EXECUTIVE SUMMARY

This report presents a conceptual model of contaminant fate and transport at Operable Unit 8 (OU 8), Hill Air Force Base, Utah (Hill AFB). Operable Unit 8 is one of twelve operable units being investigated at Hill AFB, which was placed on the National Priorities List (NPL), or "Superfund Program", in July of 1987. Operable Unit 8 is a groundwater only operable unit comprised of the shallow unconfined aquifer beneath the Base industrial complex area and the cities of Layton and Clearfield, with contaminated groundwater encompassing approximately 600 acres. Contamination detected at the site is primarily from historic releases of solvents and fuels originating in the industrial complex area of Hill AFB.

Hill AFB lies on a terrace approximately 300 feet above the Weber River Valley, directly north of Hill AFB. The hydrogeology at OU 8 is complex and consists primarily of sand, silt, and clay. The highly heterogeneous nature of the aquifer leads to several possible migration pathways in the shallow aquifer. Contaminants have migrated from on-Base sources to other on-Base areas, as well as to off-Base areas. The principal route of contaminant migration is by flow through the shallow aquifer. After entering the shallow aquifer, contaminants migrate horizontally and vertically through the higher permeability sand and silty sand units that constitute the shallow aquifer stratigraphy. Vertical migration beneath the shallow aquifer is impeded by a layer of relatively lower permeability clay and silty clay that is laterally extensive and underlies the higher permeability sand units. In addition, hydraulic gradients (both upward and downward) exist within various portions of the shallow aquifer and affect the vertical distribution of contaminants. Field drains installed by farmers in the Layton area are draining contaminated groundwater from some areas of the plume where the water table is close to the ground surface. This contaminated groundwater is then discharged to surface water bodies and/or stormwater drains. However, the highest levels of contamination off Base do not occur at or near the water table, but rather are found at depth.

Based on the *Final Remedial Investigation/Feasibility Study (RI/FS) Work Plans for Operable Unit 8* (Montgomery Watson, 1995), a variety of field investigation programs have been conducted including: monitoring well installation, groundwater sampling, surface-water sampling, air sampling, cone penetration testing and direct-push groundwater sampling, field drain sampling, and aquifer testing. Additionally, many field investigations were conducted prior to the RI fieldwork. The field and analytical results associated with the RI and previous field programs are documented, interpreted, and presented in the *Final Remedial Investigation Report for Operable Unit 8* (Montgomery Watson Harza, 2001).

Site investigations have identified several potential sources of contaminants in OU 8 groundwater. Potential sources include Buildings 220 and 225 (OU 7); Berman Pond, the Industrial Wastewater Treatment Plan (IWTP) Sludge Drying Beds, the Sodium Hydroxide Tank Site, the Refueling Vehicle Maintenance Facility (RVMF), Ponds 1 and 3 (OU 3); and the underground storage tank (UST) sites 260 (ST74) and 280 (ST35). Each of these potential source areas have been addressed under separate investigations and decision documents. Volatile Organic Compounds (VOCs) are the primary

contaminants detected in OU 8 groundwater. The VOCs most frequently detected above their respective Maximum Contaminant Levels (MCLs) in OU 8 groundwater include: trichloroethene (TCE), 1,2-dichloroethane (1,2-DCA), 1,1-dichloroethene (1,1-DCE), 1,1,1-trichloroethane (1,1,1-TCA), and chlorobenzene. In addition, gasoline and diesel range organic compounds (benzene, ethylbenzene, and toluene) have been detected in concentrations exceeding their respective MCLs at on-Base UST sites. All organic contaminants have been detected within the areal extent of the TCE and 1,2-DCA plumes. The primary inorganic contaminant in groundwater detected above its respective MCL and associated with Hill AFB is hexavalent chromium in the vicinity of Building 225 and the Hill AFB IWTP. Other inorganic contaminants detected in groundwater at OU 8 include arsenic, antimony, cadmium, lead, and nickel.

TCE and 1,2-DCA are the most widespread contaminants at OU 8. The highest TCE concentrations (up to 2,000 micrograms per liter [µg/l]) are reported on Base near Buildings 225 and 257. The maximum depth at which TCE has been detected on Base is 280 feet below ground surface (bgs) in monitoring well U8-132 (at 2.0 µg/l), near the northern extent of the on-Base TCE plume. The off-Base TCE plume is split into eastern and western portions. Off-Base TCE concentrations are highest in the Ridgeview Estates area immediately south of the OU 8 IRA Hydraulic Containment System, and the distal portions of the plume. The highest off-Base TCE concentration of 465 µg/l was detected at monitoring well U8-085 (completed at 110 feet bgs), located directly south of the IRA Hydraulic Containment System. Chemical partitioning calculations estimate the total mass of TCE within the OU 8 plume is approximately 9,800 pounds, with approximately 3,600 pounds in the aqueous phase (i.e., dissolved). The estimated volume of groundwater contaminated with TCE at OU 8 is approximately 5.9 billion gallons.

The suspected source of 1,2-DCA is in the former Berman Pond area near the southern boundary of the Base, hence 1,2-DCA primarily has been detected in the off-Base portion of the OU 8 plume. The highest concentrations of 1,2-DCA are found at the southern Base boundary and along the western lobe of the off-Base plume (i.e., near the distal end of the TCE plume). The highest 1,2-DCA concentration (697 µg/l) was detected in monitoring well U8-096, located on the western side of Interstate Highway 15 (I-15) at a depth of 76 feet bgs. The concentration of 1,2-DCA in monitoring well U8-024, located at the southern Base boundary, averages approximately 400 µg/l at a depth of 140 feet bgs. The maximum depth at which 1,2-DCA has been detected at OU 8 is 184 feet bgs in monitoring well U8-124, located southwest of I-15 in Layton. The off-Base 1,2-DCA plume has advanced several thousand feet ahead of the TCE plume in the western lobe. This is attributed to the lower retardation factor for 1,2-DCA relative to TCE. The estimated total mass of 1,2-DCA within the OU 8 plume is approximately 3,800 pounds with approximately 3,100 pounds in the aqueous phase (dissolved). The estimated volume of groundwater contaminated with 1,2-DCA at OU 8 is approximately 3.8 billion gallons.

In an effort to reduce potential risks to off-Base receptors, and minimize the potential migration of contaminants, Hill AFB constructed a hydraulic containment system as an Interim Remedial Action (IRA). The IRA Hydraulic Containment System, consisting of a series of eight vertical groundwater extraction wells, was constructed in the fall of 1997

through spring 1998 along the southern Base boundary. The objective of the IRA system is to induce a hydraulic gradient that will contain contaminated groundwater at the southern boundary of Hill AFB. The system has been in operation since May 1998, and is planned to be in operation until the final remedy for OU 8 is implemented. Data collected to date indicate that sufficient drawdown has been maintained to achieve hydraulic containment of groundwater at the southern Base boundary.

Contaminants have migrated from on-Base sources to other on-Base areas, as well as to off-Base areas through the shallow aquifer. Factors that have influenced contaminant migration include stratigraphic controls as well as hydraulic controls. Contaminants migrate primarily along preferential pathways, such as sand units, where advective velocities are greatest. Dispersion causes spreading of the contaminants as they migrate from source areas. Retardation slows the migration of contaminants relative to groundwater advective velocities and to each other.

Chemical and geochemical evidence at OU 8 suggests that biotransformation of chlorinated solvents is occurring. There is evidence of reductive dehalogenation of TCE in the off-Base plume and on Base in limited areas. However, in some areas where biotransformation is evident, concentrations of TCE have not significantly decreased through time. In the industrial complex area on Base, TCE concentrations have declined significantly through time in the most contaminated wells (e.g., WW-13, U8-017, and U7-009). However, there is little evidence of reductive dehalogenation in this area, hence the decline may be a result of other natural attenuation processes such as advection, dilution (by recharge), and dispersion, in addition to biotransformation.