

**FINAL
SOURCE EVALUATION REPORT
FORMER FORT ORD, CALIFORNIA**

Submitted to:

**California Regional Water Quality Control Board
Central Coast Region
895 Aerovista Place, Suite 101
San Luis Obispo, California 93401**

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Prepared by:



**DEPARTMENT OF THE ARMY
Fort Ord Office, Army Base Realignment and Closure
Bldg 4463 Gigling Rd - P.O. Box 5004
Monterey, California 93944-5004**

Introduction

This technical report is in response to a letter dated September 3, 2003 from the California Regional Water Quality Control Board, Central Coast Region (RWQCB). The letter requests information on six “emergent chemicals” (perchlorate, n-nitrosodimethylamine [NDMA], 1,4-dioxane, 1,2,3-trichloropropane [TCP], hexavalent chromium (chromium-VI), and polybrominated diphenyl ethers [PBDEs]), specifically for the purpose of identifying potential sources at the former Fort Ord. The letter requests the following information be included in this report:

1. Property ownership and land use history from original land grant.
2. Locations where emergent chemicals were used and stored on-site.
3. Location and time specific quantities of emergent chemicals used, if available.
4. Handling and storage procedures for the use of emergent chemicals and emergent chemical wastes used and/or generated on site.
5. Emergent chemical data from soil, surface water and groundwater already collected.
6. Schedule for when environmental samples will be collected at sites with no existing soil, surface water and groundwater data on emergent chemical.

The letter also states the following:

“Facilities that have taken a proactive approach and already evaluated source areas, and collected data on the emergent chemicals, should respond to the following request by verifying the agencies have the information.”

The United States Department of the Army (Army) has responded to requests to address five of the six emergent chemicals (excepting PBDEs) at the former Fort Ord since the initiation of investigations of groundwater and the Fort Ord landfill in the 1980s. Starting at that time, the information requested in the September 3 letter has been submitted to the agencies in documents pertaining to environmental investigations and remediation at the former Fort Ord. Additional relevant information, including electronic versions of reports, analytical data and land use history, is available at the Fort Ord cleanup web site (www.fortordcleanup.com) and on the Fort Ord Data Integration System (FODIS) web site (www.fodis.net).

In discussions with the RWQCB, it was recognized that historical information for items 2, 3 and 4 might be minimal or non-existent. Additionally, the United States Department of Defense (DoD) and the Army have only established policy regarding sampling for perchlorate, but not for any of the other five emergent chemicals. As such, the Army, regardless of past sample collection, cannot schedule environmental sampling for these five emergent chemicals at this time without approval from Army headquarters.

Property Ownership and Land Use History from Original Land Grant

Up through the 1800s, the Presidio of Monterey and Fort Ord areas were inhabited by the Rumsen, Ensen and Calendarruc Indians, subsidiaries of the Ohlone Indians. By the end of the 19th century most of the Indian population had disappeared.

In 1853, the “pueblo” of Monterey legitimized its claims to 29,698.53 acres of land before the United States Land Claims Commission in San Francisco; however, the Monterey pueblo government auctioned off its town lands in 1859 to pay off legal fees incurred in claiming the land. All 29,698.53 acres of Monterey pueblo lands were auctioned off, the only bidders being Delos Rodeyn Ashley, the Monterey city attorney, and David Jack, though Ashley sold his interest to Jack a number of years later.

The land remained mostly open space or agricultural until 1917, when the Army bought 15,809 acres from the David Jack family (Jacks Corporation). This area encompasses the present day East Garrison and nearby lands on the east side of the former Fort Ord. The new military reservation was initially named Camp Gigling after a well-known German family that had come the country many years before. The need for a military reservation that was to become Fort Ord arose from the stationing at the Presidio of Monterey the 76th Field Artillery (Horse drawn, nicknamed “Black Horse”) in 1917 and the 11th Cavalry in 1919. The terrain in this area was ideally suited for the maneuvers of the mounted troops and the horse-drawn caissons. It also was large enough for a field artillery impact range.

In 1933, Camp Gigling was renamed Camp Ord after Major General Edward Ortho Cresap Ord, but permanent improvements were made until the late 1930s, when administrative buildings, barracks, mess halls, tent pads, and a sewage treatment plant were constructed.

In 1938, additional agricultural property was purchased for the development of the Main Garrison. At the same time, the beachfront property was donated to the Army. In 1940 Camp Ord became Fort Ord. The Main Garrison was constructed between 1940 and the 1960s, starting in the northwest corner of the base and expanding southward and eastward. During the 1940s and 1950s, a small airfield within the Main Garrison was present in what later became the South Parade Ground. In the early 1960s, Fritzsche Army Airfield (FAAF) was completed. The Main Garrison airfield was then decommissioned and its facilities were redeveloped as motor pools and other facilities.

Land Use during Army Occupation

Developed Land

With up to 15,000 active duty military personnel and 5,100 military family members during its active history, developed areas at Fort Ord resembled a medium-sized city, with family housing, medical facilities, warehouses, office buildings, industrial complexes, and gas stations.

Individual land use categories were as follows:

- Residential areas included military housing, such as training and temporary personnel barracks and Army family housing for both officers and enlisted soldiers.
- Local services/commercial areas provided retail or other commercial services, such as gas stations, mini-markets, and fast food facilities.
- Military support/industrial areas included industrial operations, such as motor pools, machine shops, a cannibalization yard (area where serviceable parts are removed from damaged vehicles), and the Fritzsche Army Airfield.
- Mixed land use areas combined residential, local services/commercial, and military support operations.

- Schools included the Thomas Hayes Elementary, Roger S. Fitch Junior High, General George S. Patton Elementary, Marshall Elementary and Gladys Stone schools. High school students attended Seaside High, outside Fort Ord's southwest boundary.
- Hospital facilities included the Silas B. Hayes Army Hospital, medical and dental facilities, and a helipad.
- Training areas included a central track and field, firing ranges, and obstacle courses.
- Recreational areas included a golf course and clubhouse, baseball diamonds, tennis courts, and playgrounds.

The three principal developed areas are described below:

East Garrison

The East Garrison is on the northeast side of the base, adjacent to undeveloped training areas. Military/industrial support areas at the East Garrison included tactical vehicle storage facilities, defense recycling and disposal areas, a sewage treatment plant, and a small arms range. Also at the East Garrison areas were used as recreational open space, including primitive camping facilities, baseball diamonds, a skeet range, and tennis courts. Recreational open space comprised 25 of the approximately 350 acres of the East Garrison.

Fritzsche Army Airfield

FAAF is in the northern portion of Fort Ord, on the north side of Reservation Road. The primary land use was for military/industrial support operations; facilities included airstrips, a motor park, aircraft fuel facilities, a sewage treatment plant, aircraft maintenance facilities, an air control tower, a fire and rescue station, and aircraft hangars.

Main Garrison

The Southern Pacific Railroad right-of-way and Highway 1 separate the coastal zone from Fort Ord's Main Garrison. The Main Garrison consisted of a complex combination of the various land use categories. Facilities included schools; a hospital; housing; commercial facilities, including a former dry cleaner and a gasoline service station; and industrial operations, including motor pools and machine shops.

Undeveloped Land

Coastal Zone

A system of sand dunes lies between Highway 1 and the shoreline. The western edge of the dunes has an abrupt drop of 40 to 70 feet, and the dunes reach an elevation of 140 feet above mean sea level on the gentler, eastern slopes. The dunes provide a buffer zone that isolates the Beach Trainfire Ranges from the shoreline to the west. In some areas, spent ammunition had accumulated on the dune slopes as the result of years of range operation. Stilwell Hall (a recreation center), numerous former target ranges, ammunition storage facilities, and two inactive sewage treatment facilities lie east of the dunes.

Because of the presence of rare and/or endangered species and because of its visual attributes, Fort Ord's coastal zone has been designated an environmentally sensitive area. The beach dune

area at Fort Ord has been identified as among the best coastal dunes in California because of significant features including coastal strand vegetation and the extent of natural dune habitat.

Inland Areas

Undeveloped land in the inland portions of Fort Ord included infantry training areas and open areas used for livestock grazing and recreational activities such as hunting, fishing, and camping. The Multi-Range Area (MRA) occupies a large portion of this undeveloped land. This area was used for advanced military training operations. These undeveloped areas are primarily left in their natural state, without the development of facilities.

Closure and Reuse History

The U.S. Environmental Protection Agency (EPA) identified Fort Ord as a federal Superfund site in 1990 on the basis of groundwater contamination discovered on the base. Fort Ord was selected for closure in 1991 and placed on the Base Realignment and Closure (BRAC) list. The post officially closed on September 30, 1994.

The Army retained approximately five percent of the property for a Presidio of Monterey (POM) annex (now called the Ord Military Community [OMC]) and an Army Reserve center. The OMC is on a 785-acre parcel near Gigling Road and General Jim Moore Boulevard. The Army retained a 12-acre parcel near the Imjin Road Gate at Reservation Road for continued use as an Army Reserve center. Also located in the OMC are the commissary, Post Exchange, main chapel, the Youth Services Center, Army Community Service, AAFES gas station, the Thrift Shop, the library, a Child Development Center, a grammar school and a middle school.

The Fort Ord Reuse Authority (FORA) is responsible for planning, financing, implementing, and regulating a base reuse plan to receive former Fort Ord property from the Army for development by the local communities.

The following is a brief timeline of the conversion of the former Fort Ord to civilian use.

January 1991 – The Secretary of Defense announced the proposed downsizing/closure of Fort Ord.

July 1992 – California State University (CSU) Board of Trustees approved a resolution to support the acquisition of a small portion of the Fort Ord Site.

August 1994 – Property transferred to CSU and University of California (UC) for educational and economic development under special federal authority.

October 1995 – FAAF transferred to the City of Marina and became available for commercial business.

April 1996 – FORA conducted “Developer’s Days” to showcase the former Fort Ord for prospective developers. 200 developers attended.

October 23, 1996 – Military Golf Courses transferred to the City of Seaside for a payment of \$11 million under special congressional authorization.

October 1996 – Undeveloped land transferred to the Bureau of Land Management for protection of endangered species and passive recreational uses.

June 13, 1997 – FORA Board approved the Base Reuse Plan and certified the associated Environmental Impact Report (EIR).

September 1997 – The City of Marina and FORA renovated and opened 352 affordable housing units on the former Fort Ord for occupancy by military and general public, with 20 percent set aside for lower income.

October 1997 – FORA submitted Economic Development Conveyance (EDC) application to Army for all non-claimed properties.

June 1999 – Memorandum of Agreement between the Army and FORA governing the transfer of 5,300 acres of former Fort Ord property under a no-cost EDC authorized by both parties.

September 1999 – Congress approved no-cost EDC and President Clinton signed legislation enabling FORA to keep land sale revenues for local needs.

April 2001 – The City of Seaside completed negotiations with the Army to acquire the Hayes Housing area under special authorization for new housing.

Locations where Emergent Chemicals were Used and Stored On-site

Initial investigations identified 39 sites of concern in addition to two Operable Units (the FAAF Fire Drill Pit and the Fort Ord landfill) which had been investigated during the 1980s. The sites of concern included motor pools, vehicle maintenance areas, dry cleaners, sewage treatment plants, firing ranges, hazardous waste storage areas, and unregulated disposal areas. An additional two sites were added during the investigation process: a defueling area located at FAAF and a fire drill burn pit in East Garrison.

Historical records, including aerial photographs, personal interviews, and field observations have been used to identify many potential sources of contamination at the sites; however, records of specific locations where emergent chemicals were used or stored have been lost or are non-existent. Regardless, each emergent chemical is addressed below with reference to the sites at the former Fort Ord at which they were sampled for. Where appropriate, sites are identified as Remedial Investigation/Feasibility Study (RI/FS), Interim Action (IA), No Action (NA) or Operable Unit (OU) sites. Definitions for each of these designations are presented on page 10 in the Analysis section below.

Perchlorate

Perchlorate is a component of solid rocket fuel, explosives, and various types of ordnance commonly used by the Army. At the former Fort Ord, there are training areas and ranges where ordnance potentially containing perchlorate was used. These ordnance and explosives (OE) sites and suspected OE sites are both within and outside the multi-range area (MRA). The MRA is an approximately 8,000-acre area on the southern end of the former Fort Ord.

n-nitrosodimethylamine (NDMA)

NDMA is a product of the decomposition of unsymmetrical dimethyl hydrazine, a component used in the production of rocket fuel, and is used as an additive in liquid rocket propellant. Similar to perchlorate, there are training areas and ranges where ordnance potentially containing dimethyl hydrazine and/or NDMA was used. These OE sites and suspected OE sites are both within and outside the MRA and include Interim Action (IA) Sites 6 (Range 39 [Abandoned Car Dump]) and 39 (MRA). Additionally, this compound was suspected to be present in the following non-OE areas:

- IA Site 40 (FAAF Helicopter Defueling Areas)
- Building T-111, a storage facility in the East Garrison area of the former Fort Ord

- Defense Reutilization and Marketing Office (DRMO) storage area, also located in the East Garrison
- Operable Unit 1 (OU1) Burn Pit area

1,4-dioxane

1,4-dioxane is used as a stabilizer for chlorinated solvents or volatile organic compounds (VOCs). Releases of chlorinated solvents or VOCs may be a primary source of 1,4-dioxane in the environment. This compound was suspected to be present in the following areas at the former Fort Ord:

- RI/FS Site 12 (Lower Meadow, Directorate of Logistics [DOL] Automotive Yard, Cannibalization Yard, Southern Pacific Railroad [SPRR] Spur)
- OU1 Burn Pit area
- Operable Unit 2 (OU2) Landfill area

1,2,3-trichloropropane (TCP)

DHS' UCMR guidance describes TCP as having various industrial uses and historic pesticide uses, with the primary possible contaminating activity appearing to be being hazardous waste sites. According to the National Toxicology Program (NTP, 2002), TCP's industrial use was historically as a paint and varnish remover, cleaning and degreasing agent, and a cleaning and maintenance solvent, and more currently as a chemical intermediate. Its use as a pesticide was in formulations with dichloropropenes in the manufacture of D-D, a soil fumigant. Releases to the environment are likely to occur as a result of its manufacture, formulation or use as described above. This compound was suspected to be present in the following areas at the former Fort Ord:

- IA Site 6 (Range 39, Abandoned Car Dump)
- IA Site 24 (Old Directorate of Engineering and Housing [DEH] Yard)
- IA Site 32 (East Garrison Sewage Treatment Plant)
- Site 39 (MRA)
- IA Site 40 (FAAF Helicopter Defueling Area)
- OU1 Burn Pit area
- Water supply wells (basewide)

Hexavalent Chromium

Hexavalent chromium (chromium-VI) is a dissolved heavy metal. For now, the regulatory standards being used apply only to total chromium (the combined concentrations of chromium-III and chromium-VI). Chromium-VI was suspected to be present and sampled for specifically in the following areas at the former Fort Ord:

- OU1 Burn Pit area
- Intergarrison area
- RI/FS Site 2 (Main Garrison Sewage Treatment Plant)
- Site 3 (Beach Trainfire Ranges)
- RI/FS Site 12 (Lower Meadow, DOL Automotive Yard, Cannibalization Yard, SPRR Spur)
- IA Site 14 (707th Maintenance Facility)
- RI/FS Site 16 (DOL Maintenance Yard, Pete's Pond Extension, Pete's Pond)
- RI/FS Site 17 (1400 Block Motor Pool)

- IA Site 20 (South Parade Grounds, 3800 Block Motor Pool and 519th Motor Pool)
- IA Site 21 (4400/4500 Block Motor Pools East)
- NA Site 23 (3700 Block Motor Pool Complex)
- IA Site 24 (Old DEH Yard)
- RI/FS Site 31 (East Garrison Dump)
- IA Site 40 (FAAF Helicopter Defueling Area)
- IA Site 41 (Crescent Bluff Fire Drill Area)

Additionally, total chromium was suspected to be present and was sampled for at the sites listed below:

- OU1 Burn Pit area
- OU2 Landfill area
- Intergarrison area
- Water supply wells (basewide)
- Storm drain outfalls (basewide)
- IA Site 1 (Ord Village Sewage Treatment Plant)
- RI/FS Site 2 (Main Garrison Sewage Treatment Plant)
- Site 3 (Beach Trainfire Ranges)
- Site 5 (Range 36A, Open Burn/Open Detonation [OB/OD] Area)
- IA Site 6 (Range 39, Abandoned Car Dump)
- IA Site 10 (Burn Pit)
- NA Site 11 (AAFES Fueling Station)
- RI/FS Site 12 (Lower Meadow, DOL Automotive Yard, Cannibalization Yard, SPRR Spur).
- NA Site 13 (Railroad Right-of-Way)
- IA Site 14 (707th Maintenance Facility)
- IA Site 15 (DEH Yard)
- RI/FS Site 16 (DOL Maintenance Yard, Pete's Pond Extension, Pete's Pond)
- RI/FS Site 17 (1400 Block Motor Pool)
- NA Site 18 (1600 Block Facility)
- NA Site 19 (2200 Block Facility)
- IA Site 20 (South Parade Grounds, 3800 Block Motor Pool and 519th Motor Pool)
- IA Site 21 (4400/4500 Block Motor Pools East)
- IA Site 22 (4400/4500 Block Motor Pools West)
- NA Site 23 (3700 Block Motor Pool Complex)
- IA Site 24 (Old DEH Yard)
- NA Site 25 (Former DRMO)
- NA Site 27 (Army Reserve Motor Pool)
- NA Site 29 (DRMO)
- IA Site 30 (Driver Training Area)
- RI/FS Site 31 (East Garrison Dump)
- IA Site 32 (East Garrison Sewage Treatment Plant)
- NA Site 33 (Golf Course)
- IA Site 34 (FAAF Fueling Facility)

- NA Site 35 (FAAF Aircraft Cannibalization Yard)
- IA Site 36 (FAAF Sewage Treatment Plant)
- NA Site 37 (Trailer Park Maintenance Shop)
- Site 39 (MRA)
- IA Site 40 (FAAF Helicopter Defueling Area)
- IA Site 41 (Crescent Bluff Fire Drill Area)

Polybrominated Diphenyl Ethers (PBDEs)

PBDEs are a family of flame retardants used in polyurethane foam, textiles and plastic electronic casings. Currently, no sites at the former Fort Ord have been assessed for the presence of PBDEs; however, the Army understands that the OU2 Landfill may be an area of concern as materials containing PBDEs may have been disposed of there.

Location and Time Specific Quantities of Emergent Chemicals Used

Historical records, including aerial photographs, personal interviews, and field observations have been used to identify many potential sources of contamination at the sites listed in the previous section. The sites of concern included motor pools, vehicle maintenance areas, dry cleaners, sewage treatment plants, firing ranges, hazardous waste storage areas, and unregulated disposal areas; however, time specific records for location, quantities and use of the emergent chemicals addressed in this report appear to be non-existent or lost.

Handling and Storage Procedures for Emergent Chemicals and Emergent Chemical Wastes used and/or generated On-site

Records for handling and storage procedures specific to the emergent chemicals and related wastes addressed in this report appear to be non-existent or lost.

Existing Emergent Chemical Data from Soil, Surface Water and Groundwater

A significant number of samples have been collected and analyzed for all of the emergent chemicals addressed here, except for PBDEs. A summary of the validated final analytical results available on FODIS is provided here. Actual chemical data may be found in relevant documents or viewed at www.fodis.net, though analytical data for more recently collected samples may not be available yet.

Perchlorate

The DoD has been working with the United States Environmental Protection Agency (EPA), other federal agencies, states, tribes, water suppliers and the private sector for some time to address perchlorate as an environmental contaminant. Current Army guidance for addressing potential perchlorate contamination, as stated in a Memorandum from the Assistant Chief of Staff for Installation Management dated June 27, 2003, provides instructions for implementing Department of Defense (DoD) policy on perchlorate assessment. The DoD revised its policy as of September 29, 2003 and the Army will be revising its policy accordingly.

Soil

Prior to promulgation of the Army guidance, the Army sampled soil for perchlorate at various ordnance and explosives (OE) sites and suspected OE sites both within and outside the multi-range area (MRA) on the former Fort Ord in 2002 and 2003. Approximately 393 soil samples have been collected and analyzed for perchlorate, not including quality assurance (QA) and quality control (QC) samples. Samples were collected at ground surface and to depths of up to 25 inches below ground surface (bgs). Of these, 358 samples were non-detect (ND) for perchlorate. The remaining 35 samples contained perchlorate at concentrations from 13 micrograms per kilogram ($\mu\text{g}/\text{kg}$) to $106 \mu\text{g}/\text{kg}$; however, the $106 \mu\text{g}/\text{kg}$ value could be considered an outlier, as it was the only detection of perchlorate in the entire sampling event that occurred in June and July of 2002. In addition, the next highest detected value for perchlorate is only $34.5 \mu\text{g}/\text{kg}$. If the $106 \mu\text{g}/\text{kg}$ value is included, the mean value of detections is $26.6 \mu\text{g}/\text{kg}$ and the median value is $24.4 \mu\text{g}/\text{kg}$. If the $106 \mu\text{g}/\text{kg}$ value is excluded, the mean value of detections is $24.3 \mu\text{g}/\text{kg}$ and the median value is $24.4 \mu\text{g}/\text{kg}$.

After promulgation of the Army guidance, the Army sampled soil for perchlorate at Range 36A (formerly Site 5) on October 28, 2003 at the request of the Department of Toxic Substances Control (DTSC) as part of the RCRA closure process for the site. Range 36A was used for disposal, by open burning and open detonation (OB/OD), of various types of commercial explosives and military ordnance and ammunition, indicating the possibility of perchlorate release. Samples were collected at six locations at ground surface and at three locations five feet below ground surface (bgs). The sample locations were selected on the basis of the analytical results of previous sampling and range activity that occurred in the time since the previous sampling. Perchlorate was not detected in any of the samples collected, including QA and QC samples. Final analytical results for this sampling event were presented in a preliminary draft report dated January 5, 2004.

Water

Since 1997, public water systems in California, including those for the communities surrounding the former Fort Ord, have monitored for perchlorate in accordance with DHS regulations. Effective January 3, 2001, the State of California adopted new regulations for the UCMR for community and nontransient-noncommunity water systems. This is being implemented concurrently with the federal UCMR, which also lists perchlorate. The community and nontransient-noncommunity water systems surrounding the Former Fort Ord are in compliance with this regulation and have sampled for perchlorate, which was not detected in any of the drinking water supply wells. As of October 2003, no drinking water systems in Monterey County, California (where the Former Fort Ord is located) were listed in the EPA Unregulated Contaminants database. Additionally, as of December 2003, no drinking water systems in Monterey County had reported detection of perchlorate to DHS.

The City of Seaside (Seaside), located to the west and downgradient of the former Fort Ord MRA, owns and operates three water supply wells (Well 01, Well 03 and Well 04), one of which is a standby well, through the Seaside Municipal Water System. All three wells were most recently sampled for perchlorate in December 2002. The analytical results are presented in the table below.

California American Water (Cal-Am) owns and operates four water supply wells (Ryan Ranch 02, Ryan Ranch 07, Ryan Ranch 08 and Ryan Ranch 10) and a treatment plant in the Ryan Ranch area, which is located to the southwest and downgradient of the MRA. Ryan Ranch 07, Ryan Ranch 08 and the treatment plant effluent were most recently sampled for perchlorate in the first quarter of 2003. The analytical results are presented in the table below.

Analytical Results for Perchlorate in Water Supply Wells near the Western Boundary of the Former Fort Ord MRA

Owner/Operator	Station Name	Sample Date	Results (µg/L)
Seaside	Well 01	December 23, 2002	ND
Seaside	Well 03	December 23, 2002	ND
Seaside	Well 04	December 23, 2002	ND
Cal-Am	Ryan Ranch 07	First Quarter, 2003	ND
Cal-Am	Ryan Ranch 08	First Quarter, 2003	ND
Cal-Am	Treatment Plant, Effluent	First Quarter, 2003	ND

***n*-nitrosodimethylamine (NDMA)**

There is currently no DoD policy or Army guidance for addressing potential NDMA contamination; however, the Army has sampled for NDMA at various sites on the former Fort Ord.

Soil

The Army has sampled soil for NDMA at various OE, suspected OE and non-OE sites both within and outside the MRA on the former Fort Ord from June 1995 to May 2003. Approximately 309 soil samples have been collected and analyzed for NDMA, not including QA and QC samples. Samples were collected at ground surface and to depths of up to ten feet bgs. All 309 samples were ND for NDMA.

Water

NDMA is a chemical of current interest for DHS and has been discovered in groundwater wells at various locations throughout California; however, there have been no reports to DHS of NDMA detections in water in Monterey County (where the Former Fort Ord is located).

***1,4*-dioxane**

There is currently no DoD policy or Army guidance for addressing potential 1,4-dioxane contamination; however, the Army sampled groundwater at the former Fort Ord for 1,4-dioxane in March 2003 at the request of the RWQCB.

Soil

Currently, the Army has not sampled for 1,4-dioxane in soil at the former Fort Ord.

Water

The Army has sampled groundwater for 1,4-dioxane at three sites (OU1, OU2 and Sites 2/12) on the former Fort Ord in March 2003 as part of the quarterly groundwater monitoring program (first quarter). Twelve groundwater samples were collected and analyzed for 1,4-dioxane, not including QA and QC samples. All 12 samples were ND for 1,4-dioxane.

1,2,3-trichloropropane (TCP)

There is currently no DoD policy or Army guidance for addressing potential TCP contamination; however, the Army has sampled both soil and groundwater for TCP at various sites at the former Fort Ord from 1989 through 2002.

Soil

The Army has sampled soil for TCP at OE, suspected OE and non-OE sites on the former Fort Ord from 1994 to 2002. Approximately 118 soil samples have been collected and analyzed for TCP, not including QA and QC samples. Samples were collected at ground surface and to depths of up to 15 feet bgs. All 118 samples were ND for TCP.

Water

The Army has sampled groundwater for TCP at various water supply wells and infrastructure sites on or near the former Fort Ord from 1989 through 2003. Approximately 117 groundwater samples have been collected and analyzed for TCP, not including QA and QC samples. All 117 samples were ND for TCP.

Since 1999, public water systems in California, including those for the communities surrounding the former Fort Ord, have monitored for TCP in accordance with DHS regulations. Effective January 3, 2001, the State of California adopted new regulations for the UCMR for community and nontransient-noncommunity water systems. This is being implemented concurrently with the federal UCMR, which also lists chromium-VI. The community and nontransient-noncommunity water systems surrounding the former Fort Ord are in compliance with this regulation and have sampled for TCP, which has not been detected in any of the drinking water supply wells as of September 3, 2003.

Hexavalent Chromium

There is currently no DoD policy or Army guidance for addressing potential chromium-VI contamination; however, the Army has sampled both soil and groundwater for chromium-VI at various sites at the former Fort Ord from 1986 through 2002.

Soil

The Army has sampled soil for chromium-VI at OE, suspected OE and non-OE sites on the former Fort Ord from 1987 to 1998. Approximately 540 soil samples have been collected and analyzed for chromium-VI, not including QA and QC samples. Samples were collected at ground surface and to depths of up to 80 feet bgs. Of these, 536 samples were ND for chromium-VI. The remaining four samples contained chromium-VI at concentrations from 0.11 milligrams per kilogram (mg/kg) to 1 mg/kg.

Water

The Army has sampled groundwater for chromium-VI at three sites (OU1, Sites 2/12, Site 40) on the former Fort Ord from 1986 to 2002. Additionally, the Army has sampled groundwater for total chromium at virtually every site on the former Fort Ord (see "Locations where Emergent Chemicals were Used and Stored On-site" above). Approximately 67 groundwater samples have been collected and analyzed for chromium-VI, not including QA and QC samples. Of these, 44 samples were ND for chromium-VI. The remaining 23 samples contained chromium-VI at

concentrations from 7 µg/L to 100 µg/L. All of these detections occurred in monitoring wells and extraction wells at Site 12 from March through September 2002. The mean value of detections at this site is 38 µg/L and the median value is 29 µg/L. Of these 23 detections, seven were above the 50-µg/L maximum contaminant level (MCL) for total chromium ranging from 54 µg/L to 100 µg/L. This is further discussed below under “Analysis.”

Additionally, 392 samples were collected and analyzed for total chromium from 1986 to 1998 at stations characterizing the OU2 Landfill as a source. Of these 392 samples, 297 were ND for total chromium. The remaining 95 samples contained total chromium at concentrations from 0.01 µg/L to 32 µg/L. All of these detections were below the 50-µg/L MCL for total chromium.

Since 2001, public water systems in California, including those for the communities surrounding the former Fort Ord, have monitored for chromium-VI in accordance with DHS regulations. Effective January 3, 2001, the State of California adopted new regulations for the UCMR for community and nontransient-noncommunity water systems. This is being implemented concurrently with the federal UCMR, which also lists chromium-VI. The community and nontransient-noncommunity water systems surrounding the former Fort Ord are in compliance with this regulation and have sampled for chromium VI, which was detected in six drinking water supply wells in 2001 and 2002 from 1.6 to 5.4 µg/L. Currently, chromium-VI is regulated under the 50-µg/L MCL for total chromium.

Polybrominated Diphenyl Ethers (PBDEs)

There is currently no DoD policy or Army guidance for addressing potential PBDEs contamination.

Currently, no sites at the former Fort Ord have been assessed for the presence of PBDEs; however, the Army understands that the OU2 Landfill may be an area of concern as materials containing PBDEs may have been disposed of there.

Schedule for Environmental Samples to be collected at Sites with no existing Soil, Surface Water and Groundwater Data on Emergent Chemicals

DoD and the Army have only established policy regarding sampling for perchlorate, but not for any of the other five emergent chemicals. The policy requires that the installation obtain approval from Army headquarters to proceed with sampling for perchlorate. Similarly, the installation, regardless of past sample collection, cannot schedule environmental sampling for any of the other five emergent chemicals at this time without approval from Army headquarters because there is no established policy regarding these compounds. The RWQCB has requested the Army sample for PBDEs, which is discussed below.

Polybrominated Diphenyl Ethers (PBDEs)

Based on discussion regarding PBDEs at the December 11, 2003 BRAC Cleanup Team meeting, the RWQCB has agreed that development of a final strategy for sampling for PBDEs may be postponed until July 2004, as it was estimated the Army will resolve standards for sampling, analytical and validation methods by that time. The purpose of the delay is to assure that analytical data from the former Fort Ord for PBDEs will be acceptable well into the future. At

this time, the Army and the RWQCB have agreed upon a conceptual well sampling program for the OU2 Landfill for evaluation of PBDEs.

Analysis

Remedial investigations at the former Fort Ord have resulted in sites being placed in one of the following four categories:

1. **No Action sites** are those that require no further action, either because no release of contaminants was identified at the site or because the activity is specifically excluded under Superfund (i.e., product tanks at a gas station).
2. **Interim Action sites** are those that can be remedied with the excavation of limited amounts of soil contaminated with petroleum, pesticides and/or metals.
3. **Remedial Investigation/Feasibility Study sites** are those with more complex problems that require long-term remediation, development of a risk assessment that addresses exposures to chemicals that might occur given the identified reuse of the area and assessment of applicable or relevant and appropriate regulations.
4. **Operable Units (OU)** are those sites which have undergone considerable investigation and have remedial actions installed, or are in the process of construction.

As a result, remediation at many of the sites where these emergent chemicals have been investigated is already complete or in progress, increasing the likelihood these contaminants are not of concern at the former Fort Ord.

Perchlorate and n-nitrosodimethylamine (NDMA)

The Army understands that DHS will be proposing a maximum contaminant level (MCL) for perchlorate in 2004. Until the MCL is in place, DHS will continue to use a 4- μ g/L action level to protect water consumers.

As described above, potential perchlorate and NDMA contamination may come from many different sources, including some types of ordnance and explosives (OE) commonly used at military installations. Although OE had been used for many years at the former Fort Ord, there are no records indicating large-scale usage in the manner of any of the activities listed above that would suggest perchlorate or NDMA contamination problems.

Additionally, in the areas where OE was used for training, the depth to persistent groundwater ranges from 150 to 200 feet below ground surface. By comparison, Sierra Army Depot, where much more intense OE activity has occurred through the Resource Recovery, Reuse and Recycle (R3) process, has production wells that are ND for perchlorate, despite having similar soil conditions to the former Fort Ord and shallower groundwater.

The Army maintains only a few monitoring wells near the western boundary of the former Fort Ord MRA and has not sampled these for perchlorate; however, since 1997 public water systems for the communities surrounding the former Fort Ord generally and on the western and southern perimeters of the MRA in particular have monitored for perchlorate in accordance with DHS regulations. As of December 2003, no drinking water systems in Monterey County had reported detection of perchlorate to DHS.

Given the current understanding of the persistence of perchlorate traveling from a surface release to the groundwater, the Army believes that the depth to groundwater at the former Fort Ord reduces the potential for perchlorate and NDMA to reach the groundwater. There are no drinking water supply wells in the MRA where most of the OE was used; therefore, there does not appear to be a pathway present that could threaten human health or water resources. In addition, even after the former Fort Ord's long history as an active military installation, there is no evidence of perchlorate or NDMA contamination in drinking water supply wells at the western and southern perimeters of the former Fort Ord MRA.

1,4-dioxane

As noted above, 1,4-dioxane is used as a stabilizer for chlorinated solvents or VOCs, releases of which may be a primary source of 1,4-dioxane in the environment. There are three known groundwater plumes at the former Fort Ord that are contaminated with VOCs, in particular trichloroethene (TCE), which may indicate the presence of 1,4-dioxane. The RWQCB expressed this concern in a letter dated May 8, 2002 and requested the Army sample for 1,4-dioxane. The Army responded with a sampling plan and schedule dated July 10, 2002, which was approved by the RWQCB. The sampling plan selected 12 sample locations at wells that represented the highest TCE concentrations in each of the three TCE groundwater plumes (OU1, OU2, Sites 2/12). The Army then collected samples for 1,4-dioxane analysis in March 2003. These samples were all ND for 1,4-dioxane, indicating this compound is not found at detectable levels at the former Fort Ord.

1,2,3-trichloropropane (TCP)

DHS' drinking water action level for 1,2,3-TCP is 0.005 µg/L. As with other contaminants with action levels, certain requirements and recommendations apply if TCP is detected above the action level.

As discussed above, TCP is used in formulations for paint and varnish removers and pesticides. The Army does have a history of use of such products at the former Fort Ord and its response to this has been demonstrated in its sampling and analysis program. TCP has been sampled for at various sites in soil and groundwater and all samples have been ND.

Hexavalent Chromium

Chromium-VI is regulated under the 50-µg/L MCL for total chromium; however, DHS will be adopting an MCL that is specific for chromium-VI.

Sampling and analysis for total chromium and chromium-VI at the former Fort Ord has been extensive and comprehensive, starting in 1986 and occurring at virtually every site on the former post. This has resulted in the collection of more than 5,000 samples that were analyzed for total chromium, chromium-VI, or both. Overall, most samples for chromium-VI have been ND, and detections have been below the MCL for total chromium. Total chromium and chromium-VI were most recently sampled for in groundwater in 2002 during the Sites 2/12 in-situ chemical oxidation pilot study to evaluate the oxidation process, and for the third quarter 2002 Fort Ord Basewide groundwater sampling event. In these events there were 23 detections of chromium-VI, seven of which were above the 50-µg/L maximum contaminant level (MCL) for total chromium and ranged from 54 µg/L to 100 µg/L. Of these, one detection was at EW-12-01-

180M (67 µg/L) from a sample collected during the third quarter 2002 Fort Ord Basewide groundwater sampling event. The other six detections occurred at PZ-12-04-180U during the Sites 2/12 in-situ chemical oxidation pilot study.

EW-12-01-180M

Chromium-VI was detected above the MCL for total chromium in one out of 17 samples collected at EW-12-01-180M between March and September 2002. Possible sources of the chromium-VI observed at EW-12-01-180M include: 1) the stainless steel extraction well components including the well screen, submersible pump and discharge pump, 2) trace metal contamination of the potassium permanganate chemical supply, and 3) chromium bearing minerals in the aquifer material. The pattern of chromium detection and chromium concentration suggests that the elevated occurrence of chromium to concentrations exceeding the MCL may be related to potassium permanganate chemical supply used during the final three weeks of chemical addition and are anomalous.

PZ-12-04-180U

The presence of chromium-VI in PZ-12-04-180U during the in-situ chemical oxidation pilot study may be related to the well construction. This piezometer was constructed of 2-inch diameter galvanized steel pipe with a 10-foot long stainless steel well screen. The galvanized steel piezometer pipe and stainless steel screen material are likely affected by galvanic reactions between the metal materials and brackish groundwater associated with local sea-water intrusion. The stainless steel well screen material and the electrochemical environment are a likely source of the chromium-IV observed. The mobilization of chromium-IV from the well materials would be exacerbated by the arrival of the potassium permanganate oxidation front.

Chromium is a metal that is more mobile in an oxidized state and is a recognized redox sensitive metal that can be mobilized under oxidizing conditions. Typically metal, including chromium, mobilized by in-situ oxidation activities are reabsorbed/precipitate after the oxidizer is consumed and the groundwater returns to background redox conditions.

Polybrominated Diphenyl Ethers (PBDEs)

PBDEs are manufactured chemicals found in plastics used in a variety of consumer products (computer monitors, televisions, textiles, plastic foams, etc.) to make them difficult to burn. Because they are mixed into plastics rather than bound to them, they can leave the plastic and find their way into the environment. PBDEs are mixtures of up to 209 individual component chemicals called congeners. Some environmental features of PBDEs include:

- PBDEs entered air, water, and soil during their manufacture and use in consumer products.
- In air, PBDEs can be present as particles, but eventually settle to soil or water.
- Sunlight can degrade some PBDEs in air.
- PBDEs do not dissolve easily in water, but stick to particles and settle to the bottom of river or lakes.
- Some PBDEs in water can build up in fish.
- Low levels of PBDEs are found in air, sediments, animals, and food.
- Analyses of blood, breast milk, and body fat indicate that most people are exposed to low levels of PBDEs.

- Exposure to higher levels of PBDEs can occur in workers who produce or manufacture PBDE-containing products.
- Exposure to PBDEs can also occur by working in a confined place where plastics and foam products are recycled or computers are repaired.

Similar to most other communities in the United States, products likely to have contained PBDEs were used, and are still used, at the former Fort Ord. Unlike some other communities, there have been no activities, such as manufacturing of PBDE-containing products, which would increase exposure of the environment or the public to PBDEs; however, the Army understands that the OU2 Landfill may be an area of concern as materials containing PBDEs may have been disposed of there.

At this time an analytical test method has not been established; therefore, there are few analytical laboratories that perform the analysis for PBDEs. Those that do are using either a modified EPA Test Method 8270C or a Draft Method 1614. Additionally, there are nine homologs and 209 congeners of PBDEs. Analyzing for all of them may be impractical or impossible at this time for the reasons stated above; however, in August 2003 the Governor of the State of California signed into law a bill banning two homologs (pentabromodiphenyl ether and octabromodiphenyl ether) by 2008 because these are the two that have been found in tissue samples from humans and wildlife. When sampling occurs, it should be limited to congeners of these two homologs.

PBDEs have been commercially produced since the late 1970s. Only the western half of Area F of the OU2 landfill was receiving waste at a time when the waste may have included materials that contained PBDEs. As such, any sampling for PBDEs should be limited to wells downgradient of Area F and within a distance of Area F considerate of the likely rate of transport.

After discussion with the RWQCB about the uncertainties associated with PBDEs, it was agreed that a final strategy for sampling for PBDEs may be postponed until mid-year 2004, as it was estimated the Army will establish standards for sampling, analytical and validation methods and identify appropriate congeners and specific and appropriate sampling points by that time. The purpose of the delay is to assure that analytical data from the former Fort Ord for PBDEs will be acceptable well into the future. At this time, the Army and the RWQCB have agreed upon a conceptual well sampling program for the OU2 Landfill for evaluation of PBDEs.

Conclusion

The Army has responded to requests to address five of the six emergent chemicals (excepting PBDEs) at the former Fort Ord since the initiation of investigations of groundwater and the Fort Ord landfill in the 1980s. Sampling for these five chemicals has been reasonably based on assessment of site history and activities and has been at an appropriate level to address sites of concern and protection of water resources. In addition, many of the sites that were sampled for these chemicals have already been remediated and closed.

While the Army has not sampled groundwater at the former Fort Ord for perchlorate, most notably near the western boundary of the MRA, the surrounding municipal water suppliers have been since 1997 in accordance with DHS regulations. As of December 2003, there have been no

detections of perchlorate in the water supply in Monterey County, even in supply wells adjacent to the MRA. Given this analytical data and the example of Sierra Army Depot, the Army does not anticipate perchlorate will be an issue at the former Fort Ord and does not have plans to do additional sampling for this contaminant.

While there has not been any sampling for PBDEs, the Army understands why the RWQCB is concerned about this family of chemicals and will work with the RWQCB to develop and appropriate sampling plan once an analytical test method has been established and approved by the Army.

The DoD has only established policy regarding sampling for perchlorate, but none of the other five emergent chemicals. As such, the Army, regardless of past sample collection, cannot schedule additional environmental sampling for these five emergent chemicals at this time without specific approval from Army headquarters.

As the EPA, DHS and the other regulatory agencies continue to develop guidelines and regulations about action levels and MCLs for these emergent chemicals, the Army will revisit the potential for contamination in water resources at the former Fort Ord.