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AFFECTED ENVIRONMENT

Photo by: Robert Campbell

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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 (see figure 1-2). The U. S. owns the tidelands and submerged lands and NPS manages the marine environment from the shoreline to 0.25 miles offshore. Drakes Bay, beyond the quarter mile Seashore boundary, is part of 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 National 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. 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; Hickey and Banas 2003), 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; Hickey and Banas 2003).

The central California coastline also is susceptible to changes related to climate change and sea level rise. Recent studies provide a range of sea level rise along the west coast given these influences. A California Climate Change Center report (Heberger et al. 2009) suggests a rise of 3 to 4.5 feet by year 2100; Cayan et al. (2009) suggests a range of 0.98 to 1.48 feet by year 2050; and NAS (2012b) provides a range of 1.38 to 5.48 feet by year 2100. At these projected rates, sea-level rise, on average, could reach approximately 5.9 to 6.6 inches on the high end of the range within the next 10 years.

The marine environment 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 and a Marine Reserve designated under the Marine Life Protection Act. 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). 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 (CCC 2007a). Deeper water is found in the mainstem portion of Drakes Estero, in a central channel that is artificially maintained by boat traffic. The deepest measurements of Drakes Estero occur near the mouth (23 to 26 feet) (CCC 2007a). Because of the open character of the lagoon and the low freshwater input, much 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 strong flushing tendency 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). The beneficial effects of filter feeders are often described in the context of "benthic-pelagic coupling", which is the term used to describe 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 bivalve molluscs such as oysters, 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, "repackage" that material into other forms that are more readily available for uptake by organisms inhabiting the bottom substrate (Lenihan and Micheli 2001). Filter feeding bivalves have been shown to influence biogeochemical cycling by providing 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 (SAV) such as eelgrass (*Zostera marina*) may be growing (Reusch, Chapman, and Groger 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 smaller west coast lagoon systems like Drakes Estero 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 benefits provided by commercially grown bivalves – like the benthic-pelagic coupling functions described above – are likely to be restricted localized areas adjacent to shellfish beds/structures.

Research on biogeochemistry in Drakes Estero is limited, but there have been a few studies documenting chemical and physical characteristics of the Drakes Estero 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 (Harbin-Ireland 2004[ix]). 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. The primary researcher 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[x]). Further, the study pointed to a difference in sediment texture between racks and nearby samples, suggesting that erosion was taking place around the racks (Harbin-Ireland 2004[xi]). 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).

Finally, Drakes Estero is potentially subjected to the effects of harmful algal blooms in coastal waters, also known as "red tides", in which certain algae grow rapidly in response to warmer water temperatures

(Evens 2008). Red tides are regional in nature, occurring within Drakes Estero due to offshore influences that are brought in with the tides. The overabundance of algae during these times can result in the release of biotoxins, or biologically-derived toxic substances, that can accumulate in filter feeding organisms like bivalves. A condition known as PSP, which is a human health hazard, can result. PSP levels are monitored in Drakes Estero and can result in closure of commercial mariculture operations (CDPH 2012).

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[xii]). 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; Wilkerson et al. 2006). 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 (Fourqurean et al. 1997; Smith and Hollibaugh 1997). 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 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 research 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 habitats 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 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*), American beachgrass (*Ammophila breviligulata*), and goldenbush (*Ericameria ericoides*). Nonnative species are commonly interspersed within native plant communities of the coastal dune 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 project 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 grasses 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 490 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 "Special-status Species" sections in chapters 1 and 4; 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 areas of the Seashore.

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 but is not known to occur within the project area (see "Special-Status Species" discussion in chapter 1). 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 U.S.) is attributed to the unique geographic setting, abundant and diverse habitat availability, and maritime climate. Geographically**,** the U.S. 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 Seashore 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 AND OTHER WATERS OF THE U.S.

The federal government has defined waters of the U.S. to include a wide variety of aquatic systems (33CFR 328.3). Two sections of this definition that apply to Drakes Estero are:

- All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
- All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters.

Wetlands, as separately classified ecosystems, are designated as a special aquatic site under section 404 of the Clean Water Act (CWA) and are therefore a subset to waters of the U.S. The identification of wetlands and other waters of the U.S. 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). Under section 404, areas below the high tide line are automatically jurisdictional. Areas with less than 5 percent vegetation are classified as tidal “waters of the U.S.” and those with more than 5 percent vegetation are classified as tidal “wetlands.” Above the high tide line, wetlands are defined as:

> 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 above the high tide line requires the presence of three parameters: hydric soil, a dominance of hydrophytic vegetation, and hydrology at or above the ground surface, although it is recognized that some areas may only exhibit two parameters: soils and hydrology. Wetlands that meet the EPA/USACE definition relying on two parameters (soils and hydrology) are still recognized as a “water of the U.S.” and are therefore regulated under section 404 of the CWA.

The USFWS has developed a wetland definition that 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 (Cowardin et al. 1979). 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, all unvegetated mudflats, marshes, shorelines and subtidal aquatic systems below the ordinary high tide elevation are regulated as waters of the U.S. by USACE.

USFWS uses the following definition of wetlands.

> 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.
>
> The term wetland includes a variety of areas that fall into one of five categories; (1) areas with hydrophytes and hydric soils, such as those commonly known as marshes, swamps, and bogs; (2) areas without hydrophytes but with hydric soils – for example flats where drastic fluctuation in water level, wave action, turbidity, or high concentration of salts may prevent the growth of hydrophytes; (3) areas with hydrophytes but nonhydric soils, such as margins of impoundments or excavations where hydrophytes have become established but hydric soils have not yet developed; (4) areas without soils but with hydrophytes such as the seaweed-covered portion of rocky shores; and (5) wetlands without soil and without hydrophytes, such as gravel beaches or rocky shores without vegetation. (Cowardin et al. 1979)

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* (DO-77-1) to establish "NPS policies, requirements, and standards for implementing Executive Order 11990" (NPS 2002a). This order instructs NPS to use the USFWS determination outlined in Cowardin et al. (1979) as the standard for defining, classifying, and inventorying wetlands and determining when NPS actions have the potential to adversely impact wetlands.

DRAKES ESTERO WETLANDS AND OTHER WATERS

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[xiii]), with an average subtidal depth of around 6.5 feet (CCC 2007a). The mean tidal range of Drakes Estero is approximately 6.2 feet (Pendleton et al. 2005) to 6.5 feet (CCC 2007a). Drakes Estero consists of five narrow bays: Barries Bay, Creamery Bay, Schooner Bay, Home Bay, and Estero de Limantour. Anima (1991[xiv]) 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 the high tide line and including the land associated with the onshore facilities using the Cowardin wetland classification system (Cowardin et al. 1979). Other waters of the U.S. occur below the low tide elevation (subaquatic habitats). Large portions of the subaquatic areas in Drakes Estero are dominated by eelgrass. This EIS separates the eelgrass areas as a separate impact topic, and a more thorough description is provided in the "Eelgrass" section of this chapter. Estero de Limantour, because it falls very near the mouth of Drakes Bay and contains no mariculture facilities, is disassociated with and outside the project area, and is not considered in this section of the EIS.

A qualitative inventory of wetlands and other waters of the U.S. is summarized based on data collected by NPS staff with references such as the NPS wetlands GIS database, the *National Wetlands Inventory* established by 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. In preparation for this EIS, NPS park staff mapped wetlands within the study area based on 2009 aerial photos and digitized using ArcGIS. Wetlands at the onshore facilities were mapped based on a site-specific field inspection (NPS 2011n).

Wetlands and other waters of the U.S. within the project 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[xv]). The intertidal sand and mudflat wetland types are the most common wetlands within the project 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. Vegetated tidal marshes upstream of Sir Francis Drake Boulevard and upstream of Estero Trail are not influenced by oyster operations and are physically constrained from the rest of Drakes Estero by physical impediments to natural flow regimes including culverts and a breached dam feature.

Commercial oyster operations have been an activity at Drakes Estero spanning decades. Between the 1950s and 1970s, much of the upland areas currently supporting the onshore operations, mobile housing units, and kayak parking area were once tidal marsh filled by operators of the time. An historic aerial photograph from 1943 depicts the onshore facilities prior to the wetland and shoreline fill. The pond immediately north of the onshore facilities was originally a vegetated marsh. The pond was created by installation of a culverted outflow when the entrance road was installed. The loss of vegetated marsh and shoreline, associated with the development between the 1940s and 1970s, is estimated to be approximately 3.8 acres. Today, wetlands within and around the onshore facilities include estuarine intertidal and subtidal wetlands (E2EM and E1/E2UB3) along the northern boundary of the developed area and extending eastward, where wetlands transition into a freshwater marsh (PEM) and scrub-shrub (PSS) habitat type. The open water area, or pond, on the north side of the onshore developed area is classified as an E1UB3 system (estuarine subtidal unconsolidated bottom mud).

Existing permitted culture beds occur within various wetland classification types. Roughly 65 acres of permitted beds occur within the E1/2AB3 wetland type, primarily associated with the racks. Remaining permitted beds occur with E2US3 wetlands (15 acres) and E3US1/2 wetlands (65 acres) mostly for bottom bags.

Characteristic species within the intertidal wetland communities include saltgrass (*Distichlis spicata*), 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).

A list of wetlands and other waters of the U.S. 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. WETLANDS AND OTHER WATERS OF THE U.S. 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 and other waters of the U.S. are classified using the Cowardin system (Cowardin et al. 1979).

Wetlands and other waters of the U.S. within the project area, which are located within the coastal zone, are exposed to the effects of sea-level rise due to a variety of influences to include wind-driven differences in ocean heights; gravitational and deformational effects from melting ice; water expansion from increasing ocean temperatures; and vertical land motions or tectonics (NAS 2012b). Recent studies provide a range of sea level rise along the west coast given these influences. A California Climate Change Center report (Heberger et al. 2009) suggests a rise of 3 to 4.5 feet by year 2100; Cayan et al. (2009) suggests a range of 0.98 to 1.48 feet by year 2050; and NAS (2012b) provides a range of 1.38 to 5.48 feet by year 2100. At these projected rates, sea-level rise, on average, could reach approximately 5.9 to 6.6 inches on the high end of the range 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; NAS 2012b).

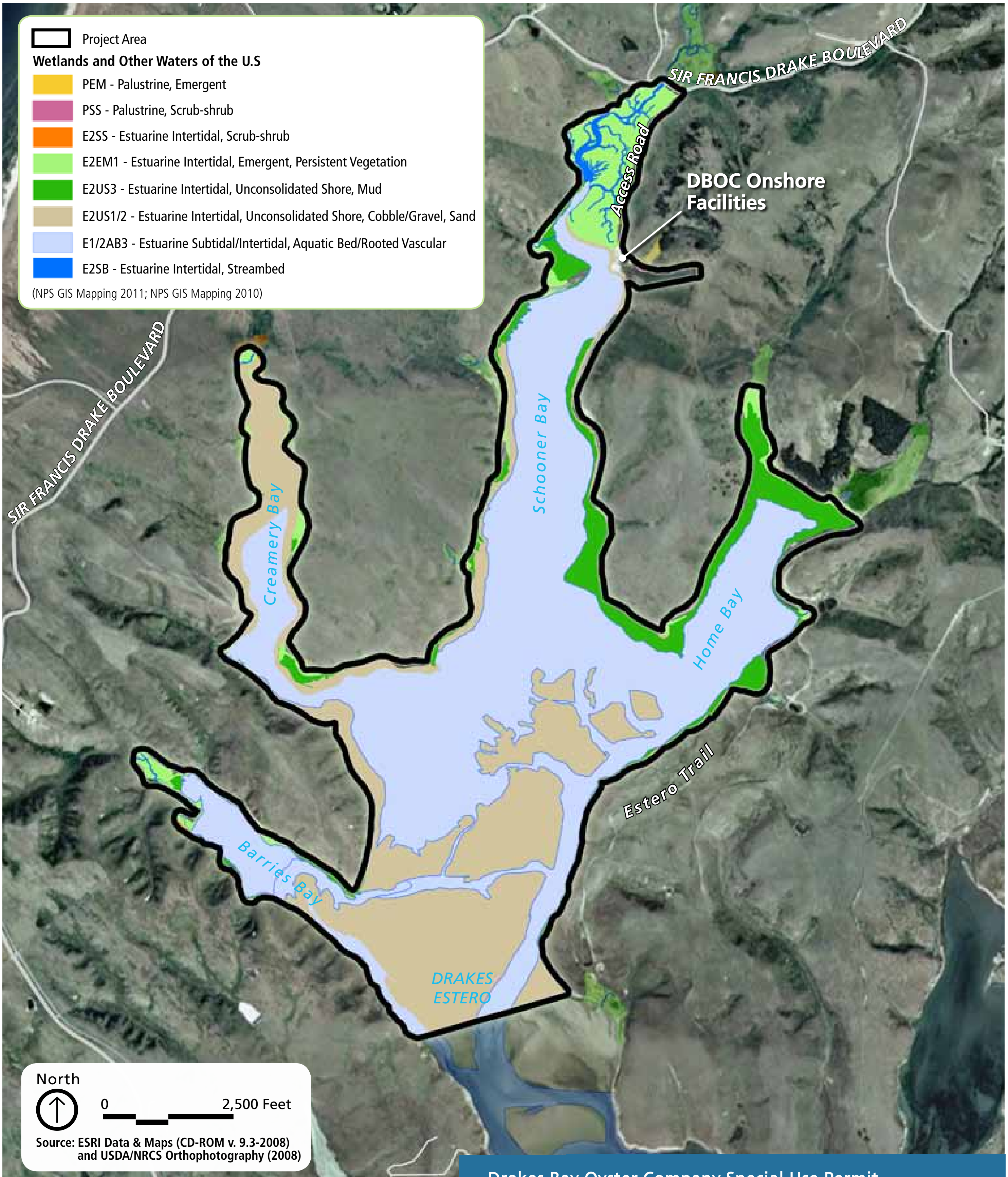

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FIGURE 3-1

Wetlands and Other Waters of the U.S.

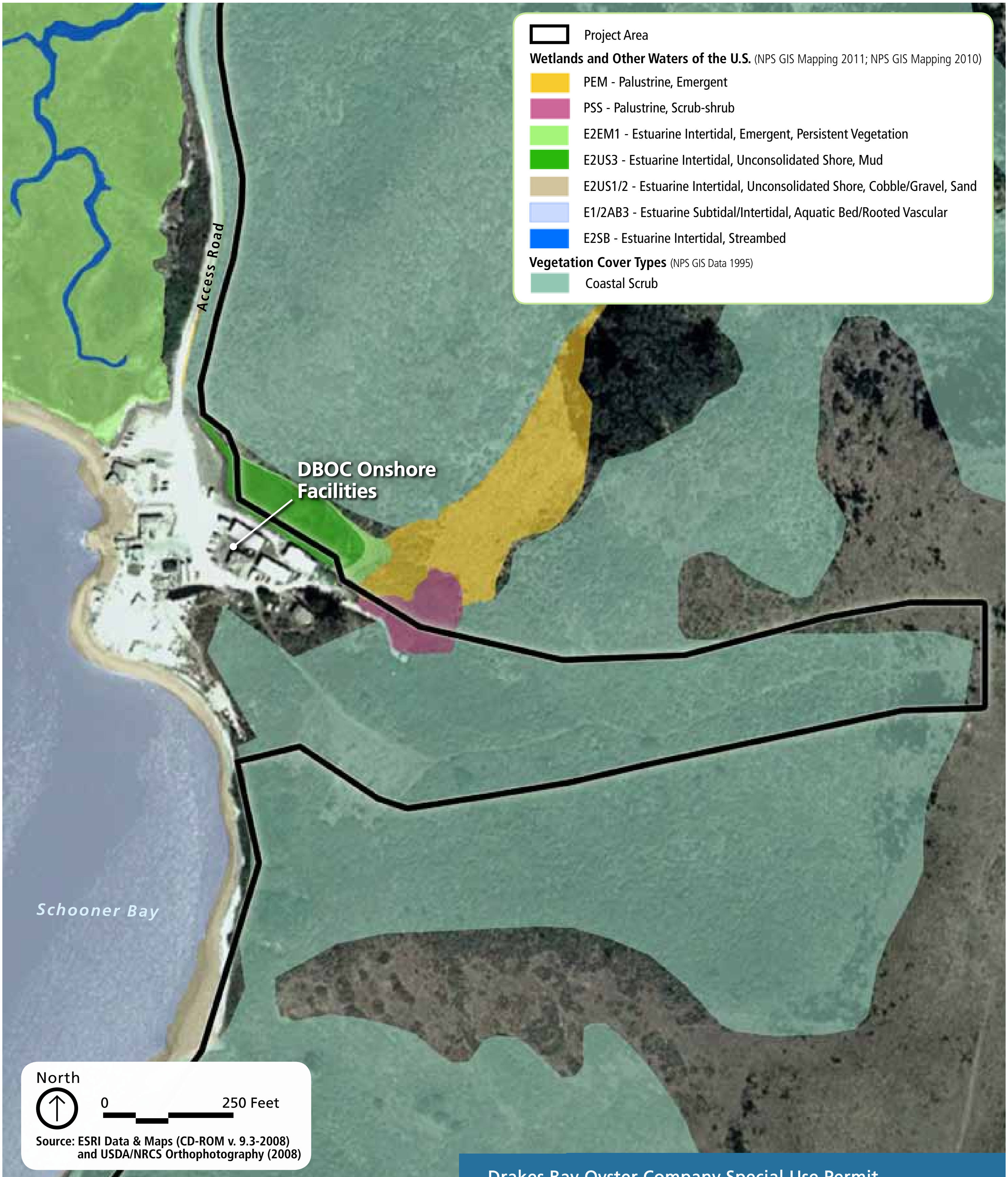

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FIGURE 3-2

Wetlands and Other Waters of the U.S. and Onshore Vegetation

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 Drakes Estero opening." In addition to eelgrass, Wechsler (2004[xvi]) 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[xvii]). Eelgrass beds help to structure 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 a dominant 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 (for further discussion, see impact topics covered under "Wildlife and Wildlife Habitat"). 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 U.S. afforded additional consideration under the CWA section 404(b)(1) guidelines developed by 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.

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) 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.

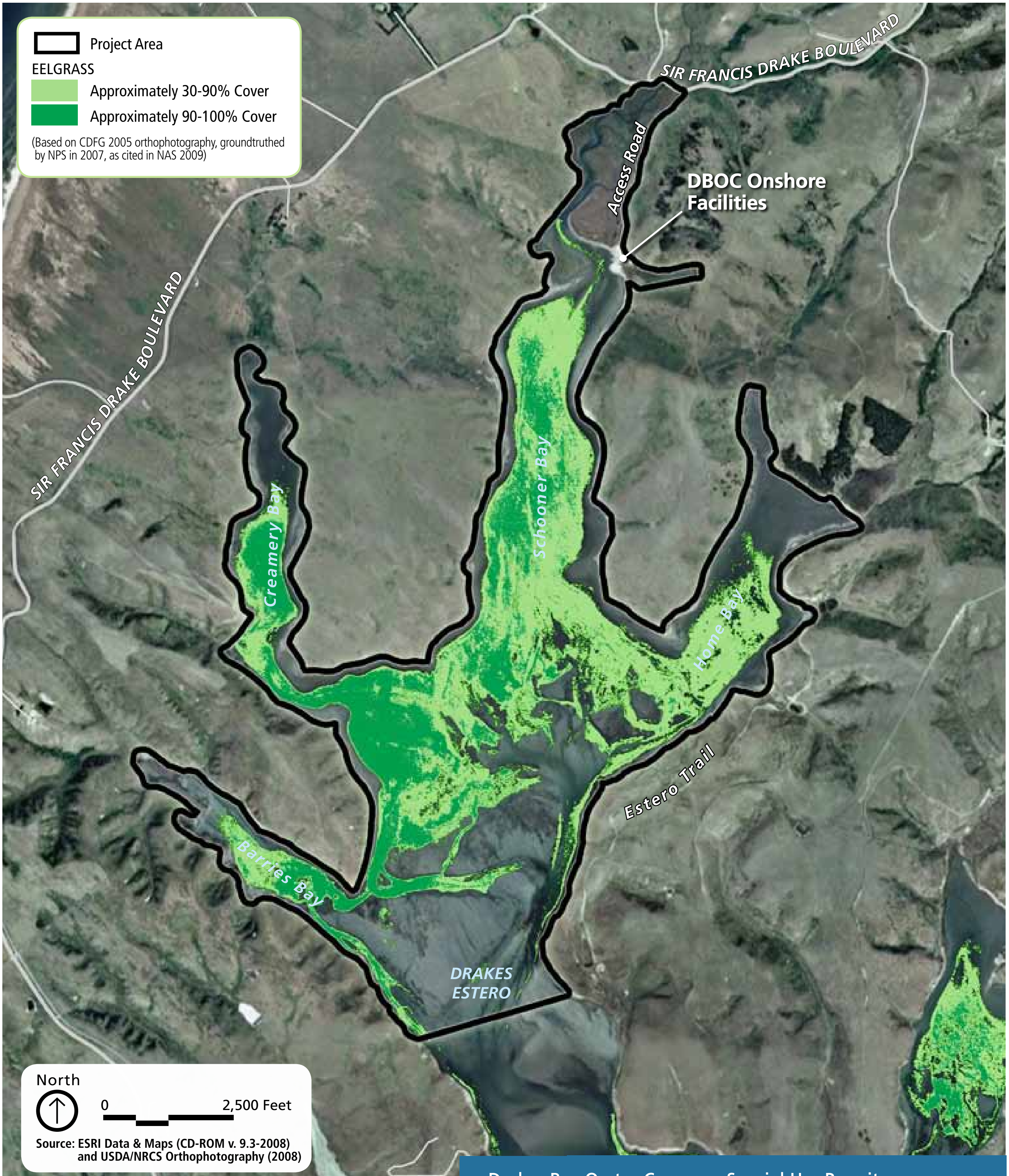

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FIGURE 3-3

Eelgrass Cover

When reviewed under the legislative purview of the Magnuson-Stevens Fishery Conservation and Management 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 the entire state of California have been drafted by NMFS and have been released for public review and comment (77 Federal Register 47 [09 March 2012], pp. 29150-29151). Although the California Eelgrass Mitigation Policy has not been officially adopted for use by the agencies, the guidelines in that policy are based on the Southern California model. For coastal projects requiring review by NMFS, USFWS, and/or CDFG, this policy will provide 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 images 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 its review of shellfish operation impacts on eelgrass in Drakes Estero, NAS (2009) cites data reported by NPS that 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 poor 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 (CDFG 2010d) 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 primarily across areas of Schooner Bay and the main body of Drakes Estero (figure 3-4). This figure represents a point-in-time estimate of propeller scarring in the estero as represented by the 2010 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). The width of the scars that were identifiable on the photographs varied from approximately 3 feet where a single track is visible (assumption based on the minimum width detectable at the scale and resolution of the aerial photographs) to 60 feet near the main channel in Schooner Bay; therefore, no uniform width was assigned to this estimate. Further, it was assumed that any scars visible at the scale of photography used in this analysis represented areas where eelgrass had been removed down to the level of the substrate because of the conspicuous contrast between the linear dark line (scar) and the surrounding green medium (eelgrass) on the photograph (i.e., propeller damage that exposed the substrate so that it was visible on the photograph at 1:600 scale). Interpretation of propeller scarring on the 2010 aerial photographs (CDFG 2010d) was limited to areas that were clearly identifiable as scars; therefore, the 8.5-mile total is likely an underestimate (figure 3-4). Scarring observed in algae, which appeared as brighter green zones on the photographs, was not included in the analysis.

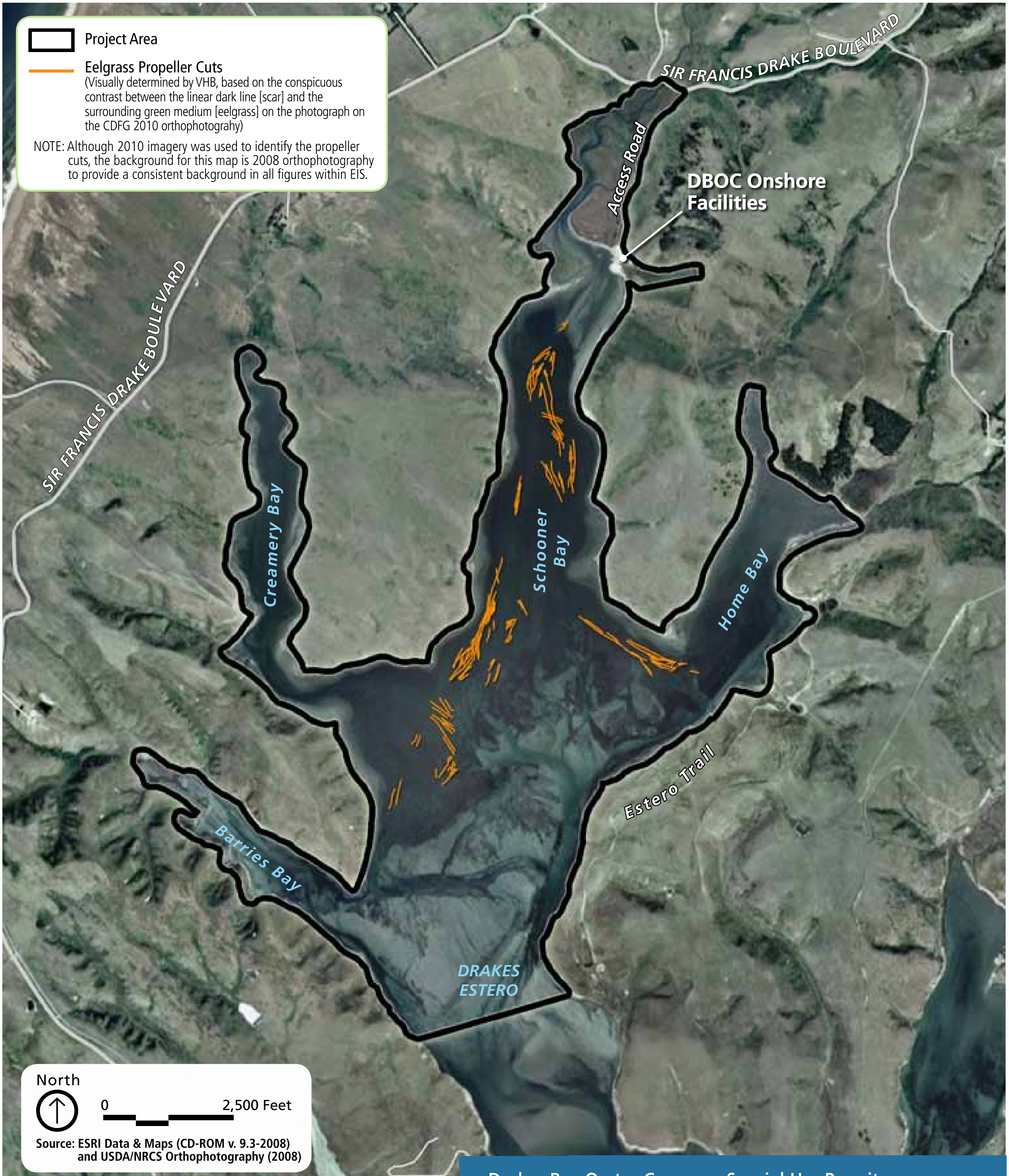

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FIGURE 3-4

Eelgrass Propeller Cuts

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, shrimp, 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; Bruno and Bertness 2001; Dumbauld, Brooks, and Posey 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).

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* [nonnative], *Rochefortia tumida*) and one species of mussel (*Musculista senhousia* [nonnative]) in plots at the mouth of Barries Bay. In addition, native marine clams (*N. confusa*, *N. tantilla*) were prevalent in the study plots of Harbin-Ireland (2004[xviii]) in Schooner Bay. Nonnative species, such as the Pacific oyster (*Crassostrea gigas*) and the Manila clam (*Ruditapes philippinarum*), are culture species introduced by the commercial shellfish operations that 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, nutrient cycling 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) (see discussion under “Biogeochemical Cycling” above). 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, the research of Dumbauld, Ruesink, and Rumrill (2009) suggests that smaller west coast estuaries like Drakes Estero are unlikely to experience most of these broad ecosystem-level 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 smaller west coast embayments like Drakes Estero. Under these conditions, ecosystem benefits from filter-feeding bivalves would be more likely to function at local scales (i.e., under or immediately adjacent to shellfish beds and structures) rather than at larger scales (Dumbauld, Ruesink, and Rumrill 2009).

The Olympia oyster (*Ostrea lurida*) is a species that is native to the Pacific coast of North America (Couch and Hassler 1989; Baker 1995). 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. 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). Inspections during the 1930s, as documented by Bonnot (1935), found no Olympia oysters growing in Drakes Estero. As Bonnot (1935) states: “No oysters were found growing there. Several small plants of Japanese seed oysters were made in 1932.” The historic presence of Olympia oysters in Drakes Estero has also been the subject of recent archeological work (Konzak and Praetzellis 2011; Babalis 2011), which found that Olympia oysters were of limited distribution in Drakes Estero even prior to the advent of large-scale commercial fishing on the California coast. This was attributed to lack of hard substrates in the estero which serve as natural attachment sites for Olympia oysters (Konzak and Praetzellis 2011).

Among documented environmental changes that are occurring on the Pacific coast, little is known about the potential effects of climate change, and associated physical/chemical ocean changes, on bivalve populations. However, it should be noted that 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 (Feely et al. 2008; Kerr 2010). 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; Gaylord et al. 2011; Barton et al. 2012). 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 (Ruesink et al. 2005). As such, there is potential for this species to develop naturally breeding populations in Drakes Estero. A recent publication from the San Francisco Estuary Institute (SFEI) identifies the Pacific oyster as an invasive species in San Francisco Bay, and establishes priorities for removal of this species (San Francisco Bay Joint Venture Science Subcommittee 2011). The Pacific oyster has been observed growing independent of culture stock in Tomales Bay and Drakes Estero (Grosholz 2011b).

Current BMPs 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 measures used in other areas of the country to deter colonies of nonnative shellfish (NAS 2004). The stock cultured by DBOC is diploid, which carries a higher risk of naturalization than triploid stock. 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 7.28 million Pacific oysters (618,375 pounds) in 2011. The greatest annual amount of Manila clams produced by DBOC is 20,520 Manila clams (684 pounds) in 2010.

Manila clam (*Venerupis philippinarum*), native to the Indo-Pacific region, is now widely distributed along the Pacific coast of the U.S. due to human introductions (Humphreys et al. 2007). As described in chapter 1 (“Commercial Shellfish Operations in Drakes Estero”) and chapter 2 (“Special Use Permit Area and Mariculture Species”), Manila clams were originally added to JOC Lease M-438-02 in 1993 but there is no record of Manila clam harvest until 2009. CFGC amended the lease in 2009 to expand cultivation of this species to Lease M-438-01, though the expansion was not authorized by NPS. DBOC reported planting 1 million Manila clam seeds in bottom bags in 2006, and also harvesting Manila clams in 2009, 2010, and 2011. A reproductive population of the Manila clam has recently been found growing independent of culture stock in Drakes Estero (Grosholz 2011b).

Finally, the purple-hinged rock scallop (*Hinnites multirugosus*), a species native to the region, has been cultivated historically in Drakes Estero. As discussed in Chapter 1 (“Commercial Shellfish Operations in Drakes Estero”) and Chapter 2 (“Special Use Permit Area and Mariculture Species”), JOC originally was approved for purple-hinged rock scallop under Lease M-438-02 in 1979. At the time this lease was issued, CDFG noted that purple-hinged rock scallops “do not occur naturally within the biota of the lease area” (CDFG 1979b). According to tax records, purple-hinged rock scallops have never been sold by DBOC. The last record of scallops being harvested at this site was from May 1994 (CDFG 2011c). Because purple-hinged rock scallops have a hard-surface attachment requirement (Kozloff 1983), natural habitat (i.e., outside of artificial habitat associated with cultivation) within Drakes Estero is not abundant for this species.

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) and herpes-like viruses (Burge et al. 2005; Burge, Griffin, and Friedman 2006; Friedman 1996). Currently, CDFG regulates DBOC's operation with respect to the stocking of aquatic organisms, brood stock acquisition, disease control, importation of aquatic organisms into the state, and the transfer of organisms between waterbodies.

In addition, the types of structures utilized in shellfish mariculture provide points of colonization for 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, 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). Tunicate overgrowth can have detrimental effects on eelgrass by inhibiting its ability to photosynthesize (Carman and Grunden 2010). 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.

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 a nonnative mud snail (*Batillaria attramentaria*), making specific reference to JOC, the previous oyster operator in Drakes Estero. This organism was found to be detrimental to native snail populations, a point that was noted in the recent NAS study of mariculture effects in Drakes Estero (NAS 2009). In addition, shell remains from a nonnative 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).

FISH

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). 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. Species included under these fishery management plans include various rockfishes, flatfishes, and sharks (The Pacific Coast Groundfish Fishery Management 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). The topic of essential fish habitat was discussed under the “Impact Topic: Eelgrass” section above.

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). A comprehensive study of the fish community within Drakes Estero has not been undertaken; however, Wechsler (2004[xix]) sampled fish in Schooner Bay and Estero de Limantour to evaluate potential effects of oyster mariculture on Drakes Estero fish populations. Capture methods at sampling stations included the use of three replicate trawl net samples, as well as supplemental sampling using gill nets and minnow traps.

Wechsler (2004[xx]) used data from the catch of 2,816 individual fish and 29 species in the analysis of fish communities in Drakes Estero and Estero de Limantour. The fish capture results were evaluated in a number of ways, including by their ecological guild (i.e. a group of species that use the same resource). The total catch was divided into five ecological guilds, including schooling planktivores (i.e., feeding primarily on plankton), structure feeders, benthic-oriented feeders, crevice dwellers, and eelgrass dependent feeders. The presence of oyster racks did not greatly alter the number of species in each guild, but an effect on the number of total fish observed within each guild was observed (Wechsler 2004[xxi]).

The five 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*), which together accounted for approximately 89 percent of the total number of individuals observed in the study (Wechsler 2004[xxii]). Wechsler (2004[xxiii]) concluded that these five species are likely permanent residents in Drakes Estero. Aside from these species, Wechsler (2004[xxiv]) found six species of intermediate abundance (10-100 individuals) and 18 species of low abundance (less than 10 individuals).

Three of the 29 species (approximately 10 percent) used for analysis by Wechsler (2004[xxv]) are currently listed in the The Pacific Coast Groundfish Fishery Management Plan (PFMC 2008), including leopard shark (*Triakis semifasciata*), starry flounder (*Platichthys stellatus*), and cabezon (*Scorpaenichthys marmoratus*). Two other included on this management plan were observed during the study; however, butter sole (*Isopsetta isolepis*) was located in reference samples within Estero de Limantour and lingcod (*Ophiodon elongates*) were part a fish collection not included in the Wechsler (2004[xxvi]) study. The study also reported a single northern anchovy (*Engraulis mordax*) (Wechsler 2004[xxvii]), which is one of the five species within the Coastal Pelagic Fishery Management Plan (PFMC 1998). The remaining 23 of the 29 species observed by Wechsler in 2004 are not listed within fishery management plans maintained by the Pacific Fishery Management Council. As such, Drakes Estero is not designated as essential fish habitat for these species.

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). 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; Acevedo-Gutierrez and Cendejas-Zarelli 2011).

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 pinniped monitoring studies conducted by NPS as part of the San Francisco Bay Area Network Inventory and Monitoring Program (e.g., NPS 2006c; Adams et al. 2009; Codde et al. 2011). Monitoring objectives of this program include: 1) determining long-term trends in annual population size and annual and seasonal distribution; 2) determining long-term trends in reproductive success through annual estimates of productivity; 3) identifying potential or existing threats (i.e. climate change, human disturbance, pollutants), and estimating degree of threat at known seal haul outs in order to guide management; and, 4) participating with the NMFS national stranding network to further document distribution, occurrence, and health of all pinnipeds (and other marine mammals). Monitoring protocols include bi-weekly surveys of colony sites during breeding seasons, and bi-monthly surveys at Point Reyes Headlands year-round.

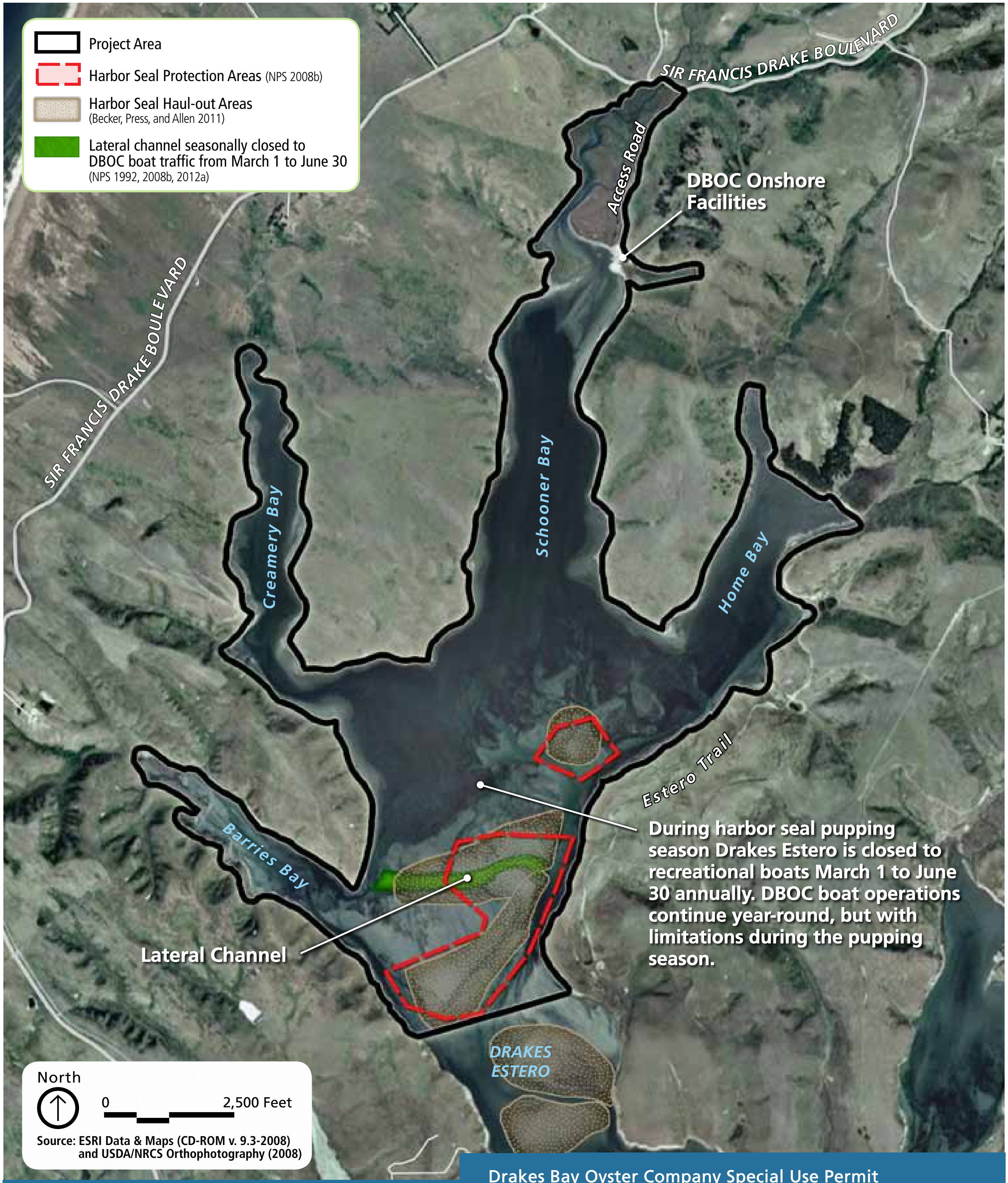
Population size and reproductive success of harbor seals can be attributed to a number of factors, one of which is the availability of high quality breeding habitat. The results of the 2010 NPS study of harbor seals in multiple Marin County survey locations indicated that the largest seal population, based on observed numbers of hauled-out adults (610) and pups born (223), is within Drakes Estero (Codde et al. 2011). In 2011, 715 adults and 364 pups were observed in Drakes Estero (Codde et al. 2012).

Haul-out sites in Drakes Estero and adjacent Estero de Limantour have been divided 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 sandbars located in the upper and middle portions of Drakes Estero during low tide, which apparently provides 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 MMC initiated a review of the potential effects of human activities, including aquaculture operations, on harbor seals in Drakes Estero. The study was concluded in 2011, and the results of this review are provided in the MMC report, *Mariculture and Harbor Seals in Drakes Estero, California* (2011b) (see also discussion under chapter 1). A more detailed discussion of MMC findings is presented under the impact topic “Wildlife and Wildlife Habitat: Harbor Seals” in chapter 4.

Between spring 2007 and spring 2010 more than 250,000 digital photographs were taken from remotely deployed cameras overlooking harbor seal haul-out areas in Drakes Estero. The photographs were taken at one minute intervals. These photographs are posted on the NPS web site at http://www.nps.gov/pore/parkmgmt/planning_reading_room_photographs_videos.htm

In response to public comments, the NPS initiated a third-party review of the photographs with the US Geological Survey, in consultation with a harbor seal specialist with the Hubbs-Sea World Research Institute. The USGS assessment focused on the 2008 harbor seal pupping season, when more than 165,000 photos were collected from two sites overlooking Drakes Estero between March 14, 2008 and June 23, 2008. The results of this review are provided in the USGS report, *Assessment of photographs from wildlife monitoring cameras in Drakes Estero, Point Reyes National Seashore* (Lellis et al. 2012) (see also discussion under chapter 1). A more detailed discussion of the USGS assessment is presented under the impact topic “Wildlife and Wildlife Habitat: Harbor Seals” in chapter 4.



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

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 (or feeding) for waterbirds and shorebirds (Shuford et al. 1989; Press 2005).

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. Since shorebirds spend most of their life away from breeding grounds (Warnock, Page, and Sandercock 1997), shorebird use of foraging habitat is an essential aspect component of normal biological activity and can indirectly affect long-term population dynamics. Drake Estero is a major foraging and resting location for nearly all species of resident (year-round) and nonresident (migratory) birds known to use the project area (Shuford et al. 1989).
In general, 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.

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 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 waterbird and shorebird 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 (White 1999). The combined inventories from each location totaled approximately 73 different species during the mid-winter count (White 1999; appendix E). 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*). Similar levels of bird abundance and diversity to those recorded in Drakes Estero is noted in other nearby lagoons. White (1999) reports data from Bolinas Lagoon and Abbott's Lagoon, showing a total of 74 and 60 different bird species at each location, respectively. This highlights the value of these habitats to attract and support a large variety of waterbird and shorebird species.

Other 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*) (Shuford et al. 1989). Osprey are raptors attracted to Drakes Estero's abundant fish population, 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 also 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).

In total, approximately 102 species of migratory waterbirds, shorebirds, and waterfowl have been recorded in the Drakes Estero and Estero de Limantour complex (Evens 2008).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. The Southern Pacific Region as a whole, which includes the Seashore and Drakes Estero, provides important wintering habitat for shorebirds that breed in both the arctic and temperate zones (Hickey et al. 2003). These include a high diversity of species, including waterbirds, shorebirds, and waterfowl (Shuford et al. 1989).

Drakes Estero's specific importance as a wintering habitat is linked to the abundant foraging and resting habitat (intertidal beaches and flats, brackish marshland, and open subtidal waters), an attribute which attracts large quantities of birds (Shuford et al. 1989). Further, shorebird wintering habitat in Drakes Estero is improved by the relative isolation of intertidal habitat areas from the surrounding terrestrial environment, reducing the threat of predation. 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.

The importance of foraging and resting habitat for migratory birds in Drakes Estero also relates to their use as "staging sites." These sites are needed in order for migratory birds to restore depleted fat reserves after long periods of flight (Myers 1983), and to improve their physical condition as they travel toward breeding grounds (Ganter 2000). By providing feeding and resting habitat, staging sites help certain species build energy reserves required for successful breeding activity at a bird's migratory destination (Harrington and Perry 1995), and can allow birds to arrive on breeding grounds in good condition (Ward et al. 1997). The use of Drakes Estero as a staging site for some species is enhanced by the presence of sandspits and sandbars, which in addition to serving as foraging habitat, provide isolated roosting and resting habitat.

Other species, such as Pacific black brant geese (*Branta bernicla*), utilize Drakes Estero as a staging site in large part due to its abundant eelgrass beds that provide highly productive foraging habitat. In particular, brant rely on eelgrass as their principle food source during migration (Davis and Deuel 2008), grazing by the hundreds on eelgrass beds before continuing spring and fall migration between Mexico and Alaska (Shuford et al. 1989; Ganter 2000; Moore et al. 2004; Evens 2008). Since they do not dive, brant usually only access eelgrass habitat at low tide. Other foraging preferences include selection of the deepest areas permitted by tides and selection of eelgrass beds close proximity to large tidal channels (Davis and Deuel 2008), like those found in Drakes Estero, where there is higher eelgrass density.

Further, brant prefer to feed in areas that are also close to "gritting" sites, such as unvegetated intertidal areas (like mud flats) (Davis and Deuel 2008). Brant must ingest grit in order to digest food, and can use preferred gritting sites repeatedly (Lee et al. 2004). During high tide, brant require protected open water or beaches that can be used for resting and loafing (Davis and Deuel 2008).

Even when all requirements are present in a selected staging site, the brant's reliance on eelgrass can limit their overall foraging success if the quality of eelgrass habitat is degraded (Davis and Deuel 2008). To this end, quality of eelgrass habitat would be more critical during spring migration, when the brant are flying north toward their Arctic breeding grounds. The migratory patterns displayed by brant reveal that spring migration differs from fall migration in terms of overall duration and habitat use. Spring-migrating brant generally make shorter flights and revisit staging sites used in the fall (Pacific Flyway Council 2002). This relates to their need to achieve good physical condition upon departure from temperate staging sites, which in turn increases the likelihood for successful reproduction upon reaching Arctic breeding grounds (Ganter 2000).

The Pacific Flyway Management Plan for Pacific Populations of Brant (2002) states that migratory use of Drakes Estero historically averaged 25,000 individual per year; however, current brant populations recorded in Drakes Estero range from 1-3,000 per year (Pacific Flyway Council 2002). The brant winter at Drakes Estero to a lesser degree, with average densities reported as less than 100 individuals per year (Pacific Flyway Council 2002). Due to decreasing abundance within their historic range, the Pacific black brant is considered by CDFG as a Bird Species of Special Concern, priority 2 (Davis and Deuel 2008). The priority 2 category is assigned to a "Population or range size greatly reduced or population or range size moderately reduced and threats projected to greatly reduce the taxon's population in California in the next 20 years" (Shuford and Gardali 2008) Brant are sensitive to a variety of human activities and responses to stimuli range from "brief alert behaviors to immediate departure from a site" (Pacific Flyway Council 2002).

The American white pelican (*Pelecanus erythrorhynchos*) is also found in Drakes Estero during summer and winter months (Evens 2008). Like the brant, this pelican species is a CDFG Bird Species of Special Concern within its current breeding range (which is outside Drakes Estero) (Shuford 2008). However, Drakes Estero provides rich foraging habitat preferred by overwintering white pelicans, which can utilize the estuary during the non-breeding period of migration (Shuford 2008). The pelican also utilizes the isolated upper and tidal flats of Drakes Estero as resting habitat.

Drakes Estero also provides habitat for several bird species recently removed from the federal list of Endangered and Threatened Wildlife. These include the brown pelican (*Pelecanus occidentalis*), peregrine falcon (*Falco peregrinus*), and bald eagle (*Haliaeetus luecocephalus*). Abundant numbers (ranging into thousands of individuals) 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.

Due to the abundance and diversity birds that inhabit and use Drakes Estero, the estuary receives recognition from multiple bird conservation initiatives. In general, recent efforts in North America to advance bird conservation are incorporated into five major bird conservation initiatives (Shuford 2011): 1) the North American Waterfowl Management Plan; 2) Canadian and U.S. shorebird conservation plans; 3) Partners in Flight; 4) the North American Waterbird Conservation Plan; and 5) the North American

Bird Conservation Initiative. Further, the Marine Life Protection Act (MLPA) Initiative is designed to help implement MLPA requirements to protect or conserve marine life and habitat

Of these, the 2003 Southern Pacific Shorebird Conservation Plan (part of the U.S. 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.

Moreover, 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 (Harrington and Perry 1995). The Bay 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 also 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, in an assessment of birds on public lands and waters from 2011 the North American Bird Conservation Initiative highlights the critical role of public agencies in bird conservation and stresses needs for increased protection and management (North American Bird Conservation Initiative 2011). It notes that coastal habitats are essential to shorebirds during migration between wintering and breeding habitat, and that designated U.S. Marine Protected Areas by the MLPA are important conservation measures to increase stocks of forage fish for coastal birds (North American Bird Conservation Initiative 2011).

In accordance with Executive Order 13158, NOAA’s National Marine Protected Areas Center partners with local, tribal, state, and federal governments to implement various levels of conservation and protection within over 1,600 MPAs. The Seashore is included as a federal MPA, with a protection level defined as “uniform multiple use.” This level of protection affords certain allowable activities or restrictions throughout the protected area. Drakes Estero has the same level of protection and is included in the Drake Estero State Marine Conservation Area (NPS 2012b). Two other MPAs border Drakes Estero, the Estero de Limantour State Marine Reserve and the Point Reyes State Marine Reserve (NPS 2012b). Both of these MPAs have a protection level of “no take.” This higher level of protection prohibits the extraction or destruction of natural and cultural resources. Another MPA, the Point Reyes Headlands Special Closure, prohibits access and use of a 1,000-foot zone south of the Point Reyes Headlands (NPS 2012b) to protect birds and bird habitat.

Other bird conservation efforts are addressed by the Pacific Flyway Council, which provides management plans for multiple bird species that migrate within the Pacific Flyway, including black brant geese. In the Pacific Flyway Management Plan for Brant, the Pacific Flyway Council recognizes the need for additional conservation measures to adequately protect primary brant staging and wintering sites from coastal development and associated disturbance (Pacific Flyway Council 2002). Of the top priorities listed for future habitat management, the plan recommends the “continued protection of critical habitats and encourages the pursuit of mitigation for impacts, including loss or degradation of eelgrass beds, grit and loafing sites, disturbance of wintering flocks, and exclusion of brant from traditional use sites” (Pacific Flyway Council 2002).

Non-governmental agencies also provide conservation initiatives and plans that recognize the importance of the Drakes Estero bird habitat. The National Audubon Society listed “Point Reyes-Outer”, which includes Drakes Estero, as an Important Bird Area (IBA) of global priority (National Audubon Society 2012a). The National Audubon Society (National Audubon Society 2012b) states that the areas of the Point Reyes-Outer IBA most important to bird conservation include the saltmarsh and mudflat habitats of Drakes Estero. In addition, the American Bird Conservancy has maintained a separate Important Bird Area program and in 2001 listed the Seashore as one of the 100 Globally Important Bird Areas. Contributions from these private organizations, in addition to those from several government agencies (like USFWS) and the aforementioned bird initiatives, comprise an important element of the bird conservation coalition established by the U.S. North American Bird Conservation Initiative.

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 USFWS and NMFS. In California, state protection is afforded through the California ESA, which is administered by CDFG.

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). 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). CNPS Rare Plant Program operates under a Memorandum of Understanding with CDFG, which formalizes and outlines its cooperation in rare plant assessment and protection.

Pursuant to section 7 of the ESA, NPS requested a species list from USFWS to determine whether federally listed threatened or endangered species occur within the project area (appendix E). 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 agency consultations (NMFS 2009; USFWS 2004, 2008) for recent NPS projects that address 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 USFWS results by species and associated habitat. NPS determined that none of the federally listed plant species in the USFWS results have potential to be affected by the proposed actions within the project area. Further, NPS determined that seven of the federally listed animal species have potential to exist within the project area. As described in chapter 1, five of the federally listed animal species were dismissed from further analysis in the EIS due to a lack of designated critical habitat in the project/action area, unconfirmed presence of the species in the project/action area, or the potential for less than minor impacts on the species and/or their critical habitat. These include Myrtle's silverspot butterfly, California red-legged frog, leatherback sea turtle, western snowy plover, and California least tern.

The two federally listed animal species retained for detailed analysis in the EIS are described in the sections below. Additional data provided by CDFG and CNPS identified state-listed or other rare or special status species. Based on habitat analysis and survey records, NPS determined that these state-listed and other unlisted rare species would be unaffected by proposed actions in the project area (see appendix E). Therefore, these species were also dismissed from further analysis.

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 USFWS searches (appendix E), 2 species are potentially affected by proposed actions in the project area: central California Coho salmon and central California steelhead. These federally listed species are described below.

Central California Coho Salmon Critical Habitat (*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, 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, 2011e). 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, 2011e).

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 NMFS as potential steelhead habitat, creeks known to support California steelhead include East and North Schooner, Glenbrook, Muddy Hollow, Home Ranch, and Laguna. As part of the 2008 Drakes Estero Coastal Watershed Restoration Project, the NPS, restored or enhanced fish passage at six sites within the Drakes Estero watershed (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 of the project area. These creeks include Creamery Bay, East Schooner, Home Ranch, Laguna, and Muddy Hollow (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).

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 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 are 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.

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).

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, but did not include site specific information on Drakes Estero.

The California Department of Public Health (CDPH) oversees the harvesting times of shellfish relative to water quality. CDPH published a “Sanitary Survey Report – Shellfish Growing Area Classification for Drakes Estero, California” for this purpose (Baltan 2006). In that report, it was noted that “[d]uring extreme hydrographic conditions Estero water floods into the oyster company’s plant area. Extreme high tides (over 6 feet), rainfall and winds can all combine to bring water over the Estero banks and into the DBOC plant area. This occurs once or twice a year” (Kevin Lunny, pers. comm. as cited in Baltan 2006).

No gauge data or FEMA modeling results are available that specify the 100-year and 500-year flood elevations specifically for Drakes Estero. While there were various accounts of flooding at the site, no site specific elevation information was available. As a result, a site specific survey was conducted and the data were evaluated in the context of the FEMA study to draw reasonable conclusions about the potential for flooding at 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, FEMA flood zone elevations for Bolinas Bay provide 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 historically measured flood events so as to predict the level of flooding during future storm 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 measured tide elevation at the onshore facilities with the NOAA tidal gauge station near the Point Reyes Light Station (Gauge 9415020), the gauge reading was found to be exactly 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 at the onshore facilities 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 as a reliable source to look at the historic record and 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 because this storm may have inundated much of the onshore area, while at the same time leaving behind significant damage to onshore facilities as well as field evidence that could be surveyed. Damage included destruction of the wooden work platform, two docks, the washing station and conveyor, and the stringing shed. A gauge reading of 8.12 feet was measured during this storm at the Point Reyes Light Station tidal gauge, 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 other 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 for the same storm event. 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 an elevation near 9.0 feet, taking into consideration the gauge reading of 8.12 and wave runup of an additional 0.88 feet.

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. In addition, several above ground caps to the DBOC wastewater storage tank fall below this flood elevation. 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.

Important to future floodplain and resource management, currently documented rates of sea-level rise due to climatic warming trends, water expansion, and vertical land motions (tectonics) predict increases in mean sea level as high as 5.48 feet by the year 2100 (Cayan et al. 2009; Heberger et al. 2009, NAS 2012b). This equates to water levels rising as much as 0.66 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 6.6 inches. A rise of this magnitude could cause a change in the 100-year flood elevation from FEMA-reported 8.2 feet to 8.75 feet NAVD–88. Taking into consideration an estimated wave runup of approximately 0.88 feet, the inundation elevation could reach 9.63 feet (approximately 9.6 feet) due to sea level rise in 10 years. This elevation is displayed in figure 3-6 as the 9.6 contour line.

Source: ESRI Data & Maps (CD-ROM v. 9.3-2008), NPS GIS Data, and Cal-Atlas Geospatial Clearinghouse Data. Field Survey, Terra Firma Surveys, Inc. (May 2011)

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

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). The average current velocity just inside the lagoon within the main channel was found to be 40.6 cm/sec (1.33 feet/sec) (Anima 1990[xxviii]). Salinity levels range between 33 and 37 parts per thousand (Anima 1991[xxix]), and water temperatures were near that of the oceanic source. More detailed information on the biogeochemical processes affecting the general condition of the water in the estero is provided in previous sections in this chapter. Overall, the daily tidal exchange in a shallow lagoon coupled with the relatively low level of anthropogenic watershed disturbances and inputs are contributing factors to the good water quality of Drakes Estero (Baltan 2006, Zubkousky 2010, NAS 2009).

Nutrient levels within estuary systems can vary greatly depending on factors such as residence periods, watershed conditions, tidal exchange rates, and biological processes. Biological processes most relevant to Drakes Estero are those provided by the bivalves as part of the DBOC mariculture operation. As noted earlier, bivalves can play an important role in water quality as suspension feeders (Dame 1996, Newell 2004). Shellfish are capable of capturing and process suspended inorganic silt, organic particulates, and phytoplankton from the water column, thus reducing water turbidity and allowing more sunlight to reach the bottom substrate. Bivalves, through ingestion and processing of suspended particles, also remove nitrogen and phosphorus from the water column, and either sequester these nutrients as tissue and shell or transfer these materials as feces and pseudofeces deposited to the sediment surface. Some of the nitrogen absorbed by bivalves is excreted as urine back into the water column elevating the level of dissolved nitrogen as ammonia for use by new phytoplankton and microbenthic organisms (Newell 2004).

While water quality studies measuring nutrient levels have been performed on area freshwater streams at Point Reyes (Hagar 1990 as reported by Anima 1990[xxx]; NPS 2001c), few data are available on nutrient levels in Drakes Estero. Wechsler (2004[xxxi]) quantified water quality parameters during his study on ichthyofauna in an effort to determine if biodeposits from the cultivated shellfish negatively affected water quality. This 2003 data, during a year when oyster production from the Johnson Oyster Company was approximately 40 percent of the 2010 DBOC production level, sheds some light on the overall condition of the estero, but also provides some insight into the influence of filtering bivalves on water quality in Drakes Estero. Water samples were analyzed at three locations for comparison – 1) Schooner Bay adjacent to oyster racks, 2) Schooner Bay away from oyster racks, and 3) the neighboring Estero de Limantour where no shellfish racks occur. Parameters measured included salinity, temperature, clarity, dissolved oxygen, ammonia, nitrate, and total suspended solids. Samples were taken 30 cm below the surface and analyzed at the DANR Analytical Lab at the University of California, Davis. Clarity was measured using a Secchi disk. Water quality data from Wecshler indicate essentially no difference in the water quality parameters between areas in Schooner Bay and Estero de Limantour (appendix H). He concludes, "In Drakes Estero, the tidal prism is high and a large volume of water drains twice daily. The anecdotal look at aquatic physico-chemical conditions undertaken in this study indicated that no major deteriorations in water quality existed adjacent to oyster racks." Again, Wechsler's purpose of collecting this data was to determine the potential harm biodeposits may have on water quality (Wechsler 2004). The data, however, also suggests that the influencing affect of filter feeding bivalves on the quality of the water column of Drakes Estero is indistinguishable in this lagoonal setting, and the water quality results are more so a function of, as Wechsler (2004) describes, a "well mixed water body with no stratification."

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[xxxii]). This study also concluded that sedimentation rates have increased in the last 150 years, possibly attributable to an increase in land uses such as trails and roads (Anima 1990[xxxiii]). 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 (1990) 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."

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 a geometric mean of 14 most probable number (MPN)/100 ml or a ninetieth percentile value of 43 MPN/100 ml when combined with a declining trend in fecal coliform levels at the sampling station or in surrounding areas (CDPH 2012).

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. For every commercial shellfishing operation in the state, CDPH prepares a site-specific management plan in which 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.

CDPH routinely prepares a *Management Plan for Commercial Shellfishing in Drakes Estero, California*. The purpose of the management plan is to identify *Approved, Conditionally Approved,* and *Prohibited* areas. Harvesting shellfish in *Prohibited* areas is not allowed. For *Conditionally Approved* areas, the plan defines "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" (CDPH 2012) based on site specific sampling of water and shellfish tissue. *Approved* areas have no time restrictions on harvesting shellfish.

In 2006, the CHPH reported 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 (Baltan 2006). However, because Drakes Estero does experience intermittent bacterial pollution, most of the shellfish harvesting areas are classified as *Conditionally Approved* with time restrictions before harvesting can resume. One area at the culture bed #17 near the mouth of Drakes Estero was classified as *Approved,* and the upper reaches of Creamery Bay, Barries Bay, and Home Bay upstream from culture beds were classified as *Prohibited* (Figure 3-7). Annual updates to the report have been conducted (Zubkousky 2010, 2011; CDPH 2012). Each update to the plan evaluated all environmental factors to identify actual and potential pollution sources affecting water quality within Drakes Estero. Both Baltan (2006) and Zubkousky (2011) list five potential 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 CDPH 2012 plan cites pollution sources as "cattle pastureland, deer and other terrestrial wildlife, birds, harbor seals, sea lions, and, to a minor degree, human activity." The primary source of bacterial pollution is from cattle waste originating from the six cattle ranches within the watershed. Only beef cattle are raised within the Drakes Estero watershed, and ranchers in cooperation with the NPS have installed riparian fencing and implemented other BMPs to reduce cattle access to stream habitat. In 1991, Anima cites these ranches as having a total of 1,185 head of cattle (Anima 1991[xxxiv]), whereas Press (2005) refers to 700 head of cattle. This change in cattle can be attributed to overall reduction in permitted Animal Unit Months during that period. 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 2011). On past occasions, range septic systems have failed and were immediately repaired by the Seashore (Baltan 2006). Leased cattle ranches surrounding Drakes Estero allow cattle to graze within close proximity to the shoreline. Other than the upper reaches of Barries, Creamery, and Home Bays, the 2012 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 CDPH sampling sites in Drakes Estero, as well as the prohibited and conditionally approved areas. In 2007, CDPH added another monitoring station in Schooner Bay near culture Bed 5 due to reported cattle being close to the shoreline.

The 2012 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.

The CDPH Sanitary Survey Report of 2010 (Zubkousky 2010) reports that rainfall-driven harvesting 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 also that DBOC complied with all required closures during the 2009–2010 monitoring year. The following 2010-2011 monitoring season, Zubkousky (2011) cites rainfall-driven harvesting closures at Schooner Bay were 113 days, all *conditionally Approved* areas except Schooner Bay were closed for 71 days, and the *Approved* area was closed for 32 days. DBOC complied with all closures during this monitoring period and fully cooperated with providing samples (Zubkousky 2011).

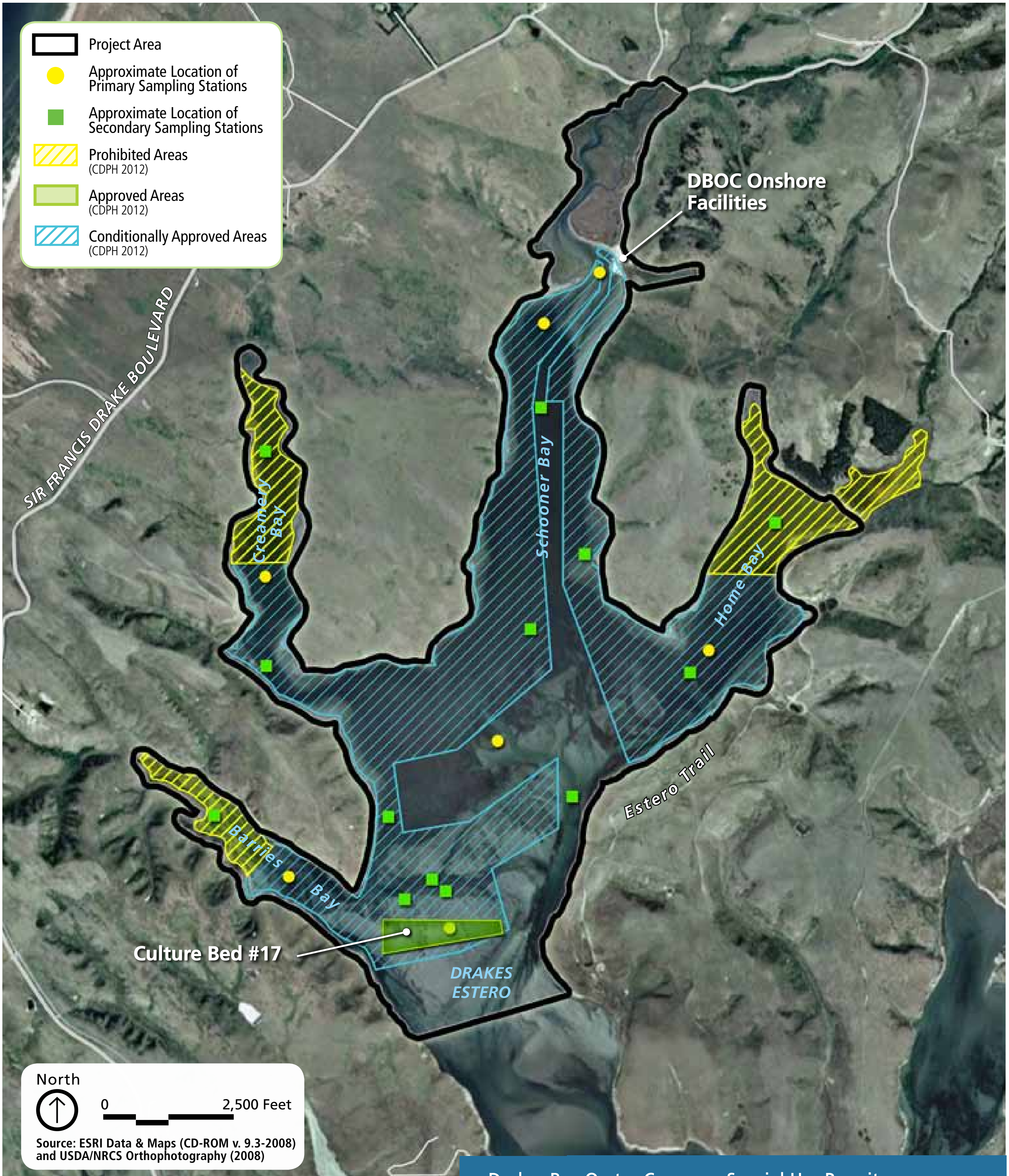
The management plan calls for self-monitoring of water quality to protect against contamination events not linked to rainfall, such as emergency sewage spills. Any water quality sample having a fecal coliform measurement greater than 43 MPN/100 ml will cause the area represented by that sample to be 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 (CDPH 2012). Actual water quality samples in Drakes Estero detected low levels of fecal coliform during the 2009 through 2011 monitoring periods (Zubkousky 2010, 2011). Fecal coliform geometric means and estimated ninetieth percentiles from the water quality samples were far below the thresholds for shellfish growing waters.

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 CDPH (2012) management plan for Drakes Estero requires collective shellfish sampling for marine biotoxins. These are measured via shellfish tissue samples. The two primary biotoxins include PSP and domoic acid. PSP 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 PSP is 80 micrograms per 100 grams. Domoic acid is a biotoxin that originates from the diatom *Pseudo-nitzschia australis* (Langlois 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 3-7
Water Quality

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.

CDPH performs a monthly analysis of shellfish samples submitted by statewide mariculturalists, state agencies, and local health departments (Langlois 2009). Results are reported monthly and summarized in an annual report covering the entire state of California. The two latest annual reports for 2009 (Langlois 2009) and 2010 (Langlois 2010) are summarized in this section. DBOC contributes more samples to CDPH than any other collector, with samples collected from 4 stations on a weekly basis. PSP is triggered by the dinoflagellate *Alexandrium catenella* that is normally first observed along the open coast before transport into bays and estuaries (Langlois 2009). *The Marine Biotoxin Monitoring Program Annual Report 2009* (Langlois 2009) states that PSP levels reached their highest in August of the 2009 monitoring year, with a reading of 966 micrograms per 100 grams taken from a sample of sentinel sea mussels from Drakes Estero. PSP levels in 2010 were much less, with only one sample reaching 147 micrograms per 100 grams. Domoic acid, from the diatom *Pseudo-nitzschia australis*, will commonly oscillate in toxicity 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). Fifty-eight (58) statewide samples were detected having measurable amounts of domoic acid in 2009. The number of samples with domoic acid increased in 2010 (149 samples) (Langlois 2010). Concentrations of domoic acid above the alert level (20 µg per gram of shellfish, or 20 parts per million [ppm]) were detected in 50 samples from the following eight counties: Marin, San Francisco, San Mateo, Monterey, Santa Barbara, Ventura, Los Angeles, and San Diego.

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 CDPH Drinking Water Unit (DBOC 2010v[xxxv]) to be tested for contaminants. In a letter dated August 3, 2009, from the Seashore 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 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* (DO-47) further guides toward the maintenance and restoration of natural soundscapes. DO- 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).

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 (i.e., 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 common term for the same measurement. Table 3-2 provides a reference list of sound levels for comparison.

Noise is defined as extraneous or undesired sound (Morfey 2000). Noise is sound produced for no purpose, or sound that a listener finds objectionable. Sources of noise within or nearby national parks include: vehicles (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 infrastructure; and energy development (NPS 2009f).

SOUND LEVELS AT DRAKES ESTERO

In preparation for an Air Tour Management Plan, acoustic data were collected at the Seashore in 2009-2010 by the John A. Volpe National Transportation Systems Center (Volpe) to establish ambient sound levels in four areas of distinct vegetation, topography, elevation, and climate (Volpe 2011). Drakes Estero was selected as a measurement site to represent wetlands, which comprise 33 percent of Point Reyes National Seashore. Measurements were taken at a bluff on the eastern shore of Drakes Estero over the course of 30 days in July/August of 2009 and 29 days in January/February of 2010. This site was located approximately 60 yards from the shore of Drakes Estero and 2 miles from the DBOC buildings. Data were collected at three other sites in Point Reyes, miles away from Drakes Estero in different ecological settings.

The variety of summary sound level data in the Volpe report presents many possible choices for the reference ambient sound level, which will be used in the noise impact analysis in chapter 4. Sound levels vary from moment to moment, and in addition to short-term variations most sites exhibit trends associated with time of day and time of year. Sound levels are usually higher during the day than at night, for example, and park visitation tends to be highest in the summer season.

In order to express the range of variation in sound levels, Volpe (2011) included three measurements: L_{Aeq}, L_{50}, and L_{90}. L_{Aeq} is an average value called an equivalent continuous sound level. For example, at the Drakes Estero site the daytime (7 am to 7 pm) L_{Aeq} was 41.6 dBA in winter and 40.3 dBA in summer. This means that the sum of all of the sound energy measured during these 12 hours was equivalent to a constant sound level of 41.6 dBA in winter and 40.3 dBA in summer (Volpe 2011). L_{Aeq} is strongly influenced by the loudest intervals, so it is generally more useful for describing noise sources than background environmental levels.

A more intuitive measure of environmental conditions is the L_{50}, which is the level that is exceeded 50 percent of the time: the median level. The daytime L_{50} at the Drakes Estero site was 35.8 dBA in winter and 33.8 dBA in summer (Volpe 2011). The L_{50} is the most intuitive and readily interpreted of the available measurements; a visitor has a 50-50 chance of experiencing levels this high or higher. L_{50} does not represent the quiet background conditions that might be experienced, because it includes noise from all human activities as well as natural sound energy from portions of the audio spectrum much higher in pitch than the noise generated by DBOC.

Both the L_{Aeq} and L_{50} values were influenced by existing noise at the site, including noise from DBOC operations. Accordingly, a third value is presented, the L_{90}, or the sound level that is exceeded 90 percent of the time. This approximates the background or residual sound level that would exist in the absence of all nearby or otherwise distinguishable sounds (ANSI 1988). For both the winter and summer Drakes Estero data, the daytime L_{90} was 25.7 dBA (Volpe 2011).

L_{Aeq} is not a preferred measurement for representing ambient sound levels, because loud events bias this value well above the L_{50}. The L_{90} value is supported by a national standard (ANSI 12.9-1) as an approximation of the background level against which all sounds are heard, and the summertime L_{90} summary provided by Volpe was fairly close to the lowest daily L_{50} measured at Drakes Estero (25.7 versus 25 dBA) (Volpe 2011). Accordingly, the L_{50} and L_{90} values document the range of sound levels that can be interpreted as the background against which DBOC sounds occur for the impact analysis in Chapter 4.

The daytime summer L_{50} is rounded to 34 dBA and used to generally describe the reference ambient level within the project area. This reference ambient level of 34 dBA represents a reasonable summary of all of the data in the Volpe report. The daily L_{50} values at Drakes Estero ranged from 44 to 25 dBA. The winter L_{50} summary value was only slightly higher at 35.8 dBA, which was likely due to higher wind speeds. However, the L_{90} summaries for summer and winter data were identical (25.7 dBA), indicating that background sound levels in between distinguishable sound events was the same in both seasons. Although the other three sites monitored by Volpe were quite distant from Drakes Estero, and in very different environments, the summer daytime L_{50} values ranged from 31.8 to 36.7 dBA, narrowly bracketing the reference ambient value of 34 dBA.

Decibels are unfamiliar units to many people, and the measurements made at Drakes Estero may not be easy to interpret in isolation. Table 3-2 provides examples of sound levels associated with possibly familiar outdoor and indoor situations. In this context, median (L_{50}) and background sound levels (L_{90}) at Drakes Estero are as low as or lower than the quietest moments that most people experience in everyday life.

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.

The other noteworthy fact about decibels is that seemingly small values can represent a significant difference. For example, the difference between the L_{Aeq} to the L_{50} values (41.6 and 35.8 dBA) translates to a scenario that would nearly double the distance at which a nearby sound could be heard. The difference between the L_{50} to the L_{90} values above (35.8 and 25.7 dBA) translates to a scenario that would cause a more than three-fold increase in the distance at which a nearby sound could be heard.

DBOC NOISE SOURCES

Overview

NPS did not obtain noise measurements of operational DBOC equipment in Drakes Estero. Data were provided by Environ International during the public comment period for the Draft EIS (Environ 2011), but these measurements are problematic to interpret and use. Environ did not follow pertinent standards and the measurement processes and the operating conditions of the equipment were not adequately described.[1] To address these concerns, the Environ measurements were compared with reports that document noise levels measured under specified conditions from comparable equipment. For outboard motor noise, precise measurements of noise were available for motors with the same horsepower rating. For other equipment categories, measurements expressing a range of noise levels were available. Front end loaders, for example, span a wide range of configurations in size and power. DBOC is likely to be using the smallest units in these equipment classes, so the lowest noise level in the reported range of values was used. Other sources of noise related to DBOC operations include radios, air compressors, and vehicles. These items are not included in this description, because no data are available regarding their noise levels or their frequency of use. For example, Environ presents the noise level of the compressor used to power the pneumatic tools at 58 dBA and described the compressor operations as intermittent, but did not provide an estimate of the duration of compressor operations. The air compressor is housed in a building (with openings), and the measurement was taken from outside the enclosure (Environ 2011). Collectively, the description of the noise emitted by the equipment summarized in table 3-3 and discussed in additional detail below is unlikely to overestimate noise generated by DBOC operations.

Noise source data are referenced to a standard measurement distance. All noise source levels presented here are referenced to a nominal distance of 50 feet, which is the reference distance for NPS noise regulation (36 CFR 2.12) and U. S. Federal Highways construction equipment measurements (FHWA 2006). The limit specified by NPS regulation is 60 dBA at 50 feet (36 CFR 2.12). A 74 dBA source (at 50 feet) has the same effect as more than 23 sources at 60 dBA running simultaneously. Additional perspective on how this sound is perceived and how it alters the soundscape of an area is discussed below.

It should be noted that noise level varies with the conditions under which the equipment is used. For example, an outboard motor produces much less noise at idle than at full throttle. The noise measurements reported in the literature correspond to the highest noise level that is generated in routine use. For example, the U. S. Federal Highways Construction Noise Handbook (FHWA 2006) reports the L_{max} during operations for all of its measurements. For boats, the standard measurement captures the peak noise level that occurs as the boat drives past the measurement device in a straight line. The peak noise level for boats corresponds to the point on the straight line track that is closest to the measurement device. More information on how noise spreads is provided below.

The reference levels for DBOC noise sources are summarized in table 3-3. The descriptions and frequencies of use are based on information provided by DBOC (DBOC [Lunny], pers. comm., 2011h). The range of

[1] NPS requested clarifying information regarding the Environ measurements from DBOC in a letter dated April 6, 2012. Clarifying information was provided to NPS in DBOC's June 5, 2012 letter. This information was reviewed; however, it did not adequately describe measurement processes and descriptions of operating conditions.

plausible noise levels for DBOC equipment derived from data reported by Environ (2011) were compared with the noise levels reported in other sources for comparable equipment. A full discussion of the rationale for selection of lower and upper bounds of operational noise levels follows table 3-3.

TABLE 3-3. NOISE GENERATORS AT DBOC

Equipment*	Description*	Duration of Use (Weather Permitting)*	Range of Operational Noise Levels (dBA at 50 ft)	
			Lower Bound	Upper Bound†
Pneumatic drill	Small hand tool	2 to 4 hours/day	67‡	80§
Motorboat	20 or 40 hp, 4-cycle engine	Approximately 12 40-minute trips/day	62ǁ	74#
Front end loader	60 hp diesel engine	2 to 4 hours/day	67**	73††
Oyster tumbler	Tube for sorting oysters by size, run by electric motor	Approximately 2 hours/day	50‡‡	75§§

Sources: * DBOC [Lunny], pers. comm., 2011h

† These operational noises levels are the upper bound of the range used for the impact analysis later in this document; however, as discussed in the text below, these noise levels do not represent the maximum noise levels produced by this equipment. Rather, these noise levels are intended to be realistic operational noise levels based on the literature cited.

‡ Environ 2011; Brueck, Stancescu, and Waters 2007, table 22, "power hand tools"

§ Environ 2011; Brueck, Stancescu, and Waters 2007, table 22, "power hand tools"; Army 2004[2], Appendix H2, "pneumatic wrench"

ǁ Environ 2011

Horn et al. 2005, Table 5.2.1-1; Rijikeboer et al. 2004, Figure 5.5; Menge et al. 2002, Table 6

** Environ 2011

†† FHWA 2006, Table 1, "Front End Loader"; Toth 1979, Table 3; Bender 1971, Table IV; Army 2004, Appendix H2, "wheeled loader"

‡‡ Environ 2011

§§ Army 2004, Appendix H2, "portable cement/mortar mixer"

---

[2] Information provided in the Army's 2004 summary of noise generation for construction equipment comes from various sources, as noted below. Whenever Army 2004 is referenced, the following sources are summarized in that reference:

EPA
1971 Noise From Construction Equipment and Operations, Building Equipment, and Home Appliances. (NTID300.1). Prepared by Bolt, Beranek and Newman. U.S. Government Printing Office. Washington, DC.

Gharabegian, A., K. M. Cosgrove, J. R. Pehrson, and T. D. Trinh
1985 *Forest Fire Fighters Noise Exposure*. Noise Control Engineering Journal 25(3): 96-111.

Dennison, E. E., D. C. Kanistanaux, and S. Ying
1980 *Outdoor Noise of Coal-Fired Power Plants*. Noise Control Engineering 14(1): 30-37.

Cowan, James P
1994 Handbook of Environmental Acoustics. Van Nostrand Reinhold. New York, NY.

National Institute for Occupational Safety and Health
nd *NIOSH Sound Meter: How Loud is Your Workplace?* Operator position data from NIOSH website (www.cdc.gov/niosh/noise/hptherm.html) extrapolated to 50-foot distance.
nd *Carpenters Noise Exposures*. Operator position data from NIOSH website (www.cdc.gov/niosh/noise/chnoises.html) extrapolated to 50-foot distance.

Pneumatic Drills

DBOC utilizes two small, handheld pneumatic drills at the pneumatic drill use station located on the DBOC floating dock (Environ 2011 appendix B photo 1) to separate clusters of shellfish. The Environ report measured operation of only one drill due to space constraints, reporting peak noise levels of 77.5 dBA and 79.7 dBA were reported from this device, with an average level (L_{eq}) of 67.4 dBA over about one minute of unspecified use. Environ 2011 notes that assuming the two drills were working at the same location simultaneously results in a L_{eq} 3 dBA higher or 70.4 dBA. Brueck, Stancescu, and Waters (2007) made 83 measurements of power hand tool use in an industrial setting, yielding an average value (L_{eq}) of 91.9 dBA at 3 feet. Extrapolating this value to 50 feet yields a value of 67.5 dBA, which agrees with the Environ L_{eq} measurement. Other sources offer levels of 85 dBA (FWHA 2006), 84-88 dBA (Bender 1971), and 80-95 dBA (Army 2004). Some of these noise levels may reflect larger or noisier tools, but the lowest value in other references agrees with the peak level reported by Environ. Accordingly, values of 67 and 80 dBA will be carried forward in the Chapter 4 analysis to represent the range of noise levels generated by the pneumatic hand tools.

Motorboats

DBOC operates outboard motorboats with 20 and 40 horsepower engines, which equals approximately 15 and 30 kilowatt (kW) rated power. The value used in the Chapter 4 analysis was derived from four references. Horn et al. (2005) present regression lines that predict noise levels (25 meter distance, which converts to a distance of approximately 82 feet) at full throttle as a function of rated power (in kW); they predict levels of 69 dBA and 72 dBA for 20 and 40 hp. To translate these levels to a 50 foot measurement distance (15 meters), these values must be increased by 20*log10(25/15), or 4.4 dBA, yielding values of 73 and 76 dBA. Rijikeboer et al. (2004) presented measurements of outboard engines measured under lowest noise conditions (i.e., engines in optimal tune and on absolutely flat water conditions) at specified boat speeds. No motor was tested that was exactly equivalent to 20 hp, but motors that were 15 and 24.7 hp were tested at speeds of 19.3 and 24.9 mph. The measured levels, adjusted to a 50 foot distance, were 70.6 and 74.2 dBA. Five motors were tested that were rated between 38.9 and 39.4 hp equivalents, at speeds between 25 and 30 mph. The measured levels, adjusted to a 50 foot distance, were 72.3 to 75.4 dBA. Menge et al. (2002) measured six outboard motorboats of unspecified horsepower ratings at speeds from 9 to 39 mph in an arm of Lake Powell in Glen Canyon National Recreation Area. The maximum noise levels at 50 feet ranged from 67.8 to 80.8 dBA, with four of the measurements falling between 75.5 and 76.7 dBA.

The Environ report provided measurements of two motorboats carrying unspecified loads at an unspecified speed. The measurements were 63.4 dBA and 61.7 dBA. Photo 5 in Appendix B of the Environ report and the limited range of dBA values in the time series of boat noise measurements on page 6 of Environ's Appendix B suggest that the boat was moving at low speed (4 mph or less). Boat-to-microphone distance measurements submitted to DOI (Goodman 2012[xxxvi]) enabled measurement of DBOC motorboat noise source levels using Volpe (2011) data collected at the PORE004 site. Six boat-to-microphone distances were matched to noise events, yielding measures of boat noise from 71.7 dBA to 85.1 dBA (appendix I). These data suggest that DBOC boats in Drakes Estero often operate at much higher throttle settings that were used in the Environ measurements. In order to more fully capture this range in operational boat noise levels, a value of 62 dBA will be retained from the Environ data to represent low throttle settings, and 74 dBA as a representative value for higher throttle settings taken from the aggregate of three published reports and the Volpe PORE004 data from Drakes Estero.

Front-end Loader

DBOC operates a small front-end loader to move shells and other items at the processing station. The Environ report provided peak passby levels of 67 to 68 dBA when this vehicle drove past a sound level meter on a hemicircular course. The speed and bucket load were unspecified in the Environ report (and later communications). Three other references offer typical front-end loader noise levels of 79 dBA at 50 feet (Bender 1971; FHWA 2006) and 86.5 dBA (Toth 1979), though these measurements may represent larger machines than the unit used by DBOC. Bender (1971) also noted that quieting technologies could reduce typical front-end loader noise levels by 4 dBA, to 75 dBA. Two of these reports offer some insights into the range of noise levels from different front end loaders. Bender (1971) offers a range of 73-84 dBA from an unspecified number of machines. Toth (1979) lists the quietest of 19 units measured at 78 dBA, and provides the minimum value from 24 units in an equipment survey as 79 dBA. In order to capture the probable range of front-end loader noise, a value of 67 dBA will be retained from the Environ report, and 73 dBA as a representative value from the three published sources.

Oyster Tumbler

DBOC operates an oyster tumbler, an inclined perforated metal tube more than 10 feet long driven by an electric motor. Oysters are dumped by hand into the upper end of the tube, and tumble down the tube, falling out through holes as they are separated from clusters. Environ reported a peak level of 59.4 dBA and a L_{eq} of 49.8 dBA for 2 minutes of operation under unspecified conditions. The figure on page 10 of Appendix B shows 1 second L_{eq} values ranging from 47 to 55 dBA, and Photo 4 on page 3 suggests that the electric motor is the primary noise source. In order to cross-validate these measurements, a portable cement/mortar mixer was selected as comparable because it slowly rotates stones and gravel in a metal cylinder. Army (2004) specifies a representative level of 82 dBA and a minimum value of 75 dBA. Accordingly, the values of 50 dBA and 75 dBA will be retained for analysis in Chapter 4.

Noise Spreading

The noise level arriving at any listening position will depend on the distance and the path traveled by the noise. In most environments, sound levels fall off with the square of distance from the source (spherical spreading loss); 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. In addition to spreading loss, absorption and scattering cause losses that are directly proportional to 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. Topography can affect sound transmission through air. Intervening terrain can greatly reduce sound transmission. Further losses can be caused by the interaction of the noise with the ground surrounding the listener’s position.

Wind conditions also have the potential to impact noise levels. Wind increases the natural background sound level. Wind also causes 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 – and less far upwind – than would be predicted by spherical spreading. Strong winds inhibit formation of the temperature inversions. The prevailing winds in Drakes Estero are from the northwest, so noise will carry farther to the southeast of noise sources.

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). The closest weather station to the project area is at the Point Reyes RCA Station, approximately 1.3 miles from the DBOC onshore operations. Average daily wind speeds over 2010 and 2011[3] have ranged between 2.75 miles per hour (mph) on October 21, 2011, and 28.54 mph on April 21, 2010, with an overall daily average of 9.06 mph. Approximately 68 percent of days during 2010 and 2011 had an average daily wind speed of less than 10 mph. Average daily air temperatures varied between 39.0 and 63.2 degrees Fahrenheit, with a maximum of 79.3 degrees and a minimum of 30.6 degrees (Western Regional Climate Center 2012).

Underwater sound levels at Drakes Estero have not been monitored by NPS, but several qualitative factors suggest that its natural underwater sound levels would be unusually low for a shallow marine ecosystem, for the following reasons. 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. Sound generally travels much farther in water than in air due to much lower absorption, less effective terrain shielding, and the potential confinement of sound energy between two reflecting layers (the surface and many types of bottom). Given the underwater noise levels of small boats with outboard motors (Kipple and Gabriele 2003, 2004) and the characteristics of underwater sound propagation, underwater noise impacts from these boats can propagate on the order of 6 miles (Hildebrand 2009).

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.

[3] Data is not available for August 19 and 20, 2011.

Numerous surveys have documented the importance of park soundscapes to visitors. 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). Ninety-one percent of park visitors consider enjoyment of natural quiet and the sounds of nature as compelling reasons for visiting National Parks (McDonald, Baumgartner, and Ichan 1995). Escaping noise ranks fourth in importance (behind enjoying nature, physical fitness, and reducing tension) among sixteen preference domains by users of wilderness and nonwilderness recreational areas (Driver, Nash, and Haas 1987). Note that enjoying nature and reducing tension are both plausibly related to noise-free environments. Ninety-five percent of all Americans regard opportunities to experience natural peace and the sounds of nature as an important reason for preserving national parks; 72 percent thought it was very important (Haas and Wakefield 1998). In nearby Muir Woods, park visitors were overwhelmingly supportive of declaring a “quiet zone” in Cathedral Grove, and signs asking visitors to preserve this quiet place were successful in reducing noise energy by half (Stack et al. 2012).

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	59
40 dBA	18
50 dBA	10
60 dBA	5
70 dBA	3
80 dBA	2

Source: EPA 1981, Fig. 4-3, noise limits for “communicating voice”

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* (DO-41) (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.

In general, wildlife species can be 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). Negative behavioral and habitat-use consequences of higher ambient sound levels from human voices, along with sound events associated with human activities (motorists, hikers), have been observed in many species both at individual and population levels (Frid and Dill 2002; Landon et al. 2003; Habib, Bayne, and Boutin 2007). Human activities can disturb harbor seals at haul-out sites, causing changes in harbor 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; Acevedo-Gutierrez and Cendejas-Zarelli 2011). Further, there may be impacts on harbor seals related to underwater sounds produced by DBOC based on previous research on other marine mammals (NAS 2003).

The diversity and population of many bird species decrease in locations closer to a road or other sources of mechanized sound, which is described as the "road effect" (Francis, Ortega, and Cruz 2009). This effect is often attributed to mechanical noise levels rather than to decreased habitat quality or direct mortality caused by vehicle collisions (Reijnen et al. 1995; 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

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. Point Reyes National Seashore is one of 46 units within the national park system that include congressionally 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 (NPS 1974). The environmental statement analyzed a number of areas in the seashore with a range of alternatives including no wilderness, less wilderness, and more wilderness (NPS 1974). The final environmental statement was published in 1974 and recommended 10,600 acres of proposed wilderness.

In 1976, Congress designated more than 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. Potential wilderness was designated at the time due to nonconforming Wilderness Act uses in those areas. Nonconforming uses are uses that are prohibited by the Wilderness Act. The Point Reyes Wilderness was renamed the Phillip Burton Wilderness in 1985 (PL 99-68).

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 Phillip Burton Wilderness Area is unique in that it is the only wilderness area between Canada and Mexico that includes marine tide and submerged lands and waters (wilderness.net 2011).

Drakes Estero is included in the Phillip Burton Wilderness at Point Reyes National Seashore. Approximately 1,363 acres within the Estero remain potential wilderness due to the presence of DBOC's commercial shellfish operations (figure 3-8). These commercial operations are referred to as nonconforming uses and prevent the area designated by Congress as potential wilderness from attaining full wilderness status.

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*.

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)

Table 3-5 lists the nonconforming uses and structures in Drakes Estero which affect the wilderness qualities of Drakes Estero. A total of 95 wooden racks occupying approximately 7 acres (the length of the racks is 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.

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 approximately 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 Seashore resources. These activities are subject to minimum use requirements, which minimize impacts on wilderness areas.

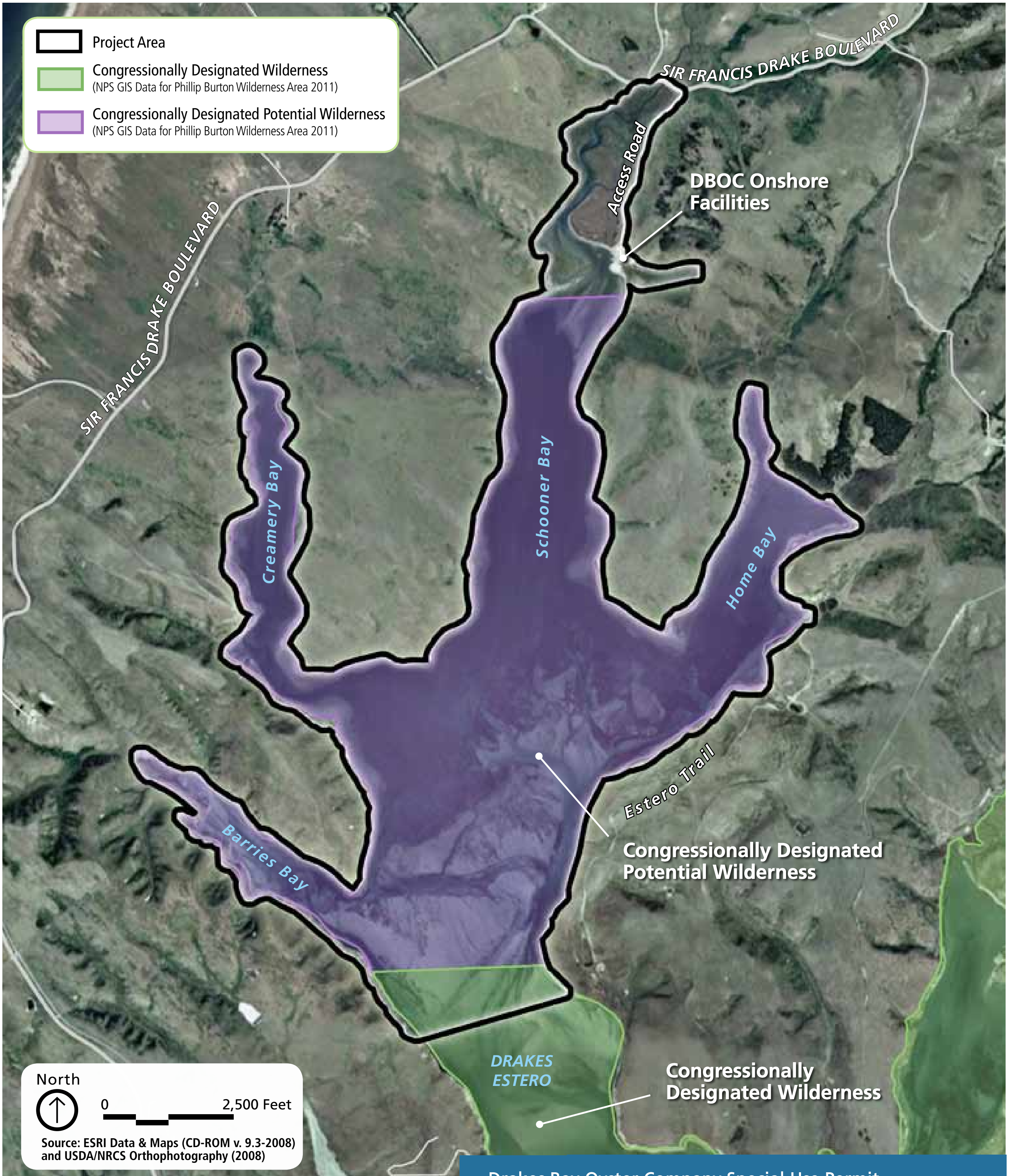


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FIGURE 3-8
Phillip Burton Wilderness

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

Nonconforming Uses	Wilderness Qualities Affected
Overnight anchorage of barges used for commercial shellfish production in potential wilderness	Undeveloped (barges are evidence of human occupation)
Commercial activities associated with the shellfish operation including, tending of nonnative or nonlocal species of private cultured shellfish using racks, bags, trays, and other cultivation materials	Natural (trays and other culture material affect the natural ecosystem; presence of cultured species, particularly nonnative species, affects the natural ecosystem) Untrammeled and natural (bags cause human manipulation of natural sediment dynamics) Undeveloped (bags are evidence of human occupation)
Motorized boat operations for commercial shellfish operations	Natural (eelgrass damage and sediment disturbance from boat operations disrupt natural processes) Solitude (sound generated by motor boats distracts from opportunities for solitude)
Nonconforming Structures	**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)

Drakes Estero provides 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 approximately 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 to an otherwise natural soundscape with ambient 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.

When the nonconforming uses within Drakes Estero cease, 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 designated 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 Phillip Burton Wilderness; however, sounds emanating from onshore activities may 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[xxxvii]). 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 (Ferry and LaFayette 1997; Fungi 1999). 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.

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”). 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 Seashore. These are not services being offered to the visiting public to further the public’s use and enjoyment of the Seashore. 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 a variety of recreational activities. For example, 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 though the public may still access the shoreline of Drakes Estero. 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 (NPS 2010g) were accommodated on these tours during the 8-month period Drakes Estero is open to kayakers (approximately 0.01 percent of total Seashore visitation that year). Data is not available to provide the total number of individual kayakers (i.e., not part of a commercial group) that use

Drakes Estero annually. Drakes Estero, which is congressionally designated potential wilderness, offers visitors such as kayakers and hikers 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, radios used by staff for music, 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.

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

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 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 (Responsive Management 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) (Responsive Management 2003). Respondents most commonly reported that they would like increased wilderness areas and more educational opportunities related to Native American cultures and exploration and settlement history at the Seashore (Responsive Management 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 (Responsive Management 2003). The respondents were generally divided regarding the amount of wilderness at the Seashore, with 43 percent identifying that they would like to see more wilderness at the Seashore, and 38 percent reporting it should stay the same (Responsive Management 2003). At the time of the survey, Drakes Estero was already designated as potential wilderness (pursuant to PL 95-544, October 18, 1976, 90 Stat. 2515 and PL 94-567, October 20, 1976, 90 Stat. 2695).

Although not a visitor service, DBOC provides visitors with a different experience within the Seashore. DBOC estimates that 50,000 people visit its commercial operation each year (DBOC 2010n[xxxviii]). 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, picnic on-site, be part of an educational tour, or simply out of curiosity in passing. Educational tours are provided to a variety of groups, including schools, clubs, families, associations, and non-profits (DBOC 2010r[xxxix]; Cummings 2011[xl]). The tours provide DBOC visitors with the opportunity to gain a variety of knowledge including the history of agriculture and aquaculture in PRNS, the benefits of oysters (both as a local food source and within the coastal ecosystem), and sustainable aquaculture (DBOC 2010r[xli]; DBOC 2011i[xlii]). DBOC does not charge visitors for these tours (DBOC 2011i[xliii]). DBOC also provides informational displays and the opportunity to experience an active commercial mariculture operation (DBOC 2010r[xliv]). As described in the "Impacts Topics Considered But Dismissed from Further Analysis" section of "Chapter 1: Purpose of and Need for Action," while the oyster-growing facility in Drakes Estero is significantly associated with the rebirth and development of the California oyster industry in the 1930s, under Johnson Oyster Company ownership, the property is ineligible for listing in the National Register because it lacks historic integrity (SHPO 2011[xlv]). However, visitors to DBOC are afforded an opportunity to learn about the history of the oyster industry, DBOC's role in local traditions, and experience the associated working landscapes. Such an experience is not offered elsewhere at the Seashore (DBOC 2011i[xlvi]). It is assumed that at least a portion of the visitors to DBOC only come to the Seashore to experience an active shellfish operation. However, data is not available to determine what percentage of DBOC visitors would fall into this category.

DBOC sells its oysters both wholesale and at a retail facility on site. It also sells other "seafood and complementary food items," as authorized in the RUO. DBOC also supplies restroom facilities and telephones for visitors, is ADA accessible, as required by law, and has staff trained in cardiopulmonary resuscitation (CPR) and first-aid so they can assist in an emergency (DBOC 2011i[xlvii]; DBOC 2011[xlviii]; Cummings 2011[xlix]).

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. For the purposes of this EIS, socioeconomic resources are considered at three different levels or project areas: Inverness Census Designated Place (CDP), Marin County, and the state of California. Shellfish operations are dispersed throughout California and not concentrated within one county or region. Therefore, evaluating operations at a scale smaller than the state level would distort the role of that operation in the larger market. In addition, much of the available data related to the shellfish market is provided at a state level. In particular, production data provided by 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. As such, it was determined that the state level is the most appropriate scale for evaluating shellfish production in this EIS. Shellfish data at the county level is presented in this section for reference purposes only and is not considered to be representative of the larger market. All other socioeconomic resources considered in this section are discussed in terms of Inverness CDP and/or the County. 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 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 county 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 economy by spending money at local establishments such as hotels, restaurants, and retail shops (NPS 2011a; NAS 2009).

NPS developed the socioeconomic analysis using CDFG production data presented in the draft EIS, and updated by 2011 reported production. In August of 2012, after NPS had completed this analysis, including IMPLAN modeling, CDFG notified NPS that in May of 2012 it modified its methodology for estimating state shellfish production. NPS acknowledges these changes; however, because this data was received after completion of the socioeconomic analysis, and is not anticipated to result in significant changes to NPS findings or conclusions, it has not been incorporated in this EIS.

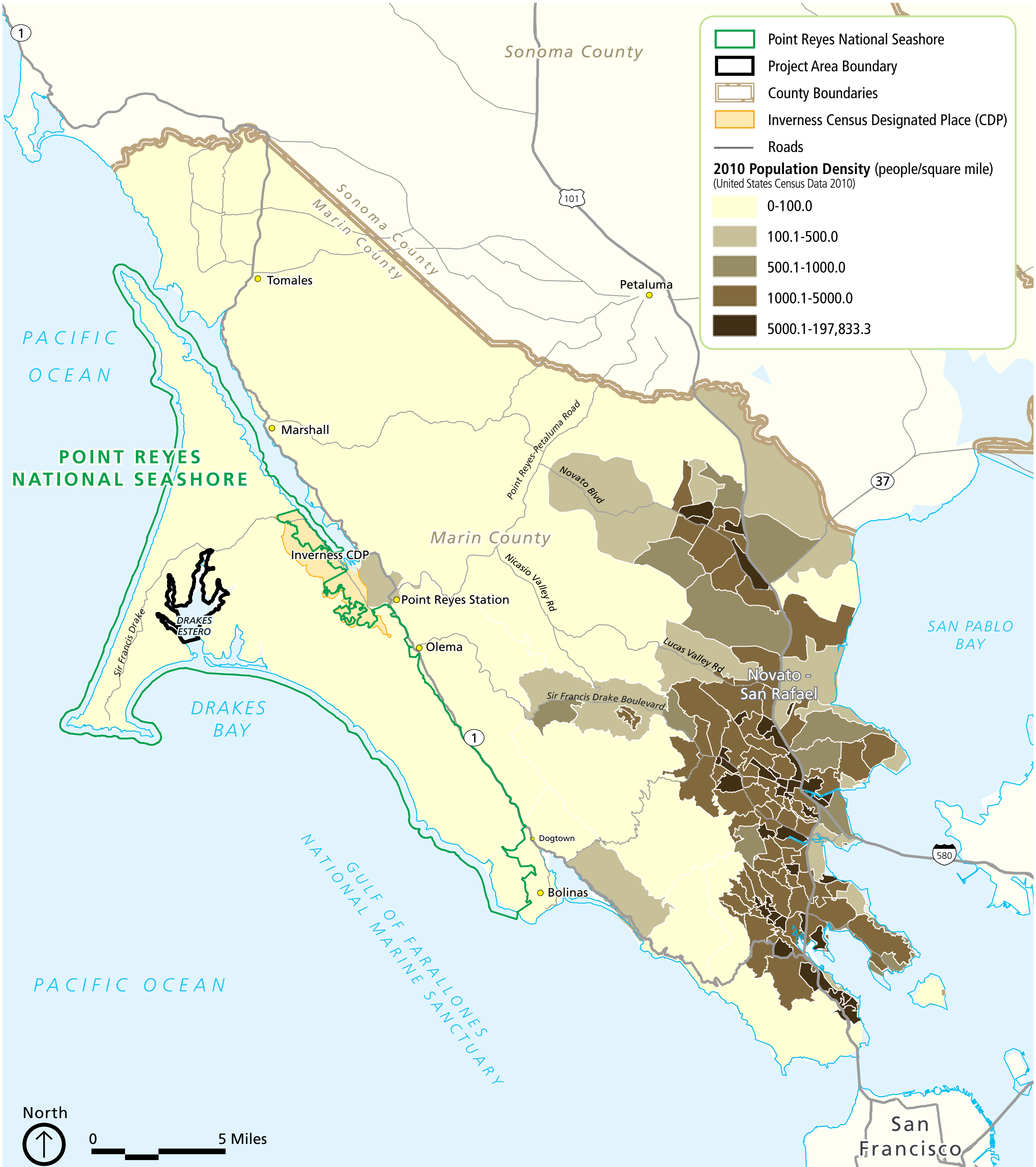
GENERAL SOCIOECONOMIC RESOURCES

Marin County occupies approximately 828 square miles, including 308 square miles of tidelands 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, within which the Seashore and Inverness CDP are located, is primarily rural, with scattered, small, unincorporated towns that serve tourism, agriculture, and local residents. Inverness CDP occupies approximately 6.4 square miles including 0.4 square miles of tidelands 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 2010 U.S. Census Bureau data, Marin County had 252,409 residents and a population density of approximately 485 people per square mile (U.S. Census Bureau 2010). In contrast, the population of Inverness CDP was estimated at 1,304 residents with a population density of 217 people per square mile, representing 0.5 percent of the overall county population.

Between 2000 and 2010 Marin County experienced a growth rate of 2.1 percent (U.S. Census Bureau 2010), while the population of Inverness CDP declined by 8.2 percent (U.S. Census Bureau 2000, 2010). In 2010, 95.8 percent of the county population reported only one race, with a80.0 percent reporting white. During the same year, 97.5 percent of the Inverness CDP population reported only one race, and 92.9 percent of the population reported to be white. The ethnicities of the minority population in the county and Inverness CDP are summarized in table 3-6 and compared to the population of the state of California. As shown in the table, minority concentrations for Marin County and Inverness CDP are below statewide averages both as a whole and for each individual race.



Source: ESRI Data & Maps (CD-ROM v. 10-2010) and United States Census Data (2010)

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FIGURE 3-9
Marin County Population Distribution

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

Race	Percent of Inverness CDP Population	Percent of Marin County Population	Percent of California Population[a]
Black	1.2	2.8	6.2
American Indian and Alaska Native	0.6	0.6	1.0
Asian	1.2	5.5	13.0
Native Hawaiian and other Pacific Islander	0.2	0.2	0.4
Some other race	1.5	6.7	17.0
Two or more races	2.5	4.2	4.9
Total minority	7.1	20.0	42.5

Source: U.S. Census Bureau 2010

a – According to U.S. Census Bureau data the total population of California was estimated at 37,253,956 in 2010.

In 2010, approximately 15.5 percent of county residents and 6.1 percent of the population in Inverness CDP identified themselves as Hispanic. For comparison, 37.6 percent of the population of California reports to be of Hispanic origin. DBOC reports that "22 of the DBOC employees are Hispanic" (DBOC 2011i[l]). The concept of race is different than the concept of Hispanic origin. Therefore, the U.S. Census collects separate data on Hispanic and minority populations. Specifically, Hispanic is not considered a minority population by the U.S. Census and must be considered independently from race. For example, nearly half of the Marin County residents who reported to be Hispanic in 2010 indicated that their race was "white only." The remaining 54 percent of the Hispanics within the county specified another race, stated they were of "some other race," or indicated they were of two or more races (U.S. Census Bureau 2010). Those Hispanics that reported to be "white only" are not considered minority. Similarly, 51 percent of the Hispanic population in Inverness CDP reported to be "white only" (U.S. Census Bureau 2010).

Approximately 79.6 percent of the people living in Marin County are native to the U.S., with 49.0 percent born in the state of California (U.S. Census Bureau 2006-2010). In comparison, 87.5 percent of the Inverness CDP population is native to the U.S., and 57.2 percent is native to California (U.S. Census Bureau 2006-2010). Neighborhoods (represented as block groups) in the eastern portion of Marin County are the most densely populated regions in the county (U.S. Census Bureau 2010).

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 2010, the unemployment rate in Marin County was 8.3 percent, well below the statewide average of 12.4 percent (U.S. Department of Labor 2010, 2011). Between 2006 and 2010, Inverness CDP reported zero unemployment (U.S. Census Bureau 2006-2010).

Between 2006-2010, the labor force in Marin County was concentrated in educational services, health care, and social assistance (20.1 percent); professional, scientific, management, administrative services, and waste management (12.2 percent); retail trade (11.0 percent); and manufacturing (10.3 percent). Together, these sectors accounted for nearly 54 percent of the labor force within the county. Similarly, in Inverness CDP, the top four employment sectors between 2006 and 2010 were educational services, health care, and social assistance (21.3 percent); construction industry (17.6 percent); retail trade (16.1 percent); arts, entertainment, and recreation, and accommodation and food service (9.2 percent); and finance and insurance and real estate and rental leasing (8.8 percent). The heavy concentration of retail trade; construction; arts entertainment and recreation; 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 0.7 percent of the labor force in Marin County and 2.2 percent of the labor force in Inverness CDP (U.S. Census Bureau 2006-2010).

The per capita income in Marin County between 2006 and 2010 averaged $53,940, an approximately 20.0 percent increase since 2000. In comparison, the per capita income in Inverness CDP averaged $47,688, a 27.7 percent increase since 2000. The per capita income for California increased approximately 28.5 percent during the same period (U.S. Census Bureau 2006-2010, 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 2010, visitor spending within the national park system supported an estimated 258,400 jobs, approximately $9.8 billion in labor income, and approximately $16.6 billion in value added[4]. Additionally in 2010 visitor spending was estimated at nearly $12.1 billion in local gateway regions around national parks (within a 60 mile radius of the parks and excluding park entry fees) (NPS 2011d). Approximately 81 percent of the total visitor spending ($9.8 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 2010, NPS employed over 26,000 staff with a combined labor income of approximately $2.0 billion (NPS 2011d). This labor income equated to approximately $2.2 billion in value added to the regions around the parks and approximately $3.0 billion in value added to the national economy (NPS 2011d). Overall in 2010, NPS payroll-related spending was estimated to result in 300,000 national jobs; 189,000 of which (63 percent) are in the region surrounding national 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 2010, the approximately 2 million recreational visitors to the Seashore contributed nearly $85 million in local spending, approximately $77 million of which was spent by non-local visitors (greater than 60 miles from the Seashore) (NPS 2011d). The non-local spending supported 981 jobs, approximately $41.2 million in labor income, and nearly $68 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 153 private sector and NPS staff in 2010 (122 NPS jobs). Maintaining these jobs resulted in approximately $10 million in labor income and

[4] Value added is a type of measure of Gross Regional Product and is the combination of wages, other property type income (corporate profits, capital, inventory) and indirect business taxes collected by business for government (e.g., sales taxes, excise taxes, licenses). It can also be defined as total sales net of the costs of all non-labor inputs. Among the measures reported here, value added is the preferred economic measure of the contribution of an industry or activity to the economy.

approximately $12 million in value added for the region (NPS 2011d). This results in a total impact of approximately $51 million in labor income and $80 million in value added, approximately 0.5 percent of the county's total value added (MIG 2012, NPS 2011d).

DBOC's contribution to the regional, state, and/or local economy could not be determined at the time of report development. Specifically, data is not available regarding the number of visitors that come to the Seashore for the sole purpose of visiting DBOC (versus those who also visit other areas of the Seashore during their trip). Visitors to DBOC who also come to experience other areas of the Seashore would contribute to the regional, state, and local economy regardless of DBOC's presence, whereas, those who only travel to DBOC may or may not continue to come to the Seashore.

Housing

In 2010 there were approximately 111,214 housing units in Marin County, 1,102 of which were located in Inverness CDP. Approximately 103,210 of the housing units in the county (92.8 percent) were occupied. In contrast, 36.7 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 2010). This is consistent with Inverness CDP's location within the Seashore, a tourist destination.

Between 2006 and 2010, Marin County homes had an estimated median value of $868,000. Median home values within Inverness CDP were consistent with those in the county, and were reported to be $827,900 during the same period. The county had an estimated median monthly owner cost of $3,416 for those with a mortgage ($2,947 for Inverness CDP) and $646 for those without a mortgage ($487 for Inverness CDP). The median gross rent was $1,523 per month for the county as a whole, while rents in Inverness CDP were slightly higher, at $1,610 per month (U.S. Census Bureau 2006-2010).

COMMERCIAL SHELLFISH OPERATIONS IN CALIFORNIA

In 2010, the seafood trade deficit in the U.S., which includes net imports/exports of shellfish, reached over $10 billion. Imports of shrimp, crab, tuna, salmon, and lobster are the primary contributors to the deficit (NAS 2010). The largest seafood exports in the U.S., based on value, are groundfish, salmon, and lobster (NAS 2010). Therefore, changes in U.S. shellfish production are "unlikely to make a significant difference in the nation's overall seafood trade balance" (NAS 2010). From a global perspective, shellfish cultivation has increased in recent years, despite declining fishery yields (NAS 2010). The most widely cultivated species of oyster is the Pacific oyster, which accounts for approximately 99 percent of the oyster produced globally each year (NAS 2010). Shellfish operations within the Pacific coast region (California, Washington, Oregon, and Alaska) contribute approximately $110 million to that region's economy each year (PCSGA 2009).

In recent years, shellfish producers across the country, including those in California, have struggled to meet shellfish demands (PCSGA 2011[li]). The state of California encompasses approximately 30 marine aquaculture operations, including 23 commercial shellfish operations (CDFG [Ramey], pers. comm., 2011d). Some operations are located on state-owned lands (including tidelands and submerged lands and land-based operations) while others are located on tidelands and submerged lands under the jurisdiction of other governmental entities or private parties. State management by CDFG of these operations differs based on the operation's location. To assess the California shellfish market, and DBOC's role in that market, sales data was reviewed from a variety of sources as follows:

- In 2007, the 23 commercial shellfish operations in California (operating on a combination of state-owned, granted, and private tidelands 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 commercial mariculture operations were reported to produce and sell shellfish in Marin County in 2007, comprising approximately $2.3 million in product sales (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 operations 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 2010, the gross value of aquaculture production in Marin County was approximately $4.26 million, 7.6 percent of the gross value of agricultural production in the county (MCDA 2011).
- The U.S. Census Bureau reported that oysters produced in the U.S. in 2008 were valued at nearly $131.6 million (U.S. Census Bureau 2012).
- The sales reported in the Census of Agriculture include the value of aquaculture distributed for restoration, conservation, or recreational purposes (USDA 2009).

In California, CDFG manages 18 leases for 9 shellfish 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 CFGC and collects revenues from the leaseholder. Lessees pay an annual per-acre rental fee and a privilege use tax to CDFG. These fees help support CDFG oversight efforts, but do not cover all associated costs. The leaseholders also maintain an aquaculture registration with CDFG. CDFG also coordinates with the shellfish hatcheries on disease and health certifications, although the California Department of Public Health is the primary agency responsible for certifying growing areas for shellfish.

There are approximately 19 aquaculture operations in the state on granted or private tidelands and submerged lands or are private land-based operations, not owned by the state of California (CDFG [Ramey], pers. comm., 2011d). Nine of these operations are on granted or private tidelands and 10 are land-based facilities. With the exception of Drakes Estero, CFGC does not issue leases for aquaculture operations located on granted or private tidelands and 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 CDFG; however, they do not pay other fees or taxes to 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), which was established in 1973 under the Humboldt Bay Harbor, Recreation and Conservation Act of 1970. Subsequently, the state of California granted all its tidelands and submerged lands to the Harbor District, 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 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 CDFG for CDFG-managed leases.

According to a recent study prepared at Oregon State University, “demand for oysters does not seem to be income elastic or vulnerable to economic shocks like those associated with the recent recession” (Sorte 2010). An additional report released by the Department of Agricultural and Resources Economics, University of California, Davis notes that demand elasticity for fish is -0.57, which is considered generally inelastic (Russo et al 2008). For the purposes of the UC Davis study, shellfish were considered as part of the fish category. Based on this information, demand for shellfish is generally unchanged, regardless of price fluctuations.

DRAKES BAY OYSTER COMPANY

Between 1979 and 2011, Pacific oyster production within Drakes Estero averaged 406,238 pounds (4.8 million individual oysters) (CDFG 2011c).[5] Table 2-1 Shellfish Species Production by Year (1979-2011) provides a complete list of shellfish produced within Drakes Estero during that timeframe. As shown in the table, during the latter part of JOC’s ownership and during the first couple years of DBOC ownership (through 2006), oyster production within Drakes Estero was significantly lower than current conditions. In 2005, production rates did not meet harvest requirements (180,030 pounds, or 2.1 million individuals, for M-438-01) due to the transfer of the lease from JOC to DBOC. Since that time, however, Pacific oyster production has increased. Between 2007 and 2009, annual Pacific oyster production averaged 454,036 pounds (5.3 million individual Pacific oysters), and increased steadily in 2010 and 2011. In 2011 oyster production at DBOC was reported to be greater than 618,000 pounds (approximately 7.28 million Pacific oysters). The 2011 levels of production represent an approximately 36 percent increase over production rates between 2007 and 2009 (CDFG 2011c). In 2009, in addition to Pacific oysters, DBOC produced 423 pounds of Manila clams (12,690 clams). In 2010, Manila clam production at DBOC increased more than 60 percent to 684 pounds (20,520 clams) (CDFG 2011c). In 2011; however, clam production at DBOC dropped nearly 83 percent to 118 pounds (3,540 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. It should be noted that DBOC has requested all financial data related to the shellfish operation be kept confidential (DBOC 2012b[lii]). Therefore, the following discussion does not include specific revenue data. According to DBOC, both the gross and net revenue projected for 2010 were expected to be greater than any year since 2005 (DBOC 2010i[liii]). 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). The actual revenue data for

5 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.”

2010 had not been received from DBOC by the time of report preparation but is assumed to approximate that previously projected by DBOC. Revenue data for 2011 also were not available at the time of report preparation; however, based on the quantity of Pacific oysters produced, 2011 revenue is assumed to be greater than the annual revenue generated each year between 2005 and 2010. 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). According to information provided by DBOC, approximately 25 percent of the shellfish produced annually at DBOC is sold in jars, while the remaining 75 percent is sold live in the shell (DBOC 2012b[liv]. DBOC also reports that, based on value, approximately 40 percent of its shellfish is sold on site, 40 percent is sold to local restaurants and markets and delivered by DBOC directly, 18 percent is sold to Tomales Bay shellfish growers, and 2 percent is sold to seafood wholesalers and distributors (DBOC 2012b[lv]). 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, DBOC staff comprised 31 full-time employees and 1 part-time (seasonal) employee (total of 32 employees), 15 of who live with their families in company-owned housing (DBOC 2010j[lvi]). 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[lvii]). Twenty-seven of 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[lviii]). It should be noted that many oysters harvested from Humboldt Bay are shucked and packed by Coast Seafoods, but its 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, CDFG has acknowledged that its 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 CDFG. As discussed previously, 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 CDFG in total numbers for most areas in California and that data gets converted into a weight in pounds. In contrast, Coast Seafooods, the largest producer in

Humboldt Bay, provides production information in gallons. Based on information provided to CDFG from Coast Seafoods, the number of Pacific oysters per gallon varies monthly and in 2007 alone ranged from 131 (December) to 257 (July) oysters per gallon (CDFG 2011e). In Drakes Estero, total numbers have been converted by CDFG into weight using a conversion of 100 oysters per gallon (CDFG [Ramey], pers. comm., 2011d). In other areas of the state, the total number of oysters has been converted by CDFG to weight using 140 oysters per gallon (CDFG [Ramey], pers. comm., 2011d). 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. Such inconsistencies are not unique to California as there is no federal standard for reporting shellfish production in the U.S (NAS 2010). 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 2009 producer survey (Kuiper 2009), Ted Kuiper, who also was a shellfish producer in Humboldt Bay, assumed 180 oysters per gallon for all oysters produced in California. For its analysis of statewide production CDFG has used the following assumptions:

For Tomales Bay:

- Pacific oyster/140 per gallon x 8.5 = 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 Humboldt Bay:

- Pacific oyster/140[6] per gallon x 8.5 = pounds
- Kumamoto oyster/300 per gallon x 8.5 = pounds

For Southern CA:

- Pacific oyster/140 per gallon x 8.5 = pounds

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

6 According to data provided by CDFG, Coast Seafoods, the largest shellfish producer in Humboldt Bay, estimates the number of Pacific oysters that comprise a gallon monthly, instead of applying a uniform conversion rate, such as 100 oysters per gallon. In 2008, Coast Seafoods averaged 154 Pacific oysters per gallon though values ranged from 132 Pacific oysters per gallon in January to 187 Pacific oysters per gallon in October. For the purposes of this EIS, a conversation rate of 140 oysters per gallon was assumed for all Pacific oysters produced in Humboldt Bay, including Coast Seafoods. This conversation rate is generally consistent with the annual average conversion rates for Coast Seafoods between 2007 and 2011 (158 Pacific oysters per gallon).

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, in 2007 and 2008, Pacific oysters produced within Drakes Estero accounted for 37 percent of the Pacific oysters produced in California, approximately 35 percent of the overall oyster market for the state, and 33 percent of the shellfish produced in the state, based on weight. During the same timeframe DBOC's share of the Marin County Pacific oyster, total oyster and shellfish markets is substantially greater, comprising 69 percent, 68 percent, and 64 percent by weight, respectively (CDFG 2011e). Based on the number of individual oysters produced during these years; however, DBOC accounted for 30 percent of the Pacific oysters, 25 percent of the total oysters, and 24 percent of the total shellfish produced in California. DBOC's share of the California oyster market in 2009-2011 was generally consistent with 2007 and 2008. DBOC shellfish comprised an average of 31 percent of the Pacific oyster market, 24 percent of the state oyster market and 22 percent of the shellfish market, based on individuals, during the 2009-2011 timeframe (CDFG 2011c, 2011e). However, due to increased production in Tomales Bay, DBOC's share of the county oyster and shellfish markets was closer to 50 percent between 2009 and 2011 (CDFG 2011e). CDFG records indicate an average of nearly 1.2 million pounds (17.1 million individuals) of Pacific oysters and 1.3 million pounds (21.2 million individuals) of total oysters were produced annually in California between 2007 and 2009 (CDFG 2011a, CDFG [Ramey], pers. comm., 2011d). From a national perspective, in 2008, 30.1 million pounds of oysters and over 1 billion pounds of shellfish were produced in the U.S. (U.S. Census Bureau 2012). In 2009, the Pacific coast region produced approximately 9.9 million pounds of oysters, 8.6 million pounds of which were cultivated in Washington (NMFS 2011f).

The most significant increase in production at DBOC, between 2007 and 2011, occurred between 2009 and 2010. In 2010, DBOC produced 585,277 pounds of shucked oyster meat (6.89 million oysters), a 28 percent increase over 2009 production levels. During this same period, the California oyster market increased 43 percent. An increase in Pacific oyster production in Humboldt Bay was the primary contributor to this change (the California Pacific oyster market increased 48 percent, by weight, between 2009 and 2010) (CDFG 2011e). As described above, CDFG data are not calculated consistently and are not inclusive of all statewide oyster production. Therefore, it is assumed that DBOC's contribution to the overall California oyster market between 2007 and 2011 is lower than that reported by CDFG.

According to CDFG data, between 2009 and 2011, the total number of individual oysters produced in Drakes Estero was similar to production rates in Tomales Bay, which is also located in Marin County (CDFG 2011e). Tomales Bay includes shellfish production by six companies with a total of 10 leases (CDFG 2011f[lix]).

According to CDFG data (CDFG 2011e), 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. In 2011, Manila clam production at DBOC declined 83 percent compared to 2010 production, while statewide clam production only declined 20 percent. 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 compose a gallon
- One gallon of oyster meat weighs 8.5 pounds
- Twenty mussels weigh 1 pound
- Thirty clams weigh 1 pound

Kuiper reported data for the same operations as those represented in CDFG data. Kuiper assumes an average of 180 oysters per gallon and does not use the actual conversion rates for each operation. Since the conversion rates vary among operations, and can be as low as 100 or 140 oysters per gallon, this conversion rate may overestimate actual production rates. To account for this variation, DBOC's share of the statewide oyster market is presented as a range and is provided in term of individuals, weight, and value. In addition, the Kuiper survey considers imported oysters and clams; however, imported shellfish were removed from the calculations presented in table 3-7.

As shown in table 3-7, between $8.8 million and $12.4 million worth of oysters were produced in California in 2007/2008. This represents approximately 12-16 percent of the value of oysters produced in the Pacific coast region, which includes Washington, California, Oregon, and Alaska (PCSGA 2009). DBOC accounted for 3.4 percent of the oyster produced in the Pacific coast region in 2008 (PCSGA 2009, CDFG 2011a, 2011c).

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

	DBOC*, a	CDFG†, a	Percent DBOC Contribution	Kuiper Survey‡, b	Percent DBOC Contribution	Pacific Coast Shellfish Growers Association§, c	Percent DBOC Contribution
Individuals							
Total Individual Oysters	5,314,005	21,173,960	25%	32,500,000	16%	N/A	N/A
Total Shellfish (individuals harvested)	5,314,005	22,549,820	24%	40,030,000	13%	N/A	N/A
Weight (lbs)							
Total Weight of Oysters (lbs)ǁ	451,691	1,306,032	35%	1,539,983	29%	N/A	N/A
Total Weight of Shellfish (lbs) ǁ	451,691	1,364,605	33%	1,895,983	24%	N/A	N/A
Value (Dollars)							
Total Value of Oysters#	$2,484,301	$8,847,028	28%	N/A	N/A	$12,361,326	20%
Total Value of Shellfish#	$2,484,301	$9,063,627	27%	N/A	N/A	$14,136,326	18%

Sources: #CDFG 2011a, *CDFG 2011c, ǁCDFG [Ramey], pers. comm., 2011d, †CDFG 2011e; ‡Kuiper 2009; and §PCSGA 2009.

N/A: not applicable; data not available

Note: In 2007 and 2008, DBOC produced only Pacific oyster.

a – Data shown is an average of production reported for 2007 and 2008.

b – Data shown is based on a combination of 2007 and 2008 production levels, depending on the year reported by each operation surveyed.

c – Data is for 2008 only, 2007 data was not available for California from this source.

In addition to its contribution to the local seafood market, the operation of DBOC has an impact on the overall local economy. An input-output methodology employing IMPLAN software (MIG 2012), originally developed by the US Government and the University of Minnesota, has been used to estimate the economic impact of DBOC operations on the Marin County economy. IMPLAN was chosen because of its ability to construct a model using data specific to Marin County while maintaining rich detail on impacts for hundreds of industrial sectors. In addition to being widely used in regional economic analysis, the model and its methodology have been extensively reviewed in professional and economic journals. IMPLAN software also was used to calculate the economic impacts of the Seashore on local communities (NPS 2011d).

Input-output models, such as IMPLAN, map the linkages of inter-industry purchases and economic output within a given region. These models trace the inputs necessary to produce a dollar of output for a specified industry in a given economy. This linked spending can be tracked through multiple rounds of spending to estimate the cumulative effect of a specific project or change in industry activity on a region's total output, earnings, and employment. The model factors how much of the required inputs can be supplied locally from within the project area and tracks spending until all money related to the original purchasing has been leaked out of the region or removed from the economy by savings, taxes and profits. If available, operation-specific payroll data can be input into IMPLAN to further refine results. The NPS has requested that DBOC provide payroll data for these purposes; however, DBOC did not provide this information. Instead, payroll was estimated by IMPLAN and considers the overall expenses and number of employees for DBOC and industry averages. These direct effect expenditures were applied to the model in *Industry Sector 14 – Animal production, except cattle and poultry and eggs.* (This IMPLAN industry sector includes oyster production, farm raising [NAICS Code 112512] and was selected as the industry that most closely resembled DBOC activity. *Sector 17 – Fishing and Sector 61 – Seafood product preparation and packaging* were also considered and tested, but did not appear to provide as close a match in terms of reported financial and employment conditions).

In addition to the direct spending activity that is required to produce a dollar amount of a given product or service, economic impacts also occur as a result of "indirect" purchases that businesses and organizations make from other local industries using revenue gained from the initial direct spending. This is often referred to as "indirect spending." "Induced spending" includes the purchases made by individuals and households within the project area as a result of the income they receive from the direct and indirect activity in the region. Input-output models yield "multipliers" that are used to calculate the total direct, indirect and induced effect on jobs, income and output resulting from a dollar of spending on goods and services in the project area. The direct, indirect and induced impacts from the annual operation of DBOC on the Marin County economy were modeled using the most recent available IMPLAN data (2010) and are summarized below. As stated previously, DBOC has requested all financial data related to the operation of DBOC be kept confidential (DBOC 2012b[lx]). To adhere to this request, separate direct, indirect, and induced impact data generated by the IMPLAN model have been excluded from the EIS and only the total results are provided below.

The IMPLAN model indicates that, overall, Marin County economic activity includes a total value added of approximately $17 billion. The top industry sectors in the county, based on employment are real estate establishments; food service and drinking places; and securities, commodity contracts, investments, and related activities. The top industry sectors based on output are real estate establishments; securities, commodity contracts, investments, and related activities; and state and local government (non-education) employment and payroll.

The estimates of DBOC impacts were produced by the IMPLAN model based on the reported estimate of 2010 gross sales and employment. These direct effect expenditures were applied to the model in *Industry Sector 14 – Animal production, except cattle and poultry and eggs.* Combined, the direct, indirect, and induced effects from the operation of DBOC support $546,025 in labor income, approximately $1.1 million in value added, $2.0 million in total output, and 35 jobs within the county.

TABLE 3-8. IMPACT SUMMARY – DBOC OPERATIONS

Impact Type	Employment (Jobs)	Labor Income	Total Value Added	Output
Total Effect	34.9	$546,025	$1,117,575	$2,026,982

Source: MIG 2012; *DBOC 2010j[lxi]

Besides the industry sector containing oyster production, which is most affected by DBOC operations, other industry sectors reported by IMPLAN that see activity as a result of related spending include real estate establishments, food services and drinking places, agriculture/forestry support activities and wholesale trade businesses.

As described previously, the visitation and payroll associated with the Seashore accounts for 0.5 percent of the value added for Marin County. Value added from DBOC operations is equivalent to 1 percent of the Seashore's value added and approximately 0.006 percent of the county total.

DBOC reports that annual visitation for the oyster company is approximately 50,000 (DBOC 2010n[lxii]), 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 many of the annual visitors to DBOC also visit other areas during their trip to the Seashore. All vehicle traffic to DBOC must travel over Sir Francis Drake Boulevard., which is monitored by the Seashore to estimate overall Seashore visitation. However, this approach does not provide an accurate measure of DBOC-only visitation because Sir Francis Drake Boulevard is a primary Seashore road that also connects visitors to a variety of popular sites within the Seashore, such as Drakes Beach, Point Reyes Beach, and Point Reyes Lighthouse.

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 and sells 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[lxiii]). 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 35 percent of the oysters and between 13 and 33 percent of the shellfish produced in California, depending on the source of the data and matrix used for comparison. 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, Seashore 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 more than 40,000 hours of Volunteers-in-Parks, Student Conservation Assistants, and AmeriCorps service.

The Seashore maintains the necessary infrastructure to support annual visitation of more than 2 million people and provides offices, support structures, and limited housing for the permanent and seasonal Seashore staff. Park structures include the following:

- 3 visitor centers
- 3 research and environmental 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 its 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 divisions, grouped into the following functional 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 split-rail wooden 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.

The maintenance of the road and parking area adjacent to DBOC are outside the boundaries of the existing permits or the ROU. Therefore, these facilities are under the authority and jurisdiction of NPS. As such, road maintenance, sign development and installation, and custodial maintenance of the vault toilet are conducted by Seashore staff, consistent with maintenance of all other NPS facilities. 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 has been 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, along with the SUP, 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. Since 2007, the NPS has received more than 100 FOIA requests related to DBOC. Administrative efforts necessary to address these includes review of the requests, collection of the requested documents/data, collation, and subsequent delivery/mailing. Internal coordination associated with these requests has been managed by existing staff. NPS responses to the FOIA requests addressed to date are available for public review at http://www/nps.gov/pore/parkmgmt/planning_reading_room.htm.

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. Public Health Service 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 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 Seashore staff and 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 USFWS and 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 FOIA responsibilities. Under existing conditions, all maintenance, management, and administrative activities are accomplished with existing staff resources.

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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 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."

xi. 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."

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

xiii. 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."

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. 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."

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. 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.”

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

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. Wechsler 2004, 18: “only the data from the seven sampling periods from June 2003 through January 2004 were used for the statistical tests and descriptive accounts of the fish communities; this data incorporated 2,816 fish and twenty-nine species.”

xxi. Wechsler 2004, 23: “Table 6. Number of fish per ecological guild captured during the Drakes Estero Ichthyofauna – Oyster Mariculture study, Point Reyes National Seashore, December 2002 – January 2004.”

xxii. Wechsler 2004, 18: “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-nine percent of the total catch (Table 3).”

xxiii. Wechsler 2004, 18: “It is likely that these five species are permanent residents of Drakes Estero, as they were collected during all sampling periods.”

xxiv. Wechsler 2004, 18-19: “Six species were intermediate in abundance, represented by greater than ten but fewer than one hundred individuals. The remaining eighteen species were captured in lower frequencies with total catch per species consisting of ten individuals or fewer.”

xxv. Wechsler 2004, 19: “Table 3. Relative abundance of the fish captured during the Drakes Estero Ichthyofauna – Oyster Mariculture Study, Point Reyes National Seashore, December 2002 – January 2004.”

xxvi. Wechsler 2004, 18: “Because of sampling difficulties encountered during the December 2002 and April 2003 sampling efforts, only the data from the seven sampling periods from June 2003 through January 2004 were used for the statistical tests and descriptive accounts of the fish communities;”

xxvii. Wechsler 2004, 34: “Appendix A. List of all species captured during the Drakes Estero Ichthyofauna – Oyster Mariculture Study, Drakes Estero, Point Reyes National Seashore.”

xxviii. Anima 1990. Table 2, page 43. “Current Measurements”

> “Current measurements were taken just inside the mouth of the lagoon and along the straight portion of the main channel. Measurements were taken during the ebbing tide on August 16, 1986.”

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

xxx. Anima 1990. Page 94. “Water samples were collected from selected creeks during water years 1987-88, with the purpose of compiling data on the transport of plant nutrients to Drakes Estero and Ebbotts Lagoon.”

xxxi. Wechsler 2004. Appendices B “Environmental Characteristics Measured in Estero de Limantour and Schooner Bay, Point Reyes National Seashore (2002-2004)” and Appendix C “Water Column Variables Measured during the Drakes Estero Ichthyofauna – Oyster Mariculture Study, Point Reyes National Seashore (December 2002-January 2004)”.

xxxii. 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.”

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

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

xxxv. DBOC 2010v, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding public health.

> “CDPH, Drinking Water Branch, permits and regulates the DBOC water system. DBOC provides well water samples to the CDPH state lab on a weekly basis year-round. DBOC also provides samples for physical, heavy metal and all other sampling to remain in compliance with public water systems requirements.”

xxxvi. Goodman 2012, Letter from Corey Goodman to Acting Inspector General and Science Integrity Officer, Department of the Interior and Science Integrity Officer, National Park Service on April 24, regarding Allegations of false representations of data, concealment of data, and deception involving unnamed NPS and VHB employees who wrote, revised, and reviewed the NPS DEIS on Drakes Estero.

> Boat-to-microphone distance measurements were identified in powerpoint slides submitted as exhibits to the aforementioned letter.

xxxvii. NPS 2011m, “Public Use Counting and Reporting Instructions, Point Reyes National Seashore.” Available at http://www.nature.nps.gov/stats/CountingInstructions/PORECI1994.pdf. Accessed April 25, 2011.

> 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.

xxxviii. DBOC 2010n, 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.”

xxxix. DBOC 2010r, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding interpretive services.

> “Lastly, more forward-planning visitors call in advance to schedule a farm tour for their groups. We host a variety of groups for tours at the farm including, but not limited to, schools (from pre-school through graduate level), clubs, families, associations and non-profits.”

xl. Cummings 2011, Letter from Ginny Lunny Cummings to Point Reyes National Seashore on December 7, 2011 regarding public comments on the National Park Service Draft Environmental Impact Statement Special Use Permit.

> “Many [visitors] tell us they come to PRNS only to visit the oyster farm, not to hike, kayak, bird watch, visit beaches or the lighthouse or to whale watch. Rather, these visitors enjoy picnicking with family and friends at the oyster farm. Picnicking is an historical and important part of our farm visiting public’s visitor experience and recreation.”

xli. DBOC 2010r, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding interpretive services.

> "Our comprehensive tours of Drakes Bay Oyster Company include the historical, cultural and ecological aspects of oyster farming in Drakes Estero. We also regularly include the broader subjects of sustainable agriculture, organic production and the history of other generational Seashore food producers within PRNS, including the dairy and beef ranches."

xlii. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "DBOC plays an essential role in educating the public on the history of oyster farming in PRNS, oysters' values as a beneficial source of protein, coastal ecosystems, and the nature and efficacy of organic sustainable farming."

xliii. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "It [DBOC] provides almost daily tours, at no cost, for the public and students from elementary through graduate school."

xliv. DBOC 2010r, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding interpretive services.

> "Some visitors enjoy simply reading and looking at our displays, viewing employees engaged in their daily work and regularly photographing images of the working farm"

xlv. SHPO 2011, Letter from State Historic Preservation Officer, Office of Historic Preservation, Department of Parks and Recreation, to Point Reyes National Seashore on August 4, regarding request for concurrence, Determination of Eligibility of Johnson's Oyster Company (aka Drake's Bay Oyster Company), Point Reyes National Seashore.

> "Through this evaluation, NPS concludes that while Johnson's Oyster Company appears to be significant under the NRHP Criterion A, it lacks historic integrity. Therefore, the property is not eligible for listing on the NRHP. After reviewing this determination of eligibility, I concur that the property is not eligible for listing on the NRHP."

xlvi. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "DBOC is the only farm of any kind within PRNS permitted to provide visitor and interpretive services to the visiting public. Without DBOC, Seashore visitors would completely lose any opportunity for services and interpretation within the Pastoral Zone or PRNS."

xlvii. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "As part of its visitor services, DBOC also provides bathrooms, directions, information about PRNS, and PRNS publications to the visiting public."

xlviii. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit.

> "In addition, DBOC is accessible to disabled visitors in the PRNS."

xlix. Cummings 2011, Letter from Ginny Lunny Cummings to Point Reyes National Seashore on December 7, 2011 regarding public comments on the National Park Service Draft Environmental Impact Statement Special Use Permit.

> "DBOC has CPR and First Air trained staff and supplies, in the event of a visitor emergency. Additionally, as cell phones do not work anywhere near DBOC, DBOC offers its land line phone to visitors in need upon request. DBOC provides safe and sanitary public restrooms."

l. DBOC 2011i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore Superintendent on December 9, 2011 regarding Drakes Bay Oyster Company's comments on National Park Service Draft Environmental Impact Statement for Special Use Permit. Attachment: Comments on Drakes Bay Oyster Company Special Use Permit Environmental Impact Statement Point Reyes National Seashore, prepared by ENVIRON International Corporation.

> "All 22 workers at DBOC, who would lose their jobs if DBOC operates were cease, are of Hispanic or Latino ethnicity, and most also fall into the category of low-income."

li. PCSGA 2011, Letter from the Pacific Coast Shellfish Growers Association to Point Reyes National Seashore on December 12, 2011 regarding Pacific Coast Shellfish Growers Association's comments on National Park Service Draft Environmental Impact Statement for Drakes Bay Oyster Company Special Use Permit.

> "Oyster growers around the country are struggling to keep up with demand for their product; such demand would increase if Drakes Bay Oyster Company is not permitted to continue its operations."

lii DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, 2012,regarding DBOC responses to the National Park Service's April 2012 questions.

> "DBOC requests that all financial information remain confidential."

liii. DBOC 2010i, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on November 15, 2010, regarding business plan. Attachment 6a "DBO 2005-2010 Income and Expenses." Specific data is not provided here, at the request of DBOC.

liv. DBOC 2012b. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on June 5, 2012 regarding DBOC responses to National Park Service's April 2012 questions.

> "Approximately 25% of DBOC product is sold in jars and 75% is sold live in the shell."

lv. DBOC 2012b. Letter from Drakes Bay Oyster Company to Point Reyes National Seashore on June 5, 2012 regarding DBOC responses to National Park Service's April 2012 questions.

> "Approximately 40% of DBOC income is from onsite retail sales, 40% is sold directly to local market and restaurants – all delivered by DBOC directly, 18% is sold to Tomales Bay shellfish growers, and 2% is sold through a wholesale seafood distributor based in San Francisco."

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

lvii. DBOC 2010k, Letter from Drakes Bay Oyster Company to Point Reyes National Seashore 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.”

lviii. DBOC 2010n, 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.”

lix. CDFG 2011f, Letter the California Department of Fish and Game to Point Reyes National Seashore on December 22, 2011 regarding California Department of Fish and Game’s comments on National Park Service Draft Environmental Impact Statement for Drakes Bay Oyster Company Special Use Permit.

> “DFG, page 223, Paragraph 2: The production rates for Drakes Estero are similar to production rates in Tomales Bay. Please make note that Tomales Bay production is a combined total of 1 0 leases held by 6 companies.”

lx DBOC 2012b, Letter (with attachments) from Drakes Bay Oyster Company to Superintendent, Point Reyes National Seashore on June 5, 2012,regarding DBOC responses to the National Park Service’s April 2012 questions.

> “DBOC requests that all financial information remain confidential.”

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

lxii. DBOC 2010n, 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.”

lxiii. DBOC 2010n, 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.”