3.4 WATER QUALITY

3.4.1 Introduction

3.4.1.1 Definition of Resource

Water quality describes the chemical and physical composition of water as affected by natural conditions and human activities. For the purposes of this analysis, marine water quality is evaluated with respect to possible release of hazardous constituents from aircraft, missiles, and targets, and freshwater quality is evaluated with respect to possible release of petroleum hydrocarbon products from aircraft and motor vehicles, and sedimentation resulting from construction activities at San Nicolas Island.

Water resource regulations focus on the right to use water and protection of water quality. The principal federal laws protecting water quality are the Clean Water Act (CWA), as amended (33 U.S.C. § 1251 et seq.) and the Safe Drinking Water Act (42 U.S.C. § 300f et seq.). Both laws are enforced by the U.S. Environmental Protection Agency (USEPA 1995). The CWA provides protection of surface water quality and preservation of wetlands. The Safe Drinking Water Act is directed at protection of drinking water supplies.

At the state level, the Porter-Cologne Water Quality Control Act (California Water Code §§ 13000-13999.10) gives the State Water Resources Control Board (SWRCB) and nine Regional Water Quality Control Boards (RWQCBs) responsibility for protection of the waters within their regions. The regional boards are also responsible for implementing provisions of the CWA delegated to states, such as the National Pollutant Discharge Elimination System (NPDES), which regulates point (industrial) and non-point (storm water) sources of pollutants.

3.4.1.2 Regional Setting

The Sea Range straddles Point Conception which is considered a major geographic feature that affects marine water resources. North of Point Conception, the marine waters are under the influence of the cold, southward flowing California Current. The shape of California's coastline south of Point Conception creates a broad ocean embayment known as the Southern California Bight (SCB). The SCB encompasses the area from Point Conception south to Mexico and is influenced by two major oceanic currents: the southward flowing, cold-water California Current and the northward flowing, warm-water California Countercurrent (Figure 3.4-1). These currents mix in the SCB and strongly influence patterns of ocean water circulation and temperatures.

A significant marine water resource at Point Mugu is Mugu Lagoon. Mugu Lagoon is one of the largest salt marshes in southern California. Unlike most lagoons along the California coast, it is relatively undisturbed and provides a habitat for a diverse assemblage of marine organisms. Mugu Lagoon is regionally significant as it is one of the last lagoons left in southern California containing unique and sensitive resources.

3.4.1.3 Region of Influence

The region of influence (ROI) for marine water resources consists of the ocean waters off Point Mugu, Mugu Lagoon, and the Point Mugu Sea Range. The Sea Range extends offshore of San Luis Obispo County and includes the northern portion of the SCB. These water resources are valuable for economic, municipal, and recreational purposes, as well as for their relationship to the natural environment.

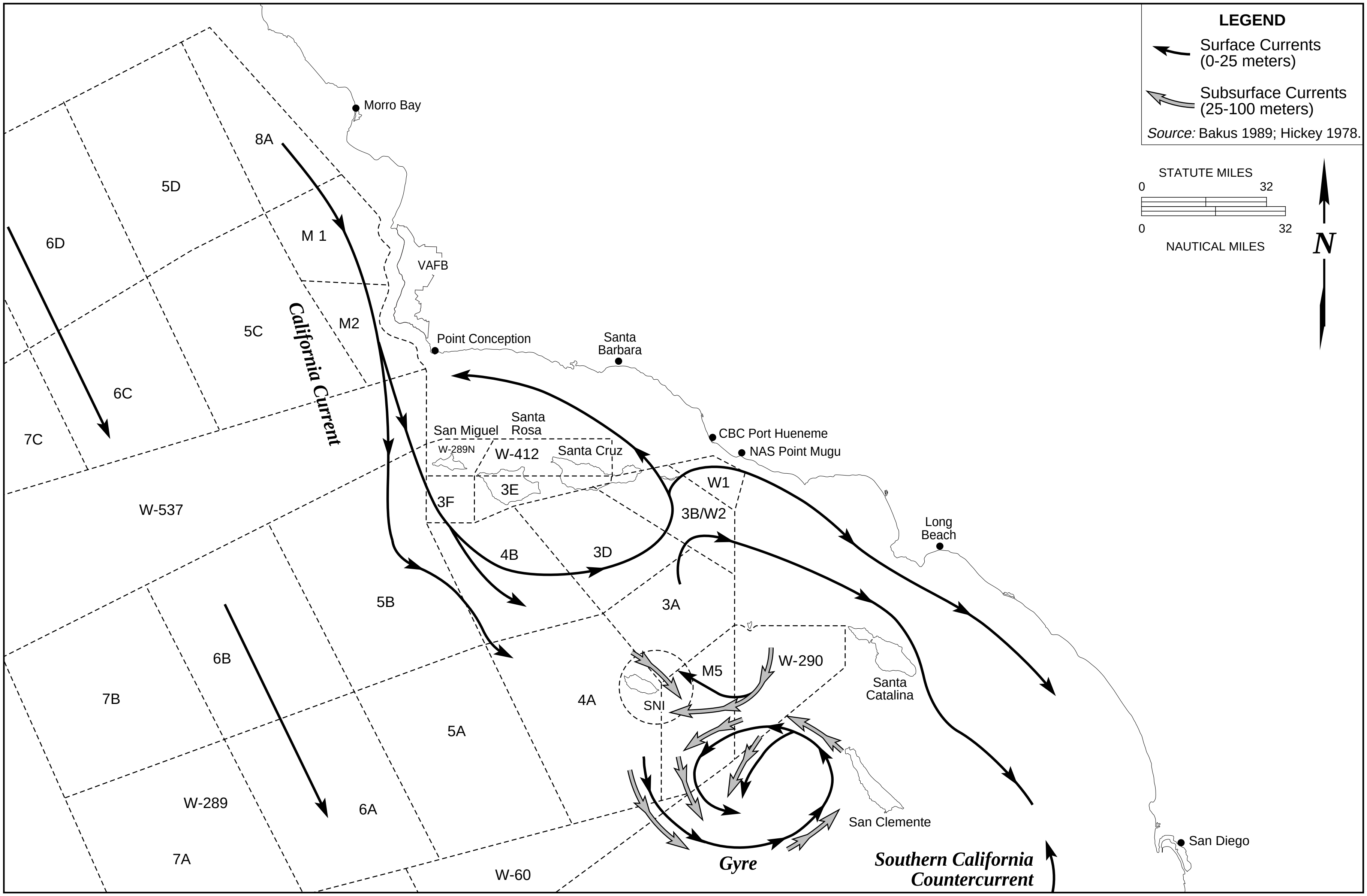


Figure 3.4-1
Ocean Circulation Patterns in the Point Mugu Sea Range

Freshwater resources include all surface water and groundwater at Point Mugu and at San Nicolas Island. Other Channel Islands where Navy support facilities are located (i.e., San Miguel Island, Santa Rosa Island, and Santa Cruz Island) are not addressed since the alternatives analyzed in this EIS/OEIS (including the No Action Alternative) would not impact freshwater resources at these sites. Freshwater resources are valuable for economic, municipal, and recreational purposes, as well as for their relationship to the natural environment.

3.4.2 Point Mugu Sea Range

3.4.2.1 General Marine Environment

A - Circulation

The Sea Range comprises the Santa Barbara Channel and Channel Islands which are located at the transition between two distinct biogeographic coastal provinces: the Oregonian and the Californian. The cold, temperate waters of the California Current flow from the north to meet the warmer waters of the California Countercurrent just south of Point Conception. These conditions influence distribution and diversity of habitats and resources throughout the area. When the cold California Current reaches Point Conception, the direction of flow carries it away from the shoreline which creates a large gyre, or eddy, in the SCB (see Figure 3.4-1). The return flow of this gyre, the California Countercurrent, moves waters from southeast to northwest, through the southern Channel Islands toward the mainland. The resulting gyres and eddies affect the distribution of marine fauna and flora leading to the presence of both cold and warm temperature species which thrive in the transition zone, and overlap in their distributions. There are also cyclical activities which contribute to the diversity of marine life. An upwelling current (where nutrient-rich deep waters are drawn to the surface) in the SCB occurs from February or March through August. High nutrient levels combined with increasing day length and light intensity produce exceptionally high phytoplankton and algae production. This increase in food supply supports even greater numbers of fish, shellfish, and other marine life.

B - Marine Water Characteristics

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium can be represented by a variety of indicators including temperature, salinity, dissolved oxygen, and nutrient levels. The following discussion characterizes in general terms the major determinants of marine water quality in the SCB.

Temperature

Surface temperatures are affected by atmospheric conditions and tend to fluctuate along lines of latitude. Surface temperatures of waters along the coast of the SCB range from approximately 54° F (12° C) in the winter to 70° F (21° C) in the summer. Surface water temperatures can show seasonal variation in association with upwelling, climatic conditions, and latitude (Tait 1980).

Chemical Characteristics

Pertinent chemical features associated with marine water quality include hydrogen ion concentration (pH), dissolved oxygen, and nutrients. The majority of ions present in seawater consist of sodium, chloride, potassium, calcium, magnesium, and sulfate.

The marine environment has a high buffering capacity due to the presence of dissolved elements, particularly carbon and hydrogen. Most of the carbon in the sea is present as dissolved inorganic carbon that originates from the complex equilibrium reaction of dissolved carbon dioxide (CO_2) and water. This carbon dioxide-carbonate equilibrium system is the major buffering system in seawater which maintains a pH between 7.5 and 8.5.

Surface waters are usually saturated or supersaturated with dissolved oxygen as a result of photosynthetic activity and wave mixing. Dissolved oxygen levels at the surface fluctuate between 5.4 and 5.9 milliliters per liter (ml/L) (over 100 percent oxygen saturation), while levels at depths below the surface remain more constant between 0.4 and 0.6 ml/L (California Cooperative Fisheries Investigation [CALCOFI] 1982).

Nutrients are chemicals or elements necessary for production of organic matter. Major nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. The nitrate concentration of water in the nearshore California Current varies annually from 0.1 to 10.0 micrograms per liter (µg/L). The lowest concentrations typically occur in the summer months. At a depth of 33 feet (10 m), concentrations of phosphate and silicate in the California Current typically range from 0.25 to 1.25 µg/L and 2 to 15 µg/L, respectively.

C - Marine Sediments and Bathymetry

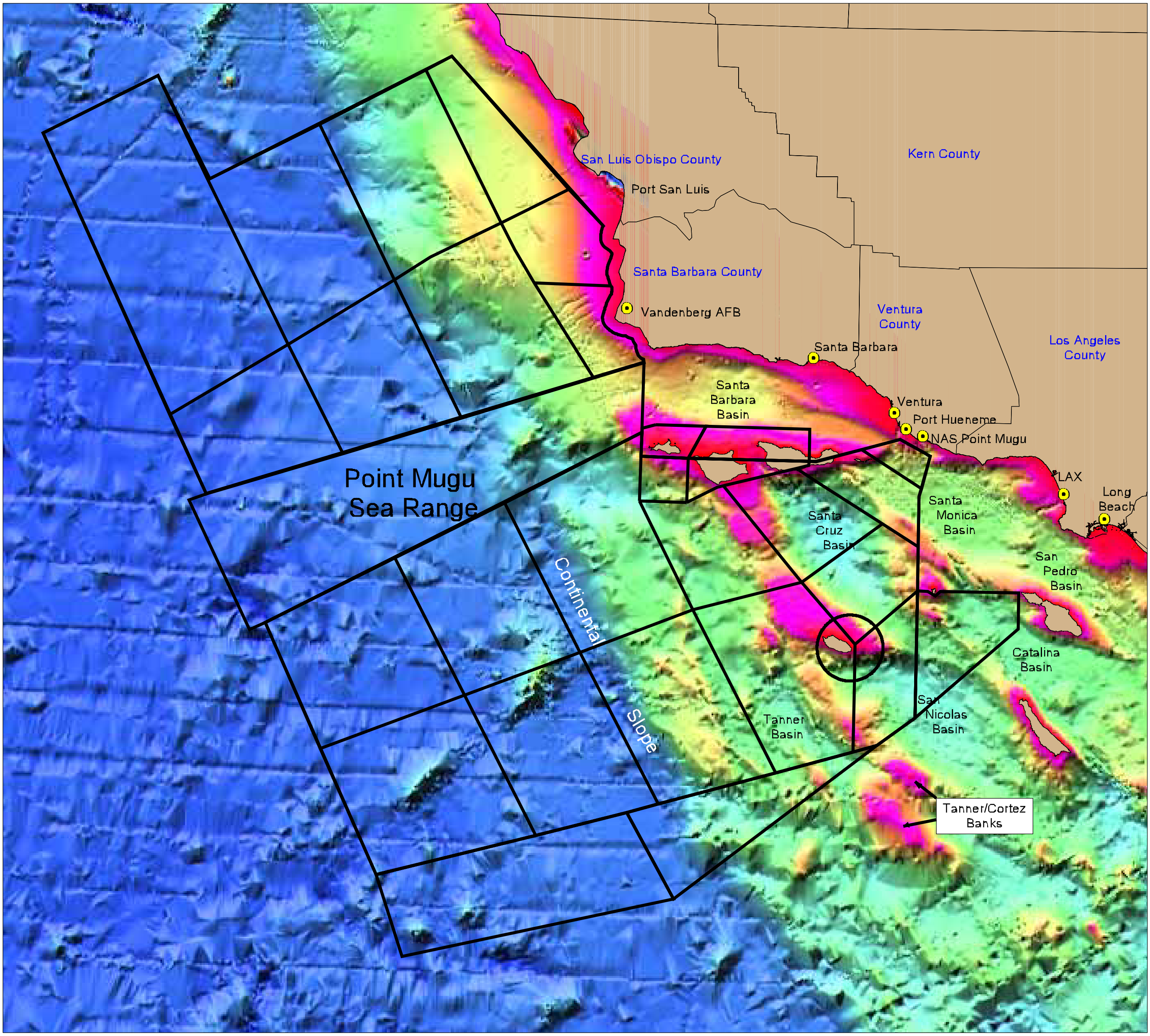
Much of the ocean floor in the northern portion of the SCB consists of the Santa Barbara, Santa Cruz, and Santa Monica basins (U.S. Department of Commerce 1980). The Santa Barbara Basin has a relatively gradual slope that reaches depths of 1,970 feet (600 m). The relatively wide Santa Monica Basin has an irregular shape, complicated by the presence of two submarine canyons, which have depths that exceed 2,300 feet (700 m). The Santa Cruz Basin also has a submarine canyon that reaches depths greater than 4,920 feet (1,500 m). North of Point Conception, the ocean floor consists of the continental shelf and slope that reaches depths exceeding 9,800 feet (3,000 m). The sediment types in these areas are generally composed of 35 to 85 percent fines (silts and clays) and 15 to 65 percent sand. There does not appear to be any significant trends in sediment distribution with respect to size, water depth, or distance offshore (SAIC and MEC 1995).

An important feature of the SCB and the northern Channel Islands is the accentuated bottom relief and varied bottom substrate. The northern Channel Islands are actually peaks of extensive offshore ridges. A relatively shallow island shelf extending to a depth of about 330 feet (100 m) surrounds the islands, usually extending from 3 to 6 NM (6 to 11 km) from the island coast. At this depth the bathymetry either plunges steeply to a deep coastal basin perhaps 1,640 to 2,460 feet (500 to 750 m) in depth or slopes more gradually to the peak of submerged ridges perhaps 600 to 1,150 feet (180 to 350 m) in depth (Figure 3.4-2). Figure 3.4-3 shows the shallow waters of the Sea Range in the vicinity of the northern Channel Islands.

3.4.2.2 Marine Water Quality

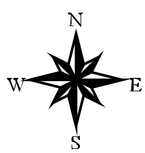
The SWRCB adopted the Water Quality Control Plan for Ocean Waters of California in 1974, and amendments have been made in 1988, 1990, and 1997 (SWRCB and California Environmental Protection Agency [Cal/EPA] 1997). The amended plan (The Ocean Plan) establishes beneficial uses and water quality objectives for waters of the Pacific Ocean adjacent to the California coast outside of enclosed bays, estuaries, and coastal lagoons. The Ocean Plan prescribes effluent quality requirements and management principles for waste dischargers and specific waste discharge prohibitions. It also contains a

Marine Bathymetry in the Point Mugu Sea Range



Legend

Depth (m)
- 0-50
- 50-150
- 150-200
- 200-500
- 500-1,000
- 1,000-2,000
- 2,000-4,000+
- Point Mugu Sea Range



Projection: Universal Transverse Mercator, Zone 11
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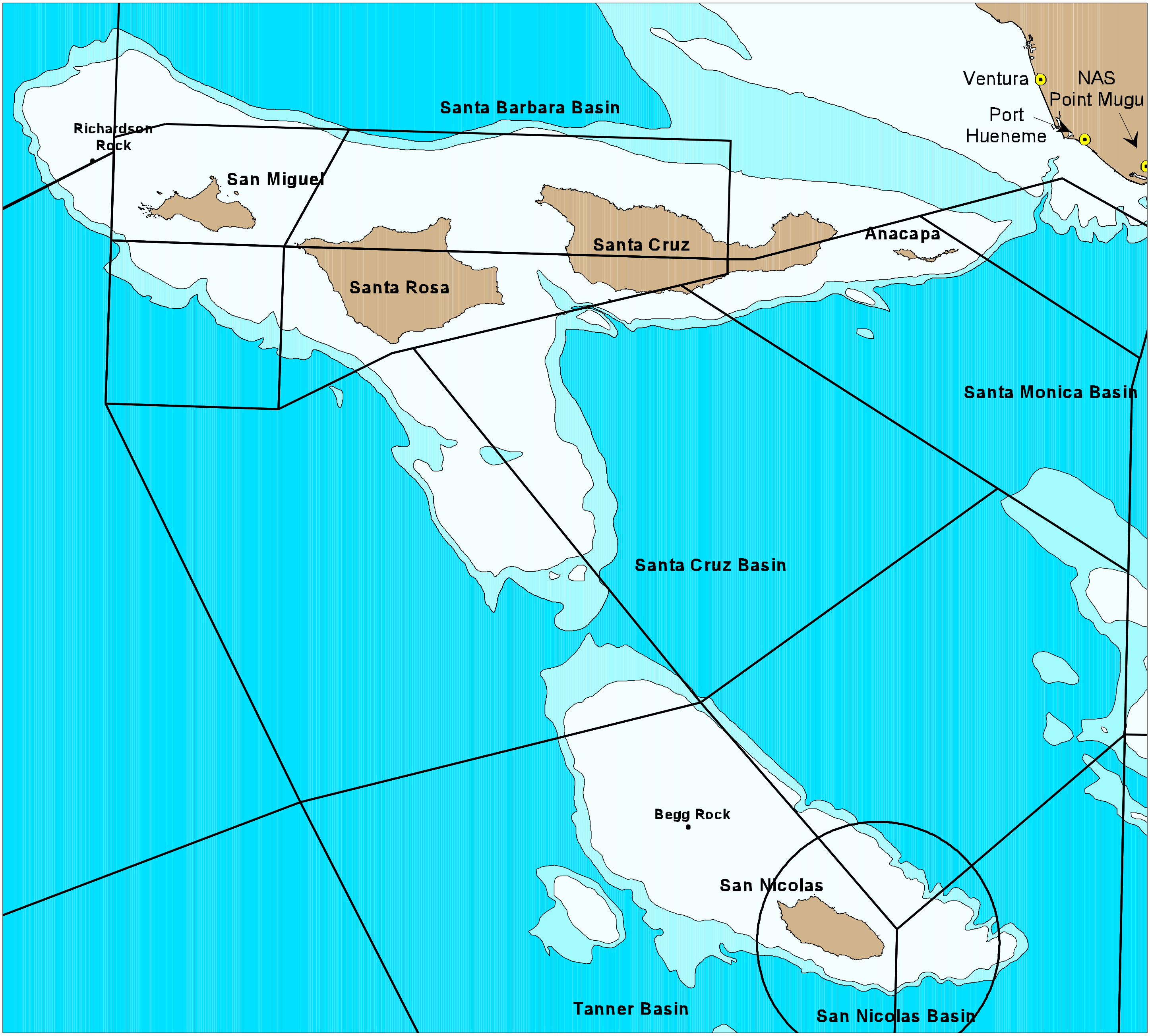
Scale shown is 1:2,750,000
Source: NOAA.

Figure

3.4-2

Shallow Water Areas



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- 0 - 600 feet
- 600 - 1,200 feet
- 1,200 + feet
- Point Mugu Sea Range

N W E S

20 0 20 Nautical Miles

Projection: Universal Transverse Mercator, Zone 11
North American Datum of 1927
Scale shown is 1:750,000
Source: NOAA.

Figure 3.4-3

prohibition against discharge of specific hazardous substances and sludge, bypass of untreated waste, and discharges that impact Areas of Special Biological Significance (ASBS). However, the SWRCB may grant exceptions to allow a discharge into an ASBS provided that the exception will not compromise protection of ocean waters for beneficial uses and that the public interest will be served (California Regional Water Quality Control Board [CRWQCB] 1994). The following areas have been designated as ASBS (Figure 3.4-4):

- Latigo Point to Mugu Lagoon: Ocean water within a line originating from Latigo Point (southern boundary), following the mean high-tide line to a distance of 1,000 feet (300 m) offshore or to the 100-foot (30-m) isobath, whichever is greater, to a point lying due south of Laguna Point (northern boundary)

- San Nicolas Island and Begg Rock: Waters surrounding San Nicolas Island and Begg Rock to a distance of 1 NM (1.9 km) offshore or to the 300-foot (91-m) isobath, whichever is greater.

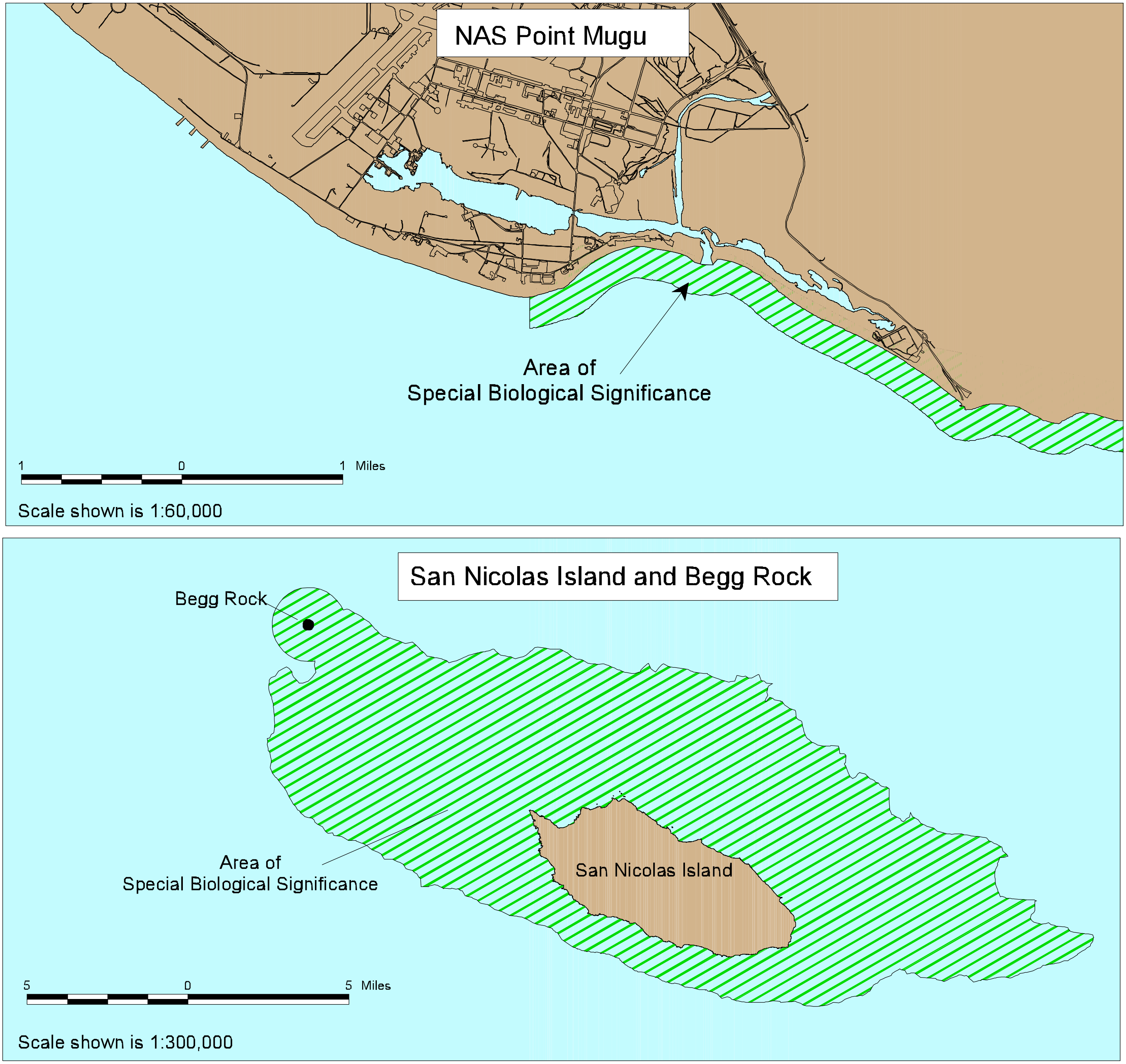
Most of the marine water pollution within the SCB area stems from municipal discharges. The distance from the mainland, the large diluting volume of the ocean, and the shelves and basins near the mainland where many pollutants settle ensure high water quality in the Sea Range. A potential source of water pollution comes from the oil and gas development industry. As activity increases from offshore oil and gas development, the potential for discharge into the Sea Range also increases. In recent years, an increase in oil leaks, accidental spills, discharge of formation water, drill mud, sediment, debris, and sludge in the area have decreased water quality (National Park Service [NPS] 1985).

The CWA prohibits discharge of hazardous substances into or upon U.S. waters out to 200 NM (370 km). In addition, shipboard waste handling procedures for commercial and Navy vessels govern the discharge of not only hazardous wastes but also non-hazardous waste streams. The categories of wastes include the following:

- Liquids
  - "Blackwater" (sewage)
  - "Greywater" (water from deck drains, showers, dishwashers, laundries, etc.)
  - Oily Wastes (oil-water mixtures)
- Solids
  - Garbage (non-plastic)
  - Garbage (plastics, non-food contaminated)
  - Garbage (plastics, food contaminated)
- Hazardous Wastes
- Medical Wastes

Table 3.4-1 summarizes the waste stream discharge restrictions for Navy vessels at sea. Historically, vessel discharge standards have been established individually by coastal states. This has been problematic since standards vary from state to state throughout the U.S. To resolve this situation, Uniform National Discharge Standards (UNDS) for military vessels have been proposed by USEPA. These regulations will provide consistent discharge standards for all military vessels.

Areas of Special Biological Significance



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Projection: Universal Transverse Mercator, Zone 11
North American Datum of 1927
Source: SWRCB & CalEPA 1997.

Legend

Areas of Special Biological Significance (ASBS)

Figure 3.4-4

Table 3.4-1. Discharge Restrictions for Navy Ships

Area	Type of Waste		
	Blackwater (Sewage)	**Greywater**	**Oily Waste**
U.S. Waters (0-3 NM)	No discharge	If vessel is equipped to collect greywater, pump out when in port. If no collection capability exists, direct discharge permitted.	Discharge allowed if waste has no visible sheen. If equipped with Oil Content Monitor (OCM), discharge < 15 ppm oil.
U.S. Contiguous Zone (3-12 NM)	Direct discharge permitted	Direct discharge permitted	Same as 0-3 NM.
12-25 NM from shore	Direct discharge permitted	Direct discharge permitted	If equipped with OCM, discharge < 15 ppm oil. Ships with an oil/water separator (OWS) but no OCM must process all bilge water through the OWS.
> 25 NM from shore	Direct discharge permitted	Direct discharge permitted	Same as 12-25 NM
> 50 NM from shore	Direct discharge permitted	Direct discharge permitted	Same as 12-25 NM
	Garbage (Non-plastic)	**Garbage (Plastic) (Non-food Contaminated)**	**Garbage (Plastic) (Food contaminated)**
U.S. Waters (0-3 NM)	No discharge	No discharge	No discharge
U.S. Contiguous Zone (3-12 NM)	Pulped garbage may be discharged	No discharge	No discharge
12-25 NM from shore	Bagged shredded glass and metal waste may be discharged > 12 NM	No discharge	No discharge
> 25 NM from shore	Direct discharge permitted	No discharge	No discharge
> 50 NM from shore	Direct discharge permitted	No discharge	No discharge
	Hazardous Materials	**Medical Wastes**	
U.S. Waters (0-3 NM)	No discharge	No discharge	
U.S. Contiguous Zone (3-12 NM)	No discharge	No discharge	
12-25 NM from shore	No discharge	No discharge	
> 25 NM from shore	No discharge	No discharge	
> 50 NM from shore	No discharge	If health and safety is threatened, discharge of negatively buoyant sterilized waste packages is permitted.	
>200 NM from shore	Discharge permitted under certain circumstances. However, to the maximum extent practicable, ships shall retain hazardous materials onboard for shore disposal.	Same as Hazardous Materials restrictions.	

Source: Northern Division 1996; Office of the Chief of Naval Operations 1994.

3.4.3 Point Mugu

NAS Point Mugu is located on a broad coastal plain adjacent to the Pacific Ocean and the Mugu Lagoon. Rainfall in the region averages approximately 10.5 inches (27 cm) per year. The base is generally level and slopes gently southward from the residential area in the north to the tidal flats surrounding Mugu Lagoon. Upland elevations range from about 7 to 12 feet (2 to 4 m) MSL, with most of the base below 10 feet (3 m) MSL.

The ROI for Point Mugu includes the nearshore marine environment, Mugu Lagoon (both marine and freshwater influences), and the onshore water environment. Water quality for these areas is discussed below.

3.4.3.1 Mugu Lagoon

A - Marine Influences

Mugu Lagoon is the largest surface water feature of NAS Point Mugu and encompasses 350 acres (142 ha) of water and tidal flats (Western Division 1986). The lagoon runs parallel to the coast for 3.5 miles (5.6 km) and is never greater than 0.6 mile (1.0 km) wide (Onuf 1987). It is composed of two long arms projecting out from a broader central basin (Figure 3.4-5). Mugu Lagoon is part of 2,500 acres (1,010 ha) of wetlands that have been designated a significant ecological resource protected by the CWA. A discussion of the lagoon's biological resources is included in Section 3.5.3.1.

Circulation

With the exception of freshwater influences generated during storm events, Mugu Lagoon is primarily marine-dominated. Therefore, tides are responsible for the majority of the day-to-day input and removal of materials. The tidal prism (volume of water moved in and out of the lagoon by tides) is large compared to the volume retained at lowest water. Persistent southeast longshore currents prevail along the coast in this region and assure that very little of the water departing the lagoon on the ebb tide is returned on the following flood tide.

Because of the relatively large tidal exchange of water within the lagoon and the narrow opening to the sea, currents are fast near the mouth. Currents were measured at 2.3 miles/hr (3.7 km/hr) on a neap (smallest tidal range) tide, and were estimated to be more than 6 miles/hr (10 km/hr) on spring (largest tidal range) tides (Onuf 1987). In open expanses of water away from the mouth, tidal currents are slow and are probably insufficient to cause much mixing. However, these areas are shallow, and water movement generated by light breezes is sufficient to cause mixing. Dissolved oxygen measurements of water collected near the bottom indicate anaerobic conditions do not occur. In general, dissolved oxygen levels in the lagoon are high because of abundant tidal exchange and shallow water depths. The only exception is reduced conditions beneath senescent mats of the green algae, *Enteromorpha* spp. and *Ulva* spp. that are found in the deepest parts of the lagoon and in a wrack line at the edge of the marsh.

Marine Water Characteristics

Temperature. Water temperatures inside the lagoon are usually similar to those of the open ocean, although temperatures may become higher and much more variable in the lagoon shallows and salt marsh ponds. The average water temperature for the June-September months is 66° F (19° C); for January, the average is 55° F (13° C). However, water temperatures up to 85° F (29° C) have been recorded during

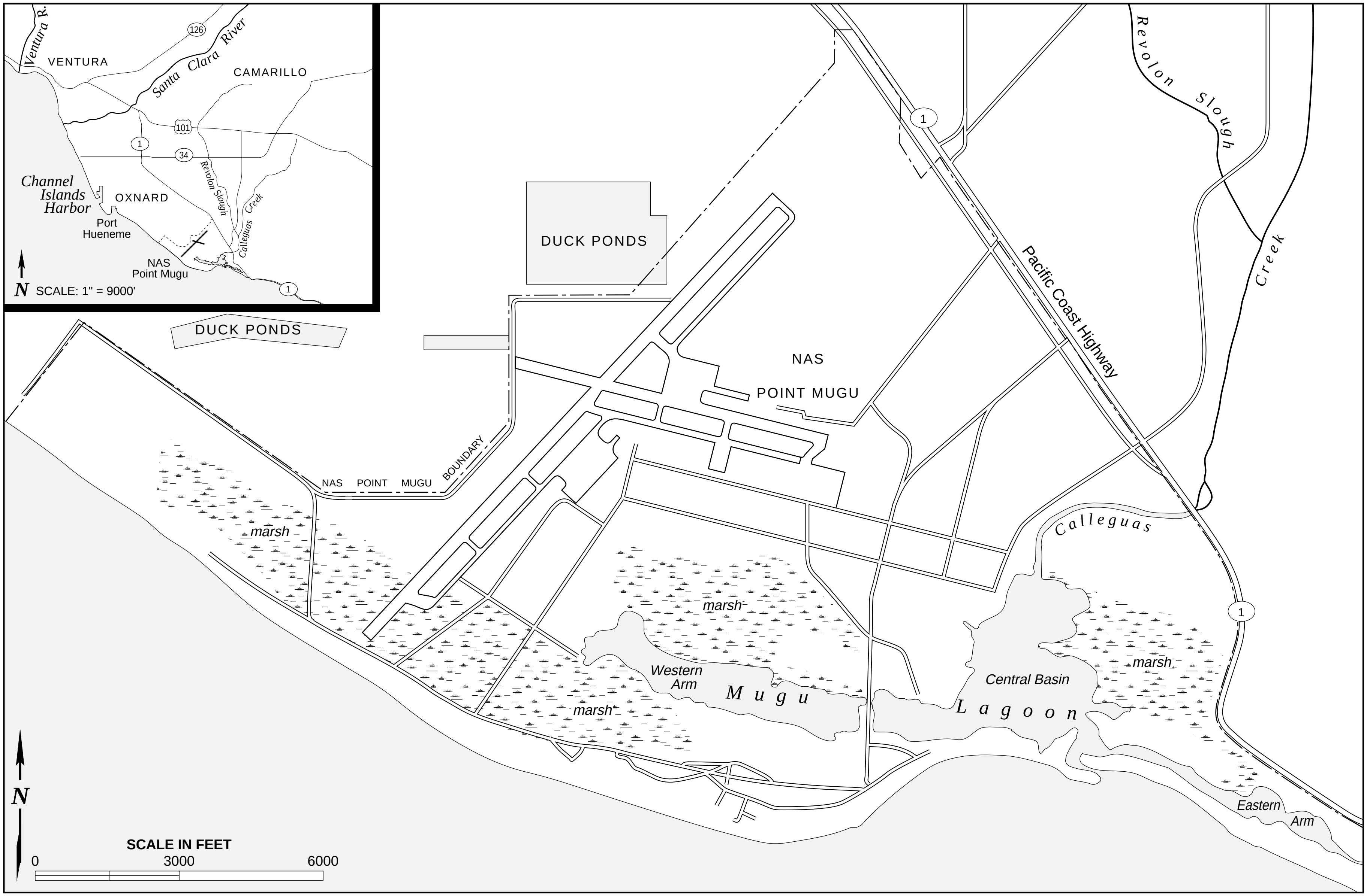

Figure 3.4-5
Surface Water Resources in the Vicinity of NAS Point Mugu

low tide conditions on hot summer days. Abrupt temperature changes of 15° F (9° C) or more are not uncommon when cold ocean waters flow into the lagoon and meet waters that have been heating up in the shallow lagoon (Onuf 1987).

Salinity. Salinities within the lagoon are generally similar to those of the ocean, with an average salinity of about 34 parts per thousand (ppt) (Onuf 1987). No long-term measurements of salinity have been taken at Mugu Lagoon. However, given the virtual absence of surface flows of freshwater except during storms, there is no reason to expect freshwater dilution except near the mouth of Calleguas Creek and during rainfall events.

The abundance of long-lived stenohaline organisms (organisms with little tolerance to salinity changes) suggests that long-term salinity concentrations below 34 ppt are rare. Poor circulation and rapid evaporation in the shallow eastern and western arms of the lagoon increase salinities, while heavy winter run-off causes dilution. Storm run-off tends to rapidly flow seaward without significantly affecting the eastern and western arms of the lagoon.

Chemical Characteristics. High-tidal exchange rates coupled with shallow water allows for mixing by the wind which keeps the dissolved oxygen concentrations in the water column high (Onuf 1987). Concentrations of other nutrients have not been studied.

Light Penetration. Light penetration varies greatly throughout the lagoon depending on tidal cycle, turbidity, water depth, and presence or absence of algae and phytoplankton blooms. Currently, at least two species of algae are found in the lagoon, and prior to the storms of 1978 eelgrass beds were found throughout the lagoon. This indicates that light penetration in the lagoon is, and has previously been, adequate to support marine flora.

Marine Sediments and Bathymetry

Onuf (1987) investigated the sediment characteristics of the eastern arm and determined that two sediment gradients existed. The sediments become finer grained from west to east (as distance from the mouth increased) and south to north (from the sand spit to the salt marsh). The east-west gradient is believed to be due to reduced water velocities of tidally generated currents as the distance away from the mouth increases. The south-north gradient appears to be due to a combination of factors. The south shore of the lagoon is enriched by sand from high surf and/or spring tides. The high water motion also appears to be able to keep fine particles in suspension. Moving northward, silt and clays are common in the salt marsh due to the weak tidal currents, small volume of moving water, and the presence of vegetation, which can further reduce water motion and can cause the settlement of fine particles.

B - Freshwater Influences

Freshwater Sources

There are two major influences on surface water hydrology within Mugu Lagoon: 1) ocean tides and the associated flushing of the lagoon waters, and 2) freshwater input from various sources. Tidal height and movement also influences groundwater flow.

Calleguas Creek is the principal stream draining NAS Point Mugu (see Figure 3.4-5); it originates in the Santa Susana Mountains and flows for about 37 miles (60 km) to the Pacific Ocean at Mugu Lagoon. Runoff to the creek from upstream areas includes treated sewage effluent and agricultural return flows potentially contaminated by pesticides. The largest tributary of Calleguas Creek is Conejo Creek, which drains an area of approximately 66 square miles (171 km^2). Conejo Creek rises in the Santa Monica Mountains and the Simi Hills and courses for 27 miles (43 km), joining Calleguas Creek at a point nearly 5 miles (8 km) upstream from the Pacific Ocean. Revolon Slough is the second largest tributary, draining 52 square miles (135 km^2) and joining Calleguas Creek about 1 mile (1.6 km) upstream from the Pacific Ocean.

Revolon Slough is also a major source of drainage to the lagoon, combining with Calleguas Creek after crossing the NAS Point Mugu boundary. Oxnard Drainage Ditches No. 2 and No. 3 enter NAS Point Mugu from the west and discharge into Mugu Lagoon. These ditches receive irrigation return flows from the surrounding farmlands. Approximately 18 square miles (47 km^2) of agricultural land north of NAS Point Mugu and west of Revolon Slough are drained by Ditch No. 2, while Ditch No. 3 drains the narrow coastal strip between the western arm of Mugu Lagoon and the adjacent Southern California Edison Company, Ormond Beach Generating Station (Western Division 1986).

The steep topography of the mountains promote rapid run-off, and extensive flooding along Calleguas Creek and its largest tributary, Conejo Creek, is common. During these times, large amounts of sediment are also transported and deposited in the lagoon. Because of the shallow nature of the lagoon, a large input of freshwater can completely flush the lagoon for short periods rather than create a longitudinal salinity gradient that moves up or down the estuary as the freshwater input changes. Agricultural irrigation and sewage plant return waters also make for a continuous, small input of freshwater into the lagoon. Because much of this water comes directly from intensively cultivated lands, toxic substances and nutrients may affect water quality.

Water Quality

Increased urbanization of the upstream watershed affects both quantity and quality of freshwater discharging into Mugu Lagoon. Within the past 30 to 40 years, agricultural development and urbanization have increased runoff into Calleguas Creek to the point that the lower creek course flows almost continually (Western Division 1986). Paving associated with increased urban development has increased the volume of runoff generated in the watersheds and, coupled with the effects of stream channelization, has caused severe stream bed and bank erosion in some areas. As a result of water quality deterioration, state and local agencies have coordinated and implemented regulatory programs to identify the source and cause of water quality degradation. These programs have been designed to classify the type of point source pollutants, and to monitor the extent of pollutants discharged into the Calleguas Creek basin.

“Beneficial uses” are the basis for water quality protection under the Los Angeles Region Basin Plan, within which NAS Point Mugu and Mugu Lagoon are located. The existing beneficial uses for Mugu Lagoon include navigation, non-contact water recreation, commercial and sport fishing, shellfish harvesting, and preservation of estuarine, wetland, and marine habitats for terrestrial and aquatic organisms (CRWQCB 1994). Water quality objectives for enclosed bays and estuaries, such as Mugu Lagoon, were established by the SWRCB to ensure the reasonable protection of beneficial uses and the prevention of nuisance. These objectives include:

- Enclosed bay and estuarine communities and populations (including vertebrate, invertebrate, and plant species) shall not be degraded as a result of the discharge of waste.
- The natural taste and odor of fish, shellfish, or other enclosed bay and estuarine resources used for human consumption shall not be impaired.

- Toxic pollutants shall not be discharged at levels that will bioaccumulate in aquatic resources to levels which are harmful to human health.
- The concentration of contaminants in waters which are existing or potential sources of drinking water shall not occur at levels which are harmful to human health.
- The concentration of toxic pollutants in the water column, sediments, or biota shall not adversely affect beneficial uses (CRWQCB 1994).

Once beneficial uses and water quality objectives are established, it is possible to form water quality standards, which are mandated for all water bodies within the state under the California Water Code (CWC) and the CWA.

Regional water quality issues in the Oxnard Plain area were first assessed by the Ventura Regional County Sanitation District during a 3-year program initiated in 1975. A second phase of the program, which sought to develop solutions to identified problems, was conducted in 1979 and 1980. The County Water Quality Planning Program identified several water quality problems, of which saltwater intrusion of groundwater supplies in the Oxnard Plain was considered to be the most significant. Other water quality problems identified included non-point sources such as septic tank discharge and hillside agricultural erosion. Records also indicate that the lagoon has received wastes from the Navy's past disposal practices including waste oil, solvents, JP-4, JP-5, aviation gas, motor gasoline, helicopter fuel, detergents, degreaser, grit, paint, stripping waste, trichloroethane, acid, hydrogen peroxide, aniline, dimethyl hydrazine, tin, and zinc. Storm sewers and drainage ditches that lead to Mugu Lagoon have also received waste oil, solvents, paint, sludge, battery acid, and other waste products generated from shop activities (Southwest Division 1996). These contaminants have been identified and remediated through the Installation Restoration Program (IRP).

The Los Angeles RWQCB (LARWQCB) administers two programs, the NPDES and the State Mussel Watch Program, which address water quality in Calleguas Creek, its tributaries, and Mugu Lagoon. There are currently 20 dischargers permitted under the NPDES program that contribute effluent flows to Calleguas Creek and its tributaries. The monitoring required for each of these dischargers varies on a case-by-case basis, but the major dischargers and those contributing potentially hazardous material regularly monitor their effluent. Under the State Mussel Watch Program, transplanted mussels and clams, fish, and sediments have been used to monitor the occurrence of anthropogenic pollutants in Mugu Lagoon, Calleguas Creek, and Revolon Slough. Mussel Watch data indicate elevated levels of organochlorine pesticides (e.g., chlordane, dichlorodiphenyltrichloroethane [DDT]), as well as other organic chemicals, are present in tissue and sediment samples from these areas (SWRCB and Cal/EPA 1995).

In general, water quality in Calleguas Creek does not meet drinking water standards due to upstream sources of agricultural chemicals and treated sanitary wastewater effluent. Water quality in Calleguas Creek and its tributaries varies significantly depending on sampling locations and flow conditions. Sampling indicates that total dissolved solids (TDS) increase as water moves toward Mugu Lagoon. For example, TDS in water samples collected north of U.S. Highway 101 have ranged between 100 and 600 milligrams per liter (mg/L); at Broome Ranch Road, measurements have ranged between 900 and 1,100 mg/L; and at the mouth of Calleguas Creek TDS values have ranged as high as 14,200 mg/L (Western Division 1993b). Surface water samples collected at Mugu Lagoon also indicate that semi-volatile organic compounds and inorganics are contaminants of concern (COC) based on human health or ecological risk (Western Division 1993b, Southwest Division 1996). The COCs and their maximum concentrations are pentachlorophenol (10 µg/L), arsenic (12.5 µg/L), copper (9.9 µg/L), and mercury (50.2 µg/L). Variability appears to be strongly correlated with flow.

A study of Revolon Slough from October 1980 to July 1981 indicates that mean concentrations of four analytes are at or above potentially hazardous levels for marine environments according to USEPA criteria: lead (equal to USEPA standard), mercury (20x), silver (10x), and methoxychlor (20x) (Onuf 1987). Revolon Slough is a tributary of Calleguas Creek that drains most of the intensively cultivated part of the Oxnard Plain. Since the flow of Calleguas Creek is approximately three times higher than that of Revolon Slough, and Calleguas Creek drains less intensively cultivated land, the pollutants may be diluted before they enter the lagoon.

The flow characteristics of Calleguas Creek strongly influence the transport of sediments and pollutants in the system. Flows are seasonal in much of the upper drainage basin where point source discharges and irrigation return flows frequently percolate into the groundwater before reaching Mugu Lagoon. Under such conditions, the contaminants associated with these sources would be expected to either infiltrate into groundwater or become bound with surface sediments, depending on the specific chemical (Western Division 1993b). During high flows, sediment and organically bound pollutants may be carried downstream and deposited into areas of channel overflow or into Mugu Lagoon.

3.4.3.2 Nearshore Marine Environment

The area that borders NAS Point Mugu adjacent to the ocean is dominated by sandy beach habitat. The topography of the sand beaches is strongly influenced by wave conditions. The beaches, composed of fairly coarse sand, are relatively steep. The foreshore extends out to a depth of about 10 to 12 feet (3 to 4 m), where the slope of the bottom decreases substantially. This marks the point of transition from beach into shallow shelf. Sand dunes are also present along most of the beaches. A detailed discussion of biological resources associated with the beach habitat is included in Section 3.5.3.2. Water quality in the nearshore area of Point Mugu is dependent upon the presence of particulates and contaminants in the outflow from Mugu Lagoon (see previous discussion in Section 3.4.3.1).

3.4.4 San Nicolas Island

San Nicolas Island is part of Ventura County and is situated in Watershed 11 which also includes Anacapa, Santa Barbara, San Clemente, and Santa Catalina islands (CRWQCB 1994). San Nicolas Island and its surrounding waters have been designated as an ASBS (see Section 3.4.3.1). The island is a mesa with the topography sloping gently upward from the northern end of the island. The average surface elevation is 500 feet (152 m) above MSL, with a maximum elevation of 908 feet (277 m) above MSL. San Nicolas Island is arid; total precipitation averages 8.40 inches (21.3 cm) per year. The dry season occurs between May and September, and the wet season occurs between November and February when the island receives 74 percent of its total rainfall. The existing beneficial uses for water resources at San Nicolas Island include navigation, water contact recreation, non-contact water recreation, commercial and sport fishing, shellfish harvesting, and preservation of terrestrial and marine habitats and rare, threatened or endangered species (CRWQCB 1994).

3.4.4.1 Marine Environment

<u>A - Circulation</u>

The Channel Islands are located in a region of variable mixing between the cold waters of the California Current and the warm nearshore water of the California Countercurrent (see Figure 3.4-1). San Nicolas Island is located far enough offshore and to the south that it is subjected both to the warmer waters of the California Countercurrent and to the colder waters of the California Current. In general, the circulation patterns around the island are similar to the patterns of the two major currents. However, some localized currents and eddies are caused by the island's shape and orientation (Engle 1994).

B - Marine Water Characteristics

The coldest sea surface temperatures occur in March (57° F [14° C]), while the warmest temperatures occur in September (66° F [19° C]) (Engle 1994). Consequently, marine biota of the island have been termed "intermediate" because both cold and warm water species occur at the island. The island is relatively isolated from the effects of human activities that typically occur in the nearshore environments of the mainland (Engle 1994). Thus, there is no reason to expect that the marine waters are degraded or different than the water quality of the Sea Range (see Section 3.4.2.1-B for a more detailed discussion).

C - Marine Sediments and Bathymetry

The bathymetry surrounding San Nicolas Island is irregular in shape. The island is basically a pinnacle that is surrounded by water depths of 2,000 feet (610 m) which slope to less than 3,900 feet (1,190 m) within less than 6 NM (11 km) of the island (see Figure 3.4-3). The subtidal area nearest the island is much shallower (less than 100 feet [30 m]) and is characterized by either sand, bedrock, or boulder. The deep bottom sediments that surround the island are similar to those of the Sea Range (see Section 3.4.2.1-C).

3.4.4.2 Nearshore Marine Water Quality

The quality of ocean water in the immediate area of the island is high. Most of the marine water pollution within the SCB area stems from municipal discharges. The distance of the island from the mainland, the large diluting volume of the ocean, and the shelves and basins near the mainland where many pollutants settle ensure high water quality at the island. As discussed in Section 3.4.2.2, a potential source of water pollution comes from the oil and gas development industry.

3.4.4.3 Freshwater Quality

Domestic water for San Nicolas Island is obtained from a combination of sources including four wells, three springs, a desalination (reverse osmosis [RO]) plant, and imported water barged to the island which is used only in the case of emergency. The hydrology of San Nicolas Island is shown in Figure 3.4-6.

A - Surface Water

Topography on the island is shaped by runoff of surface water to the ocean. A drainage divide is located at the top of the east-west trending southern escarpment of the island. Ephemeral streams along the southern portion of the island drain surface water through very steep, V-shaped canyons along straight courses with few tributaries to the ocean. The surface water runoff on the northern portion of the island drains initially through steep-walled gullies in the upland area, and as the water approaches the ocean it spreads out onto flat marine terraces and then into poorly defined, shallow channels within the sand dunes (U.S. Army 1994).

San Nicolas Island contains no perennial (i.e., year-round) bodies of water. The only perennial stream, Tule Creek, is located at the northern part of the island and runs northeastward from the highest part of the island to a sand dune area on the shore. It is fed by natural springs that flow during most of the year except during periods of drought. Zitnic Springs is located in the groundwater recharge area near Redeye

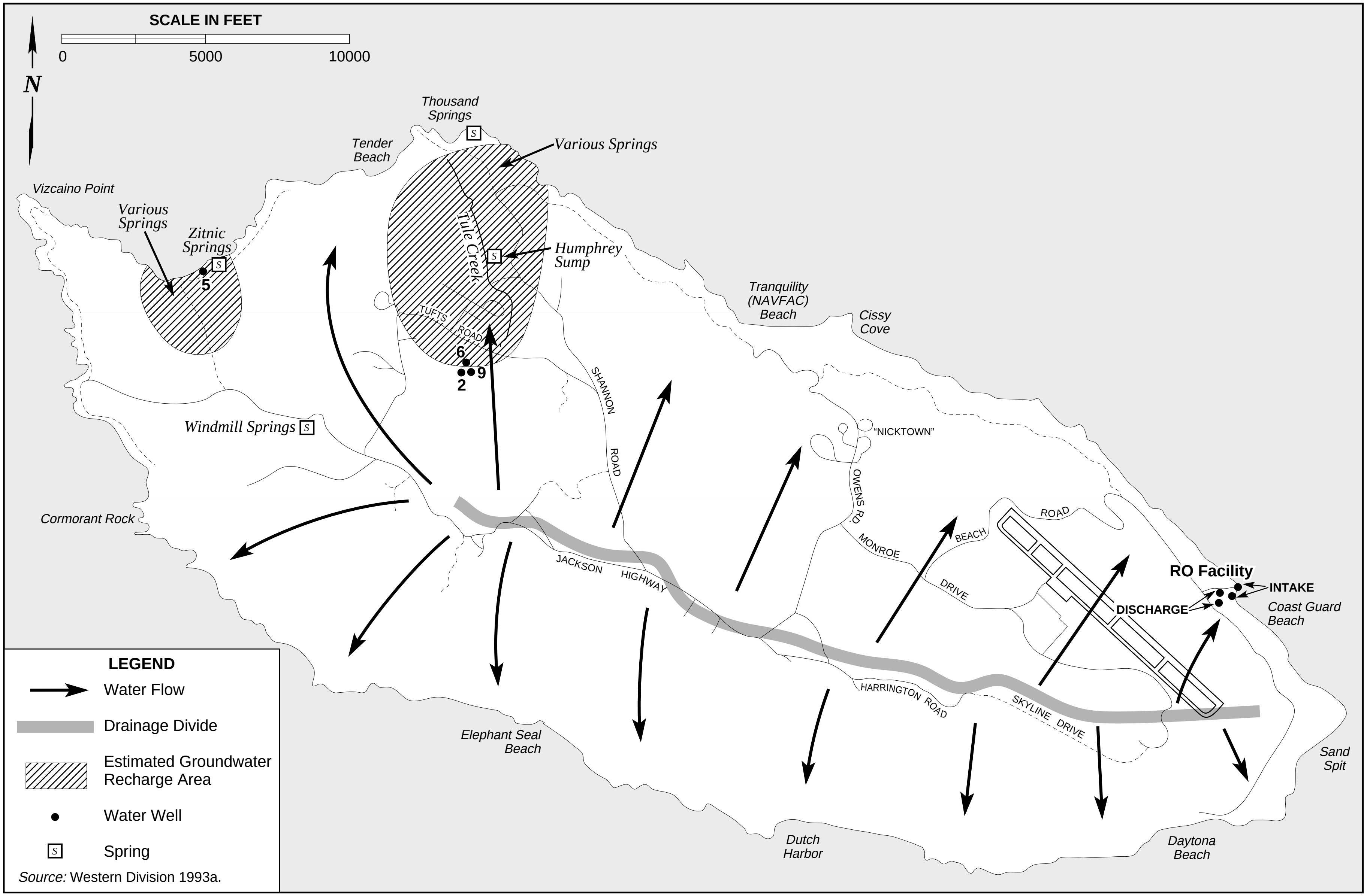

Figure 3.4-6
Hydrology of San Nicolas Island

Beach, and Windmill Springs is located 1.3 miles (2.1 km) southeast of Redeye Beach near the Alpha Launch Complex (see Figure 3.4-6).

A wetland exists on the northeast side of the airfield and supports various plant species; small wetlands are also present at Sand Spit, Twin Rivers, and Tule Creek. Although surface water on San Nicolas Island is not used as a potable water supply source, it does recharge the groundwater supply (U.S. Army 1994). The water sources are considered under the influence of surface waters on San Nicolas Island. There are no specific surface water quality objectives for selected constituents at San Nicolas Island (CRWQCB 1994).

B - Groundwater

Consolidated marine sediments that make up San Nicolas Island have limited storage capacity for groundwater. The western end of the island is covered by significant deposits of wind blown sand and is the only location where conditions support groundwater resources. Some perched aquifers are located in this area within the upper 3 feet (1 m) of weathered surficial deposits (U.S. Army 1994). The groundwater flows in a northwest direction toward the water bearing areas: the Zitnic, Upper Tule Creek, and Vizcaino basins (see Figure 3.4-6). The southern beaches and terraces lack freshwater springs and seeps, and water that infiltrates the terraces becomes saline through mixing with brackish groundwater.

The LARWQCB provides groundwater quality objectives for San Nicolas Island. The groundwater quality objectives for selected constituents include: TDS (1,100 mg/L), sulfate (150 mg/L), and chloride (350 mg/L) (CRWQCB 1994). Studies indicate that groundwater quality meets these objectives (U.S. Navy 1996b).

Due to the isolation of the island, limited access, and limited island operations, there are few potential sources of contaminants in the watershed. Overdrafting of groundwater appears to have the greatest effect on water quality, as saltwater intrusion has become evident, especially during drought years. The wastewater treatment plant is an unlikely source of contamination for the watershed areas since it is several miles from the water supply sources and does not share the same watershed (U.S. Navy 1996b). Contamination with respect to the seawater well points appears unlikely due to the location of the discharge area and low probability of surface flow. Surface flow of treated sewage as a result of irrigation operations is not likely under proper operating procedures (U.S. Navy 1996b).

As required by Section B.16 of the California Industrial Activities Storm Water General Permit, the Navy is responsible for reporting storm water discharges at San Nicolas Island. However, urban runoff is not a major concern for the island's watersheds due to the geographic separation of the compound area from the watershed. Urban storm water runoff is addressed in the station's Storm Water Pollution Prevention Program. San Nicolas Island has a NPDES General Industrial Activities Storm Water Permit which was issued by the SWRCB. To comply with permit requirements, the station has implemented a storm water pollution prevention program which includes eliminating illicit discharges, implementing best management practices, conducting storm water monitoring, conducting industrial inspections, and training employees.

Wells, Springs, and Catchments

Numerous freshwater wells and catchments have been installed at various locations and provide the major portion of freshwater for San Nicolas Island. There are various types of water catchments on the island designed to capture underground water seepage and spring water. One type of catchment, found at Thousand Springs, is a concrete barrier/wall type, similar to a small dam or retaining wall. Water from this catchment flows through an aboveground pipe, by gravity, to a nearby storage tank. Similarly, a shallow underground perforated pipe at Windmill Springs collects and directs, by gravity, subsurface water to a storage tank at a lower elevation. The other types of catchments are underground sumps (Zitnic and Thousand Springs) that pump the collected subsurface water to a nearby storage tank.

The springs are considered groundwater under the direct influence of surface water and must comply with the Surface Water Treatment Rule. These sources are also prone to flooding during rain events. A new surface water filtration plant was constructed in 1994 to treat the springs and well source. Filtration performance is monitored by turbidity measurements of the filtered water, and disinfection is monitored by measuring residuals (U.S. Navy 1996b).

San Nicolas Island has a total of 22 septic and holding tanks which are used at the outlying buildings. The buildings consist of range support facilities, office spaces, and one small living area. Septic/holding tank locations are necessary due to the size of the island and the remote locations of some of the buildings. The septic and holding tanks are inspected on a quarterly basis. Holding tanks are pumped quarterly and septic tanks are pumped as required during quarterly inspections. The septic and holding tanks do not appear to pose a significant risk of contaminating the watershed areas. The majority of the outlying buildings are used infrequently or during a limited work day schedule.

C - Desalination Plants

Two RO desalination units were installed in 1990 at Coast Guard Beach. The raw water source for the units is seawater which is pumped from two locations on the beach. The two locations are manually alternated during winter and spring. Each location has six shallow seawater well points. Water is pumped from the well points to a holding tank. Brine (highly mineralized wastewater) discharge from the RO unit is pumped to a second holding tank next to the seawater tank. When the wastewater tank is full, the brine is discharged to a brine pit located approximately 660 feet (200 m) from the RO unit and near the beach (see Figure 3.4-6), and then is dispersed through the sand. Discharge of brine wastes produced from the operation of the desalination plant and monitoring requirements are specified under NPDES Permit No. CA0058700 issued by the LARWQCB.

D - Wastewater Treatment

The wastewater treatment facility consists of a series of three aerated stabilization ponds and a gas chlorination facility. Due to the large capacity of the stabilization ponds and the small population served by the plant, the primary method of wastewater disposal is by evaporation. The secondary method of disposal is by discharging the wastewater through irrigation. Treated wastewater is discharged via spray nozzles over a 6 acre (2.4 ha) area of land which is restricted and off-limits to personnel. The sludge is stored in stabilization ponds. As required by its Waste Discharge Permit, the Navy is responsible for reporting effluent discharge (amount and concentration of potential contaminants) for the San Nicolas Island Sewage Treatment Facility. The treatment facility must meet effluent discharge limitations for the following: TDS (1,100 mg/L), sulfate (150 mg/L), chloride (350 mg/L), nitrate plus nitrite plus ammonia (10 mg/L), biochemical oxygen demand (60 mg/L), oil and grease (15 mg/L), and coliform. Monitoring reports are submitted quarterly, and a corrective action plan is in place to meet the limitations for chlorides and TDS set forth under the Waste Discharge Permit issued by the LARWQCB.

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