

APPENDIX B

# Groundwater

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## Introduction

This appendix discusses groundwater investigations conducted at the Inboard Area and the coastal salt marsh at the former Hamilton Army Airfield (HAAF). An assessment of the condition of groundwater is provided. Additional specific details regarding the hydrogeologic and groundwater investigations can be obtained from the reports listed at the end of this appendix.

Seven environmental investigations of groundwater at HAAF, dating back to 1985 (Woodward-Clyde Federal Services [WCFS], 1985) through groundwater sampling in 2002 (Cerrudo Services, 2002), were conducted at the Inboard Area and coastal salt marsh. The referenced reports present the groundwater data, associated soil data, and the geologic and hydrogeologic conditions at the property.

## Summary of Hydrogeology

As discussed in Section 1.4, the Inboard Area and the coastal salt marsh have similar compositions of Bay Mud but somewhat different hydrogeology, primarily as the result of differences in elevation and levels of saturation. Most of the Inboard Area lies below sea level and is inundated only seasonally with rainfall and stormwater surface runoff. During drier weather, this water either evaporates from the property or slowly percolates to the perimeter ditch and eventually is pumped to San Pablo Bay. In contrast, the coastal salt marsh is inundated regularly with saltwater from the higher tides of San Pablo Bay as well as receiving normal stormwater and stormwater discharges from the Inboard Area runoff via the pump stations.

Groundwater at HAAF is uniformly distributed throughout the saturated clay formation in the Inboard Area and coastal salt marsh. Groundwater levels at the Inboard Area vary according to seasonal rainfall (and the associated stormwater pumping) and evapotranspiration rates. The levels are influenced, to a lesser degree, by irrigation water discharged onto the property from upland areas. Groundwater levels and saturation of the coastal salt marsh vary with the diurnal fluctuations of tide elevations and inundation during storm events.

Where the Inboard Area is composed of Bay Mud (saturated or desiccated) and from zero to approximately two meters of overlying fill, groundwater moves slowly along the path of least resistance to the lowest area of the property percolating through the consolidated fill and over the saturated clay, tens of meters thick. The clay retards the vertical movement of any contaminants, and the consolidated fill retards horizontal movement. The sediment composition of the coastal salt marsh is predominantly soft Bay Mud, made up of very dense, relatively homogeneous clay. Groundwater does not move through this type of solid, highly porous, but weakly permeable formation without a significant applied hydraulic

pressure difference. The continuous saturated clay and the lack of movement of groundwater within the clay limit movement of contaminants within the marsh.

## Investigations

### Inboard Area

In 1985, the Army installed three investigation trenches, four test pits, and four wells at the west end of the airfield (northwest runway area – suspected Landfill 23) during the initial investigation within that area of the property. The groundwater sample reports for the October 1985 event indicated trace levels of metals, just above the method detection limits, in three down-gradient wells, trace detections of three priority pollutant organic compounds in two of the wells, and trace alpha and beta particles in one well – the only well sampled for these constituents.

Groundwater was sampled monthly between December 1985 and March 1986, and from June 1986 through September 1986. Very low concentrations of five volatile organic compounds (VOCs), lindane, and 12 semi-volatile organic compounds (SVOCs) were detected sporadically in the groundwater samples. No contaminant plumes were identified during the investigations. Four additional temporary wells were installed in the area of the levee to the southwest of the earlier wells, during a follow-on investigation by IT Corporation. Associated groundwater sampling, in April 1997, showed no evidence of impacts on groundwater from organic chemicals, and metals were detected within the range of observed values from background wells.

The investigations by Engineering Science, Inc. (ESI), conducted between 1990 and 1993, defined the distribution, type, and concentrations of contaminants at HAAF and assessed the risk associated with the chemicals (ESI, 1993). The investigation included installation of and sample collection from 18 groundwater monitoring wells at six sites: the revetment area, Revetment 10 firefighter training area (Burn Pit), aircraft maintenance and storage facility (AMSF), pump station area (PSA), former sewage treatment plant (FSTP) area, and at the coastal salt marsh-east levee construction debris disposal area (ELCDDA). The ELCDDA is discussed in the coastal salt marsh investigation subsection of this appendix.

Groundwater samples from the ESI investigation were analyzed for VOCs; SVOCs; benzene, toluene, ethylbenzene, and total xylenes (BTEX); total recoverable petroleum hydrocarbons (TRPH); total metals (unfiltered); pesticides/polychlorinated biphenyl (PCBs); and general chemistry parameters. Metals were detected in all the groundwater samples. With the exception of the groundwater sample results at the FSTP, the detections of organic chemicals in groundwater were at trace concentrations. Methyl ethyl ketone (MEK), a common laboratory glassware cleaning solvent, was reported at trace concentrations ranging from 25.3 to 32.2 micrograms per liter ( $\mu\text{g}/\text{L}$ ) in the groundwater samples collected from several wells across the facility.

Three wells were installed at Revetments 6, 20, and 26 in 1991, and sampled in 1991 and 1992. The well at Revetment 26 never accumulated sufficient water to sample. No TRPH, VOCs, SVOCs, BTEX, pesticides, or PCBs were detected in two rounds of sampling at the other two wells. Cyanide and five other metals were detected in a groundwater sample collected from the monitoring well (RV-MW-101) installed adjacent to Revetment 6

(IT, 1999). In 1993, one boring was also completed as a temporary monitoring well; no analytes were detected in the groundwater sample (IT, 1999).

At the Burn Pit (Revetment 10), TRPH was reported at just above the reporting limit of 100 µg/L in two of the four wells. MEK also was detected in the groundwater samples. The wells were removed during interim removal actions conducted at Revetment 10 in 1998 to remove contaminated soil.

Four wells were installed at the aircraft maintenance area. Wells AM-MW-101, 102, and 103 were located near former Building 86. TRPH and SVOCs were not detected. Benzene and 1,2-dichloroethene were reported at low concentrations (1.16 and 5.4 µg/L, respectively) in Well 101. In subsequent sampling events, chloromethane was reported at 8.3 µg/L in Well 103 and tentatively identified compounds (TICs) were reported as VOCs at 10 µg/L in Well 102. Napthalene was reported in a primary sample and a duplicate in Well 103 at 1.31 and 1.41 µg/L, respectively. TICs as SVOCs also were reported in Well 102 at 36 µg/L and in Well 103 at 20 and 40 µg/L in the primary and duplicate samples, respectively. In a second sampling event, napthalene was detected at 1.98 µg/L in Well 103 and TICs reported at 210 µg/L. Only metals were detected in groundwater samples collected from Monitoring Well AM-MW-104 located near Building 87.

One well was installed at the PSA adjacent to an aboveground storage tank (AST) north of Building 35. Soil samples, collected from three depths within the boring, indicated the presence of toluene at concentrations of 0.16, 0.15, and 0.57 mg/kg. However, no organics, including toluene, were reported in the groundwater sample after construction of the well. The well was closed in 1998, in anticipation of the removal of the AST and the excavation and disposal of diesel contaminated soil underneath the AST that was completed in 1999.

One well was installed at the south end of the sludge drying beds and within the footprint of the FSTP, which had been demolished in the mid-1980s. Concentrations of VOCs ranging from 1.24 to 198 µg/L, and SVOCs ranging from 3.19 to 232 µg/L, were reported. During the 1998 and 1999 interim removal actions at the FSTP, the well and surrounding soil containing VOC and SVOC chemicals were removed and disposed of offsite.

The U.S. Army Corps of Engineers (USACE) installed temporary wells and conducted groundwater sampling in 1994 to investigate (1) the potential for contamination from underground and aboveground fuel storage tanks at the pump station buildings, and (2) potential contamination from the sludge drying beds and a brackish water “seep” in the levee at the FSTP. Samples at both sites were analyzed for VOCs, SVOCs, TRPH, TPH-diesel, cyanide, and lead. No contaminants were identified in the groundwater at the pump stations and none identified in the temporary wells installed at the FSTP.

An investigation conducted by WCFS in 1995 and 1996 provided additional environmental groundwater data for the main airfield parcel. The Additional Environmental Investigation Report described the investigation for several areas of the main airfield parcel and summarized information from previous investigations (WCFS, 1996). Seventeen groundwater wells were constructed at five sites – revetment area (near Revetment 5), jet (onshore) fuel lines, pump station area (near Building 41), AMSF (Buildings 82/87/92/94 and 86 near the perimeter ditch outfall from AMSF area storm drains) – and five background locations. The five background wells were installed away from known artificial

or natural drainage features to evaluate the background groundwater quality for comparison on the main airfield parcel. Groundwater samples were collected and analyzed for VOCs; SVOCs including polynuclear aromatic hydrocarbons (PAHs); TPH measured as gasoline, diesel, and jet propulsion fuel (JP-4); BTEX; metals; pesticides; herbicides; oil and grease; total organic carbon; and other physical water quality parameters. The only organic chemical detected was toluene at trace concentrations in PSA-MW3. This well was installed, south of former Building 41, adjacent to a known area of hydrocarbon contamination that has been remediated. The samples from all but one well (PSA-MW1) had detected metals concentrations on par with or, in most cases, below the corresponding values observed in the background wells.

In 1996, Monitoring Wells RVT-MW-1 through RVT-MW-3 were installed around a catch basin located next to Revetment 5 (IT, 1999). Ten metals were detected in the groundwater samples collected from these wells, but organics were not detected (IT, 1999).

Also in 1996, eight temporary monitoring wells, RVT-TW1 through RVT-TW8, were installed in soil borings at the unpaved Revetments 9, 11, 12, and 23. Groundwater samples were collected and analyzed for TPH-D, TPH-G, TPH-JP-4, BTEX, and PAHs. Xylene was detected in the groundwater at Revetment 9, and ethylbenzene was detected in the groundwater at Revetment 12 (IT, 1999).

One groundwater sample was also collected from groundwater Monitoring Well PSA-MW-3, located southeast of Building 41, in an area adjacent to a former aboveground fuel tank and fuel leak to the soil. Metals and unknown extractable hydrocarbons (UHE) were detected in the groundwater sample collected from the monitoring well. As noted above, this area was remediated in 1998 and 1999.

A remedial investigation conducted by International Technology Corporation (IT) in 1997 and 1998 evaluated conditions at specific sites within the main airfield parcel. Data from previous investigations were evaluated during the Remedial Investigation, and additional samples were collected at specific sites and analyzed to aid in characterizing and determining the chemical conditions of groundwater. Groundwater samples were collected from six sites – Buildings 15, 20, 84/90, and 86; the FSTP sludge drying beds; and the northwest runway area – during the Remedial Investigation. The samples were analyzed for TPH (measured as gasoline, diesel, and JP-4), VOCs, BTEX, PAHs, PCBs, pesticides, metals, and dissolved organic carbon. Both inorganic and organic chemicals were detected at low levels.

At Building 15, a fuel tank was removed during the Remedial Investigation, and soil was excavated. Potholes were dug to determine the lateral extent of fuel impacts around the former tank location. One groundwater sample collected from the step-out pothole east of the concrete pad was analyzed for hydrocarbons and lead. UHE was reported in the water sample at 72 µg/L (IT, 1999).

During the Remedial Investigation, an aboveground fuel tank and contaminated soil were removed from Building 20. UHE, unknown purgeable hydrocarbons (UHP), and lead were detected at 3,300 µg/L, 7,800 µg/L, and 23 µg/L, respectively, in a water sample collected from the excavation pit at Building 20; the concentrations detected in the pit water sample were not suspected to be representative of the groundwater outside of the underground storage tank excavation (IT, 1999).

For the Remedial Investigation conducted at Buildings 84/90, one groundwater sample was collected from one soil boring drilled west of Building 90, adjacent to the edge of the wash racks. Lead was detected at 13 µg/L in the groundwater sample. No other analytes were detected (IT, 1999).

At Building 86, one groundwater sample was collected from AM-MW-101 and analyzed for TPH-P, TPH-E, VOCs, BTEX, PAHs, pesticides, PCBs, and metals during the Remedial Investigation. Five metals, four of which had been detected in previous sampling, and UHE were detected in the groundwater sample (IT, 1999).

TPH-G, UHE, BTEX, VOCs, heptachlor, and 13 metals were detected in one groundwater sample collected from the former monitoring well at the FSTP (IT, 1999). Monitoring Well TP-MW-101 and surrounding soil and sludge were removed during the 1998 and 1999 interim removal actions.

In 1997 at the northwest runway area, four direct-push soil samples were collected and temporary Monitoring Wells TW-001 through TW-004 were installed in the boreholes (U.S. Army, 2001). Metals were detected in groundwater collected from the temporary monitoring wells.

In 1998 and 1999, interim removal actions were conducted at a transformer pad outside Building 82. In the 1999 action, fuel was chased along the backfill surrounding a sewer pipe. Potholes were dug along the sewer line, and piezometer wells were constructed within the potholes. TPH-E was detected in a groundwater sample collected from the pothole well closest to the removal action excavation. PCBs were not detected in groundwater samples collected from the potholes (IT, 2000).

During the 1999 interim removal actions, a temporary piezometer well had been constructed in each of the three potholes at Building 82. In 2002, USACE sampled the three piezometers. The samples had analyses for TPH-gasoline range; TPH-diesel range; and benzene, toluene, ethylbenzene, and total xylenes (BTEX). No gasoline-range TPH or BTEX volatile compounds were reported. The analyses did report TPH in the diesel range at 410, 730, and 330 µg/L, respectively, in the three piezometer wells (B82E-TW001, B82E-TW002, and B82E-TW003); however, the chromatograms showed peaks uncharacteristic of the diesel standard, suggesting the results reflected weathered diesel or perhaps heating oil. The Army was unsure of the source of the petroleum, as there was no evidence of a tank at Building 82. The Army speculated that (1) an aboveground or underground tank may have been used for heating oil storage and was formerly located in the vicinity of what is now the northwest corner of Building 82, given that a natural gas system for building heating currently is located here; or (2) fuel had been drained into the sewer line from the building, but had leaked at a piping joint, given that TPH had been found along the pipeline.

In 2001 and 2002, at the request of a representative of the Regional Water Quality Control Board, the Army (through the USACE, Sacramento District) conducted a final groundwater survey of 18 of the 42 monitoring wells at the Inboard Area, including three background wells and two wells at the coastal salt marsh. The goal of the sampling was to add to the limited data on filtered metals in groundwater; and the focus was wells located in the vicinity of the planned channels for the Hamilton Wetland Restoration Project. Water samples were collected and analyzed for specific chemicals of interest. All 18 wells were

analyzed for dissolved (filtered) metals; and selected wells were analyzed for extractable-range TPH, VOCs, SVOCs, pesticides, and PCBs. The results of the sampling indicated background levels of metals and organic chemicals in the groundwater.

Of the 18 samples collected, three metals – copper, nickel, and zinc – exceeded the Salt Water Aquatic Life Protection values. Of these results, only two copper results exceeded any background metals concentrations, both by less than 10 percent. All three background wells (BKG-MW-2, BKG-MW-4, BKG-MW-5) exceeded the Salt Water Aquatic Life Protection values for these three metals, suggesting that military activity did not cause the exceedances, and ambient groundwater concentrations may be higher than the Salt Water Aquatic Life Protection values. UHE was tentatively identified in the sample collected from Well JFL-MW-1 and reported at an estimated concentration of 320 µg/L (USACE, 2002).

In January 2002, Monitoring Wells MW-PVC-1, -2, -3, and -4 at the northwest runway area were sampled. Following completion of the sampling in 2002, Wells -1, -2, and -3 were removed (USACE, 2002); Monitoring Well 4 was retained for future groundwater monitoring related to Landfill 26 located off of the main airfield parcel approximately 1,000 feet to the west of the runway panhandle. Other wells on the property were closed following the sampling in December 2001, January 2002, and October 2002.

An additional soil and groundwater investigation was conducted around the piezometers at the northwest corner of Building 82 in September 2002. Eight direct-push soil borings were completed. Two were driven through cores in the concrete floor inside Building 82, and the other six were located around the former transformer excavation and the piezometers to encompass an area of about 40 feet wide by 110 feet long. Soil samples were obtained from all eight cores, and groundwater was found and sampled in six of the eight cores. The samples were analyzed for TPH-purgeable range, TPH-extractable range, and BTEX. Gasoline-range hydrocarbons were reported at 190 µg/L in one of the push boring groundwater samples. An unknown fuel hydrocarbon was reported at 740 µg/L in an adjacent boring water sample. Diesel-range hydrocarbons were detected in all six water samples at concentrations ranging from 0.52 to 1.9 mg/L. No VOCs (BTEX) were reported in any of the water samples. No TPH or BTEX was reported in any of the eight soil samples. These data did not exceed water quality objectives for TPH applied to groundwater.

Three wells on the runway were thought to have been destroyed or lost during remediation construction activities on the airfield and adjacent General Services Administration property in 1995 and 1996. Several attempts to locate them had failed. After the final well sampling had been completed, three different individuals relocated the three wells successively. The Army decided to obtain a sample before these three wells were closed. Only one of the wells provided sufficient water for sampling, which was conducted in August 2002.

Organic constituents that were reported in groundwater appear to be distributed randomly at relatively low concentrations (below Water Quality Goals, California Toxics Rule Criteria, Enclosed Bays and Estuaries and below the Presidio, Saltwater Ecological Protection Zone numbers for TPH and its constituents). It was determined that no further action would be required for groundwater at the Inboard Area.

All groundwater analytical data from the 2001/2002 sampling of the 18 wells are presented in the table Groundwater Analytical Data for Select Wells at Hamilton Army Airfield in the

*Groundwater Data Report, Final Well Sampling, Hamilton Army Airfield, Novato, California, June 2002 and addendum, September 2002 (USACE, 2002).*

## Coastal Salt Marsh

In 1986, the Army investigated the ELCDDA within the coastal salt marsh as an area of potential concern because of reported former dumping of construction debris and open incineration of wood (WCFS, 1987). Pairs of soil samples were collected from a series of 15 trenches within the ELCDDA and analyzed for metals, TRPH, VOCs, SVOCs, pesticides, and PCB arochlors. The results of the trench investigation indicated no releases had occurred within the disposal area. No organic chemicals were detected, and metals were reported within background concentrations (WCFS, 1987). Groundwater was not sampled at the ELCDDA during the investigation.

In 1991, ESI conducted an investigation of soil and groundwater at the coastal salt marsh to evaluate the potential of contaminants from the ELCDDA. The investigation included installation of five wells (EL-MW-101, EL-MW-102, EL-MW-103, EL-MW-104, and EL-MW-105) placed at four perimeter locations and at the center of the ELCDDA; sample collection; and sample analyses. Groundwater samples at four consecutive quarterly sampling events – January, April, July, and October 1991 – were analyzed for a comprehensive suite of organic compounds, including VOCs, SVOCs, PCBs, PAHs, pesticides, and herbicides, and inorganic compounds (metals) and general chemistry parameters.

There was only one trace detection of a VOC – MEK, at 27.6 µg/L – in one well and no other organic detections (ESI, 1993). MEK, a common laboratory contaminant, was interpreted to be an investigation-related contaminant rather than related to the in-situ groundwater condition. Varied detections of metals (unfiltered samples) were reported. Hydrocarbons were not suspected on the basis of previous soil sample results. As a consequence, groundwater samples were not analyzed for TPH at that time. All other VOCs and SVOCs, PAHs, pesticides, and PCBs were not detected in any groundwater samples analyzed.

Values for metals detected in the coastal salt marsh groundwater samples collected during the 1991 quarterly sampling events are listed in Table 4.23 of the ESI report. In general, the detections of metals are at low concentrations, sporadic, and not indicative of any contaminant release.

In December 2001 and January 2002, the U.S. Army sampled two of the ELCDDA wells: EL-MW-103, and EL-MW-104. The samples were analyzed for metals, including mercury, TPHs in the extractable range, pesticides, and PCBs. Metals (filtered samples) were detected in both wells, diesel-range hydrocarbons (TPH-d) were detected in well EL-MW-104 at 200 µg/L, and endrin initially was estimated at a trace concentration of 0.008 µg/L. The TPH-d detection was below the Presidio, Saltwater Ecological Protection Zone numbers for TPH. Upon more rigorous evaluation, the reported trace concentration of endrin was determined to be a false positive result; thus, the chemical was not detected. With the exception of the TPH-d result, essentially no organics and only varied detections of metals were reported in the groundwater.

All groundwater analytical data from the 2001/2002 sampling of the 18 wells are presented in the table Groundwater Analytical Data for Select Wells at Hamilton Army Airfield in the

*Groundwater Data Report, Final Well Sampling, Hamilton Army Airfield, Novato, California, June 2002 and addendum, September 2002 (USACE, 2002).*

Results indicated that groundwater does not appear to have been affected by former site activities. The one previous MEK result was just above the detection limit in one sample in only the first of four events from one well. The TPH-d result was at trace concentrations. It was determined that no further action would be required for groundwater at the coastal salt marsh.

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APPENDIX C

# Responsiveness Summary

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