Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS): FOB Hammer and Vicinity, Iraq: 2011-2016

AUTHORITY: This periodic occupational and environmental monitoring summary (POEMS) has been developed in accordance with Department of Defense (DoD) Instructions 6490.03, 6055.05, and JCSM (MCM) 0017-12 (References 1-3).

PURPOSE: This POEMS documents the Department of Defense (DoD) assessment of occupational and environmental health (OEH) risk for Forward Operating Base (FOB) Hammer, Iraq and vicinity that includes Besmiyah Range and Kersaw Range, Iraq. It presents a qualitative summary of health risks identified at this location and their potential medical implications. The report is based on information collected from 1 June 2011 through 31 December 2016 to include deployment OEHS sampling and monitoring data (e.g., air, water, and soil), field investigation and health assessment reports, as well as country and area-specific information on endemic diseases.

This assessment assumes that environmental sampling at FOB Hammer and vicinity during this period was performed at representative exposure points selected to characterize health risks at the *population–level*. Due to the nature of environmental sampling, the data upon which this report is based may not be fully representative of all the fluctuations in environmental quality or capture unique occurrences. While one might expect health risks pertaining to historic or future conditions at this site to be similar to those described in this report, the health risk assessment is limited to 1 June 2011 through 31 December 2016.

The POEMS can be useful to inform healthcare providers and others of environmental conditions experienced by individuals deployed to FOB Hammer and vicinity during the period of this assessment. However, it does not represent an individual exposure profile. Individual exposures depend on many variables such as: how long, how often, where and what someone is doing while working and/or spending time outside. Individual outdoor activities and associated routes of exposure are extremely variable and cannot be identified from or during environmental sampling. Individuals who sought medical treatment related to OEH exposures while deployed should have exposure/treatment noted in their medical record on a Standard Form (SF) 600 (Chronological Record of Medical Care).

SITE DESCRIPTION: FOB Hammer, established in February 2007, was located approximately 20 miles east, southeast of Baghdad, Iraq. Located in the Qada region of Iraq, FOB Hammer was constructed adjacent to the Besmaya Combat Training Center, an Iraqi military training facility. In 2009, FOB Hammer was redesignated as a Contingency Operating Base (COB), in accordance with base FOB Hammer definitions in use at the time. The region surrounding FOB Hammer consisted of mostly undeveloped land and barren desert. The site was previously an Iraqi artillery and firing range complex. Coalition forces operated approximately 16 different ranges at FOB Hammer. Also included in this POEMS is Besmiyah Range and Kersaw Range. The exact date these ranges were established could not be found.

SUMMARY: Conditions that may pose a moderate or greater health risk are summarized in Table 1. Table 2 provides population based risk estimates for identified OEH conditions at FOB Hammer and vicinity. As indicated in the detailed sections that follow Table 2, controls established to reduce health risk were factored into this assessment. In some cases, e.g., ambient air, specific controls are noted, but not routinely available/feasible.

Table 1: Summary of Occupational and Environmental Conditions with MODERATE or Greater Health Risk

Short-term health risks & medical implications:

The following hazards may be associated with potential acute health effects in some personnel during deployment at FOB Hammer and vicinity that includes Besmiyah Range and Kersaw Range:

Food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis, hepatitis E); other endemic diseases (cutaneous leishmaniasis (acute), leishmaniasis-visceral, Crimean-Congo hemorrhagic fever, sandfly fever, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever, soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans); and heat stress. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis, hepatitis E), if ingesting local food and water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid/paratyphoid fever, brucellosis, hepatitis E). Risks from food/waterborne diseases may have been reduced with preventive medicine controls and mitigation, which includes hepatitis A and typhoid fever vaccinations and only drinking from approved water sources in accordance with standing CENTCOM policy. For other vector-borne endemic diseases (cutaneous leishmaniasis (acute), leishmaniasis-visceral, Crimean-Congo hemorrhagic fever, sandfly fever), these diseases may constitute a significant risk due to exposure to biting vectors; risk reduced to 'Low' by proper wear of the treated uniform, application of repellent to exposed skin, bed net use, and appropriate chemoprophylaxis, as well as minimizing areas of standing water and other vector-breeding areas. For water contact diseases (leptospirosis, schistosomiasis) activities involving extensive contact with surface water increase risk. For respiratory diseases (TB), personnel in close-quarter conditions could have been at risk for person-to-person spread. Animal contact diseases (rabies, Q fever), pose year-round risk. For soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans), risk may have been reduced by limiting exposure to soil contaminated with human or animal feces (including not sleeping on bare ground, and not walking barefoot). For heat stress, risk can be greater during months of April through October, and greater for susceptible persons including those older than 45, of low fitness level, unacclimatized, or with underlying medical conditions, and those under operational constraints (equipment, PPE, vehicles). Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, proper hydration and nutrition, and mitigation.

Air quality: For inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}) from environmental dust, the PM_{10} overall short-term health risk was not evaluated due to no data for analysis. For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) from environmental dust, the $PM_{2.5}$ overall short-term health risk was not evaluated due to insufficient data for analysis. However, the FOB Hammer and vicinity area is a dust-prone desert environment with a semi-arid climate, also subject to vehicle traffic. Consequently, exposures to PM_{10} and $PM_{2.5}$ may vary, as conditions may vary, and may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel while at this site, particularly exposures to high levels of dust such as during high winds or dust storms. For PM_{10} and $PM_{2.5}$, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio-pulmonary conditions) are at greatest risk of developing notable health effects. In addition, there was a brick factory located within four miles of FOB Hammer (see section 10.8 for a summary and factsheet reference of the brick factory). There was insufficient data from the brick factory to evaluate short-term health risk. In the vicinity of the brick factory, exposures to the smoke and soot may have varied, and exposures to high levels of PM_{10} and $PM_{2.5}$ from smoke may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel and certain subgroups. Although most short-term health effects from exposure to particulate matter and smoke should have resolved post-deployment, providers should be prepared to consider the relationship between deployment exposures and current complaints. Some individuals may have sought treatment for acute respiratory irritation while at FOB Hammer and vicinity. Personnel who reported with symptoms or required treatment while at site(s) with burn pit activity should have exposure and treatment noted in medical record (e.g., electronic medical record and/or on a Standard Form (SF) 600 (Chronological Record of Medical Care).

Long-term health risks & medical implications:

The following hazards may be associated with potential chronic health effects in some personnel during deployment at FOB Hammer and vicinity that includes Besmiyah Range and Kersaw Range:

Air quality: For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) from environmental dust, the overall long-term health risk was not evaluated due to insufficient data for analysis. Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}) from environmental dust was not evaluated for long-term health risk due to no data for analysis and no available health guidelines. However, the FOB Hammer and vicinity area is a dust-prone desert environment with a semi-arid climate, also subject to vehicle traffic, and conditions may have varied. In addition, there was a brick factory located within four miles of FOB Hammer (see section 10.8 for a summary and factsheet reference of the brick factory). There was insufficient data from the brick factory to evaluate long-term health risk. In the vicinity of the brick factory, exposures to the smoke and soot may have varied, as conditions may have varied. For inhalational exposure to high levels of dust containing PM_{10} and $PM_{2.5}$, such as during high winds or dust storms, and for exposures to smoke, it is considered possible that some otherwise healthy personnel, who were exposed for a long-term period to dust and

particulate matter, could develop certain health conditions (e.g., reduced lung function, cardiopulmonary disease). Personnel with a history of asthma or cardiopulmonary disease could potentially be more likely to develop such chronic health conditions. While the dust and particulate matter exposures and exposures to smoke are acknowledged, at this time there were no specific recommended, post-deployment medical surveillance evaluations or treatments. Providers should still consider overall individual health status (e.g., any underlying conditions/susceptibilities) and any potential unique individual exposures (such as burn pits/barrels, incinerators, occupational or specific personal dosimeter data) when assessing individual concerns. Certain individuals may need to be followed/evaluated for specific occupational exposures/injuries (e.g., annual audiograms as part of the medical surveillance for those enrolled in the Hearing Conservation Program; and personnel covered by Respiratory Protection Program and/or Hazardous Waste/Emergency Responders Medical Surveillance).

Table 2. Population-Based Health Risk Estimates - FOB Hammer and vicinity that includes Besmiyah Range and Kersaw Range[1, 2]

Source of Identified Health Risk[3]	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
AIR			
Particulate matter less than 10 micrometers in diameter (PM_{10})	Short-term: No data were available for analysis to characterize health risk. Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during days with elevated PM levels. More serious effects are possible in susceptible persons (e.g., those with asthma/pre-existing respiratory diseases).	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: No data were available for analysis to characterize health risk. Daily levels vary, acute health effects (e.g., upper respiratory tract irritation) more pronounced during days with elevated PM levels. More serious effects are possible in susceptible persons (e.g., those with asthma/pre-existing respiratory diseases).
	Long-term: No health guidelines		Long-term: No health guidelines
Particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$)	Short-term: Data not representative of exposure and is insufficient to characterize risk. Because FOB Hammer and vicinity is situated in a dusty semi-arid desert environment, a majority of the time mild acute (short term) health effects are anticipated. Elevated levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Data not representative of exposure and is insufficient to characterize risk. Because FOB Hammer and vicinity is situated in a dusty semi-arid desert environment, a majority of the time mild acute (short term) health effects are anticipated. Elevated levels may produce mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.
	Long-term: Data not representative of exposure and is insufficient to characterize risk. A small percentage of personnel may be at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/pre-existing respiratory diseases).		Long-term: Data not representative of exposure and is insufficient to characterize risk. A small percentage of personnel may be at increased risk for developing chronic conditions. Particularly those more susceptible to acute effects (e.g., those with asthma/existing respiratory diseases).
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: High (bacterial diarrhea, hepatitis A, typhoid fever) to Moderate (diarrhea-cholera, diarrhea-protozoal, brucellosis and hepatitis E). If local food/water were consumed, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid fever, brucellosis, hepatitis E).	Preventive measures include hepatitis A and typhoid fever vaccination and consumption of food and water only from approved sources.	Short-term: Low to none
	Long-term: none identified		Long-term: No data available
Arthropod Vector Borne	Short-term: Moderate (leishmaniasis-cutaneous, leishmaniasis-visceral, Crimean-Congo hemorrhagic fever, sandfly fever) to Low (rickettsioses, typhus-murine; West Nile fever, and sindbis).	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin, and bed net use, minimizing areas of standing water and appropriate chemoprophylaxis.	Short-term: Low
	Long-term: Low (leishmaniasis-visceral infection)		Long-term: No data available
Water-Contact (e.g., wading,	Short-term: Moderate (leptospirosis and schistosomiasis).	Control measures implemented: Avoid water	Short-term: Moderate for leptospirosis and schistosomiasis.

swimming)	Long-term: No data available	contact and recreational water activities, properly wear of the uniform (especially footwear), and utilize protective coverings for cuts/abraded skin.	Long-term: No data available
Respiratory	Short-term: Moderate (tuberculosis (TB) to Low (meningococcal meningitis and Middle East respiratory syndrome coronavirus (MERS-CoV)).	Providing adequate living and work space; medical screening; vaccination	Short-term: Low
	Long-term: No data available		Long-term: No data available
Animal Contact	Short-term: Moderate (rabies and Q-fever) to Low (anthrax and avian Influenza).	Prohibiting contact with, adoption, or feeding of feral animals IAW U.S. Central Command (CENTCOM) General Order (GO) 1C. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW The Center for Disease Control's (CDC) Advisory Committee on Immunization Practices guidance.	Short-term: No data available
	Long-term: Low (rabies)		Long-term: No data available
Soil-transmitted	Short-term: Moderate for soil transmitted helminthes (hookworm, strongyloidiasis, cutaneous larva migrans).	Risk was reduced to Low by limiting exposure to soil contaminated with human or animal feces (including sleeping on bare ground, and walking barefoot).	Short-term: Low
	Long-term: No data available		Long-term: No data available
VENOMOUS ANIMAL/ INSECTS			
Snakes, scorpions, and spiders	Short-term: Low; If encountered, effects of venom vary with species from mild localized swelling (e.g., *Scorpio maurus*) to potentially lethal effects (e.g., *Vipera albicornuta*).	Risk reduced by avoiding contact, proper wear of uniform (especially footwear), and proper and timely treatment.	Short-term: Low; If encountered, effects of venom vary with species from mild localized swelling (e.g., *Scorpio maurus*) to potentially lethal effects (e.g., *Vipera albicornuta*).
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Variable; Risk of heat injury is Low from November - March, High in April, and Extremely High from May – October.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	Short-term: Variable; Risk of heat injury in unacclimatized or susceptible personnel Low from November - March, High in April, and Extremely High from May – October
	Long-term: Low; However, the risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.		Long-term: Low; However, the risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions.
Cold	Short-term: Low risk of cold stress/injury.	Risks from cold stress reduced with protective measures such as use of the buddy system, limiting exposure during cold weather, proper hydration	Short-term: Low risk of cold stress/injury.
	Long-term: Low; Long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frost bite.		Long-term: Low; Long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frost bite.

		and nutrition, and proper wear of issued protective clothing.	
NOISE			
Continuous (Flightline, Power Production)	Short-term: High to Low; High risk to individuals working near major noise sources without proper hearing protection.	Hearing protection used by personnel in higher risk areas.	Short-term: Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.
	Long-term: High to Low; High risk to individuals working near major noise sources without proper hearing protection.		Long-term: Low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.
Unique Incidents/ Concerns			
Narhwan Brick Factory	The brick factory was located within four miles north of FOB Hammer. Soldiers often complained about the heavy smoke and soot blowing over the FOB from the brick factory. There was insufficient air surveillance data from the brick factory to evaluate short- and long-term health risk.		Short-term: Insufficient data to assess risk.
			Long-term: Insufficient data to assess risk.
Burn Pits	Short-term: FOB Hammer and vicinity do not have a burn pit.		Short-term: FOB Hammer and vicinity do not have a burn pit.
	Long-term: FOB Hammer and vicinity do not have a burn pit.		Long-term: FOB Hammer and vicinity do not have a burn pit.

[1]This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational environment conditions at FOB Hammer and vicinity that includes Besmiyah Range and Kersaw Range. It does not represent an individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may have been present in the environment, if a person did not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may have been no health risk. Alternatively, a person at a specific location may have experienced a unique exposure which could result in a significant individual exposure. Any such person seeking medical care should have their specific exposure documented in an SF600.

[2] This assessment is based on specific environmental sampling data and reports obtained from 1 June 2011 through 31 December 2016. Sampling locations are assumed to be representative of exposure points for the FOB Hammer population, but may not reflect all the fluctuations in environmental quality or capture unique exposure incidents.

[3]This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at FOB Hammer and vicinity. The health risks are presented as Low, Moderate, High or Extremely High for both acute and chronic health effects. The health risk level is based on an assessment of both the potential severity of the health effects that could be caused and probability of the exposure that would produce such health effects. Details can be obtained from the Army Public Health Center (APHC). Where applicable, "None Identified" is used when though a potential exposure is identified, and no health risks of either a specific acute or chronic health effects are determined. More detailed descriptions of OEH exposures that are evaluated but determined to pose no health risk are discussed in the following sections of this report.

[4]Health risks in this Summary Table are based on quantitative surveillance thresholds (e.g., endemic disease rates, host/vector/pathogen surveillance) or screening levels, e.g., Military Exposure Guidelines (MEGs) for chemicals. Some previous assessment reports may provide slightly inconsistent health risk estimates because quantitative criteria such as MEGs may have changed since the samples were originally evaluated and/or because this assessment makes use of all historic site data while previous reports may have only been based on a select few samples.

1 Discussion of Health Risks at FOB Hammer and vicinity, Iraq by Source

The following sections provide additional information about the OEH conditions summarized above. All risk assessments were performed using the methodology described in the U.S. Army Public Health Command Technical Guide 230, *Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel* (Reference 4). All OEH risk estimates represent residual risk after accounting for preventive controls in place. Occupational exposures and exposures to endemic diseases are greatly reduced by preventive measures. For environmental exposures related to airborne dust, there are limited preventive measures available, and available measures have little efficacy in reducing exposure to ambient conditions.

The ProUCL version 5.0 software package was used for statistical analyses (Reference 5). Means are followed by standard deviation (SD). Risk characterization was based on the 95 percent upper confidence level of the arithmetic mean (95% UCL) or the arithmetic mean depending on the quality and quantity of the data being evaluated. The sample mean is an uncertain estimate of the true mean of the population exposure point concentration (PEPC). The 95% UCL reduces the uncertainty inherent in the sample mean and states with a higher level of confidence that the mean PEPC is no greater than the 95% UCL.

2 Air

2.1 Site-Specific Sources Identified

FOB Hammer and vicinity is situated in dusty semi-arid desert environment. Sources of airborne contaminants at the base camps included diesel vehicle and generator exhaust, a brick factory located within four miles north of the FOB, dust from unpaved roads and surfaces, on-site firing ranges, and aircraft exhaust. In addition, dust storms, periods of high winds, and vehicle traffic passing through moon dust (very fine silts with the consistency of talcum powder) contributed to particulate matter (PM) exposures above health-based MEGs.

2.2 Particulate matter

Particulate matter (PM) is a complex mixture of extremely small particles suspended in the air. The PM includes solid particles and liquid droplets emitted directly into the air by sources such as: motor vehicles, aircraft, generators, construction activities, fires, and natural windblown dust. The PM can include sand, soil, metals, volatile organic compounds (VOC), allergens, and other compounds such as nitrates or sulfates that are formed by condensation or transformation of combustion exhaust. The PM composition and particle size vary considerably depending on the source. Generally, PM of health concern is divided into two fractions: PM_{10}, which includes coarse particles with a diameter of 10 micrometers or less, and fine particles less than 2.5 micrometers ($PM_{2.5}$), which can reach the deepest regions of the lungs when inhaled. Exposure to excessive PM is linked to a variety of potential health effects.

2.3 Particulate matter, less than10 micrometers (PM_{10})

2.3.1 Exposure Guidelines:

Short Term (24-hour) PM_{10} MEGs (micrograms per cubic meter, $\mu g/m^3$):

- Negligible MEG = 250
- Marginal MEG = 420
- Critical MEG = 600

Long-term PM_{10} MEG ($\mu g/m^3$):

- Not defined and not available.

2.3.2 Sample data/Notes:
There were no PM_{10} samples from FOB Hammer and vicinity.

2.3.3 Short-term and Long-term health risks:
Not evaluated.

2.4 Particulate Matter, less than 2.5 micrometers ($PM_{2.5}$)

2.4.1 Exposure Guidelines:

Short Term (24-hour) $PM_{2.5}$ MEGs ($\mu g/m^3$):
- Negligible MEG = 65
- Marginal MEG = 250
- Critical MEG = 500

Long-term (1-year) $PM_{2.5}$ MEGs ($\mu g/m^3$):
- Negligible MEG = 15
- Marginal MEG = 65.

2.4.2 Sample data/Notes:
A total of seven valid $PM_{2.5}$ air samples were collected at FOB Hammer in 2013 (three samples) and 2016 (four samples). The range of 24-hour $PM_{2.5}$ concentrations was 31 $\mu g/m^3$ to 131 $\mu g/m^3$, with an average concentration of 81 $\mu g/m^3$.

2.4.3 Short-term health risk:
The $PM_{2.5}$ short-term Negligible MEG (65 $\mu g/m^3$) was exceeded by the peak $PM_{2.5}$ concentration in 2013 (131 $\mu g/m^3$) and 2016 (121 $\mu g/m^3$). However, the data quantity was insufficient to characterize the potential short-term health risk from $PM_{2.5}$ exposure to U.S. personnel. Confidence in the risk estimate was low because of the small sample size.

2.4.4 Long-term health risk:
The $PM_{2.5}$ long-term Marginal MEG (65 $\mu g/m^3$) was exceeded by the average $PM_{2.5}$ concentration in 2013 (94 $\mu g/m^3$) and 2016 (72 $\mu g/m^3$). With repeated exposures above the MEG, a small percentage of personnel may have increased risk for developing chronic conditions, such as reduced lung function or exacerbated chronic bronchitis, COPD, asthma, atherosclerosis or other cardiopulmonary diseases. Personnel with a history of asthma or cardiopulmonary disease were considered to be at particular risk. However, the data quantity was insufficient to characterize the potential long-term health risk from $PM_{2.5}$ exposure to U.S. personnel. Confidence in the risk estimate was low because of the small sample size.

2.5 Airborne Metals

2.5.1 Sample data/Notes:
There were no PM_{10} airborne metal samples from FOB Hammer and vicinity. A total of seven valid $PM_{2.5}$ airborne metal samples were collected at FOB Hammer and vicinity. None of the detected metals had a peak concentration above the 1-year negligible MEGs.

2.5.2 Short and long-term health risks:
None identified based on the available sampling data. No parameters exceeded its respective 1-year Negligible MEGs. However, the data quantity was insufficient to characterize the potential health risk of airborne metal exposure to U.S. personnel.

2.6 Volatile Organic Compounds (VOC)

The likely sources of VOCs on FOB Hammer and vicinity were fuel storage, fuel transfers between storage tanks, and vehicle and aircraft emissions.

2.6.2 Sample data/Notes:
Two valid VOCs air samples were collected at FOB Hammer and vicinity in 2013 (one sample) and 2016 (one sample).

2.6.3 Short and long-term health risks:
None identified based on the available sampling data. No parameters exceeded its respective 1-year Negligible MEGs. However, the data quantity was insufficient to characterize the potential short-term and long-term health risks from VOCs exposure to U.S. personnel.

3 Soil

3.1 Site-Specific Sources Identified

3.1.1 Sample data/Notes:
Ten valid soil samples were collected at FOB Hammer and vicinity in 2013 (three samples), 2015 (one sample) and 2016 (six samples). The four composite samples were taken at the Entry Control Point, buffalo living area, and the athletic field/court. The six discrete samples were taken at the fuel tank and airfield gate, beside the fuel blivet and generators between the LSA tents, Range #10, and the Iraqi compound near the old Parade Ground.

The primary soil contamination exposure pathways are dermal contact and dust inhalation. Typical parameters analyzed for included semi volatile organic compounds (SVOCs), heavy metals, polychlorinated biphenyls (PCBs), pesticides, and herbicides. If the contaminant was known or suspected, other parameters may have been analyzed for (i.e., total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) near fuel spills). For the risk assessment, personnel are assumed to remain at this location for 6 months to 1 year.

3.1.2 Short-term health risk:
Not an identified source of health risk. Currently, sampling data for soil are not evaluated for short term (acute) health risks**.**

3.1.3 Long-term health risk:
No parameters exceeded the 1-year Negligible MEGs.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the APHC identified the most probable exposure pathways. These are based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated. It is assumed that 100% of all U.S. personnel at FOB Hammer and vicinity will be directly exposed to reverse osmosis water purification unit (ROWPU) treated, disinfected fresh bulk water, bottled water, and untreated well water.

4.1 Drinking Water: Bottled or Packaged Water

4.1.1 Site-Specific Sources Identified

4.1.2 Sample data/Notes:
To assess the potential for adverse health effects to troops, the following assumptions were made about dose and duration: A conservative (protective) assumption was that personnel routinely ingested 5 L/day of bottled water for up to 365 days (1-year). It was further assumed that control measures were not used.

Water used as drinking water was bottled water (primary source) and ROWPU-treated water. Four valid drinking water samples were collected in 2015 (one sample) and 2016 (three samples). There were no sampling data for 2011-2014.

4.1.3 Short-term and long-term health risks:
The data were insufficient to characterize the potential short-term and long-term health risks from drinking water exposure to U.S. personnel.

4.2 Non-Drinking Water: Disinfected

4.2.1 Site-Specific Sources Identified
Although the primary route of exposure for most microorganisms is ingestion of contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may also cause adverse health effects. Complete exposure pathways would include drinking, brushing teeth, personal hygiene, cooking, providing medical and dental care using a contaminated water supply or during dermal contact at vehicle or aircraft wash racks.

4.2.2 Sample data/Notes:
To assess the potential for adverse health effects to troops the following assumptions were made about dose and duration: All U.S. personnel at this location were expected to remain at this site for approximately 1 year. A conservative (protective) assumption is that personnel routinely consumed less than 5L/day of non-drinking water for up to 365 days (1-year). It is further assumed that control measures and/or personal protective equipment were not used.

Six valid water samples representing non-drinking water were collected in 2015 (one sample) and 2016 (five samples) from ROWPU-treated water. There were no sampling data for 2011-2014.

4.2.3 Short and long-term health risks:
The data were not representative of exposure and were insufficient to characterize the potential short-term and long-term health risks from non-drinking water exposure to U.S. personnel. Long-term MEGs are not available for chloride, chromium, magnesium, sulfate, and trichloroacetic acid, therefore long-term health risk associated with these chemicals could not be evaluated.

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons
No specific hazard sources were documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS) or the Military Exposure Surveillance Library (MESL) from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

5.2 Depleted Uranium (DU)
No specific hazard sources were documented in the DOEHRS, or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

5.3 Ionizing Radiation
No specific hazard sources were documented in the DOEHRS, or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

5.4 Non-Ionizing Radiation
No specific hazard sources were documented in the DOEHRS, or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

6 Endemic Diseases

This document lists the endemic diseases reported in the region, its specific health risks and severity and general health information about the diseases. USCENTCOM MOD 12 (Reference 12) lists deployment requirements, to include immunizations and chemoprophylaxis, in effect during the timeframe of this POEMS.

6.1 Foodborne and Waterborne Diseases

Foodborne and waterborne diseases in the area are transmitted through the consumption of local food and water. Local unapproved food and water sources (including ice) are heavily contaminated with pathogenic bacteria, parasites, and viruses to which most U.S. Service Members have little or no natural immunity. Effective host nation disease surveillance does not exist within the country. Only a small fraction of diseases are identified or reported in host nation personnel. Diarrheal diseases are expected to temporarily incapacitate a very high percentage of U.S. personnel within days if local food, water, or ice is consumed. Hepatitis A and typhoid fever infections typically cause prolonged illness in a smaller percentage of unvaccinated personnel. Vaccinations are required for DOD personnel and contractors. In addition, although not specifically assessed in this document, significant outbreaks of viral gastroenteritis (e.g., norovirus) and food poisoning (e.g., *Bacillus cereus*, *Clostridium perfringens*, *Staphylococcus* spp.) may occur. Key disease risks are summarized below:

Mitigation strategies were in place and included consuming food and water from approved sources, vaccinations (when available), frequent hand washing and general sanitation practices.

6.1.1 Diarrheal diseases (bacteriological)

High, mitigated to Low: Unmitigated health risk to U.S. personnel was High year round. Diarrheal diseases are expected to temporarily incapacitate a very high percentage of personnel (potentially over 50% per month) within days if local food, water, or ice is consumed. Field conditions (including lack of hand washing and primitive sanitation) may facilitate person-to-person spread and epidemics. Typically mild disease treated in outpatient setting; recovery and return to duty in less than 72 hours with appropriate therapy. A small proportion of infections may require greater than 72 hours limited duty, or hospitalization.

6.1.2 Hepatitis A, typhoid/paratyphoid fever, and diarrhea-protozoal

High, mitigated to Low: Unmitigated health risk to U.S. personnel is High year round for hepatitis A and typhoid/paratyphoid fever, and moderate for diarrhea-protozoal. Hepatitis A, typhoid/paratyphoid fever, and diarrhea-protozoal disease may cause prolonged illness in a small percentage of personnel (less than 1% per month). Although much rarer, other potential diseases in this area that are also considered a moderate risk include: hepatitis E, diarrhea-cholera, and brucellosis.

6.1.3 Short-term Health Risks:

Low: The overall unmitigated short-term risk associated with foodborne and waterborne diseases are considered High (bacterial diarrhea, hepatitis A, typhoid/paratyphoid fever) to Moderate (diarrhea-cholera, diarrhea-protozoal, brucellosis, hepatitis E) if local food or water is consumed. Preventive Medicine measures reduced the risk to Low.

6.1.4 Long-term Health Risks:

None identified based on available data.

6.2 Arthropod Vector-Borne Diseases

During the warmer months, the climate and ecological habitat support populations of arthropod vectors, including mosquitoes, ticks, mites, and sandflies. Significant disease transmission is sustained countrywide, including urban areas. Mitigation strategies were in place and included proper wear of treated uniforms, application of repellent to exposed skin, and use of bed nets and chemoprophylaxis

(when applicable). Additional methods included the use of pesticides, reduction of pest/breeding habitats, and engineering controls.

6.2.1 Malaria
None: Indigenous transmission of malaria in Iraq was eliminated as of 2008 reducing risk among personnel exposed to mosquito bites to None.

6.2.2 Leishmaniasis
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (April-November). Leishmaniasis is transmitted by sandflies. A small number of cases (less than 1% per month attack rate) could occur among personnel exposed to sandfly bites in areas with infected people, rodents, dogs, or other reservoir animals. In groups of personnel exposed to heavily infected sandflies in focal areas, attack rates can be very high (over 50%). There are two forms of the disease: cutaneous (acute form) and visceral (a more latent form of the disease). The leishmaniasis parasites may survive for years in infected individuals and this infection may go unrecognized by physicians in the U.S. when infections become symptomatic years later. Cutaneous infection is unlikely to be debilitating, though lesions may be disfiguring. Visceral leishmaniasis disease can cause severe febrile illness which typically requires hospitalization with convalescence over 7 days.

6.2.3 Crimean-Congo hemorrhagic fever
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Crimean-Congo hemorrhagic fever occurs in rare cases (less than 0.1% per month attack rate in indigenous personnel) and is transmitted by tick bites or occupational contact with blood or secretions from infected animals. The disease typically requires intensive care with fatality rates from 5% to 50%.

6.2.4 Sandfly fever
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (May-June and September-October). Sandfly fever potential disease rates are from 1% to 10% per month; under worst case conditions, disease rates can be as high as 50%. The disease is transmitted by sandflies and occurs more commonly in children though adults are still at risk. Sandfly fever disease typically resulted in debilitating febrile illness requiring 1 to 7 days of supportive care followed by return to duty.

6.2.5 Sindbis (and Sindbis-like viruses)
Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). Sindbis and sindbis-like viruses are maintained in a bird-mosquito cycle in rural areas and occasionally caused limited outbreaks among humans. The viruses are transmitted by a variety of *Culex* mosquito species found primarily in rural areas. A variety of bird species may serve as reservoir or amplifying hosts. Extremely rare cases (less than 0.01% per month attack rate) could have occurred seasonally (April - November). Debilitating febrile illness often accompanied by rash, typically requires 1 to 7 days of supportive care; significant arthralgias may persist for several weeks or more in some cases.

6.2.6 Rickettsioses, tickborne (spotted fever group)
Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). Rare cases (less than 0.1% per month) of rickettsioses disease are possible among personnel exposed to tick bites. Rickettsioses are transmitted by multiple species of hard ticks, including *Rhipicephalus* spp., which are associated with dogs. Other species of ticks, including *Ixodes* are also capable of transmitting rickettsial pathogens in this group. In addition to dogs, various rodents and other animals also may serve as reservoirs. Ticks are most prevalent from April through November. Incidents can result in debilitating febrile illness, which may require 1 to 7 days of supportive care followed by return to duty.

6.2.7 Typhus-murine (fleaborne)
Low: Unmitigated health risk to U.S. personnel was Low year round. Typhus-murine is assessed as present, but at unknown levels. Rare cases are possible among personnel exposed to rodents (particularly rats) and flea bites. Incidents may result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty.

6.2.8 West Nile fever
Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). West Nile fever is present. The disease is maintained by the bird population and transmitted to humans via mosquito vector. Typically, infections in young, healthy adults were asymptomatic, although fever, headache, tiredness, body aches (occasionally with a skin rash on trunk of body), and swollen lymph glands can occurred.

6.2.9 Short -term health risks:
Low: The overall short-term unmitigated health risk associated with arthropod vector-borne diseases at FOB Hammer and vicinity was considered Moderate (for sandfly fever, leishmaniasis (cutaneous and visceral), and Crimean-Congo hemorrhagic fever) and Low (for rickettsioses, typhus-murine (fleaborne), West Nile fever, and sindbis). Preventive measures such as proper wear of treated uniforms and application of repellent to exposed skin reduced the health risk to Low to None for arthropod vector-borne diseases.

6.2.10 Long -term health risks:
Low: The overall long-term unmitigated health risk was Moderate for leishmaniasis-visceral (chronic). Risk is reduced to Low by proper wear of the uniform and application of repellent to exposed skin.

6.3 Water Contact Diseases

Tactical operations or recreational activities that involve extensive contact with surface water such as lakes, streams, rivers, or flooded fields may result in significant exposure to leptospirosis and schistosomiasis. Arid portions of Iraq without permanent or persistent bodies of surface water do not support transmission of leptospirosis or schistosomiasis. Risk was restricted primarily to areas along rivers and lakes. These diseases can debilitate personnel for up to a week or more. Leptospirosis risk typically increases during flooding. In addition, although not specifically assessed in this document, bodies of surface water are likely to be contaminated with human and animal waste. Activities such as wading or swimming may result in exposure to enteric diseases, including diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact also may lead to the development of a variety of potentially debilitating skin conditions including bacterial or fungal dermatitis. Mitigation strategies were in place and included avoiding water contact and recreational water activities, proper wear of uniform (especially footwear), and protective coverings for cuts/abraded skin.

6.3.1 Leptospirosis
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (April-November). Human infections occur through exposure to water or soil contaminated by infected animals and is associated with wading, and swimming in contaminated, untreated open water. The occurrence of flooding after heavy rainfall facilitates the spread of the organism because as water saturates the environment *Leptospira* spp. present in the soil passes directly into surface waters. *Leptospira* spp. can enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Infection may also occur from ingestion of contaminated water. The acute, generalized illness associated with infection may mimic other tropical diseases (for example, dengue fever, malaria, and typhus), and common symptoms include fever, chills, myalgia, nausea, diarrhea, cough, and conjunctival suffusion. Manifestations of severe disease can include jaundice, renal failure, hemorrhage, pneumonitis, and hemodynamic collapse. Recreational activities involving extensive water contact may result in personnel being temporarily debilitated with leptospirosis.

6.3.2 Schistosomiasis

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate with seasonal transmission (April-November). Humans are the principal reservoir for schistosomes; humans shed schistosome eggs in urine or feces. Animals such as cattle and water buffalo may also be significant reservoirs. Rare cases (less than 0.1% per month attack rate) may occur seasonally (typically April through November) among personnel wading or swimming in lakes, streams, or irrigated fields which were frequently contaminated with human and animal waste containing schistosome eggs. In groups with prolonged exposure to heavily contaminated foci, attack rates may exceed 10%. Exceptionally heavy concentrations of schistosomes may occur in discrete foci, which were difficult to distinguish from less contaminated areas. In non-immune personnel exposed to such foci, rates of acute schistosomiasis may be over 50%. Mild infections are generally asymptomatic. In very heavy acute infections, a febrile illness (acute schistosomiasis) may occur, especially with *Schistosoma japonicum* and *S. mansoni*, requiring hospitalization and convalescence over 7 days.

6.3.3 Short -term health risks:

Low: The overall short-term unmitigated health risk associated with water contact diseases at FOB Hammer and vicinity was considered Moderate (leptospirosis and schistosomiasis). Preventive measures, such as avoiding water contact, recreational water activities and protective coverings for cuts/abraded skin reduced the health risk to Low to None. Confidence in the risk estimate was medium.

6.3.4 Long -term health risks:

None identified based on available data.

6.4 Respiratory Diseases

Although not specifically assessed in this document, deployed U.S. forces may be exposed to a wide variety of common respiratory infections in the local population. These include influenza, pertussis, viral upper respiratory infections, viral and bacterial pneumonia, and others. The U.S. military populations living in close-quarter conditions are at risk for substantial person-to-person spread of respiratory pathogens. Influenza is of particular concern because of its ability to debilitate large numbers of unvaccinated personnel for several days. Mitigation strategies were in place and included routine medical screenings, vaccination, enforcing minimum space allocation in housing units, implementing head-to-toe sleeping in crowded housing units, implementation of proper personal protective equipment (PPE) when necessary for healthcare providers and detention facility personnel.

6.4.1 Tuberculosis (TB)

Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Transmission typically requires close and prolonged contact with an active case of pulmonary or laryngeal TB, although it also can occur with more incidental contact. Rates of latent TB (LTBI) may be elevated for personnel with prolonged indoor exposure to local populations. Tuberculin skin tests (TST) screening or blood test may be warranted in personnel with a history of prolonged close exposure to local populations.

6.4.2 Meningococcal meningitis

Low: Unmitigated health risk to U.S. personnel was Low year round. Meningococcal meningitis is transmitted from person to person through droplets of respiratory or throat secretions. Close and prolonged contact facilitates the spread of this disease. Meningococcal meningitis is potentially a very severe disease typically requiring intensive care; fatalities may occur in 5-15% of cases.

6.4.3 Middle East respiratory syndrome coronavirus (MERS-CoV)

Low: Unmitigated health risk to U.S. personnel was Low year round. Although no cases have been

reported in Iraq, Middle East respiratory syndrome coronavirus (MERS-CoV) is known to occur within the region. Most MERS patients developed severe acute respiratory illness with symptoms of fever, cough and shortness of breath. MERS-CoV has spread from ill people to others through close contact, such as caring for or living with an infected person. The incubation period for MERS-CoV is usually about 5 to 6 days, but can range from 2 to 14 days. Currently, there is no vaccine to prevent MERS-CoV infection.

6.4.4 Short-term health risk:
Low: The overall short-term unmitigated health risk associated with respiratory diseases at FOB Hammer and vicinity was considered Moderate (tuberculosis) to Low (meningococcal meningitis, MERS-CoV). Preventive measures reduced the health risk to Low. Confidence in the risk estimate was medium.

6.4.5 Long-term health risk:
None identified based on available data. Tuberculosis is evaluated as part of the Post Deployment Health Assessment (PDHA). A TB skin test is required post-deployment if potentially exposed and is based upon individual service policies.

6.5 Animal-Contact Diseases

6.5.1 Rabies
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Occurrence in local animals was well above U.S. levels due to the lack of organized control programs. Dogs were the primary reservoir of rabies in Iraq, and a frequent source of human exposure. In June 2008, the New Jersey Health department in The United States reported a confirmed case of rabies in a mixed-breed dog recently imported from Iraq. Rabies is transmitted by exposure to the virus-laden saliva of an infected animal, typically through bites, but could occur from scratches contaminated with the saliva. No cases of rabies acquired in Iraq have been identified in U.S. Service Members to date. The vast majority (>99%) of persons who develop rabies disease will do so within a year after a risk exposure, there have been rare reports of individuals presenting with rabies disease up to six years or more after their last known risk exposure. Mitigation strategies included command emphasis of CENTCOM GO 1C, reduction of animal habitats, active pest management programs, and timely treatment of feral animal scratches/bites.

6.5.2 Q-fever
Moderate, mitigated to Low: Unmitigated health risk to U.S. personnel was Moderate year round. Rare cases are possible among personnel exposed to aerosols from infected animals, with clusters of cases possible in some situations. Significant outbreaks (affecting 1-50%) can occur in personnel with heavy exposure to barnyards or other areas where animals are kept. Unpasteurized milk may also transmit infection. The primary route of exposure is respiratory, with an infectious dose as low as a single organism. Incidence could result in debilitating febrile illness, sometimes presenting as pneumonia, typically requiring 1 to 7 days of inpatient care followed by return to duty. Mitigation strategies in place as listed in paragraph 6.5.1 except for vaccinations.

6.5.3 Anthrax
Low: Unmitigated health risk to U.S. personnel was Low year round. Anthrax cases are rare in indigenous personnel, and pose a Low risk to U.S. personnel. Anthrax is a naturally occurring infection; cutaneous anthrax is transmitted by direct contact with infected animals or carcasses, including hides. Eating undercooked infected meat may result in contracting gastrointestinal anthrax. Pulmonary anthrax is contracted through inhalation of spores and is extremely rare. Mitigation measures included consuming approved food sources, proper food preparation and cooking temperatures, avoidance of animals and farms, dust abatement when working in these areas, vaccinations, and proper PPE for personnel working with animals.

6.5.4 Avian influenza
Low: Unmitigated health risk to U.S. personnel was Low year round. Although avian influenza (AI) is easily transmitted among birds, bird-to-human transmission is extremely inefficient. Human-to-human transmission appears to be exceedingly rare, even with relatively close contact. Extremely rare cases (less than 0.01% per month attack rate) could occur. Incidence could result in very severe illness with fatality rate higher than 50 percent in symptomatic cases. Mitigation strategies included avoidance of birds/poultry and proper cooking temperatures for poultry products.

6.5.5 Short-term health risk:
Low: The overall short-term unmitigated health risk associated with animal contact diseases at FOB Hammer and vicinity was considered Moderate (rabies, Q-fever) to Low (anthrax, avian influenza). Preventive measures reduced the health risk to Low. Confidence in risk estimate was medium.

6.5.6 Long-term health risk:
Low: The long-term risk for rabies is Low because the incubation period for rabies can be several years in rare cases.

6.6 Soil-transmitted helminths (hookworm, strongyloidiasis, cutaneous larva migrans)
Low: Unmitigated health risk to U.S. personnel was Low with seasonal transmission (April-November). A small number of cases (less than 0.1% per month attack rate) could occur among personnel with direct skin exposure to soil contaminated with human or animal feces (including sleeping on bare ground, or walking barefoot). Initial skin symptoms typically are mild and are not debilitating. However, systemic symptoms of fever, cough, abdominal pain, nausea, and diarrhea may develop weeks to months after initial infection with hookworm or *Strongyloides*. More severe infections with high worm burden may be debilitating in some cases. Rates of infection in U.S. personnel will be highly variable, depending on specific local environmental conditions. Rates of infection in U.S. personnel are expected to be less than 1 percent per month in most locations. However, rates in some focal areas with heavily contaminated soil could exceed 1 percent per month.

6.6.1 Short-term health risk:
Low: Low for soil transmitted helminthes. Overall risk was further reduced with mitigation measures. Confidence in the health risk estimate is high.

6.6.2 Long-term health risk:
None identified based on available data.

7 Venomous Animals

All information was taken directly from the Armed Forces Pest Management Board (Reference 13) and the Clinical Toxinology Resources web site from the University of Adelaide, Australia (Reference 14). The species listed below have home ranges that overlap the location of FOB Hammer and vicinity, and may present a health risk if they are encountered by personnel. See Section 10.5 for more information about pesticides and pest control measures.

7.1 Spiders

- *Latrodectus pallidus*: Clinical effects uncertain, but related to medically important species, therefore major envenoming cannot be excluded.

7.2 Scorpions

- *Androctonus crassicauda (black scorpion)*: Severe envenoming possible and potentially lethal, however most stings cause only severe local pain.

- *Buthacus leptochelys*, *Buthacus macrocentrus*, *Compsobuthus matthiesseni*, *Compsobuthus werneri, Mesobuthus caucasicus, Mesobuthus eupeus, Odontobuthus doriae*, *Orthochirus iraqus*, and *Orthochirus scrobiculosus*: Clinical effects unknown; there are a number of dangerous Buthid scorpions, but ther are also some known to cause minimal effects only. Without clinical data it is unclear where this species fits within that spectrum.

- *Euscorpius italicus*, *Scorpio maurus,* and *Scorpio maurus palmatus*: Mild envenoming only, not likely to prove lethal.

- *Hemiscorpius lepturus*: Severe envenoming possible, potentially lethal.

- *Hottentotta saulcyi*, *Hottentotta scaber*, and *Hottentotta schach*: Moderate envenoming possible but unlikely to prove lethal.

7.3 Snakes

- *Cerastes gasperettii* (Gasperetti's horned viper): Potentially lethal envenoming, though unlikely.

- *Malpolon moilensis* (Hooded Malpolon), M*alpolon monspessulanus* (Montpellier snake), *Pseudocerastes persicus* (Persian Horned Viper), *and Pseudocerastes persicus fieldi* (Field's horned viper): Clinical effects varies, but unlikely to cause significant envenoming.

- *Macrovipera lebetina* subspecies e*uphratica* and subspecies *obtuse* (Levantine viper), *Vipera albicornuta* (white-horned viper), and *Walterinnesia aegyptia* (black desert cobra*)*: Severe envenoming possible, potentially lethal.

7.4 Short-term health risk:
Low: If encountered, effects of venom vary with species from mild localized swelling (e.g., *S. maurus*) to potentially lethal effects (e.g., *V. albicornuta*). See effects of venom above. Mitigation strategies included avoiding contact, proper wear of uniform (especially footwear), and timely medical treatment.

7.5 Long-term health risk:
None identified.

8 Heat/Cold Stress

8.1 Site-Specific Sources Identified

Site-specific information was not available for FOB Hammer. The following information is from the city of Baghdad, which is approximately 20 miles, northwest of FOB Hammer. The climate is hot and dry in the summer, cool and damp in the winter. Between May and September, the average daily maximum temperature reaches the low 100s F, and the high may reach the low 120s F. In winter, the average daytime temperature is in the mid-50s, and the temperature occasionally drops below freezing. Precipitation is sparse (6 inches annually) and occurs mainly between December and April.

The summer months are marked by two kinds of wind phenomena. The southern and southeasterly sharqi, a dry, dusty wind with occasional gusts of 50 miles per hour, occurs from April to early June and again from late September through November. It may last for a day at the beginning and end of the season but for several days at other times. This wind is often accompanied by violent dust storms that may rise to heights of several thousand meters and close airports for brief periods. From mid-June to

mid-September the prevailing wind, called the shamal, is from the north and northwest. It is a steady wind, absent only occasionally during this period. The very dry air brought by this shamal permits intensive sun heating of the land surface, but the breeze has some cooling effect. Heat stress/injuries and cold stress/injuries are largely dependent on operational and individual factors instead of environmental factors alone (Reference 15).

8.2 Heat

8.2.1 Short-term health risk:
High, mitigated to Low: The short-term health risk of heat injury was High in unacclimated personnel. Preventive measures such as work-rest cycles and proper hydration reduced the health risk to Low.

8.2.2 Long-term health risk:
Low: The long-term risk is Low. However, the risk may be greater for certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions. Long-term health implications from heat injuries are rare but may occur, especially from more serious injuries such as heat stroke. It is possible that high heat in conjunction with various chemical exposures may increase long-term health risks, though specific scientific evidence is not conclusive.

8.3 Cold

Short and Long-term health risks: **Low:** The health risk of cold injury is Low. Confidence in the health risk estimate is medium.

9 Noise

9.1 Continuous

Aircraft operations have the potential to cause significant noise hazard to flight line and helicopter landing zone support personnel. Because of the potential noise hazard inherent in the helicopter landing zone, personnel are required to wear dual hearing protection when working on the flight line. The noise levels in a test read 100 decibels (dB) when helicopters land to transport troops which exceeds the 85 dB maximum threshold allowed for steady noise without hearing protection.

A noise survey showed personnel residing in close proximity to generators will routinely be exposed to noise levels above 85 decibels (dB). DoD personnel are exposed to this noise level while in the housing tents (Reference 6). Workers in multiple areas were observed not adhering to the posted PPE standards for hearing protection.

9.1.1 Short-term health risk:
Low: The short-term risk of noise injury with appropriate hearing protection use is Low. Few exposed personnel (if any) are expected to have noticeable health effects during mission.

9.1.2 Long-term health risk:
Low to Moderate: The long-term risk of noise injury with appropriate hearing protection use is Low with few exposed personnel (if any) are expected to develop delayed onset, irreversible effects. If protective measures are not used, the risk is elevated to moderate and many exposed personnel are plausibly expected to develop delayed onset, irreversible effects.

9.2 Impulse

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

10 Unique Incidents/Concerns

10.1 Potential environmental contamination sources

DoD personnel are exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depend on the mission of the unit and the operations and tasks which the personnel are required to perform to complete their mission. The health risk associated with these hazards depends on a number of elements including what materials are used, how long the exposure last, what is done to the material, the environment where the task or operation is performed, and what controls are used. The hazards can include exposures to heavy metal particulates (e.g. lead, cadmium, manganese, chromium, and iron oxide), solvents, fuels, oils, and gases (e.g., carbon monoxide, carbon dioxide, oxides of nitrogen, and oxides of sulfur). Most of these exposures occur when performing maintenance tasks such as painting, grinding, welding, engine repair, or movement through contaminated areas. Exposures to these occupational hazards can occur through inhalation (air), skin contact, or ingestion; however exposures through air are generally associated with the highest health risk.

10.2 Waste Sites/Waste Disposal

10.2.1 Hazardous and Non-Hazardous Waste

Hazardous materials were stored throughout the camp without secondary containment or spill kits. There were multiple spills observed without remediation. The HAZMAT storage was uncovered and located less than 50 meters from the fuel and water points. The regulated medical waste was properly stored and sent to Spain for disposal.

10.2.2 Solid Waste Management

A review of five documents (Basecamp Assessments and OEHSAs) identified solid waste management issues. One issue noted was uncovered dumpsters and trash cans. The dumpsters were emptied twice a day and cleaned daily. Most of the dumpsters and trash cans did not have lids.

Waste water accumulated in tanks and was disposed by an Iraqi contractor.

10.3 General and Field Sanitation

Several reports and databases were assessed for waste collection/storage; latrine, shower and laundry facilities; hand washing stations; sanitary practices in barber/beauty shops and gymnasiums; living accommodations and report vector/pest problems. Five reports (Basecamp Assessments and OEHSAs) characterized overall sanitation conditions at FOB Hammer and vicinity.

Sanitation concerns that affected or could potentially affect personnel stationed at FOB Hammer and vicinity included; unsatisfactory waste management operations; ripped and torn gym equipment, lacking sanitizing capabilities in the gym and the barber shop; feral animals, primarily cats migrating onto FOB; and flies.

Short-term health risk: Low risk.

Long-term health risk: None identified based on available data.

The overall risk estimate was Low.

10.4 Fuel/petroleum products/industrial chemical spills

An OEHSA identified several POL spills. However, records for remediation were not available.

Short-term and Long-term health risks: Not evaluated.

10.5 Pesticides/Pest Control:

The health risk of exposure to pesticide residues is considered within the framework of typical residential exposure scenarios, based on the types of equipment, techniques, and pesticide products that have been employed, such as enclosed bait stations for rodenticides, various handheld equipment for spot treatments of insecticides and herbicides, and a number of ready-to-use (RTU) methods such as aerosol cans and baits. The control of rodents required the majority of pest management inputs, with the acutely toxic rodenticides staged as solid formulation lethal baits placed in tamper-resistant bait stations indoors and outdoors throughout cantonment areas. Nuisance insects, including biting and stinging insects such as bees, wasps, and ants, also required significant pest management inputs. Use of pesticides targeting against these pests generally involved selection of compounds with low mammalian toxicity and short-term residual using pinpoint rather than broadcast application techniques.

Flies were observed in multiple areas throughout the basecamp, to include the work areas and food service areas. There were also reports of stray animals and rodents present in the basecamp.

10.6 Asbestos

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

10.7 Lead-based Paint

No specific hazard sources were documented in the DOEHRS or MESL from 1 June 2011 through 31 December 2016 timeframe (References 1 and 11).

10.8 Narhwan Brick Factory

The Narhwan Brick Factory was located within four miles north of FOB Hammer. Brick factory operations generally burned heavy residual oils that generated heavy smoke and cement kiln dust. The Soldiers noted that they could see the smoke plume generated from the brick factory on a daily basis. Several air samples included notes pertaining to the brick factory's location relative to the FOB.

There were no ambient air PM samples taken near the brick factory. There was one VOC air sample taken near the brick factory fence line. However, VOCs were not identified as a hazard (see Section 2.6 for VOCs information).

A factsheet was developed to assess the air quality at the brick factory in 2008-2009 (Reference 16). The results showed that the PM_{10} and $PM_{2.5}$ concentrations were consistent with levels found at many of the basecamps in Iraq. VOCs were not detected above health based screening levels in any of the samples.

10.9 Burn Pit

FOB Hammer and vicinity do not have a burn pit.

While not specific to FOB Hammer and vicinity, the consolidated epidemiological and environmental sampling and studies on burn pits that have been conducted as of the date of this publication have been unable to determine whether an association does or does not exist between exposures to emissions from the burn pits and long-term health effects (Reference 17). The Institute of Medicine committee's (Reference 17) review of the literature and the data suggests that service in Iraq or Afghanistan (i.e., a broader consideration of air pollution than exposure only to burn pit emissions) may be associated with long-term health effects, particularly in susceptible (e.g., those who have asthma) or highly exposed subpopulations, such as those who worked at the burn pit. Such health effects would be due mainly to high ambient concentrations of PM from both natural and anthropogenic sources, including military sources. If that broader exposure to air pollution turns out to be relevant, potentially related health effects of concern are respiratory and cardiovascular effects and cancer. Susceptibility to the PM health effects could be exacerbated by other exposures, such as stress, smoking, local

climatic conditions, and co-exposures to other chemicals that affect the same biologic or chemical processes. Individually, the chemicals measured at burn pit sites in the study were generally below concentrations of health concern for general populations in the United States. However, the possibility of exposure to mixtures of the chemicals raises the potential for health outcomes associated with cumulative exposure to combinations of the constituents of burn pit emissions and emissions from other sources.

11 References

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2. DoDI 6055.05, Occupational and Environmental Health, 2008.

3. Joint Staff Memorandum (MCM) 0017-12, Procedures for Deployment Health Surveillance, 2012.

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7. Base Camp Assessment, Besmaya North, Iraq, 03-04 March 2016.

8. Base Camp Assessment, Besmaya North, Iraq, 06 March- 02 April 2016.

9. Base Camp Assessment, Besmaya, Iraq, 18-20 July 2016.

10. Base Camp Assessment, Besmaya, Iraq, 09-11 November 2016.

11. DoD MESL Data Portal: https://mesl.apgea.army.mil/mesl/.Some of the data and reports used may be classified or otherwise have some restricted distribution.

12. Modification 12 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 02 December 2013.

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14. Clinical Toxinology Resources: http://www.toxinology.com/. University of Adelaide, Australia.

15. Goldman RF. 2001. Introduction to heat-related problems in military operations. *In*: Textbook of military medicine: medical aspects of harsh environments Vol. 1, Pandolf KB, and Burr RE (Eds.), Office of the Surgeon General, Department of the Army, Washington DC.

16. USAPHC, *Medical Assessment of Air Quality at Narhwan Brick Factory and FOB Hammer in Iraq (2008-9)*, Factsheet 64-023-0412, 2012.

17. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.

12 Where Do I Get More Information?

If a provider feels that the Service member's or Veteran's current medical condition may be attributed to specific OEH exposures at this deployment location, he/she can contact the Service-specific organization below. Organizations external to DoD should contact Deputy Assistant Secretary of Defense for Health Readiness Policy and Oversight (HRP&O).
Army Public Health Center Phone: (800) 222-9698. http://phc.amedd.army.mil/
Navy and Marine Corps Public Health Center (NMCPHC) (formerly NEHC) Phone: (757) 953-0700. http://www.med.navy.mil/sites/nmcphc/Pages/Home.aspx
U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. http://www.wpafb.af.mil/afrl/711hpw/USAFSAM/
DoD Health Readiness Policy and Oversight (HRP&O) Phone: (800) 497-6261. https://health.mil/Military-Health-Topics/Health-Readiness