

Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Joint Base Balad (JBB) and vicinity, Iraq
Calendar Years: (2003 to 2009)

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, See *REFERENCES*.

PURPOSE: This POEMS documents the DoD assessment of Occupational and Environmental Health (OEH) risk for JBB, Iraq and vicinity that includes Balad Air Base (AB) and Logical Support Area Anaconda (LSAA). 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 April 2003 through 31 October 2009 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 JBB 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 April 2003 through 31 October 2009.

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

Joint Base Balad was one of the largest airbases in Iraq. It is located in central Iraq, approximately 68 kilometers (km) north of Baghdad and 1.5 km from the Tigris River. It was built in the 1980s and was previously used as an air base for the Iraqi military. The airfield had two runways and was used for Air Force fighter jets, Army helicopters, and Army unmanned aerial systems. It was home to approximately 25,000 military, civilian, and coalition personnel. There were approximately 557 structures on JBB including barracks, administrative buildings, hospitals, clinics, dining facilities, bunkers, aircraft hangers, warehouses, maintenance facilities, a theater, a mosque, gymnasiums, swimming pools, and other buildings. The adjacent property was primarily used for agriculture. Irrigation canals fed by the Tigris River ran around the northeastern and western sections of the base perimeter.

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 JBB 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 may have caused acute health effects in some personnel during deployment at JBB and vicinity that includes Balad AB and LSAA:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM₁₀); certain airborne chemical pollutants (e.g., acrolein and hexachlorobutadiene); food/waterborne diseases (e.g., diarrhea); other endemic diseases (e.g., sandfly fever and cutaneous leishmaniasis), and heat stress. If ingesting local food and water, food/waterborne disease resulting in diarrhea can temporarily incapacitate personnel. For heat stress, risk can be greater for susceptible persons including those older than 45, of low fitness level, or with underlying medical conditions. Risks from food/waterborne diseases and heat stress can be reduced with preventive medicine controls and mitigation. For PM₁₀ and airborne chemical pollutants, 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. Although most effects from exposure to PM₁₀ and chemical pollutants 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 JBB. Personnel who reported with symptoms or required treatment while at this site should have exposure/treatment noted in medical record on a Standard Form (SF) 600 (*Chronological Record of Medical Care*).

Long-term health risks & medical implications:

The following may have caused acute health effects in some personnel during deployment at JBB and vicinity that includes Balad AB and LSAA:

The types of hazards associated with potential long-term health effects at JBB include inhalable fine particulate matter less than 2.5 micrometers in diameter (PM_{2.5}), visceral leishmaniasis and for certain populations, continuous and impulse noise. It is considered possible that some otherwise healthy personnel who were exposed for a long-term period to PM_{2.5} levels 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 PM_{2.5} exposures are documented and archived, at this time there are no specific recommended, post-deployment medical surveillance evaluations or treatments. However, providers should consider overall individual health status (e.g., any underlying conditions/susceptibilities). Likewise—especially for noise hazards—providers should consider any potential unique individual exposures (such as occupational or specific personal dosimeter data) when assessing individual concerns. For example, at all basecamps certain individuals 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 - JBB and vicinity that includes Balad AB and LSAA^{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 microns in diameter (PM ₁₀)	Short-term: Low to High, Daily levels varied, acute health effects (e.g., eye and upper respiratory tract irritation) were more pronounced during peak days. More serious effects were 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 to High, Daily levels varied, acute health effects (e.g., eye and upper respiratory tract irritation) were more pronounced during peak days. More serious effects were 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 microns in diameter (PM _{2.5})	Short-term: Low to High, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may have produced very notable eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may have been exacerbated.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Low to High, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may have produced very notable eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may have been exacerbated.
	Long-term: Moderate. It is plausible that development of chronic health conditions such as reduced lung function or exacerbated chronic bronchitis, chronic obstructive pulmonary disease, asthma, atherosclerosis, or other cardiopulmonary diseases could have occurred in generally healthy troops. Those with a history of asthma or cardiopulmonary disease were considered to be at particular risk.		Long-term: Moderate. It is plausible that development of chronic health conditions such as reduced lung function or exacerbated chronic bronchitis, chronic obstructive pulmonary disease, asthma, atherosclerosis, or other cardiopulmonary diseases could have occurred in generally healthy troops. Those with a history of asthma or cardiopulmonary disease were considered to be at particular risk.
Metals	Short-term: Low for beryllium and vanadium.		Short-term: Low for beryllium and vanadium.
	Long-term: Low for aluminum and vanadium.		Long-term: Low for aluminum and vanadium.
Volatile Organic Compounds (VOC)	Long-term: Low for acrolein.		Long-term: Low for acrolein.
Water			
Consumed Water (Water Used for Drinking)	Short-term: Low for lead.	APHC (former VETCOM) Approved Bottled Water; Potable water only from approved water sources	Short-term: Low for lead.
	Long-term: Low for phosphorus.		Long-term: Low for phosphorus.
Water for Other Purposes	Short-term: Low for phosphorus.	Water treated in accordance with standards applicable to its intended use	Short-term: Low for phosphorus.
	Long-term: Low for phosphorus.		Long-term: Low for phosphorus.

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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 and appropriate chemoprophylaxis.	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.		Short-term: Moderate 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 CENTCOM GO 1B. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis IAW The CDC's ACIP 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 varied with species from mild localized swelling (e.g. <i>Psammophis lineolatus</i>) to potentially lethal effects (e.g. <i>Hemiscorpius lepturus</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 varied with species from mild localized swelling (e.g. <i>Psammophis lineolatus</i>) to potentially lethal effects (e.g. <i>Hemiscorpius lepturus</i>).
	Long-term: No data available		Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Low to Extremely High; Risk of heat injury was Extremely High for June-August, High in May and September, and Low for all other months.	Work-rest cycles, proper hydration and nutrition, and WBGT monitoring..	Short-term: Low to Extremely High; Risk of heat injury was Extremely High for June-August, High in May and September, and Low for all other months.

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	Long-term: Low, The long-term risk was Low. However, the risk may have been 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 was Low. However, the risk may have been 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 were rare but can occur, especially from more serious injuries such as frost bite.		Long-term: Low; Long-term health implications from cold injuries were rare but can occur, especially from more serious injuries such as frost bite.
NOISE			
Continuous (Flightline, Power Production)	Short-term: Low to Moderate.	Hearing protection used by personnel in higher risk areas	Short-term: Low to Moderate.
	Long -term: Low to Moderate.		Long -term: Low to Moderate.
Impulse	Short-term: Moderate to High		Short-term: Moderate to High
	Long -term: Moderate to High		Long -term: Moderate to High
Unique Incidents/Concerns			
Pesticides/Pest Control	Short-term: Low.	See Section 10.4	Short-term: Low.
	Long -term: Low.		Long -term: Low.
Asbestos	Short-term: Low.		Short-term: Low.
	Long -term: Low.		Long -term: Low.
Lead Based Paint	Short-term: Low.		Short-term: Low.
	Long -term: Low.		Long -term: Low.
Burn Pits	Short-term: Low.	Risks reduced by limiting strenuous physical activities when air quality was especially poor; and action such as closing tent flaps, windows, and doors. Other control measures included locating burn pits downwind of prevailing winds, increased distance from troop populations, and improved waste segregation and management techniques.	Short-term: Low.
	Long-term: Low.		Long-term: Low.

¹This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational environment conditions at JBB and vicinity that includes Balad AB and LSAA. 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.

²This assessment is based on specific environmental sampling data and reports obtained from 1 April 2003 through 31 October 2009. 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.

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 JBB 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/AIPH. 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.

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.

1 Discussion of Health Risks at JBB 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 US Army Public Health Command Technical Guide 230, *Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel* (USAPHC TG 230). 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

Personnel deployed to JBB were exposed to various airborne constituents. These were identified through monitoring and sampling efforts between April 2003 and October 2009. Windblown dust, industrial pollution, and sand contributed to particulate matter (PM) exposures. There were a number of industrial activities, including manufacturing, construction, fuel storage and distribution, water and wastewater treatment, and concrete and asphalt production, located on and around JBB that may have contributed air contaminants. An additional source of exposure came from the Army's use of open burn pits to dispose of waste/refuse such as paper, plastic, and wood. JBB installed four waste incinerators (two in 2007, one in 2008, and one in 2009); instituted an installation-wide recycling plan (2008) that incorporated glass, plastics and aluminum disposal; and implemented the disposal of used cooking oil/grease to an off-site rendering and biodiesel production facility (2009) in an effort to mitigate U.S. contributions to local air quality. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms, may have resulted 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) were 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 micron (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) PM₁₀ MEGs (µg/m³):

- Negligible MEG = 250
- Marginal MEG = 420

Long-term PM₁₀ (1-year) MEGs (µg/m³):

- Not defined and not available.

- Critical MEG = 600

2.3.2 Sample data/Notes:

A total of 499 valid PM₁₀ air samples were collected from 1 April 2003 – 31 October 2009. The range of 24-hour PM₁₀ concentrations was 1 µg/m³ – 9576 µg/m³ with an average concentration of 342.5 µg/m³.

2.3.3 Short-term health risks:

Low to High: The short-term PM₁₀ health risk assessment was Low to High based on average and peak PM₁₀ sample concentrations, and the likelihood of exposure at these hazard severity levels. A Low health risk assessment is expected to have little or no impact on accomplishing the mission. Little to no in-theater medical resources anticipated for protection and treatment. A High health risk assessment is expected to have significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard if hazards occur during the mission. Some in-theater medical countermeasures and resources anticipated. (Reference 9, Table 3-2). Daily average health risk levels for PM₁₀ showed no hazard for 62%, low health risk for 23%, moderate health risk for 5%, and high health risk for 9% of the time. Confidence in the short-term PM₁₀ health risk assessment is medium (Reference 9, Table 3-6).

The hazard severity for average PM₁₀ concentrations in samples was negligible. The results indicate that 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 9, Table 3-10).

For the highest observed PM₁₀ sample concentration, the hazard severity was critical. During peak exposures at the critical hazard severity level, most if not all personnel will experience very notable eye, nose, and throat irritation and respiratory effects. Visual acuity is impaired, as is overall aerobic capacity. Some personnel will not be able to perform assigned duties. Some lost-duty days are expected. Those with a history of asthma or cardiopulmonary disease will experience more severe symptoms (Reference 9, Table 3-10).

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 152 valid PM_{2.5} air samples were collected from 1 October 2006 to 31 October 2009. The range of 24-hour PM_{2.5} concentrations was 21 µg/m³ – 2889 µg/m³ with an average concentration of 187 µg/m³.

2.4.3 Short-term health risks:

Low to High: The short-term PM_{2.5} health risk assessment was Low to High based on average and peak PM_{2.5} sample concentrations, and the likelihood of exposure at these hazard severity levels. A Low health risk assessment is expected to have little or no impact on accomplishing the mission. Little to no in-theater medical resources anticipated for protection and treatment. A High health risk assessment is expected to have significant degradation of mission capabilities in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission to standard if hazards occur during the mission. Some in-theater medical countermeasures and resources anticipated. (Reference 9, Table 3-2). Daily average health risk levels for PM_{2.5} showed no hazard for 26%, low health risk for 62%, moderate health risk for 7%, and high health risk for 6% of the time. Confidence in the short-term PM_{2.5} health risk assessment is low to medium (Reference 9, Table 3-6).

The hazard severity for average PM_{2.5} concentrations in samples was negligible. The results indicate that 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 9, Table 3-10).

For the highest observed PM_{2.5} sample concentration, the hazard severity was critical. During peak exposures at the critical hazard severity level, most if not all personnel will experience very notable eye, nose, and throat irritation and respiratory effects. Visual acuity is impaired, as is overall aerobic capacity. Some personnel will not be able to perform assigned duties. Some lost-duty days are expected. Those with a history of asthma or cardiopulmonary disease will experience more severe symptoms (Reference 9, Table 3-10).

2.4.4 Long-term health risks:

Moderate: The long-term health risk assessment was Moderate based on average PM_{2.5} concentration, and the likelihood of exposure at this hazard severity level. A Moderate health risk level suggests that long-term exposure to PM_{2.5} is expected to require limited future medical surveillance activities and related resources anticipated, documentation of environmental data in designated Department of Defense archive, and documentation of exposed groups or personnel of surveillance interest. (Reference 9, Table 3-3). Confidence in the long-term PM_{2.5} health risk assessment is low to medium (Reference 9, Table 3-6).

The hazard severity was marginal for average PM_{2.5} sample concentrations. The results suggest that with repeated exposures above the marginal hazard severity threshold, it is plausible that development of chronic health conditions such as reduced lung function or exacerbated chronic bronchitis, chronic obstructive pulmonary disease, 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 9, Table 3-11).

2.5 Airborne Metals

2.5.1 Exposure Guidelines:

Short Term (14-day) Beryllium MEGs (µg /m³):

- Negligible MEG = 1.4E-2

Long-term (1-year) Beryllium MEGs (µg /m³):

- Negligible MEG = 1.4E-2

Short Term (14-day) Vanadium MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = $5.5\text{E-}1$

Long-term (1-year) Vanadium MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = $6.8\text{E-}2$

Short Term (14-day) Aluminum MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 340

Long-term (1-year) Aluminum MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 3.4

2.5.2 Sample data/Notes:

A total of 499 valid PM_{10} airborne metal samples were collected at JBB and vicinity from 1 April 2003 to 31 October 2009.

2.5.3 Short-term health risks:

Low: Beryllium had an average ($0.03 \mu\text{g}/\text{m}^3$) and peak ($0.64 \mu\text{g}/\text{m}^3$) sample concentration that exceeded the short-term 14 day negligible MEG ($1.4\text{E-}2 \mu\text{g}/\text{m}^3$). The short-term health risk assessment for PM_{10} airborne beryllium sample concentrations was Low. Confidence in the health risk assessment is medium (Reference 9, Table 3-6).

The hazard severity for average and peak PM_{10} airborne beryllium concentrations in samples was negligible. The results indicate that 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 (Reference 9, Table 3-4).

Low: Vanadium had an average ($0.12 \mu\text{g}/\text{m}^3$) and peak ($0.75 \mu\text{g}/\text{m}^3$) sample concentration that exceeded the short-term 14 day negligible MEG ($5.5\text{E-}1 \mu\text{g}/\text{m}^3$). The short-term health risk assessment for PM_{10} airborne vanadium sample concentrations was Low. Confidence in the health risk assessment is medium (Reference 9, Table 3-6).

The hazard severity for average and peak PM_{10} airborne vanadium concentrations in samples was negligible. The results indicate that 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 (Reference 9, Table 3-4).

2.5.4 Long-term health risks:

Low: Aluminum had an average ($5.4 \mu\text{g}/\text{m}^3$) sample concentration that exceeded the long-term 1 year negligible MEG ($3.4 \mu\text{g}/\text{m}^3$). The long-term health risk assessment for PM_{10} airborne aluminum sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity was negligible for average PM_{10} aluminum sample concentrations. The results suggest that with repeated exposures above the negligible hazard severity threshold, few exposed personnel (if any) are expected to develop delayed onset, irreversible effects (Reference 9, Table 3-4).

Low: Vanadium had an average ($0.12 \mu\text{g}/\text{m}^3$) sample concentration that exceeded the long-term 1 year negligible MEG ($6.8\text{E-}2 \mu\text{g}/\text{m}^3$). The long-term health risk assessment for PM_{10} airborne vanadium sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity was negligible for average PM₁₀ vanadium sample concentrations. The results suggest that with repeated exposures above the negligible hazard severity threshold, few exposed personnel (if any) are expected to develop delayed onset, irreversible effects (Reference 9, Table 3-4).

2.6 Volatile Organic Compounds (VOC)

2.6.1 Exposure Guidelines:

Short Term (14-day) Acrolein MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 46

Long-term (1-year) Acrolein MEGs ($\mu\text{g}/\text{m}^3$):

- Negligible MEG = 1.4E-1

2.6.2 Sample data/Notes:

The health risk assessment is based on average and peak concentration of 419 valid volatile organic chemical (VOC) air samples collected from 1 August 2004 to 31 October 2009.

2.6.3 Short-term health risks:

None of the analyzed VOC pollutants were found at concentrations above short-term MEGs.

2.6.4 Long-term health risks:

Low: Acrolein had an average ($1.26 \mu\text{g}/\text{m}^3$) sample concentration that exceeded the long-term 1 year negligible MEG ($1.4\text{E}-1 \mu\text{g}/\text{m}^3$). The long-term health risk assessment for acrolein sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity was negligible for average acrolein sample concentrations. The results suggest that with repeated exposures above the negligible hazard severity threshold, few exposed personnel (if any) are expected to develop delayed onset, irreversible effects (Reference 9, Table 3-4).

3 Soil

3.1 Site-Specific Sources Identified

3.2 Sample data/Notes:

A total of 52 valid surface soil samples were collected from 1 May 2003 to 31 October 2009, to assess OEH health risk to deployed personnel. The primary soil contamination exposure pathways were dermal contact and dust inhalation. Typical parameters analyzed for included SVOCs, heavy metals, 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). The percent of the population exposed to soil and associated dust in the sampled areas was > 75% for 0 samples, 50–75% for 1 sample, 25–50% for 1 sample, 10–25% for 3 samples, 0–25% for 2 samples and <10% for 42 samples. For the risk assessment, personnel were 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 were detected more than five percent of the time and exceeded 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.

4.1 Drinking Water: Bottled or Packaged Water and ROWPU Water

4.1.1 Site-Specific Sources Identified

From 2003 to 2005, drinking water supplies at JBB were from locally procured bottled water sources approved by US Army Veterinary Services personnel. Since 2005, commercial contractor, Al-Morrell Development (© 2007 Morrell International) produced drinking (bottled/packaged) water using reverse osmosis water purification units (ROWPUs) to filter and disinfect source water taken from an irrigation canal fed by the Tigris River. The U.S. Army Veterinary Services personnel monitored the bottled water production process and conducted monthly bacteriological (bac-t) testing and additional quarterly quality assurance (QA) analysis. Bottled water expired 6 months after production. Routine field tests conducted by US Army Veterinary Services and preventive medicine detachments included bacteriological, chemical, biological, radiological, and nuclear (CBRN), free available chlorine (FAC), and other sanitation surveillance parameters per Department of the Army (DA) Technical Bulletin, Medical 577, Sanitary Control and Surveillance of Field Water Supplies, December 2005. In addition to the military QA analyses, the contractor performed its own QA testing.

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 15 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 51 valid bottled water and ROWPU water samples were collected from 1 April 2003 to 31 December 2008.

4.1.3 Short-term health risks:

Low: Lead had an average (0.0015 mg/L) and peak (0.02 mg/L) sample concentration that exceeded the 1 year negligible MEG (0.015 mg/L) and short-term MEGs were unavailable. The short-term health risk assessment for lead sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity for average and peak lead concentrations in samples was negligible. The results indicate that 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 (Reference 9, Table 3-4).

Low: Phosphorus had an average (0.0065 mg/L) and peak (0.03 mg/L) sample concentration that exceeded the 1 year negligible MEG (9.3E-5 mg/L) and short-term MEGs were unavailable. The short-

term health risk assessment for phosphorus sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity for average and peak phosphorus concentrations in samples was negligible. The results indicate that 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 (Reference 9, Table 3-4).

4.1.4 Long-term health risks:

Low: Phosphorus had an average (0.0065 mg/L) sample concentration that exceeded the long-term 1 year negligible MEG (9.3E-5 mg/L). The long-term health risk assessment for phosphorus sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity was negligible for average phosphorus sample concentrations. The results suggest that with repeated exposures above the negligible hazard severity threshold, few exposed personnel (if any) are expected to develop delayed onset, irreversible effects (Reference 9, Table 3-4).

4.2 Non-Drinking Water: Disinfected

4.2.1 Site-Specific Sources Identified

Although the primary route of exposure for most microorganisms was ingestion of contaminated water, dermal exposure to some microorganisms, chemicals, and biologicals may have also caused adverse health effects. Complete exposure pathways included 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.

Potable water used for purposes other than drinking was produced by the contractor KBR (© 2010 KBR, Inc.) using ROWPUs to filter and disinfect source water taken from an irrigation canal fed by the Tigris River. Military ROWPUs were on the ground but were only used for emergency backup. Raw-water testing (pre-ROWPU treatment) was performed annually or for new water sources. Groundwater wells located throughout JBB were certified by preventive medicine personnel and were authorized for use in conjunction with a ROWPU for water production, but they were only for backup if the water levels in the irrigation canal drop. Treated water was distributed to the dining facilities for cooking and hand washing. Additionally, treated water produced by KBR was used to fill all the water tanks on the installation for showers, toilets, personal hygiene, dust abatement, street cleaning, and washing of aircraft. Routine field tests conducted by KBR included bacteriological, CBRN, FAC, and other sanitation surveillance parameters per TB MED 577. In addition to the military QA monitoring, the contractor performed its own QA testing.

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 51 ROWPU-treated, non-drinking water samples from 1 April 2004 to 31 October 2009 were evaluated for this health risk assessment.

4.2.3 Short-term health risks:

Low: Phosphorus had an average (0.006 mg/L) and peak (0.03 mg/L) sample concentration that exceeded the 1 year negligible MEG (9.3E-5 mg/L) and short-term MEGs were unavailable. The short-term health risk assessment for phosphorus sample concentrations was Low. Confidence in the health risk assessment is low/medium/high (Reference 9, Table 3-6).

The hazard severity for average and peak phosphorus concentrations in samples was negligible. The results indicate that 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 (Reference 9, Table 3-4).

4.2.4 Long-term health risks:

Low: Phosphorus had an average (0.006 mg/L) sample concentration that exceeded the long-term 1 year negligible MEG (9.3E-5 mg/L). The short-term health risk assessment for phosphorus sample concentrations was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

The hazard severity was negligible for average phosphorus sample concentrations. The results suggest that with repeated exposures above the negligible hazard severity threshold, few exposed personnel (if any) are expected to develop delayed onset, irreversible effects (Reference 9, Table 3-4).

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 Environmental Surveillance Library (MESL) from the 1 April 2003 to 31 October 2009 timeframe.

5.2 Depleted Uranium (DU)

DU was a component of some aircraft that were on JBB and/or transited through JBB, as well as a component of some weapon systems. The Multi-National Corps (MNC)-I Nuclear Medical Science Officer conducted a DU survey of JBB on 3 April 2007. The only site identified to have DU present was at the abandoned/damaged US and Iraqi military vehicles storage area near the burn pit. Only one vehicle at the site contained DU. DU levels found were not a health hazard or concern to personnel.

No specific health risks were identified.

5.3 Ionizing Radiation

No specific hazard sources were documented in the DOEHRS, or MESL from the 1 April 2003 to 31 October 2009 timeframe.

5.4 Non-Ionizing Radiation

No specific hazard sources were documented in the DOEHRS, or MESL from the 1 April 2003 to 31 October 2009 timeframe.

6 Endemic Disease

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 11 (Reference 11) 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. 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 was in place to reduce the risks to low. 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 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. 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. 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 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 tuberculosis (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. 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 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 US 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 Clinical Toxinology Resources web site from the University of Adelaide, Australia (Reference 2). The species listed below have home ranges that overlap the location of JBB 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*

wernerii, *Odontobuthus doriae*, 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.

- *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 ravergerii*, *Malpolon monspessulanus*, *Psammophis schokari*, *Pseudocyclophis persicus*, and *Telescopus fallax*: 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. *P. lineolatus*) to potentially lethal effects (e.g. *H. lepturus*). 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 9, Table 3-6).

7.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

8.1 Heat

Summer (May - September) monthly mean temperatures ranged from 67 °F to 112 °F with an average daily high temperature of 102 °F based on historical climatological data. The health risk of heat stress/injury based on temperatures alone is Low (< 78 °F) from October – April, high (82-87.9°F) in May and September, and extremely high (≥ 88°F) from June – August. However, work intensity and clothing/equipment worn pose greater health risk of heat stress/injury than environmental factors alone (Reference 6). 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) was Extremely High from June – August, High in May and September, and Low from October – April. The risk of heat injury was reduced to low through preventive measures such as work/rest cycles, proper hydration and nutrition, and monitoring wet bulb globe temperature. Confidence in the health risk estimate is low (Reference 9, Table 3-6).

8.1.2 Long-term health risk:

Low: The long-term risk was Low. However, the risk may have been 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 9, Table 3-6).

8.2 Cold

8.2.1 Short-term health risks:

Winter (December - March) temperatures ranged from 38 °F to 75 °F with an average temperature of 54 °F based on historical climatological data. Because even on warm days a significant drop in temperature after sunset by as much as 40 °F can occur, there was a risk of cold stress/injury from December – March. The risk assessment for Non-Freezing Cold Injuries (NFCI), such as chilblain, trench foot, and hypothermia, was Low based on historical temperature and precipitation data. Frostbite was 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.

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

8.1.2 Long-term health risk:

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

9 Noise

9.1 Continuous

Power generation and flight operations taking place on JBB created outdoors noise levels that occasionally fluctuated above the threshold level requiring single-level hearing protection (85 A-weighted decibels (dBA)). In addition, health effects of noise exposure as low as 80 dBA occurring the same time as exposures to certain chemicals (carbon monoxide, aircraft fuels, and industrial chemicals) can cause permanent hearing loss.

For the majority of personnel on this site, noise levels above the hearing protection threshold were for short durations and average daily exposures were below levels requiring participation in a hearing conservation program.

For those individuals working on or near the flight line there may have been intermittent high level (>105 dBA) exposures, depending on sortie rates of fighter aircraft and takeoffs and landings of

transport and other aircraft. Individuals working or living near the flight line may have also been exposed to low level 'nuisance' noise (< 85 dBA). These continuous low level exposures may have caused sleep loss, fatigue, increased stress levels and increased blood pressure. The health effects due to this 'nuisance' noise were undetermined at this time.

9.1.1 Short and long-term health risks:

Low for the majority of personnel on this site. **Moderate** for individuals working on or near the flight line without proper hearing.

9.2 Impulse

Impulse noise was associated with weapons firing and exposures to enemy explosives (artillery, improvised explosive devices, etc). Exposure was intermittent; however exposures could have been associated with temporary hearing loss and permanent hearing loss as well as other hearing or central nervous system disorders.

9.2.1 Short-term and Long-term health risks:

The risk of acute and chronic hearing impairment effects from impulse noise for troops involved in combat or convoy operations was **Moderate** to **High**.

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

Regulated hazardous medical waste (red-bagged) was collected and incinerated. Household waste was primarily disposed of through incineration using large-scale industrial incinerators. Solid waste was also disposed of using an open-air burn pit. The JBB burn pit was closed on 1 October 2009. Hazardous waste storage was limited to used and off-spec petroleum, oil, and lubricant products, and small spill cleanup residue. Proper handling, storage, and disposal of industrial waste generated on base were coordinated at the unit level with long-term storage at the hazardous material/waste storage site. Obvious signs of major spills or tank leakage were not noted when coalition forces occupied JBB. Chemical latrines were pumped out by trucks and waste was disposed of using two sewage treatment plants located on JBB.

10.2.1 Short-term and Long-term health risks:

No specific health risks associated with these waste management operations were identified.

10.3 Fuel/petroleum products/industrial chemical spills

No specific hazard sources were documented in the DOEHRS, or MESL from the 1 April 2003 to 31 October 2009 timeframe.

10.4 Pesticides/Pest Control:

The health risk of exposure to pesticide residues was 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 DOEHRS or MESL data portal. For each pesticide product applied during this period, the USEPA approved label has been archived, providing a framework how each pesticide handled and applied (see below).

10.4.1 Rodenticides

Baits and glue boxes were used to control rodents.

10.4.2 Insecticides

Insecticides used to control ants, beetles, mosquitoes, and spiders included: baits, glue boxes, pyrethroids, larvicides (i.e., agnique and altosid briquets). Some limited area residual pest control was performed to control mosquitoes.

10.4.3 Short-term and Long-term health risks

Low: Long term health risk was Low. Confidence in the health risk assessment is low (Reference 9, Table 3-6).

10.5 Asbestos

Some buildings occupied by personnel were former Iraqi facilities. There was evidence that asbestos-containing materials were used in the construction of preexisting Iraqi facilities and structures at this site. No specific exposure conditions of concern or health risks to personnel were identified. Procedures were established to limit exposures (i.e., reviewing work orders, checking areas of known asbestos-containing materials to ensure the materials are non-friable).

10.5.1 Short-term and Long-term health risks:

The risk of acute and chronic health effects from exposure to asbestos was **Low**.

10.6 Lead Based Paint

Some buildings occupied by personnel were former Iraqi facilities. There was evidence that lead-based paint was used in the construction of preexisting Iraqi facilities and structures at this site. No specific exposure conditions of concern or health risks to personnel were identified. Procedures were established to limit exposures (i.e., reviewing work orders, checking areas of known lead based paint for flaking).

10.6.1 Short-term and Long-term health risks:

The risk of acute and chronic health effects from exposure to lead based paint was **Low**.

10.7 Burn Pit

Since 2003, open burn pits have been used for solid waste disposal at JBB. The JBB burn pit was closed on 1 October 2009. The smoke from the burn pits was nearly ubiquitous and has resulted in significant risk communication challenges. Personnel at the site have expressed concerns from intermittent exposure to burn pit emissions and have complained of during and post deployment health effects.

Ambient air samples were collected at JBB from 2 January 2007 to 21 April 2007 and from 18 October 2007 to 25 November 2007 to assess the compounds emitted from the burn pits and determine health risk, if any, to personnel. The air sampling study targeted expected emissions to include PM₁₀, volatile organics, metals, polycyclic aromatic hydrocarbons, and dioxins and furans. This study did not evaluate several important components of smoke such as acid gases or inorganics other than metals. For example chlorine (Cl₂), a byproduct of burning plastic, was not characterized. This has weakened any ability to determine if health effects can be specifically linked to the burn pits.

A total of 163 samples in the spring and 107 samples in the fall were collected. Particulate matter levels were typical of what would be expected in the region and similar to background levels; however, this evaluation did not examine PM further due to comprehensive studies of PM₁₀ in the Central Command Area of Responsibility. Dioxins and furans were not detected above a 1-year MEG in any sample, and polycyclic aromatic hydrocarbons were not detected above a 1-year MEG in any sample.

Additionally, results from a pilot study done to assess dioxin/furan levels in blood from 25 random Soldiers stationed at Balad (from 2006 to 2007) indicated that there were no significant body-burden levels after a 1-year deployment. Post-deployment dioxin/furan levels were consistent with background U.S. levels measured in the National Health and Nutrition Examination Survey.

While not specific to JBB 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 7). The committee's 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.

10.7.1 Short-term health risks:

Low: Acute health effects (eye, nose, throat, and lung irritation) have been possible at times when concentrations are similar to, or intermittently above, those detected during these sampling efforts. However, there was significant uncertainty as to the reported risk levels as many compounds were not evaluated. There is medium confidence in this risk estimate based on limited sampling data.

10.7.2 Long-term health risk:

Based on the sampled media, chronic health effects from exposure to ambient air at JBB were not expected. However, there was significant uncertainty as to the reported risk levels as many compounds were not evaluated. There is medium confidence in this risk estimate based on limited sampling data.

11 References¹

1. Casarett and Doull's Toxicology: the Basic Science of Poisons, Chapter 2- Principles of Toxicology; Fifth Edition, McGraw Hill, New York.
2. Clinical Toxinology Resources: <http://www.toxinology.com/>. University of Adelaide, Australia.
3. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRSEH database) at <https://doehrs-ih.csd.disa.mil/Doehrs/>. Department of Defense (DoD) Instruction 6490.03, *Deployment Health*, 2006.
4. DoDI 6055.05, Occupational and Environmental Health, 2008.
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. 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.
7. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.
8. Joint Staff Memorandum (MCM) 0028-07, Procedures for Deployment Health Surveillance, 2007.
9. USA PHC TG230, June 2010 Revision.
10. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM). 2008. Particulate Matter Factsheet; 64-009-0708, 2008.
11. Modification 11 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 2 December 2011.
12. Logistics Support Area (LSA) Anaconda Environmental Baseline Survey (EBS), 2003.
13. USACHPPM, Phase I Deployment Occupational and Environmental Health Assessment-Balad Air Base/LSA Anaconda, 2004.
14. USACHPPM, Joint Base Balad Depleted Uranium Survey, 2007.

¹ NOTE. The data are currently assessed using the 2010 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.

15. USACHPPM, Screening Health Risk Assessment Burn Pit Exposures Balad Air Base, Iraq, 2008.

16. USACHPPM, Addendum 2 Screening Health Risk Assessment Burn Pit Exposures Balad Air Base, Iraq, 2008.

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 DoD Force Health Protection and Readiness (FHP & R).

Army Institute of Public Health 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-nehc.med.navy.mil>

U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. <http://www.wpafb.af.mil/afri/711hpw/usafsam.asp>

DoD Force Health Protection and Readiness (FHP & R) Phone: (800) 497-6261. <http://fhp.osd.mil>