of Health and Human Services during inspections of DBOC employee housing units within the existing permit area. The Seashore responsibilities do not include monitoring or enforcement associated with other DBOC facilities or operations. Such inspections are conducted by the CDPH.

Natural resource monitoring, management, and research are ongoing within Drakes Estero. Natural resource management staff members, with the assistance of volunteers, conduct inventories of various plant and animal species, as well as annual surveys for invasive species, including nonnative *Spartina*. Monitoring of the Pacific harbor seal has been ongoing in Drakes Estero since the early 1980s through a combination of park staff and park volunteers. Other regular monitoring efforts conducted onshore adjacent to the project area include archeological site surveys, threatened and endangered species surveys, and range management. Cultural resource management staff would be responsible for carrying out the archeological site surveys, while natural resource management staff would be responsible for performing the threatened and endangered species surveys and range management. Natural resource management staff is also responsible for preparation of all required annual reports for protected species, research on protected species or factors that could affect the species, predator control, and coordination of regulatory and scientific activities with other entities such as the USFWS and the CDFG.

Seashore staff have spent approximately 200 labor hours per year since 2008 for maintenance and custodial activities on facilities, including the Schooner Bay Road and vault toilet. Labor hours associated with administrative activities have exceeded 2000 hours per year, in association with SUP management and Freedom of Information Act responsibilities. Under existing conditions, all maintenance, management, and administrative activities are accomplished with existing staff resources.

.

ENDNOTES

i. Anima 1990, 57: "Sediment in Drakes Estero ranges between medium grained sand to medium-fine silt, and varies slightly within each branching bay and the central Estero area."

ii. Anima 1991, 42: "In the mid to upper parts of the branching bays, where silt becomes predominant, the tidal channels become less distinct to a point where mud makes up the tidal flats and the channels take on a meandering dendritic pattern and become very narrow and shallow."

iii. Anima 1991, 42: "In Schooner Bay the channel is somewhat artificial in that it has been scoured out by the constant boat traffic from the oyster operation."

iv. Anima 1990, 72–95: Sedimentation rates included in table 12 through table 17.

v. Anima 1991, 64–75: Sedimentation rates included in table 12 through table 16.

vi. Anima 1990, 87: "The geophysical records suggest that approximately 30 meters of sediment has filled the valley occupied by Drakes Estero near the entrance . . . [which] puts the onset of filling at 8,000 yrs B.P."

vii. Anima 1990, 38: "The inlet to the Estero has migrated in an east to west [sic] and then reversed during historic times…During the course of this study, surveys were [sic] of the barrier spits were conducted and the barriers were found to have migrated approximately 80 meters in 1 year."

viii. Wechsler 2004, 12–13: "A high width to depth ratio combined with a large exchange volume results in a well-mixed water body with no stratification."

ix. Harbin-Ireland 2004, 27: "The organic matter input into the estuary with the breakdown of vegetative material from the eelgrass in the fall and winter when the sampling for this study took place likely accounts for the relatively high percent organic matter found in all sediment cores."

x. Harbin-Ireland 2004, 27: "The decrease in silt content values beneath racks in this study may indicate some sediment erosion is taking place due to the presence of the racks; however the difference . . . is not likely great enough to alter invertebrate community composition."

xi. Wechsler 2004, 13: "Aquatic macrophytes, primarily eelgrass (Zostera marina) beds, were the predominant form of subtidal and intertidal biological material in Drakes Estero."

xii. Anima 1991, 29: "Maximum water depths in Drakes Estero were found at the entrance and near the first major bend in the main channel west of the inlet, where the water depth is between 7.0 to 7.9 m."

xiii. Anima 1991, 29: "The total area of the lagoon at higher high tide is 9.4 km2. Of this area, approximately 4.8 km2 consist of intertidal flats that are exposed during low tide."

xiv. Anima 1991, 29: "The total area of the lagoon at higher high tide is 9.4 km2. Of this area, approximately 4.8 km2 consist of intertidal flats that are exposed during low tide."

xv. Wechsler 2004, 13: "Aquatic macrophytes, primarily eelgrass (Zostera marina) beds, were the predominant form of subtidal and intertidal biological material in Drakes Estero. These beds provide an extensive array of habitat for aquatic biota, and are likely important breeding grounds and refuge areas for juvenile fish. Small zones of giant kelp (Macrocystis pyrifera) and big-leaf algae (Ulva spp.) were present in the Estero . . ."

xvi. Wechsler 2004, 13: "Aquatic macrophytes, primarily eelgrass (Zostera marina) beds, were the predominant form of subtidal and intertidal biological material in Drakes Estero. These beds provide an extensive array of habitat for aquatic biota, and are likely important breeding grounds and refuge areas for juvenile fish. Small zones of giant kelp (Macrocystis pyrifera) and big-leaf algae (Ulva spp.) were present in the Estero . . ."

xvii. Harbin-Ireland 2004, 46: “Appendix B. Invertebrate Taxonomic Groups and Species Found in Core Samples.”

xviii. Letter from Drakes Bay Oyster Company to California Coastal Commission on January 31, 2008 regarding CCC-07-CD-04 Drakes Bay Oyster Company (section 3.2.10 of Consent Order).

> “Small numbers of European flat oysters (Ostrea edulis) and Kumamoto oysters (Crassostrea sikamea), which were planted by the Johnson’s Oyster Company prior to 2005, still exist within the cultivated area.”

xix. Wechsler 2004, 18: “I caught 3,128 fish, which represented twenty families and thirty-five species (Appendix A).” “Five species, topsmelt (*Atherinopsis affinis*), three-spined stickleback (*Gasterosteus aculeatus*), staghorn sculpin (*Leptocottus armatus*), bay pipefish (*Sygnathus leptorhynchus*), and kelp surfperch (*Brachyistius frenatus*) dominated the fish assemblage and accounted for eighty-five percent of the total catch (Table 3).”

xx. Anima 1991, 38: Table4. Salinity and Conductivity, measurements taken in Drakes Estero.

xxi. Anima 1990, ii: “Based on interpretations made of geophysical records, Pb210, and Carbon14 dating techniques the study determined that sediment input into the Drakes Estero and Abbotts Lagoon has fluctuated over the last 8,000 years B.P. from 35 cm/100 yrs to between 12 cm/100yrs to 30 cm/100yrs over the last 120-150 years.”

xxii. Anima 1990, 140: “Comparison of Pb210 age dates and those of c14 suggest that sedimentation has increased in the last 150 yrs.”

xxiii. Anima 1991, 23: “Six ranches surrounding Drakes Estero support an approximate total of 1,185 head of cattle.”

xxiv. Data for the Point Reyes National Seashore public use reports is calculated using the Public Use Counting and Reporting Instructions located at http://www.nature.nps.gov/stats/CountingInstructions/PORECI1994.pdf.

xxv. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, 2010, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

> “DBOC also is a popular visitor attraction, bringing approximately 50,000 people each year to West Marin.”

xxvi. This data was derived using the most current tax records on file with CDFG. It should be noted that the data presented in the NAS report used previous information “not supported by tax records that are on file with CDFG.”

xxvii. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Scientist on November 15, 2010, regarding employee list. DBOC provided a list of current staff (as of the date of the letter).

xxviii. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Scientist on November 15, 2010, regarding housing.

> “DBOC provides five homes with a total of 14 bedrooms for its employees; and in some cases, their families.”

xxix. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, 2010, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

> “[The DBOC] produces nearly 40% of California’s grown oysters and, as the last operating cannery in the State, 100% of shucked and packed oysters.”

xxx. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, 2010, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

> “DBOC also is a popular visitor attraction, bringing approximately 50,000 people each year to West Marin, which increases the demand for goods and services in the area.”

xxxi. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on November 24, 2010, regarding Drakes Bay Oyster Company comments on National Park Service scoping letter for Special Use Permit Environmental Impact Statement.

> “DBOC contributes to science and research related to native oysters, estuarine biodiversity, and human health protection. It is the only oyster farm in the state with an on-site hatchery, lab, and biologists on staff. DBOC also presently recognized the importance of native oyster restoration projects, and donated $10,000 worth of oyster shells to the largest such project in California.”

This page intentionally left blank.