4.5 WATER RESOURCES

4.5.1 Hydrology and Water Quality

4.5.1.1 Surface Water

Fort Ord is located between the Salinas and Carmel River watersheds and covers an area of about 44 square miles. Because of the proximity of Fort Ord to the Pacific Ocean, the area has a moderate Mediterranean climate, with 90% of the annual precipitation occurring from November through April. The average annual precipitation of the area is about 14.2 inches (Defense Mapping Agency 1980).

The topography of Fort Ord is characterized by stabilized sand dunes in the western half of the installation, transitioning to rolling hills and canyons in the eastern half. Well-defined natural drainage channels are largely absent in the western half of the installation because the sandy soils in this area are highly permeable and absorb much of the rainfall and runoff.

The streams in the canyons in the eastern part of the installation are small and intermittent. Impossible, Wildcat, Barloy, and Pilarcitos Canyons and Toro Creek drain to the northeast and into the Salinas River. Canyon Del Rey drains the southern portion of the installation and empties into Monterey Bay, a designated national marine sanctuary.

4.5.1.2 Groundwater

For purposes of discussion, geologic conditions on Fort Ord can be divided into three general areas (Figure 4.5-1). Each area has distinct geologic and hydrologic characteristics.

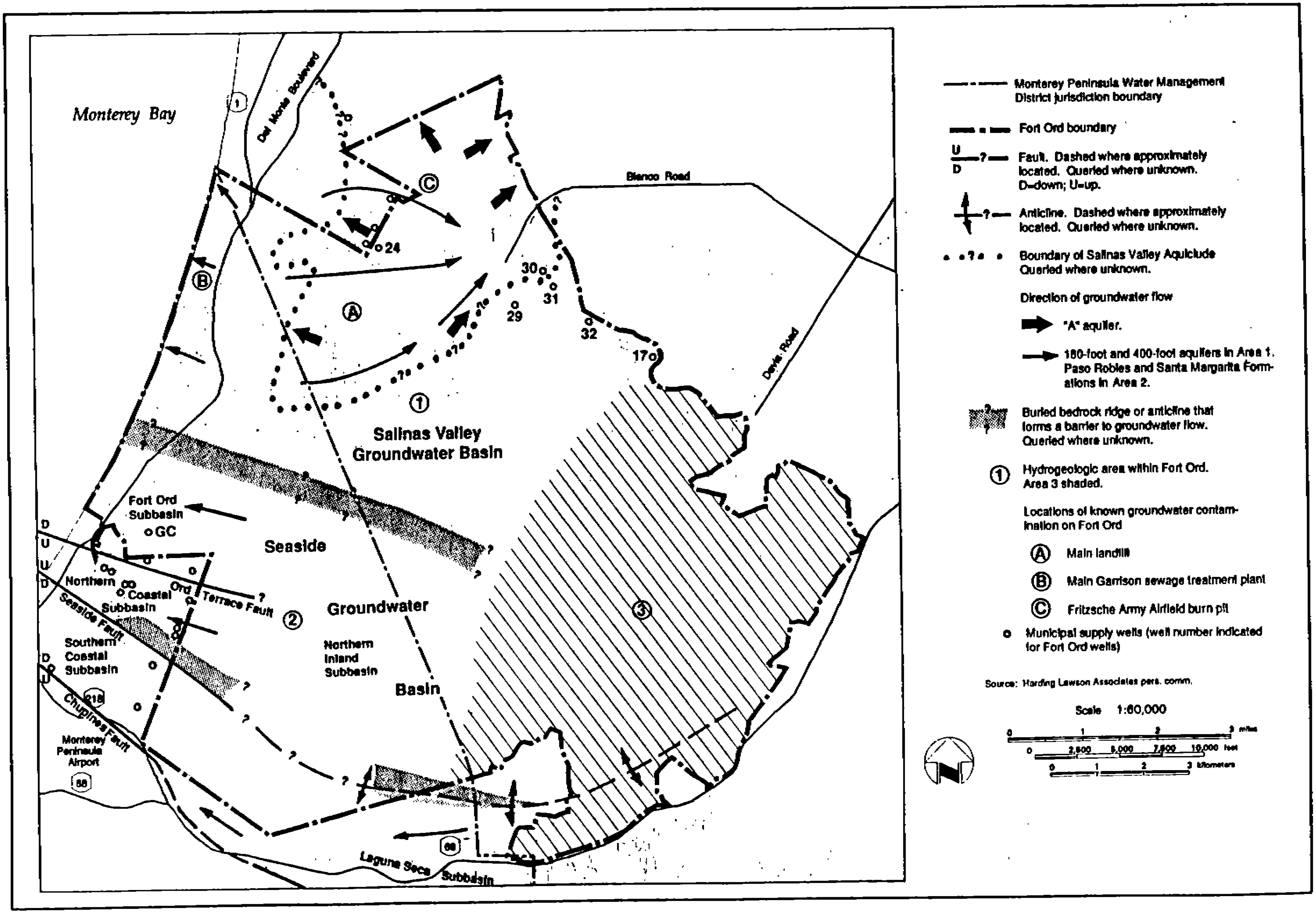
The northwest part of Fort Ord (Area 1 in Figure 4.5-1) overlies a small part of the Salinas Valley groundwater basin, which contains several aquifers separated by aquicludes. Area 1 is covered with dune sand deposits that are largely unsaturated. The depth of the water table is typically about 100 feet. An extensive clay layer, known as the Salinas Valley Aquiclude, underlies the dune sand deposits in the Main Garrison area. Beneath the aquiclude is the 180-foot aquifer, which is the shallowest aquifer with substantial pumpage. The aquiclude is absent along a strip near the coast and in an area extending south from East Garrison. In these areas, recharge from the surface can percolate down to the 180-foot aquifer. Beneath the 180-foot aquifer are two deeper aquifer zones referred to as the 400-foot and 900-foot aquifers.

Historically, most pumpage for Fort Ord and Marina was from the 180-foot aquifer. Seawater began intruding into this aquifer as a result of the pumping, and early wells were replaced with wells that were deeper or farther inland. By the early 1980s, seawater had intruded about 2.5 miles into the 180-foot aquifer and 1.2 miles into the 400-foot aquifer in the vicinity of Marina. Around that time, Fort Ord drilled new wells into the 180-foot and 400-foot aquifers near East Garrison and Marina drilled three wells into the 900-foot aquifer.

A few recent water quality measurements indicate that the rate of intrusion in the Marina-Fort Ord area might have slowed since the mid-1980s, presumably as a result of the change in pumping locations and drought-related decreases in total pumpage. However, intrusion is definitely continuing in the Castroville-Salinas area.

The southwest part of Fort Ord (Area 2 in Figure 4.5-1) overlies the Seaside groundwater basin. This basin is structurally complex and divided into several subbasins by faults and folds in the underlying Monterey Shale formation. Fort Ord overlies most of the northern part of the basin and supplies a substantial amount of total recharge to the basin. The only pumpage from this basin by Fort Ord is for

Figure 4.5-1.
Hydrogeologic Conditions in the Fort Ord Vicinity



irrigation at the golf course. Most of the remaining pumpage is by municipal wells in Seaside and Sand City. Although water levels near these wells were slightly below sea level in spring 1990, water levels are generally above sea level. Except at one shallow well near the shoreline, seawater intrusion has not affected wells in this basin. The existing amount of pumpage appears to be close to the safe yield of the basin.

The eastern part of Fort Ord (Area 3 in Figure 4.5-1) is hilly and lacks the surficial dune deposits that cover Areas 1 and 2. Because of relatively low infiltration rates and subsurface permeability, this area is not promising for groundwater development and probably does not contribute substantial amounts of groundwater inflow to the western part of Fort Ord.

4.5.1.3 Water Rights

Water supplies under which Fort Ord currently operates are from groundwater sources, which could continue to be used or could be passed to the new property owner. Each owner has the right to drill and pump on their property; however, the locations, timing, and amounts to be pumped could be limited or controlled by state and local regulatory agencies. There are no transferrable water rights to groundwater in California. The groundwater overdrafts and seawater intrusion make the value of the rights to these groundwater sources questionable.

4.5.1.4 Water Quality

Surface Water. Surface water quality data within Fort Ord are minimal because surface waters are not used for domestic supply but are used to a limited extent for stock watering. In general, surface water quality of drainage channels within the installation varies with the seasons. During the first strong rains of the season, ditches and storm drainage systems draining the urban areas of the installation receive the highest concentration of urban pollutants. Urban pollutants are variable but generally consist of oils, grease, heavy metals (lead, copper, cadmium), pesticide residues, and coliform bacteria. Surface soils sampled at onshore storm drain discharges to swales indicated a presence of urban pollutants. Pesticides and organics, hydrocarbon products and their breakdown components, and metals were found. It is not yet known whether a human or environmental health risk exists because of the pesticides or organics or whether the concentration of metals exceeds background levels. Gas samples were also analyzed and no volatile organic compounds were detected.

Winter storms contribute to erosion and gullying in some areas, particularly the drainages of the eastern half of the installation. Surface erosion can cause high concentrations of suspended sediment loading in streams causing increased siltation, turbidity, and accompanying high total dissolved solids. In general, the surface waters of this region are hard and high in total dissolved solids. Streams may contain elevated levels of sulfates, bicarbonates, calcium, magnesium, and sodium depending on localized conditions (Defense Mapping Agency 1980).

Urban stormwater runoff discharging into the ocean may also locally impair coastal water quality. Results of water quality monitoring by the California State Water Resources Control Board (SWRCB) through its State Mussel Watch Program indicate that resident mussels from parts of Monterey Bay contain high levels of lead, pesticides, and petroleum hydrocarbon concentrations (National Oceanic and Atmospheric Administration 1990).

Groundwater. Groundwater quality within Fort Ord is variable depending on the location and depth of the well. Saltwater intrusion from groundwater pumping has reduced water quality in most wells in the Main Garrison area so that these waters are unacceptable for drinking because of high chloride content. Recent water quality data for the three active potable supply wells (wells 29, 30, and 31), the standby potable supply wells (wells 17 and 24), and the golf course well are shown in Table 4.5-1.

Water from standby well 24 and the golf course well have occasionally had concentrations of dissolved solids greater than 500 milligrams per liter, which is the recommended limit for drinking water. Concentrations probably have not exceeded 1,000 milligrams per liter, which is the maximum concentration allowed under secondary drinking water standards. During periods of high salinity, water from these wells could be blended with water from the other wells to meet drinking water standards. Use of water from either of these two wells for potable purposes may require approval from the California Department of Health Services.

Regulatory Issues. Permits have not been required in the past to discharge urban runoff within the installation. However, Section 6217 of the Federal Coastal Zone Management Act of 1972 (CZMA) Reauthorization Amendments of 1990 requires local entities that discharge any stormwaters into the ocean to participate in the future in a non-point-pollution control plan developed by the California Coastal Commission and the State Water Resources Control Board (SWRCB). The plan must then be submitted to U.S. Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration for approval. The SWRCB must then have an enforceable plan through the local governments no later than 3 years after the plan is approved.

The EPA also has mandated states to develop a statewide National Pollution Discharge Elimination System (NPDES) general stormwater discharge permitting system for industrial activities required by federal regulation to obtain a permit. Construction activities disturbing 5 or more acres of soil will be regulated as an industrial activity under this permitting system; soil disturbances of less than 5 acres that is part of a larger common plan of development is also subject to regulation. The goal of the general stormwater discharge permit is to reduce surface water pollution from industrial and construction activities.

The SWRCB adopted the general stormwater permitting system in November 1991, which requires the above facilities to obtain a permit for stormwater discharge. Under this permitting system, a stormwater pollution prevention plan is required to be developed, which provides an organized means of controlling hazardous and nonhazardous runoff and sediment transport by implementing stormwater best management practices (BMPs). The stormwater discharge permit also requires a stormwater sampling and monitoring program to ensure stormwater management implementation. It is unclear how the CZMA amendments for non-point-source pollution control plans will be implemented in relation to general stormwater discharge permits, but the California Coastal Commission and the SWRCB will likely work together to eliminate stormwater management plan duplication.

On September 21, 1992, Monterey Bay was officially designated a national marine sanctuary. Under this designation, resource protection is assigned the highest priority among research and education programs and visitor use. The Marine Protection, Research, and Sanctuaries Act of 1972, as amended, and its implementing regulations (15 CFR 922) requires a management plan to protect the sanctuary's resources. Regulations established for this purpose have adopted best management plans to control non-point-source runoff; they do not, however, alter or change existing SWRCB non-point-source runoff regulations discussed above. However, the Marine and Estuarine Management Division of the National Oceanic and Atmospheric Administration reserves the right to regulate any substance that enters the sanctuary from outside sources and injures sanctuary resources.

4.5.2 Water Supply and Demand

Wells provide the sole source of water supply for Fort Ord. More than 29 wells have historically been used at various times for water supply, and approximately 10 wells are presently available for use. These include three active potable supply wells near East Garrison (wells 29, 30, and 31); two small wells providing water to two inland traning camps (Jacks and Pilarcitos wells); five inactive standby wells (wells EG-17, 24, 25, 27, and 28); and the golf course well; which is used only for irrigation. In August 1992, mechanical problems within the turbine in well 32 caused it to pump excessive amounts of sand. The well has been shut down indefinitely while the Army decides whether to abandon, repair, or replace the well. Excessive sand production and the advance of seawater intrusion into the 180-foot and 400-foot aquifers forced older wells in the Main Garrison area to be abandoned in favor of deeper wells farther inland. The main potable supply wells are all located in the Salinas Valley groundwater basin, and the golf course well is located in the Seaside basin.

The Cities of Marina and Seaside have active water supply wells near the northwest and southwest corners of Fort Ord, respectively. Because of seawater intrusion in the 180-foot aquifer, the City of Marina presently obtains all of its water from one well completed in the 400-foot aquifer and three wells perforated in the 900-foot aquifer. The City of Seaside uses a combination of local groundwater and surface water from the Carmel River system distributed by the Cal-Am Water Company.

Groundwater pumpage by Fort Ord and other nearby users is shown in Table 4.5-2. Monthly average consumption rates for the Fort Ord potable supply system have ranged from 3.49 million gallons per day (mgd) to 9.41 mgd, or 77%-207% of the average annual consumption rate (Ace Pacific Company 1988).

Per capita consumption for the Fort Ord potable supply system averaged 143 gallons per capita per day during 1986-1989, when the effective population (including the effects of visitors and employees who live off the installation) was 31,986 people. This consumption rate was substantially lower than the rate in the early 1980s (209 gallons per capita per day) because of water conservation measures implemented during the current drought, which began in 1987. Annual water consumption decreased from a high of 6,600 acre-feet in 1984 to an average of 5,100 acre-feet during 1986-1989.

Safe yield is the amount of groundwater that can be pumped annually on a long-term basis without causing undesirable effects, the greatest of which in the Fort Ord area are excessive drawdown and seawater intrusion. The concept of safe yield is meaningful only when applied to an entire groundwater basin. The amount of yield available to individual users within the basin depends on the amounts and locations of pumping by other users. In the Salinas Valley groundwater basin, present pumpage in and near Fort Ord exceeds safe yield in the 180-foot and 400-foot aquifers, as indicated by continuing seawater intrusion and water levels below sea level in those aquifers. This indicates that the yield from the 180-foot and 400-foot aquifers for Fort Ord is less than its present pumpage, assuming that pumping by other users remains unchanged. Conditions in the 900-foot aquifer are uncertain, but the Marina wells currently producing from this zone have not experienced seawater intrusion. Seawater intrusion has not affected wells in the Seaside basin (except for one shallow well near the shoreline) although water levels near the coast are sometimes slightly below sea level. This indicates that yield available to Fort Ord and other Seaside basin users may be less than the present total pumpage of 4,700 acre-feet per year.

Fort Ord's contribution to groundwater supply (recharge) and demand (pumpage) is very different for the two groundwater basins, as shown in Table 4.5-2. Contributions by Marina, Seaside, and other users in the basins are also shown for comparison. These itemizations are not complete groundwater budgets. The budgets are balanced by other items, including seawater intrusion, possibly recharge from Area 3 (Figure 4.5-1), and groundwater inflow from adjacent areas in the Salinas Valley and the El Toro Creek Valley. The amounts of recharge to the Salinas Valley groundwater basin shown for Fort Ord and Marina are the amounts that occur within the boundaries of these two jurisdictions. For the Seaside basin, all recharge and pumpage for the entire basin is included in the table.

Table 4.5-1 Water Quality of Fort Ord Wells

Constituents	Well 17EG 4/90	Well 24 6/11/92	Well 29 6/11/92	Well 30 6/11/92	Well 31 6/11/92	Well 32 11/85	Golf Course Well 6/11/92	Public Health Standard (maximum)
	Source Name and Date Sampled							
Constituents in mg/L								
Dissolved solids	650[a]	410	390	320	410	431	320	500[b]
Hardness	430	200	240	260	240	142	130	None
Calcium	90	33	37	32	45	64	26	None
Magnesium	28	13	13	9.1	15	22	6.9	None
Sodium	50	45	33	24	36	47	45	None
Chloride	63	74	67	33	66	43	86	250[b]
Sulfate	170	29	77	68	92	101	25	250[b]
Fluoride	0.45	<0.10	<0.1	<0.1	<0.1	0.27	<.10	1.4 to 2.4[c]
Nitrate	<1	35	3.3	11	1.6	0.4	10	45[c]
Constituents in um/L								
Iron	<10	510	<100	<100	<100	<110	<100	300[b]
Manganese	520	<30	<30	<30	40	95	<30	50[b]
Arsenic	<10	<10	<10	<10	<10	<5	<10	50[c]
Barium	<100	<100	<100	<100	<100	58	<100	1,000[c]
Cadmium	<1	1.7	<1.0	<1	<1	<0.5	<1.0	10[c]
Chromium	<5	<10	<10	<10	<10	<25	<10	50[c]
Lead	16	7.4	<5	<5	<5	<1	<5	50[c]
Mercury	<0.2	<1.0	<1.0	<1.0	<1.0	<0.2	<1.0	2[c]
Selenium	<10	<5	<5	<5	<5	<1	<5.0	10[c]
Silver	<10	<10	<10	<10	<10	<25	<10	50[c]

Note: Allowable fluoride varies with temperature between 0.8 and 2.4 mg/L. Optimum is about 1.0 mg/L.

[a] Exceeds recommended standard.
[b] Secondary (recommended) drinking water regulation.
[c] Primary (mandatory) drinking water regulation.

Source: Well water quality from annual reports to the California State Health Department and standards from Driscoll 1986.

Table 4.5-2 Local Contributions to Groundwater Recharge and Pumpage in the Vicinity of Fort Ord

	Salinas Valley Groundwater Basin		Seaside Groundwater Basin	
Groundwater Flow Item	Fort Ord (acre-feet)	Marina (acre-feet)	Fort Ord (acre-feet)	All others (acre-feet)
Recharge				
Rainfall	2,500	1,200	1,800	880
Pipe leaks	760	320	60	430
Irrigation return flow	760	320	200	650
Total	4,020	1,840	2,060	1,960
Pumpage				
Total	5,100	2,100	400	4,300

Notes: Recharge from rainfall assumed to equal 2.75 inches per year (Staal, Gardner, & Dunne, Inc. 1987) over areas 1 and 2 in Figure 4.5-1.

Irrigation return flow assumed to equal 15% of total water use, except equals 50% of golf course irrigation.

Pipe leaks assumed to equal 15% of total water use.

Fort Ord pumpage equals measured average for 1986-1989.

Golf course pumpage equals 400 acre-feet per year (Hurst 1992).

Marina pumpage equals 1989 measured pumpage (similar to 1990 and 1991).
Other pumpage and recharge in Seaside basin from Staal, Gardner, & Dunne, Inc. (1988, 1990).

One acre-foot equals 325,800 gallons.

Fort Ord's contribution to pumpage in the Salinas Valley groundwater basin is greater than its contribution to recharge. The opposite is true in the Seaside basin, where Fort Ord recharge is five times greater than its pumpage. However, much of the existing groundwater use in Seaside depends on recharge from Fort Ord. Any increase in pumpage in the southern part of Fort Ord could cause total pumpage to exceed the basin's safe yield.

These comparisons of pumpage and recharge ignore the fact that most recharge accrues to shallow aquifers and may not be readily available to wells pumping from deeper aquifers.

The occurrence or threat of seawater intrusion has prompted local agencies to pursue water conservation measures and development of new supplies. Supply options currently receiving the most active consideration include Monterey Peninsula Water Management District's New Los Padres Reservoir in the Carmel River basin, Monterey County Water Resources Agency's Salinas Valley Water Transfer Project and a 3-mgd desalination plant in Sand City. The Salinas Valley Water Transfer Project could mitigate for increased water demand resulting from reuse of Fort Ord. It is described in greater detail in Volume II, Section II.5, "Water Resources".