

Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Camp Al Fallujah and vicinity, Iraq
Calendar Years: (2004 to 2011)

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) 0028-07 (References 1-3).

PURPOSE: This POEMS documents the Department of Defense (DoD) assessment of occupational and environmental health (OEH) risk for Camp Al Fallujah, Iraq which includes: Camp Baharia, Combat Outpost (COP) Castillo, Camp Karmah, Camp Mercury, and Rock Ammunition Supply Point (ASP) Paladdin. Camp Al Fallujah is also known as Camp Fallujah, FOB St. Mere, and Camp Mercury. Camp Baharia was also known as Dreamland and FOB Volturno. Rock ASP Paladdin is also known as Paladin-Rock Ammunition Supply Point. 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 08 June 2004 through 20 August 2011 to include deployment OEH surveillance 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 Camp Al Fallujah 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 08 June 2004 through 20 August 2011.

The POEMS can be useful to inform healthcare providers and others of environmental conditions experienced by individuals deployed to Camp Al Fallujah 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:

Al Fallujah is a city in the Iraqi province of Al Anbar. Camp Al Fallujah was a former Iraqi military base and training camp for the Iranian dissident group Mujahidin-E-Khalq (MEK) located about 7 miles to the southeast of Al Fallujah city. In May 2003 after the MEK was forced to surrender to U.S. forces the camp was established as FOB Mercury. FOB St. Mere was established on the property adjacent to FOB Mercury and both FOBs were renamed to Camp Al Fallujah. Camp Baharia was to the northwest of Camp Al Fallujah and Camp Karmah was to the north of Camp Al Fallujah. COP Castillo was located near Camp Baharia. Camp Baharia was formally named FOB Volturno and renamed to Camp Baharia in 2004. There was little information on Rock ASP Paladdin.

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 Camp Al Fallujah 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 Camp Al Fallujah and vicinity:

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), Crimean-Congo hemorrhagic fever, sandfly fever, typhus-miteborne, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); 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), Crimean-Congo hemorrhagic fever, sandfly fever, typhus-miteborne), 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 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}), the PM_{10} overall short-term risk was 'Low.' For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), the $PM_{2.5}$ overall short-term risk was 'Low.' However, 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. For burn pits, although the short-term risk for PM_{10} and for $PM_{2.5}$ was not evaluated due to insufficient data, there were operating burn pits utilized at or around Camp Al Fallujah and vicinity – see Section 10.7. For burn pits, exposures may vary, and exposure to high levels of PM_{10} and to $PM_{2.5}$ in the smoke may also result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel (e.g., burn pit workers and any other personnel who worked at or in close proximity of the burn pits) and certain subgroups (e.g., those with pre-existing asthma/cardio-pulmonary conditions) while at this site. Although most short-term health effects from exposure to particulate matter and burn pit 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 during their time at Camp Al Fallujah and vicinity. Personnel who reported with symptoms or required treatment while at this site 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 Camp Al Fallujah and vicinity:

Air quality: For inhalable fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), the overall long-term risk was 'Low to Moderate.' Inhalable coarse particulate matter less than 10 micrometers in diameter (PM_{10}) was not evaluated for long-term risk due to no available health guidelines. However, the area was a dusty desert environment, and conditions may have varied. In addition, for burn pits, although the long-term risk for PM_{10} was not evaluated for long-term risk due to no available health guidelines and the risk for $PM_{2.5}$ was not evaluated due to not enough air sampling data available to characterize risk, there were operating burn pits

utilized at or around Camp Al Fallujah and vicinity, and conditions may have varied – see Section 10.7. For inhalational exposure to high levels of dust, PM₁₀ and PM_{2.5}, such as during high winds or dust storms, and for exposure to burn pit 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 burn pits 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 - Camp Al Fallujah which include: Camp Baharia, COP Castillo, Karmah, Camp Mercury, and Rock ASP Paladdin ^{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: Low, Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/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: Low, Daily levels vary; acute health effects (e.g., upper respiratory tract irritation) more pronounced during peak days. More serious effects are possible in susceptible persons (e.g., those with asthma/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: Low, A majority of the time mild acute (short term) health effects are anticipated; certain peak 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: Low, A majority of the time mild acute (short term) health effects are anticipated; certain peak 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: Low to Moderate. 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).		Long-term: Low to Moderate. 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).
Metals	Short-term: None identified from sample data.		Short-term: None identified from sample data.
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
Volatile Organic Compounds (VOC)	Short-term: None identified from sample data.		Short-term: None identified from sample data.
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
SOIL			
Metals	Short-term: Not an identified source of health risk.		Short-term: Not an identified source of health risk.
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
Organic Compounds	Short-term: Not an identified source of health risk.		Short-term: Not an identified source of health risk.
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
Inorganic Compounds	Short-term: Not an identified source of health risk.		Short-term: Not an identified source of health risk.
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
Water			
Consumed Water (Water Used for Drinking)	Short-term: Low	Use of U.S. Army Public Health Center (Provisional) (APHC (Prov)) [former Army Institute of Public Health (AIPH) and U.S. Army Veterinary Command] approved bottled water and potable water only from approved water sources.	Short-term: Low
	Long-term: None identified from sample data.		Long-term: None identified from sample data.

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Water for Other Purposes	Short-term: Low	Water treated in accordance with standards applicable to its intended use.	Short-term: Low
	Long-term: None identified from sample data.		Long-term: None identified from sample data.
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-bacteriological)	Short-term: Variable, (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: Variable, Moderate for leishmaniasis-cutaneous, Crimean-Congo hemorrhagic fever, sandfly fever and typhus-miteborne; Low for West Nile fever, and Plague.	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin, and bed net use, minimizing areas of standing water.	Short-term: Low
	Long-term: Low (Leishmaniasis-visceral infection)		Long-term: No data available
Water-Contact (e.g., wading, swimming)	Short-term: Moderate for leptospirosis and schistosomiasis.	Prohibiting recreational water activities and water contact avoidance.	Short-term: Low for leptospirosis and schistosomiasis.
	Long-term: No data available		Long-term: No data available
Respiratory	Short-term: Variable; Moderate for tuberculosis (TB) to Low for meningococcal meningitis.	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: Variable; Moderate for rabies and Q-fever, and Low for Anthrax and H5N1 avian influenza.	Prohibiting contact with, adoption, or feeding of feral animals IAW U.S. Central Command (CENTCOM) General Order (GO) 1B. 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
VENOMOUS ANIMAL/ INSECTS			
Snakes, scorpions, and spiders	Short-term: Low; If encountered, effects of venom vary with species from mild localized swelling (e.g., <i>Scorpio maurus</i>) to potentially lethal effects (e.g., <i>Vipera albicornuta</i>).	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., <i>Scorpio maurus</i>) to potentially lethal effects (e.g., <i>Vipera albicornuta</i>).
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Variable; Risk of heat injury is Extremely High from May – October, High in April, and Low from November – March.	Work-rest cycles, proper hydration and nutrition, and Wet Bulb Globe Temperature (WBGT) monitoring.	Short-term: Variable mitigated to low; Risk of heat injury in unacclimatized or susceptible personnel is Extremely High from May – October, High in April, and Low from November –

			March.
	Long-term: Low, The long-term risk was 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, The long-term risk is 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 and nutrition, and proper wear of issued protective clothing.	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.
Unique Incidents/Concerns			
Pesticides/Pest Control	Short-term: Low	See Section 10.4	Short-term: Low
	Long-term: Low		Long-term: Low
Burn Pit PM ₁₀	Short-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.	Control measures may have included locating burn pits downwind of prevailing winds, increased distance when possible, and improved waste segregation and management techniques.	Short-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.
	Long-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.		Long-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.
Burn Pit PM _{2.5}	Short-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.	Control measures may have included locating burn pits downwind of populated areas, increased distance from populated area when possible, and improved waste segregation and management techniques.	Short-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.
	Long-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.		Long-term: Not enough samples to assess risk. Samples identified with burn pits were assessed with base wide assessment.
<p>¹This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational and environment conditions at Camp Al Fallujah which include: Camp Baharia, COP Castillo, Karmah, Camp Mercury, and Rock ASP Paladdin. 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.</p> <p>² This assessment is based on specific environmental sampling data and reports obtained from 08 June 2004 through 20 August 2011. Sampling locations are assumed to be representative of exposure points for the camp population but may not reflect all the fluctuations in environmental quality or capture unique exposure incidents.</p> <p>³This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Camp Al Fallujah 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 APHC (Prov). 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.</p> <p>⁴Health 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.</p>			

1 Discussion of Health Risks at Camp Al Fallujah and vicinity, Iraq by Source

The following sections provide additional information about the occupational and environmental health (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.

2 Air

2.1 Site-Specific Sources Identified

Camp Al Fallujah and vicinity were situated in a dusty semi-arid desert environment. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms, may result in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel. Additionally, 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.

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: power plants, 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: PM₁₀, 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 than 10 micrometers (PM₁₀)

2.3.1 Exposure Guidelines:

Short Term (24-hour) PM ₁₀ (micrograms per cubic meter, $\mu\text{g}/\text{m}^3$):	Long-term PM ₁₀ MEG ($\mu\text{g}/\text{m}^3$):
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- | | |
|--|--|
| <ul style="list-style-type: none"> • Negligible MEG = 250 • Marginal MEG = 420 • Critical MEG = 600 | <ul style="list-style-type: none"> • Not defined and not available. |
|--|--|

2.3.2 Sample data/Notes:

A total of 23 valid PM₁₀ air samples were collected from 2004–2008, no samples were taken after 2008. The range of 24-hour PM₁₀ concentrations was 61 $\mu\text{g}/\text{m}^3$ – 427 $\mu\text{g}/\text{m}^3$ with an average concentration of 176 $\mu\text{g}/\text{m}^3$.

2.3.3 Short-term health risks:

Low: The short-term PM₁₀ health risk assessment is Low based on average and peak PM₁₀ sample concentrations, and the likelihood of exposure at these hazard severity levels. Risk from peak and average exposures was low in 2004 and 2008. All other years had insufficient data available with which to determine risk. A low health risk suggests little or no impact on accomplishing the mission (Reference 4, Table 3-2). Daily average health risk levels for PM₁₀ show no hazard for 88.9% and low health risk for 11.1% of the time. Confidence in the short-term PM₁₀ health risk assessment is low (Reference 4, Table 3-6).

The hazard severity for average PM₁₀ concentrations in samples was negligible in 2004 and 2008. The results indicate that for negligible hazard severity a few personnel may experience notable mild eye, nose, or throat irritation; most personnel will experience only mild effects. Pre-existing health conditions (e.g., asthma or cardiopulmonary diseases) may be exacerbated (Reference 4, Table 3-11).

For the highest observed PM₁₀ sample concentration, the hazard severity was negligible. During peak exposures at the negligible hazard severity a few personnel may experience notable mild eye, nose, or throat irritation; most personnel will experience only mild effects. Pre-existing health conditions (e.g., asthma or cardiopulmonary diseases) may be exacerbated (Reference 4, Table 3-11).

2.3.4 Long-term health risk:

Not Evaluated-no available health guidelines. The U.S. Environmental Protection Agency (EPA) has retracted its long-term standard (national ambient air quality standards, NAAQS) for PM₁₀ due to an inability to clearly link chronic health effects with chronic PM₁₀ exposure levels.

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

2.4.1 Exposure Guidelines:

Short Term (24-hour) PM_{2.5} (µg/m³):

- Negligible MEG = 65
- Marginal MEG = 250
- Critical MEG = 500

Long-term (1 year) PM_{2.5} MEGs (µg/m³):

- Negligible MEG = 15
- Marginal MEG = 65.

2.4.2 Sample data/Notes:

A total of 27 valid PM_{2.5} air samples were collected from 2004–2009, no samples were taken after 2009. The range of 24-hour PM_{2.5} concentrations was 34 µg/m³ – 312 µg/m³ with an average concentration of 81 µg/m³.

2.4.3 Short-term health risks:

Low: The short-term PM_{2.5} health risk assessment for peak and average sample concentrations is low for 2004 and 2009. All other years had insufficient data available with which to determine risk. A low health risk suggests little or no impact on accomplishing the mission (Reference 4, Table 3-2). Daily average health risk levels for PM_{2.5} show no hazard for 58.3% and low health risk for 41.7% of the time. Confidence in the short-term PM_{2.5} health risk assessment was low (Reference 4, Table 3-6).

The hazard severity was negligible for average PM_{2.5} sample concentrations in 2004 and 2009. The results indicate that for a negligible hazard severity a few personnel may experience notable mild eye,

nose, or throat irritation; most personnel will experience only mild effects. Pre-existing health conditions (e.g., asthma or cardiopulmonary diseases) may be exacerbated (Reference 4, Table 3-11).

For the highest observed PM_{2.5} exposure, the hazard severity was negligible. During peak exposures at the negligible hazard severity a few personnel may experience notable mild eye, nose, or throat irritation; most personnel will experience only mild effects. Pre-existing health conditions (e.g., asthma or cardiopulmonary diseases) may be exacerbated (Reference 4, Table 3-12).

2.4.4 Long-term health risks:

Low to Moderate: The long-term health risk assessment is low for 2004 and moderate for 2009 based on average PM_{2.5} concentration, and the likelihood of exposure at this hazard severity level. There were not enough samples taken in 2008 to assess long-term health risk. A low health risk assessment for average exposure concentrations suggest that exposure to PM_{2.5} concentrations was expected to result in little or no impact on accomplishing the mission. A moderate health risk suggests a degraded mission capabilities in terms of the required mission standard and in reduced mission capability if hazards occurred during the mission (Reference 4, Table 3-3). Confidence in the long-term PM_{2.5} health risk assessment is low (Reference 4, Table 3-6).

The hazard severity was marginal for average PM_{2.5} sample concentrations (50 µg/m³ – 149 µg/m³). The results predict that with repeated exposures above the marginal hazard severity threshold, it is plausible that development of chronic health conditions such as reduced lung function, exacerbated chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, atherosclerosis, or other cardiopulmonary diseases could occur in generally healthy troops. Those with a history of asthma or cardiopulmonary disease are considered to be at particular risk (Reference 4, Table 3-12).

2.5 Airborne Metals

2.5.1 Airborne Metals from PM₁₀

2.5.1.1 Sample data/Notes:

A total of 23 valid PM₁₀ airborne metal samples were collected at Camp Al Fallujah and vicinity from 2004 to 2008; no samples were taken after 2008. None of the analyzed metals in the collected samples were found at concentrations above the 1-year negligible MEGs.

2.5.1.2 Short-term health risks:

None identified based on available sampling data.

2.5.1.3 Long-term health risks:

None identified based on the available sampling data.

2.5.2 Airborne Metals from PM_{2.5}

2.5.2.1 Sample data/Notes:

A total of 27 valid PM_{2.5} airborne metal samples were collected at Camp Al Fallujah and vicinity from 2004 to 2009; no samples were taken after 2009. None of the analyzed metals in the collected samples were found at concentrations above the 1-year negligible MEGs.

2.5.2.2 Short-term health risks:

None identified based on available sampling data.

2.5.2.3 Long-term health risks:

None identified based on the available sampling data.

2.6 Volatile Organic Compounds (VOC)

2.6.1 Exposure Guidelines

Short Term (1-hour) Benzene: Negligible MEG=166,000 $\mu\text{g}/\text{m}^3$, Marginal MEG=2,560,000 $\mu\text{g}/\text{m}^3$, Critical MEG=12,800,000 $\mu\text{g}/\text{m}^3$.

Long Term (1-year) Benzene: Negligible MEG=54.79 $\mu\text{g}/\text{m}^3$.

2.6.1 Sample data/Notes:

The health risk assessment is based on average and peak concentration of 24 valid volatile organic chemical (VOC) air samples collected at Camp Al Fallujah and vicinity in 2005, 2007, and 2008. No samples were available from any other year. Benzene was found at concentrations above the long term MEG in two out of 12 samples (16.66% frequency) from 2007 but the average concentration was below the long term MEG so it was not identified as a long term health risk. Peak Benzene concentrations did not exceeded the short term MEG.

2.6.2 Short-term health risks:

None identified based on the available sampling data.

2.6.3 Long-term health risk

None identified based on the available sampling data.

3 Soil

3.1 Site-Specific Sources Identified

3.2 Sample data/Notes:

A total of 40 valid surface soil samples were collected from 2004 to 2009 to assess OEH health risk to deployed personnel. 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, 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.

3.3 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.

3.4 Long-term health risk:

None identified based on available sample data. No parameters exceeded 1-year Negligible MEGs for dermal contact. The dust inhalation exposure pathway is addressed in Section 2 above.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the APHC (Prov) 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 Camp Al Fallujah and vicinity were directly exposed to reverse osmosis water purification unit (ROWPU) treated and disinfected fresh bulk water, since this classification of water is primarily used for personal hygiene, showering, cooking, and for use at vehicle wash racks. There is a possibility that personnel, particularly at small outlying camps, may use water that is not regularly disinfected for showering, personal hygiene, or cleaning. Field data sheets indicate that bottled water is the only approved source of drinking water however in instances where bottled water was unavailable ROWPU treated water was used.

4.1 Drinking Water: Bottled or Treated 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 liters per day (L/day) of bottled water for up to 365 days (1-year). It was further assumed that control measures were not used. A total of 5 valid drinking water samples were collected in 2006 and 2009, no drinking water samples were collected any other year.

4.1.3 Short-term health risk:

Low: The short-term health risk, based on peak concentrations, from the drinking water was assessed as low. Boron, magnesium, and sulfate exceeded their 14-day 15L/d Negligible MEGs. A low short-term health risk suggests little or no impact on accomplishing the mission. Boron exceeded its respective MEG (0.93 mg/L) in 2006. In 2006 and 2009, magnesium (MEG 30 mg/L), and sulfate (MEG 250 mg/L) exceeded their respective MEGs for short-term health risk. Lead was detected in one sample above the Negligible 1 Year 15L/d MEG but had no associated 14-day 15L/d Negligible MEG for short-term health risk and was not assessed further.

The hazard severity was negligible for average boron, magnesium, and sulfate concentrations in drinking water in all years assessed. The results indicate that for a negligible hazard severity a few exposed personnel (if any) are expected to have noticeable health effects during mission. Exposed personnel are expected to be able to effectively perform all critical tasks during mission operations. Minimal to no degradation of abilities to conduct complex tasks are expected.

For the highest observed boron, magnesium, and sulfate concentrations in drinking water the hazard severity was negligible in all years assessed. During peak exposures at the negligible hazard severity a few exposed personnel (if any) are expected to have noticeable health effects during the mission. Exposed personnel are expected to be able to effectively perform all critical tasks during mission operations. Minimal to no degradation of abilities to conduct complex tasks are expected.

4.1.4 Long-term health risk:

None identified based on the available sampling data. Average concentrations of Boron and Lead were below the long term MEG. There were no long-term MEGs available for magnesium, and sulfate; therefore these chemicals were not retained as potential hazards.

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. A total of 18 disinfected bulk water (Non-Drinking) samples from 2004 to 2009 were evaluated for this health risk assessment, no samples were taken after 2009. Sulfate was found in concentrations exceeding the 2.5 x Negligible short-term 14-day 5L/d MEG.

4.2.3 Short-term health risks:

Low. The short-term health risk from sulfate (MEG 750 mg/L) exceeded the negligible short-term 14-day 5L/d MEG in 2004 and was assessed a low health risk. A low short-term health risk suggests little or no impact on accomplishing the mission.

The hazard severity was negligible for average sulfate concentrations in non-drinking water in 2004. The results indicate that for a negligible hazard severity a few exposed personnel (if any) are expected to have noticeable health effects during mission. Exposed personnel are expected to be able to effectively perform all critical tasks during mission operations. Minimal to no degradation of abilities to conduct complex tasks are expected.

For the highest observed sulfate concentration in non-drinking water the hazard severity was negligible in all years assessed. During peak exposures at the negligible hazard severity a few exposed personnel (if any) are expected to have noticeable health effects during mission. Exposed personnel are expected to be able to effectively perform all critical tasks during mission operations. Minimal to no degradation of abilities to conduct complex tasks are expected.

4.2.4 Long-term health risks:

None identified based on the available sampling data. There were no long-term MEGs available for sulfate; therefore it was not retained as a potential hazard.

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons

Based on a search of records, incidents involving potential exposure to chemical warfare agents in the vicinity of Camp Al Fallujah and vicinity were reported. Specific exposures may have included weaponized toxic industrial compounds (e.g., chlorine tank improvised explosive devices), and rarely, small amounts of traditional chemical warfare agents.

5.2 Depleted Uranium (DU)

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe (References 1 and 5).

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe (References 1 and 5).

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe (References 1 and 5).

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 6) lists deployment requirements, to include immunizations and chemoprophylaxis, in effect during the timeframe of this POEMS.

6.1 Foodborne and Waterborne Diseases

Food borne 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*) 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: 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. Mitigation strategies in place include consumption of approved food, water, and ice;

handwashing; and applied food/water safety mechanisms. 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. Mitigation strategies in place include immunization, consumption of approved food, water, and ice; handwashing; and applied food/water safety mechanisms. U.S. Personnel did not drink untreated water, and vaccination for Hepatitis A is required for deployment into the CENTCOM Area of Responsibility (AOR). 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:

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

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: The disease risk is Moderate during the warmer months when sandflies are most prevalent, but reduced to low with mitigation measures. Mitigation strategies in place include Individual Protective Measures (IPM) practices, permethrin treated uniforms, pesticides, reduction of pest/breeding habitats, and engineering controls. Leishmaniasis is transmitted by sand flies. 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 risk is moderate, but reduced to low with mitigation measures. 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: Sandfly fever has a Moderate risk with potential disease rates from 1% to 10% per month under worst case conditions. Mitigation measures reduced the risk to low. 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: 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. This disease is associated with a low health risk estimate.

6.2.6 Rickettsioses, tickborne (spotted fever group)

Low: 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. The health risk of rickettsial disease is Low.

6.2.7 Typhus-murine (fleaborne)

Low: Typhus-murine has a Low risk estimate and 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: 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 occur. This disease is associated with a low risk estimate.

6.2.9 Short-term health risks:

Low: The unmitigated risk is moderate for leishmaniasis - cutaneous (acute), Crimean-Congo hemorrhagic fever, and sandfly fever; Low for, sindbis, rickettsioses-tickborne, typhus-fleaborne, and West Nile fever. No hazard from malaria (2008 - 2011). Risk is reduced to Low by proper wear of the uniform and application of repellent to exposed skin. Confidence in the risk estimate is high.

6.2.10 Long-term health risks:

Low: The unmitigated risk is moderate for leishmaniasis-visceral (chronic). Risk is reduced to Low by proper wear of the uniform and application of repellent to exposed skin. Confidence in the risk estimate is high.

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: Human infections occur seasonally (typically April through November) 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 leptospirosis present in the soil passes directly into surface waters. Leptospirosis 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. Mitigation strategies in place include avoiding water contact and recreational water activities; proper wear of uniform, especially footwear, and protective coverings for cuts/abraded skin. This disease is associated with a Moderate health risk estimate.

6.3.2 Schistosomiasis

Moderate, mitigated to Low: 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. This disease is associated with a Moderate health risk estimate.

6.3.3 Short -term health risks:

Low: Unmitigated Health risk of schistosomiasis and leptospirosis is Moderate during warmer months. Mitigation measures reduce the risk to Low. Confidence in the health risk estimate is high.

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: Potential health risk to U.S. personnel is Moderate, mitigated to Low, 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. The Army Surgeon General has defined increased risk in deployed Soldiers as indoor exposure to locals or third country nationals of greater than one hour per week in a highly endemic active TB region. Mitigation strategies include routine medical screenings; enforcing minimum space allocation in housing units; implementing head-to-toe sleeping in crowded housing units; and implementation of proper personal protective equipment (PPE), when necessary (treating active case, detainee operations). Additional mitigation included active case isolation in negative pressure rooms, where available.

6.4.2 Meningococcal meningitis

Low: Meningococcal meningitis poses a Low risk and 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 Short-term health risks:

Low: Moderate (TB) to Low (for meningococcal meningitis). Overall risk was reduced to Low with mitigation measures. Confidence in the health risk estimate is high.

6.4.4 Long-term health risks:

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: Rabies posed a year-round moderate risk. 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 U.S. 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 1B, reduction of animal habitats, active pest management programs, and timely treatment of feral animal scratches/bites.

6.5.2 Anthrax

Low: 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.

6.5.3 Q-Fever

Moderate, mitigated to Low: Potential health risk to U.S. personnel is Moderate, but mitigated to Low, 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 6.5.2 except for vaccinations.

6.5.4 H5N1 avian influenza

Low: Potential health risk to U.S. personnel is Low. Although H5N1 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 risks:

Low: The short-term unmitigated risk is Moderate for rabies, and Q-fever, to Low for anthrax, and H5N1 avian influenza. Mitigation measures reduced the overall risk to Low. Confidence in risk estimate is high.

6.5.6 Long-term health risks:

Low: A Low long term risk exists for rabies because, in rare cases, the incubation period for rabies can be several years.

7 Venomous Animal/Insect

All information was taken directly from the Armed Forces Pest Management Board (Reference 7) and the Clinical Toxinology Resources web site from the University of Adelaide, Australia (Reference 8). The species listed below have home ranges that overlap the location of Camp Al Fallujah and vicinity, and may present a health risk if they are encountered by personnel. See Section 9 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 weneri*, *Odontobuthus doriae*, *Orthochirus iraqus*, and *Orthochirus scrobiculosus*: Clinical effects unknown; there are a number of dangerous Buthid scorpions, but there are also some known to cause minimal effects only. Without clinical data it is unclear where this species fits within that spectrum.
- *Euscorpis italicus*, and *Scorpio maurus*: 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*: Potentially lethal envenoming, though unlikely.

- *Hemorrhoids ravergeri*, *Malpolon monspessulanus*, *Psammophis schokari*, *Pseudocyclophis persicus*, *Telescopus fallax*, and *Telescopus tessellatus*: Clinical effects unknown, but unlikely to cause significant envenoming.
- *Macrovipera lebetina* subspecies *euphratica* and subspecies *obtusa* and *Vipera albicornuta*: Severe envenoming possible, potentially lethal.
- *Platyceps rhodorachis* and *Psammophis lineolatus*: Mild envenoming only, not likely to prove lethal.
- *Walterinnesia aegyptia*: Clinical effects unknown, but potentially lethal envenoming, though unlikely, cannot be excluded.

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. Confidence in the health risk estimate is low (Reference 4, Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

8.1 Heat

Summer (June - September) monthly mean temperatures range from 105 degrees Fahrenheit (°F) to 111°F with an average temperature of 108°F based on historical climatological data from the U.S. Air Force Combat Climatology Center, 14th Weather Squadron. The health risk of heat stress/injury based on temperatures alone is Low (< 78°F) from November – March, high (82-87.9°F) in April, and extremely high (≥ 88°F) from May – October. However, work intensity and clothing/equipment worn pose greater health risk of heat stress/injury than environmental factors alone (Reference 9). Managing risk of hot weather operations included monitoring work/rest periods, proper hydration, and taking individual risk factors (e.g., acclimation, weight, and physical conditioning) into consideration. Risk of heat stress/injury was reduced with preventive measures

8.1.1 Short-term health risk:

Low to Extremely High, mitigated to Low: Risk of heat injury in unacclimatized or susceptible populations (older, previous history of heat injury, poor physical condition, underlying medical/health conditions), and those under operational constraints (equipment, PPE, vehicles) is Low from November – March, high in April, and extremely high from May – October. The risk of heat injury was reduced to low through preventive measures such as work/rest cycles, proper hydration and nutrition, and monitoring WBGT. Confidence in the health risk estimate is low (Reference 4, Table 3-6).

8.1.2 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. Confidence in these risk estimates is medium (Reference 4, Table 3-6).

8.2 Cold

8.2.1 Short-term health risks:

Winter (December - March) temperatures range from 39°F to 48°F with an average temperature of 43°F based on historical climatological data from the U.S. Air Force Combat Climatology Center, 14th Weather Squadron. Because even on warm days a significant drop in temperature after sunset by as much as 40°F can occur, there is a risk of cold stress/injury from December – February. The risk assessment for Non-Freezing Cold Injuries (NFCI), such as chilblain, trench foot, and hypothermia, is Low based on historical temperature and precipitation data. Frostbite is unlikely to occur because temperatures rarely drop below freezing. However, personnel may encounter significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries are largely dependent on operational and individual factors instead of environmental factors alone (Reference 9).

Low: The health risk of cold injury is Low. Confidence in the health risk estimate is medium.

8.2.2 Long-term health risk:

Low: The health risk of cold injury is Low. Confidence in the health risk estimate is high.

9 Noise

9.1 Continuous

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe.

9.1.1 Short and long-term health risks:

Not evaluated

9.2 Impulse

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe.

9.2.1 Short-term and Long-term health risks:

Not evaluated.

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 task 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

No specific hazard sources were documented in the DOEHS or MESL from 08 June 2004 through 20 August 2011 timeframe.

10.3 Fuel/petroleum products/industrial chemical spills

No specific hazard sources were documented in the DOEHS or MESL from 08 June 2004 through 20 August 2011 timeframe.

10.4 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. No specific hazard sources were documented in DOEHS or MESL. A total of 21 monthly pesticide application reports in the MESL for Camp Al Fallujah and vicinity (January 2005 to July 2005) list the usage of pesticides on the site. For each pesticide product applied during this period, the EPA approved label has been archived, providing a framework how each pesticide handled and applied (see below).

10.4.1 Rodenticides

Di fenacoum and Bromadiolone were used to control rodents.

10.4.2 Insecticides

Insecticides used to control ants, bees, crickets, fleas, flies, lice, mosquitoes, spiders, termites, and wasps include: Methomyl, (Z)-9-Tricosene, Cypermethrin, Nithiazine, deltamethrin, Polybutylenes, Polyisobutylenes, Lambda-cyhalothrin, Pyrethrins, β -Cyfluthrin, Fipronil, Bacillus thuringiensis subspecies israelensis, and Piperonyl Butoxide.

10.4.3 Short-term and Long-term health risks

Low: Long term health risk is Low. Confidence in the health risk assessment is medium (Reference 4,

Table 3-6).

10.5 Asbestos

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe.

10.6 Lead Based Paint

No specific hazard sources were documented in the DOEHRS or MESL from 08 June 2004 through 20 August 2011 timeframe.

10.7 Burn Pit

There were multiple burn pit inspection reports for Camp Al Fallujah in 2006 and 2008 but there was little information provided such as the operator, location, or contents. Base camp assessment reports in 2011 noted that no landfill or incinerator operations of this type were being performed at Camp Al Fallujah.

While not specific to Camp Al Fallujah 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 10). The Institute of Medicine committee's (Reference 10) review of long-term health consequences of exposure to burn pits in Iraq and Afghanistan 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 or near 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.

10.7.1 Particulate matter, less than 10 micrometers (PM₁₀)

10.7.2 Exposure Guidelines:

Short Term (24-hour) PM₁₀ (µg/m³):

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

Long-term PM₁₀ MEG (µg/m³):

- Not defined and not available.

10.7.2.1 Sample data/Notes:

Only 2 air samples identified with burn pits were collected in 2009. There were insufficient data to characterize the health risk from samples taken near the burn pit. The samples taken near the burn pit

were similar to the base wide samples ($133 \mu\text{g}/\text{m}^3$ to $427 \mu\text{g}/\text{m}^3$) therefore the samples identified with the burn pits were analyzed as part of the base wide assessment in section 2.3.

10.7.3 Particulate matter, less than 2.5 micrometers ($\text{PM}_{2.5}$)

10.7.4 Exposure Guidelines

Short Term (24-hour) $\text{PM}_{2.5}$ ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 65
- Marginal MEG = 250
- Critical MEG = 500

Long-term $\text{PM}_{2.5}$ MEG ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 15
- Marginal MEG = 65

10.7.4.1 Sample data/Notes:

Because only 2 air samples identified with burn pits were collected in 2009 there was insufficient data to characterize the health risk from samples taken near the burn pit. The samples taken near the burn pit were similar to the base wide samples ($108 \mu\text{g}/\text{m}^3$ to $284 \mu\text{g}/\text{m}^3$) therefore the samples identified with the burn pits were analyzed as part of the base wide assessment in section 2.4.

11 References¹

1. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRS-EH Module) at <https://doehrs-ih.csd.disa.mil/Doehrs/>. Department of Defense (DoD) Instruction 6490.03, *Deployment Health*, 2006.
2. DoDI 6055.05, Occupational and Environmental Health, 2008.
3. Joint Staff Memorandum (MCM) 0017-12, Procedures for Deployment Health Surveillance, 2012.
4. USA PHC TG230, June 2013 Revision.
5. 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.
6. Modification 12 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 13 December 2013.
7. Armed Forces Pest Management Board: <http://www.afpmb.org/content/venomous-animals-country-i#Iraq>. U.S. Army Garrison - Forest Glen, Silver Spring, MD.
8. Clinical Toxinology Resources: <http://www.toxinology.com/>. University of Adelaide, Australia.
9. 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.
10. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.

¹ NOTE. The data are currently assessed using the 2013 TG230. The general method involves an initial review of the data which eliminates all chemical substances not detected above 1-yr. negligible MEGs. Those substances screened out are not considered acute or chronic health hazards so are not assessed further. For remaining substances, acute and chronic health effects are evaluated separately for air water (soil is only evaluated for long term risk). This is performed by deriving separate short-term and long term population exposure level and estimates (referred to as population exposure point concentrations (PEPC)) that are compared to MEGs derived for similar exposure durations. If less than or equal to negligible MEG the risk is Low. If levels are higher than negligible then there is a chemical-specific toxicity and exposure evaluation by appropriate SMEs, which includes comparison to any available marginal, critical or catastrophic MEGs. For drinking water 15 L/day MEGs are used for the screening while site specific 5-15 L/day are used for more detailed assessment. For nondrinking water (such as that used for personal hygiene or cooking) the 'consumption rate' is limited to 2 L/day (similar to the EPA) which is derived by multiplying the 5 L/day MEG by a factor of 2.5. This value is used to conservatively assess non drinking uses of water.

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 (Provisional) 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.asp>

DoD Health Readiness Policy and Oversight (HRP&O) Phone: (800) 497-6261.
<http://fhpr.dhhq.health.mil/home.aspx>