

Military Deployment Periodic Occupational and Environmental Monitoring Summary (POEMS): Green Zone (International Zone), Baghdad, Iraq: 2003 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, See *REFERENCES*.

PURPOSE: This POEMS documents the DoD assessment of base camp level occupational and environmental health (OEH) exposure data for areas within the International Zone (Green Zone) of Baghdad, Iraq which include: Forward Operating Base (FOB) Fernandez, Freedom I, FOB Freedom Rest, FOB Honor, FOB Prosperity, FOB Union, FOB Union III, Ibn Sina Hospital, International Zone Embassy, Embassy Estate, International Zone Travis, International Zone USAID, Riverside Billeting, Camp Blackhawk and Steel Dragon. Some samples and data that had a non-specific Baghdad label were determined through further investigation to have been collected within the Green Zone and thus were included in this evaluation. It presents the identified health risks and associated medical implications. The findings are based on information collected from March 2003 through May 2011 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. While this assessment may reflect similar exposures and risks pertaining to historic or future conditions at this site, the underlying data are limited to the time period(s) and area(s) sampled and thus may not reflect fluctuations or unique occurrences. It also may not be fully representative of all the fluctuations during the timeframe. To the extent data allow, this summary describes the general ambient conditions at the site and characterizes the risks at the *population-level*. While useful to inform providers and others of potential health effects and associated medical implications, it does not represent an individual exposure profile. Actual individual exposures and specific resulting health effects depend on many variables and should be addressed in individual medical records by providers as appropriate at the time of an evaluation of a unique exposure. There are no data available for the sites in the International zone past May 2011, thus this POEMS is the final one for the locations listed above in the Green Zone.

SITE DESCRIPTIONS: The International Zone, which is more commonly referred to as the Green Zone, was a 5.6 square mile area in central Baghdad that was the main base for Coalition and Iraqi Government officials in Iraq. There are several foreign embassy buildings, former palaces of Saddam Hussein and former Iraqi Military buildings and monuments located throughout the Green Zone. There were thirteen FOBs scattered throughout the Green Zone. The city of Baghdad sits on part of the delta lowland region of Iraq and the Green Zone is located on a vast plain bisected by the River Tigris. Baghdad has a subtropical arid climate and is the largest city in Iraq. At times, the structures on the camps included hardened permanent structures, which were used primarily for workspaces. Trailers called Containerized Housing Units (CHU) were used for housing of coalition forces as well as being used for latrines. Tents were used primarily for temporary housing, with a usual stay of two to three nights.

The population of interest for this assessment is personnel who were deployed at the Green Zone/International Zone to include FOB Prosperity, FOB Freedom, FOB Freedom Rest, FOB Union I, FOB Union III, FOB Honor, FOB Fernandez, FOB Blackhawk, Steel Dragon and Ibn Sina Hospital for up to one year between March 2003 and May 2011. Based on historical Operation Iraqi Freedom (OIF) rotations, Army deployment lengths typically did not exceed 14 months at any one time.

SUMMARY: Summarized below are the key health risks estimated to present a moderate or greater risk of medical concern along with appropriate follow-on medical actions, if any. The table on the following page provides a list of the overall identified health risks at these locations. As indicated in the detailed sections that follow the table, controls that have been effectively established to reduce risk levels have been factored into this overall assessment. In some cases, (e.g., ambient air) specific controls are not routinely available/feasible.

Short-term health risks & medical implications: The following may have caused acute health effects in some personnel during deployment at the International Zone (Green Zone) of Baghdad, Iraq during 2003-2011:

Inhalable coarse particulate matter less than 10 micrometers in diameter (PM₁₀); food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis); other

endemic diseases (malaria, cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, sandfly fever, leptospirosis, schistosomiasis, Tuberculosis (TB), rabies, Q fever); heat stress; and continuous noise. For food/waterborne diseases (e.g., bacterial diarrhea, hepatitis A, typhoid fever, diarrhea-cholera, diarrhea-protozoal, brucellosis), if ingesting local food and water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid fever, brucellosis). 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 USCENTCOM policy. For other vector-borne endemic diseases (cutaneous leishmaniasis, Crimean-Congo hemorrhagic fever, sandfly fever), these diseases may constitute a significant risk due to exposure to biting vectors; risk reduced to Low by proper wear of the treated uniform, application of repellent to exposed skin and bed net, 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 April through October and greater for susceptible persons including those older than 45, of low fitness level, unacclimatized, or with underlying medical conditions. Risks from heat stress may have been reduced with preventive medicine controls, work-rest cycles, and mitigation. For continuous noise, the risk is high to individuals working near major noise sources without proper hearing protection; there is low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection. Air quality: For PM₁₀ and for particulate matter less than 2.5 micrometers in diameter (PM_{2.5}), (although the PM_{2.5} overall short-term risk was not evaluated due to insufficient data), exposures 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 PM₁₀ 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. Although no samples were taken near the FOB Honor burn pit to evaluate short-term risk, there were open burning operations outside the Green Zone perimeter – see section 10.7. For burn pits, exposures to high levels of PM₁₀ and 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 and certain subgroups 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 the International Zone (Green Zone) of Baghdad, Iraq. 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 hazards associated with potential long-term health effects at the International Zone (Green Zone) of Baghdad, Iraq, include Leishmaniasis-visceral infection and continuous noise.

Leishmaniasis is transmitted by sand flies. Visceral leishmaniasis (a more latent form of the disease) causes a severe febrile illness, which typically requires hospitalization with convalescence over 7 days. The leishmaniasis parasites may survive for years in infected individuals. Consequently, this infection may go unrecognized until infections become symptomatic years later. For continuous noise, the long-term risk is high to individuals working near major noise sources without proper hearing protection; there is low risk to the majority of personnel and to individuals working near major noise sources who use proper hearing protection.

Air quality: Although particulate matter less than 10 micrometers in diameter (PM₁₀) was not evaluated for long-term risk due to no available health guidelines, the area was a dusty desert environment. In addition, though there were no burn pit samples taken near the FOB Honor burn pit to evaluate long-term assessment, there were open burning operations outside the Green Zone perimeter – 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, 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 1. Population-Based Health Risk Estimates – Green Zone, Iraq^{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 (PM ₁₀)	Short-term: Low to High. Daily levels vary acute health effects (e.g., upper respiratory tract irritation) 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 vary acute health effects (e.g., upper respiratory tract irritation) 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 micrometers (PM _{2.5})	Short-term: Not Evaluated. There were not enough data to assess this risk.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: Not Evaluated. There were not enough data to assess this risk.
	Long-term: Not Evaluated. There were not enough data to assess this risk.		Long-term: Not Evaluated. There were not enough data to assess this risk.
Metals	Short-term: Low. A majority of the time mild acute (short-term) health effects were anticipated from inhalation of PM ₁₀ cadmium. Exposure had little or no impact on accomplishing the mission.	Limiting strenuous physical activities when air quality is especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: A majority of the time mild acute (short-term) health effects were anticipated from inhalation of PM ₁₀ cadmium. Exposure had little or no impact on accomplishing the mission.
	Long-term: Low. Small percentage of persons may have been at increased risk for developing chronic conditions, from PM ₁₀ vanadium inhalation		Long-term: Low. Small percentage of persons may have been at increased risk for developing chronic conditions, from PM ₁₀ vanadium inhalation
Other Pollutants	No short or long-term hazards identified based on available data		No short or long-term hazards identified based on available data
SOIL			
Metals	No short (not evaluated) or long-term hazards identified based on available data	Exposure to contaminated soil is mitigated through Preventive Medicine inspections and if contaminated areas are found, they will be blocked off.	No short (not evaluated) or long-term hazards identified based on available data
Organic Compounds	No short (not evaluated) or long-term hazards identified based on available data		No short (not evaluated) or long-term hazards identified based on available data
Inorganic Compounds	No short (not evaluated) or long-term hazards identified based on available data		No short (not evaluated) or long-term hazards identified based on available data
WATER			
Consumed Water	Short-term: Low. ROWPU treated water from exposures to boron, copper, and magnesium in drinking water was Low.	U.S. Army Public Health Command (USAPHC) former U.S. Army Veterinary Command (VETCOM) approved bottled water and potable water only from approved water sources.	Short-term: Low. ROWPU treated water from exposures to boron, copper, and magnesium in drinking water was Low.
	No long-term hazards identified based on available data		No long-term hazards identified based on available data
Water for Other Purposes	No short or long-term hazards identified based on available data	Water treated in accordance with standards applicable to its intended use.	No short or long-term hazards identified based on available data
ENDEMIC DISEASE			
Food borne/Waterborne (e.g., diarrhea-	Short-term: Variable: High (bacterial diarrhea, Hepatitis A, Typhoid fever) to Moderate (diarrhea-cholera, diarrhea-	Preventive measures include Hepatitis A and Typhoid fever vaccination	Short-term: Low to none

bacteriological)	protozoal, brucellosis) to Low (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). Long-term: None identified	and consumption of food and water only from approved sources.	Long-term: No data available
Arthropod Vector Borne	Short-term: Variable: Moderate (Leishmaniasis-cutaneous, Crimean-Congo hemorrhagic fever, and sandfly fever. Low: Rickettsioses, Typhus-fleaborne, Sindbis, and West Nile fever). Long-term: Moderate (Leishmaniasis-visceral infection)	Preventive measures include proper wear of treated uniform, application of repellent to exposed skin, bed net use, , and minimizing areas of standing water and other vector breeding areas.	Short-term: Low Long-term: Low
Water-Contact (e.g. wading, swimming)	Short-term: Moderate (Leptospirosis and schistosomiasis) Long-term: None identified	Prohibiting recreational water activities and water contact avoidance.	Short-term: No data available Long-term: No data available
Respiratory	Short-term: Variable: Moderate (Tuberculosis) to Low (meningococcal meningitis) Long-term: None identified	Providing adequate living and workspace; medical screening; vaccination.	Short-term: Low Long-term: No data available
Animal Contact	Short-term: Variable: Moderate (Rabies and Q-fever) to Low (Anthrax and H5N1 avian influenza) Long-term: Low (Rabies)	Prohibiting contact with, adoption, or feeding of feral animals IAW USCENCOM General Order 1B. Risks are further reduced in the event of assessed contact by prompt post-exposure rabies prophylaxis in accordance with the Center for Disease Control's (CDC) Advisory Committee on Immunization Practices guidelines.	Short-term: No data available Long-term: No data available
VENOMOUS ANIMAL/ INSECTS			
Snakes, scorpions, and spiders	Short-term: Low. If encountered, effects of venom vary with species from mild localized swelling (e.g., <i>S. maurus</i>) to potentially lethal effects (e.g. <i>A. crassicauda</i>). Long-term: No data available	Risk reduced by avoiding contact, proper wear of uniform (especially footwear), and with proper and timely treatment.	Short-term: Low. If encountered, effects of venom vary with species from mild localized swelling (e.g., <i>S. maurus</i>) to potentially lethal effects (e.g. <i>A. crassicauda</i>). Long-term: No data available
HEAT/COLD STRESS			
Heat	Short-term: Low to High: Risk of heat injury was High for May – October, and Low for all other months. 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.	Work-rest cycles, proper hydration and nutrition, and Wet bulb globe temperature (WBGT) monitoring.	Short-term: Low to Moderate: Risk of heat injury in unacclimatized or susceptible personnel was Moderate; All others were Low. 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 frostbite.		Long-term: Low; Long-term health implications from cold injuries are rare but can occur, especially from more serious injuries such as frostbite.
UNIQUE INCIDENTS/ CONCERNS			
Noise-Continuous	Short-term: High. High for individuals working near major noise sources without proper hearing protection.	Hearing protection used by personnel in higher risk areas	Short-term: Low
	Long-term: High. High for individuals working near major noise sources without proper hearing protection.		Long-term: Low
Pesticides/Pest Control	Short-term: High. High for individuals mixing and applying pesticides without proper protection.	Individual Preventive Medicine Measures (IPMM), proper pesticide application/storage, appropriate personal protection equipment (PPE), and use by trained personnel	Short-term: Low
	Long-term: High. High for individuals mixing and applying pesticides without proper protection.		Long-term: Low
Burn Pits	Short-term: No data to evaluate.	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: No data to evaluate.
	Long-term: No data to evaluate.		Long-term: No data to evaluate.
<p>¹This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the general ambient and occupational environment conditions at Green Zone, Iraq. It does not represent a unique 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>²This assessment is based on specific data and reports obtained from the 19 March 2003 through 31 May 2011 timeframe. It is considered a current representation of general site conditions but may not reflect certain fluctuations or unique exposure incidents. Acute health risk estimates are generally consistent with field-observed health effects.</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 Green Zone, Iraq. 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.</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 the Green Zone/International Zone by Source

The major source categories of potential health risks that were evaluated at the Green Zone (International Zone) are described below. The evaluation process includes identifying what, if any, specific sub-categories/health concerns are present. This initial step results in “screening out” certain sub-categories that pose no identifiable health risk (for example if all data are below screening levels). While this section discusses sub-categories that have been determined to present no identifiable health risk, the Summary Table on the previous page only contains those sub-categories that were determined to pose some level of potential health risk.

2 Air

2.1 Site-Specific Sources Identified

The city of Baghdad sits on part of the delta lowland region of Iraq and the Green Zone was located on a vast plain bisected by the River Tigris. Airborne environmental hazards within the Green Zone include wind-blown sand and dust from gravel roads and vehicle emissions. A cement plant used to be located on Camp Blackhawk. There were several industrial operations in the area that include numerous oil refineries, food processing plants, tanneries, textile mills and metal fabrications. There were also power plants and burn pits observed outside the perimeter. Typical military operations, including vehicular traffic, generators and other local sources also contribute to the ambient environment at these locations. The summary of results follows.

2.2 Particulate Matter, less than 10 micrometers (PM₁₀).

2.2.1 Sample data/Notes:

Military Exposure Guidelines (MEGS):

Short-term (24-hour) PM₁₀ (micrograms per cubic meter, $\mu\text{g}/\text{m}^3$): Negligible MEG=250, Marginal MEG=420, Critical MEG=600.

Long-term (1-year) PM₁₀ ($\mu\text{g}/\text{m}^3$): MEGs Not Available.

There were 100 valid 24-hour PM₁₀ samples collected within the Green Zone during 2003-2011. The breakdown of samples in each year were as follows; one sample taken in 2003, eight samples taken in 2004, five samples in 2006, eight samples in 2007, 64 samples from 2008, 16 samples taken in 2009, and nine samples from 2010. There were no valid PM₁₀ samples in 2005 or 2011. The PM₁₀ sample concentrations ranged from 60 $\mu\text{g}/\text{m}^3$ to 817 $\mu\text{g}/\text{m}^3$, with an average concentration of 312 $\mu\text{g}/\text{m}^3$.

There were eleven samples taken in 2008 and 2009, with PM₁₀ concentrations that exceed 1,000 $\mu\text{g}/\text{m}^3$. These concentrations are well beyond normal exposures outside of some type of transient excursion event such as a sand storm. As such there is low confidence associated that these higher concentrations are representative of a 24 hour continuous exposure. Thus, these samples were not included in the evaluation of short and long-term health risk based on continuous 24-hour exposures.

2.2.2 Short-term health risk:

The short-term PM₁₀ health risk assessment in the Green Zone was Low to High based on average PM₁₀ concentrations and Low to High based on peak PM₁₀ concentrations.

Therefore, on typical days, exposure to PM₁₀ could have impact on accomplishing the mission. In theatre, medical resources may have been needed for protection and treatment as a result of exposure to PM₁₀ levels on a typical day. Mission capabilities may have been degraded and may have required in-theater medical countermeasures and resources or mission capabilities may have been significantly degraded in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission. Peak exposures could have occurred, increasing the health risk level (Reference 9, Table 3-2). Under peak exposures, mission capabilities may have been significantly degraded and may have required in-theater medical countermeasures and resources. Mission capabilities may have been significantly degraded in terms of the required mission standard, inability to accomplish all parts of the mission, or inability to complete the mission.

Daily health risk levels for PM₁₀ had no hazard (did not exceed acute MEGs) for 53%, low health risk for 28%, moderate health risk for 12%, and high health risk for 7% of the time. Confidence in the short-term PM₁₀ health risk assessment was low (Reference 9, Table 3-6).

For the highest observed PM₁₀ exposure at the Green Zone, the hazard severity was critical. During peak exposures at the critical hazard severity level (above 600 µg/m³), most if not all personnel may have experienced very notable eye, nose, and throat irritation and respiratory effects. Visual acuity may have been impaired, as was overall aerobic capacity. Some personnel may not have been able to perform assigned duties. Lost duty days were expected. Those with a history of asthma or cardiopulmonary disease may have experienced more severe symptoms. Confidence in short-term PM₁₀ risk assessment was low (Reference 9, Table 3-6).

2.2.3 Long-term health risk:

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

2.3 Particulate Matter, less than 2.5 microns (PM_{2.5})

2.3.1 Sample data/Notes:

Military 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} (µg/m³): Negligible MEG=15, Marginal MEG=65.

There were four PM_{2.5} samples taken within the Green Zone and all were collected during 2010. The range of 24-hour PM_{2.5} concentrations in the four samples was 58 to 436 µg/m³. The average concentration during this time was 176 µg/m³. Because two samples were taken during the end of

May and two were taken in the middle of June, it cannot be assumed that these samples were representative of the typical conditions in the Green Zone.

2.3.2 Short-term health risk:

Not enough data were available to support a short-term health risk assessment.

2.3.3 Long-term health risk:

Not enough data were available to support a long-term health risk assessment.

2.4 Airborne Metals from PM₁₀

2.4.1 Sample data/Notes:

The health risk assessment was based on average and peak concentration of 100 valid PM₁₀ samples with associated metal levels collected from the Green Zone from 2003 to 2011. Cadmium and Vanadium both had concentrations detected above their long-term MEGs and assessed further in the assessment; all other metals were below the long term MEGs.

Cadmium was detected in two out of the 100 samples and Vanadium was detected in nine out of the 100 samples taken at the Green Zone. All of these detections took place during 2008 and 2010. The peak concentrations for Vanadium were below its corresponding short-term MEGs, thus there was no short-term risk for Vanadium; however, it was evaluated for long-term risk. Cadmium exceeded its short term MEGS but was not evaluated for long-term risks due because it was detected in less than 5% of the samples.

2.4.2 Short-term health risks:

Low. The peak concentration for Cadmium (0.09 µg/m³) in 2008 exceeded the short term negligible MEG (0.021ug/m³). The short-term health risk for PM₁₀ airborne cadmium concentrations was Low based on peak and typical PM₁₀ Cadmium concentrations.

Long-term health risks:

Low. Vanadium had an average concentration of 0.12ug/m³ in 2008, which was slightly above the 1-year negligible MEG (0.07ug/m³). The long-term health risk assessment for PM₁₀ airborne Vanadium concentrations was Low based on average PM₁₀ Vanadium concentrations. Therefore, there was no specific medical action required for long-term exposure to PM₁₀ Vanadium.

The hazard severity was negligible for long-term PM₁₀ vanadium exposures in the Green Zone. During long-term exposures at the negligible hazard severity level, few exposed personnel (if any) were expected to develop delayed onset, irreversible effects. Confidence in the health risk assessment was low (Reference 9, Table 3-6).

2.5 Chemical Pollutants (gases and vapors)

2.5.1 Sample data/Notes:

There were 71 valid ambient air volatile organic compounds (VOCs) samples collected in the Green Zone during 2006, 2007, and 2008. There were four VOC chemicals with concentrations detected above their 1-year negligible MEGS during the pre-screen and retained for further

evaluation. These chemicals were 1,2-Dibromo-3-chloropropane, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene, and Benzene. None of the remaining analyzed VOCs were found at concentrations above short or long-term MEGs. No sample data were available for 2003 – 2005 and 2009 – 2011.

2.5.2 Short-term health risks:

None are identified based on the available data. None of the four chemicals (1,2-Dibromo-3-chloropropane, 1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene and Benzene) carried through to the short-term risk assessment exceeded their corresponding short-term MEGs.

2.5.3 Long-term health risks:

None are identified based on the available data. Out of the four chemicals carried through (1,2-Dibromo-3-chloropropane) was eliminated because it had less than 5% detected values so the three remaining chemicals (1,2,4-Trimethylbenzene, 1,3,5-Trimethylbenzene and Benzene) were evaluated in the long-term health risk assessment. None of the three chemicals' annual averages exceeded their corresponding 1-year negligible MEGs.

3 Soil

3.1 Sample data/Notes:

Analytical data for 21 valid soil samples within the Green Zone collected at Baghdad (n=5), Camp Freedom (n=3), Camp Freedom Rest (n=2), Camp Honor (n=1), Ibn Sina Hospital (n=1), FOB Prosperity (n=6), Camp Union I (n=1), Camp Union III (n=1), and Steel Dragon (n=1) during 2003-2010 were used to assess OEH health risk to deployed personnel. The primary soil contamination exposure pathways were dermal contact and inhalation. Typical parameters analyzed for included heavy metals, semi-volatile organic compounds, insecticides, and radionuclides. For the purposes of the soil risk assessment, personnel were assumed to remain at this location for 6 months to 1 year. No detected parameters were above the corresponding 1-year negligible MEGs.

3.1.1 Short and long-term health risks:

Not an identified source of health risk. Currently, sampling data for soil is not evaluated for an acute risk assessment and all detected contaminants were below applicable 1-year negligible MEGs.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the Army Public Health Command identified the most probable exposure pathways. These were based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated. Based on the information provided from the field, all samples for untreated water samples were associated with source water for treatment and no exposure pathways were associated with those samples. Therefore, untreated samples were not assessed as potential health hazards.

It was assumed that 100% of all U.S. personnel at the Green Zone were directly exposed to Reverse Osmosis Water Purification Unit (ROWPU) treated and disinfected fresh bulk water, since

this classification of water was primarily used for personal hygiene, showering, cooking, and for use at vehicle wash racks. Field data sheets indicated that bottled water and ROWPU treated water were used as sources of drinking water. Non-drinking specific exposure sources (such as personal hygiene or food preparation sources) are where much less than 5-15 Liters of water are ingested per day (assumed range of military ingestion rates).

4.1 Drinking Water.

Based on the available data, bottled water and ROWPU treated water were used as primary drinking water sources at the FOBs within the Green Zone. There were 30 drinking water samples available. Four out of the 30 drinking water samples were bottled water and the remaining 26 were ROWPU treated water. None of the bottled water samples had any detections above the 1-year negligible MEGs. Boron, Copper, Cyanide, and Magnesium all had maximum detections above their corresponding 1-year negligible MEGs and are retained for further evaluation. Magnesium was detected in drinking water samples but there are no long-term MEGs, thus it could not be evaluated for long-term risks.

There were two drinking water samples taken on FOB Prosperity in 2007 to investigate for suspected Petroleum, Oil and Lubricants (POL) contamination at two separate locations. One sample was located at the ROWPU that was newly acquired at the time of sampling and the other was taken from a water tanker located at the motor pool. Neither of these samples was included in the overall drinking water pre-screen due to being specifically taken as part of POL contamination. The ROWPU sample did have levels of Lead (0.018 milligrams per liter, mg/L), Antimony (0.009 mg/L), Copper (1.2 mg/L) and Nickel (17 mg/L) above their corresponding 1 year negligible MEGs for 15 liters per day (L/day). The other suspected POL contaminated sample did not have any parameters above their corresponding 1 year negligible MEGs. There was not any additional information about the suspected POL contamination.

4.1.1 Short-term health risks:

Low: Boron had a peak concentration (1.18 mg/L) that was slightly above its short-term MEG (0.93 mg/L). There were two boron detections out of 30 samples that were above the short-term MEGs. Both of these samples were ROWPU treated samples taken in 2008. Copper also had a peak concentration (0.075 mg/L) above its short-term MEG (0.047 mg/L). The only detection of Copper that was above the short-term MEGs was a ROWPU treated sample taken in 2008. Magnesium was the only other chemical with a peak concentration (32 mg/L) that was slightly above its short-term MEG (30 mg/L). The only detection of Magnesium that was above the short-term MEG was from a ROWPU treated sample taken in 2007.

4.1.2 Long-term health risks:

None are identified based on the available sample data. All collected samples were below the long-term MEGs.

4.2 Water: Used for Other Purposes (Personal Hygiene, Cooking, Showering, etc.)

To assess the potential for adverse health effects to troops the following assumptions were made about dose and duration: All U.S. personnel at these locations were assumed to remain at this site for approximately 1 year. It was further assumed that control measures were not used.

Non-drinking water samples were reverse osmosis treated (n=10), municipal (n=13), and one labeled tap water. Dermal, inhalation, and incidental ingestion exposures that result from non-drinking use of water sources during showering, personal hygiene and/or cooking were considered incidental ingestion and evaluated as nondrinking exposures (See Reference 9, Appendix G, and Section G.3). In case of incidental ingestion of the non-drinking water sources, or in instances of ice production in dining facilities, water was assumed to have been ingested at less than 5 L/day for up to 365 days (1-year). No health risks from ROWPU-treated (non-drinking) and municipal exposures were identified based on limited sample data. Magnesium was detected in all 24 non-drinking water samples but there are no long-term MEGs, thus it could not be evaluated for long-term risks. None of the other parameters in the available samples exceeded their 1 year negligible MEGs for any parameters.

4.2.1 Short-term health risks:

None are identified based on the available sample data. All collected samples were below the long-term MEGs. Magnesium was the only parameter carried through to the short-term risk assessment due to not having a long-term MEG, however it did not exceed the short-term MEGs.

4.2.2 Long-term health risks:

None are identified based on the available sample data. All collected samples were below the long-term MEGs.

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons:

The Defense Occupational and Environmental Health Readiness System-Industrial Hygiene Environmental Health business area (DOEHRS-IH (EH)) and Military Environmental Surveillance Library (MESL) databases were searched for any information on CBRN weapons related to the FOBs located within the Green Zone. No related data/information were found.

Short-term and long-term health risks: No data available to assess health risk.

5.2 Depleted Uranium (DU):

No specific hazard sources were documented in the DOEHRS-IH (EH) or MESL for the FOBs located within the Green Zone.

Short-term and long-term health risks: No data available to assess health risk.

5.3 Ionizing Radiation:

The Combat Support Hospital located in the Ibn Sina Hospital has an X-ray unit. No worker exposures exceeding radiation exposure standards have been identified. No other information was available.

No other sources of ionizing radiation were documented in the DOEHRS-IH (EH) or MESL for any of the FOBs within the Green Zone.

Short-term and long-term health risks: No data available to assess health risk.

5.4 Non-Ionizing Radiation:

No specific sources of non-ionizing radiation were documented in the DOEHS-IH (EH) or MESL for any of the FOBs within the Green Zone.

Short-term and long-term health risks: No data available to assess health risk.

6 Endemic Disease

This document lists the endemic disease reported in the region, its specific health risks and severity and general health information about the diseases. USCENTCOM Modification (MOD) 11 (Reference 13) 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 had 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 could be expected to temporarily incapacitate a very high percentage of U.S. personnel within days if local food, water, or ice was 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 have occurred. 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 could be expected to temporarily incapacitate a very high percentage of personnel (potentially over 50 percent per month) within days if local food, water, or ice was consumed. Field conditions (including lack of hand washing and primitive sanitation) may have facilitated person-to-person spread and epidemics. Typically these resulted in 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 have required greater than 72 hours limited duty, or hospitalization.

6.1.2 Hepatitis A, typhoid fever, and diarrhea-protozoal

High, mitigated to Low: Unmitigated health risk to U.S. personnel was high year round. Mitigation was in place to reduce the risks to low. Hepatitis A and typhoid fever could cause prolonged illness in a small percentage of personnel, (less than 1 percent per month) and have a high risk estimate if no preventive medicine measures were taken. Diarrhea-cholera and diarrhea-protozoal had a moderate risk estimate if no preventive medicine measures were taken, although cases for all were rare. However, much rarer, other potential diseases in this area included diarrhea-cholera and brucellosis with a moderate risk estimate and Hepatitis E with a low risk estimate.

6.1.3 Short-term health risks:

Low: The overall unmitigated short-term risk associated with foodborne and waterborne diseases at the Green Zone was considered High (for bacterial diarrhea, hepatitis A, typhoid fever) to Moderate (for diarrhea-cholera, diarrhea-protozoal, brucellosis) to Low (for hepatitis E) if local food or water was consumed. Preventive Medicine measures as indicated above reduced the overall risk to low. Confidence in risk estimate is medium.

6.1.4 Long-term health risks:

None identified based on available data. Confidence in risk estimate is medium.

6.2 Arthropod Vector-Borne Diseases

During the warmer months (typically from April through November), the climate and ecological habitat supported populations of arthropod vectors, including mosquitoes, ticks, and sandflies. Significant disease transmission was 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: Potential health risk to U.S. personnel was Moderate year round, but reduced to low with mitigation measures. Leishmaniasis is transmitted by sand flies. The disease risk is highest when sand flies are most prevalent in March through November. 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. However, in this region there were only a small number of cases (less than 1 percent per month attack rate in indigenous personnel). Cutaneous infection is unlikely to be debilitating, though lesions can be disfiguring. Visceral leishmaniasis causes a 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 was moderate, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation included proper wear of treated uniforms and application of repellent to exposed skin. Crimean-Congo hemorrhagic fever (CCHF) most commonly occurred in rare cases (less than 0.1 percent per month attack rate in indigenous personnel) and was transmitted by tick bites or occupational contact with blood or secretions from infected animals. It is a very severe illness typically requiring intensive care with fatality rates from five to fifty percent.

6.2.4 Sandfly fever

Moderate, mitigated to Low: Unmitigated risk was moderate, but reduced to low with mitigation measures. Estimated potential disease rates were 1 to 10 percent of personnel per month under worst-case conditions. It is transmitted by sandflies and occurs more commonly in children though adults still at risk. Incidents could have resulted in debilitating febrile illness typically requiring 1-7 days of supportive care followed by return to duty.

6.2.5 Rickettsioses, tickborne

Low: Rickettsioses disease was assessed as present, but levels at the Green Zone were unknown; rare cases were possible among personnel exposed to tick bites. Incidents could have resulted in a potentially debilitating febrile illness, which may have required 1 to 7 days of supportive care followed by return to duty. More prolonged and severe infections may have occurred with rare fatalities. Fatality rates in untreated cases may have been higher. The risk was low for rickettsioses.

6.2.6 Typhus-fleaborne

Low: Typhus-fleaborne has a low risk estimate and was assessed as present, but levels were unknown. Rare cases were possible among personnel exposed to rodents and flea bites. Debilitating febrile illness typically required 1 to 7 days of inpatient care, followed by return to duty.

6.2.7 West Nile fever

Low: West Nile fever was present and maintained by the bird population and mosquitoes that help to transfer the diseases from birds to humans. The majority of infections in young, healthy adults were asymptomatic although it can result in fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands. This disease was associated with a low risk estimate.

6.2.8 Sindbis

Low: Sindbis presented a negligible risk (extremely rare cases) among personnel exposed to mosquito bites. Debilitating febrile illness were often accompanied by a rash, and typically required 1 to 7 days of supportive care. Significant arthralgias could persist for several weeks or more in some cases.

6.2.9 Short -term health risks:

Moderate, mitigated to Low: Moderate (for leishmaniasis-cutaneous (acute), Crimean-Congo hemorrhagic fever, Sandfly fever,); and Low (for rickettsioses, typhus-fleaborne, sindbis and West Nile fever). Mitigation reduced the overall risk to low. Confidence in risk estimate is medium.

6.2.10 Long -term health risks:

Moderate, mitigated to Low (for leishmaniasis-visceral [chronic]). Confidence in risk estimate is medium.

6.3 Water Contact Diseases

Tactical operations or recreational activities that involved extensive contact with surface water such as lakes, rivers, or flooded fields may have resulted in significant exposure to leptospirosis and schistosomiasis. Risk was restricted primarily to areas along rivers and lakes. These

diseases could have debilitated personnel for up to a week or more. Leptospirosis risk typically increased 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 Schistosomiasis

Moderate, mitigated to Low: Schistosomiasis cases could occur in rare cases (less than 0.1% per month attack rate) among personnel wading or swimming in fecally contaminated bodies of water such as lakes, streams, or irrigated fields. Mild infections were generally asymptomatic. In very heavy acute infections, a febrile illness (acute schistosomiasis) may have occurred, especially with *S. japonicum* and *S. mansoni*, requiring hospitalization and convalescence over 7 days.

6.3.2 Leptospirosis

Moderate, mitigated to Low: Leptospirosis was present in Iraq at unknown levels. Human infection occurs 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 saturated the environment, leptospirosis present in the soil passed directly into surface waters. Leptospirosis can enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Ingestion of contaminated water can also lead to infection. The acute generalized illness associated with infection can 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 have resulted in personnel being temporarily debilitated with leptospirosis.

6.3.3 Short -term health risks:

Moderate, mitigated to Low: for schistosomiasis and leptospirosis. Confidence in risk estimate is medium.

6.3.4 Long -term health risks:

None identified based on available data. Confidence in risk estimate is medium.

6.4 Respiratory Diseases

Although not specifically assessed in this document, deployed U.S. forces may have been exposed to a wide variety of common respiratory infections in the local population. These included influenza, pertussis, viral upper respiratory infections, viral and bacterial pneumonia, and others. U.S. military populations living in close-quarter conditions were at risk for substantial person-to-person spread of respiratory pathogens. Influenza was 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: Tuberculosis (TB) posed a moderate, mitigated to low, year round risk to U.S. personnel in Iraq. Tuberculosis is usually transmitted through close and prolonged exposure to an active case of pulmonary or laryngeal tuberculosis, but can also occur with incidental contact. The Army Surgeon General had 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 posed a low risk and was transmitted from person to person through droplets of respiratory or throat secretions. Close and prolonged contact facilitated the spread of this disease.

6.4.3 Short-term health risks:

Varies, mitigated to Low: Moderate (tuberculosis) to Low (for meningococcal meningitis). Mitigation reduced the overall short-term risk to low. Confidence in the health risk estimate is medium.

6.4.4 Long-term health risks:

None identified based on available data. TB was evaluated as part of the Post Deployment Health Assessment (PDHA). A TB skin test was required post-deployment if potentially exposed and was 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 posed a year-round low risk, but cases were rare even in indigenous 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 can result in contracting Gastrointestinal Anthrax. Pulmonary Anthrax is contracted through inhalation of spores and was extremely rare. Mitigation strategies 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: Q-Fever posed a year-round moderate risk. Rare cases were possible among personnel exposed to direct contact with infected livestock and domesticated animals or contaminated manure straw or dust in areas where herd animals were sheltered and grazed. Significant outbreaks (affecting 1-50 percent) 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. Mitigation strategies in place as listed in paragraph 6.5.2 except for vaccinations

6.5.4 H5N1 avian influenza

Low: H5N1 avian influenza posed a year-round low risk. No illnesses were reported in U.S. personnel, however those who have close contact with birds or poultry have an increased risk of H5N1 infection. Mitigation strategies included avoidance of birds/poultry and proper cooking temperatures for poultry products.

6.5.5 Short-term health risks:

Varies, mitigated to Low: Moderate (for rabies and Q-fever) to Low (for anthrax and H5N1 avian influenza) short-term risk due to rare occurrence. Mitigation reduced the overall short-term risk to low. Confidence in risk estimate is medium.

6.5.6 Long-term health risks:

Low: The long term risk for rabies was Low because the incubation period for rabies can be several years in rare cases.

7 Venomous Animal/Insect

7.1 Snakes, scorpions, and spiders

Routine pest control measures were conducted within the Green Zone. There was no site-specific documentation of any species of venomous snakes or scorpions identified at any of the FOBs within the Green Zone. There were pesticide application logs to target oriental roaches, spiders, scorpions, snakes, rats, flies and mosquitoes. Generally, if there are any identified they are

limited in number and personnel experience minimal sightings or contact. Exposure to hazardous animals and insects are considered a negligible hazard. A number of medically relevant venomous species had home ranges that overlapped the location of the Green Zone and vicinity and may have presented a health risk when encountered by personnel.

7.1.1 Spiders

- White widow spider (*Latrodectus pallidus*): Clinical effects were uncertain, but it is related to medically important species, therefore major envenoming could not be excluded.

7.1.2 Scorpions

- Fattail scorpion (*Androctonus crassicauda*): Severe envenoming was possible, potentially lethal. Cardiotoxicity may be direct or indirect, but is a feature of severe envenoming, with cardiac arrhythmias, cardiac failure. Hypovolaemic hypotension was possible in severe cases due to fluid loss through vomiting and sweating. Most stings caused only severe local pain, which could be treated using local anesthetic infiltration. Systemic envenoming could develop rapidly, though occasionally may have been delayed in onset, so caution in assessment was required.

- *Buthacus leptochelys*, Turkish Scorpion (*Buthacus macrocentrus*), *Compsobuthus matthiesseni*, and *Compsobuthus werneri*: Clinical effects were unknown; there are a number of dangerous Buthid scorpions, but there are also some known to cause minimal effects only. Without clinical data it was unclear where these species fits within that spectrum.

- *Hemiscorpius lepturus*: Severe envenoming was possible, potentially lethal. Stings caused local necrosis and variable, sometimes fatal systemic effects, including haemolysis, cardiac failure, and CNS effects.

- *Hottentotta saulcyi*, *Hottentotta scaber*, and *Hottentotta schach*: Moderate envenoming was possible but unlikely to prove lethal. Stings by these scorpions were likely to cause only short lived local effects, such as pain, without systemic effects.

- *Orthochirus iraqus* and Israel pillar tail scorpion (*Orthochirus scrobiculosus*): Clinical effects were unknown; there were a number of dangerous Buthid scorpions, but there are also some known to have caused minimal effects only. Without clinical data it was unclear where these species fits within that spectrum.

- Large-clawed scorpion (*Scorpio maurus*): Mild envenoming only, not likely to prove lethal. Stings by these scorpions were likely to cause only short lived local effects, such as pain, without systemic effects.

7.1.3 Snakes

- Montpellier snake (*Macrovipera lebetina* subspecies *euphratica* and subspecies *obtuse*): Severe envenoming was possible, potentially lethal. Moderate to severe coagulopathy and haemorrhagins causing extensive bleeding. Renal damage was a recognized complication, usually secondary to coagulopathy. All cases should have been managed as potentially severe.

- Dark-headed Dwarf Racer (*Pseudocyclophis persicus*): Clinical effects unknown, but unlikely to cause significant envenoming. Limited clinical data suggested bites resulted in local effects only. Carefully assess. Role of antivenom most uncertain and unlikely to be required.

- Desert Black Snake (*Walterinnesia aegyptia*): Clinical effects unknown, but potentially lethal envenoming, though unlikely, could not have been excluded. Local pain, swelling, probably not necrosis, general systemic effects, possibly flaccid paralysis was expected due to bites. Antivenom was available and used at first sign of paralysis or for intractable general systemic effects, such as persistent vomiting not responding to antiemetics.

7.1.4 Short-term health risk:

Low: If encountered, effects of venom varied with species from mild localized swelling (e.g. widow spider) to potentially lethal effects (e.g. desert black snake). 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).

7.1.5 Long-term health risk:

None identified.

8 Heat/Cold Stress

The Green Zone has a mostly dry climate ranging from 56 - 105 degrees Fahrenheit (°F), with yearly highs up reaching around 120 °F. Summers are long, hot, and dry with low humidity. The predominant wind direction from mid-June through mid-September is out of the North- Northeast and from April to June the wind is usually from a south-southeasterly direction.

8.1 Heat

Average monthly peak temperature during the summer months (June – September) was 111 °F. The health risk of heat stress/injury based on temperatures alone was 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 posed a greater health risk of heat stress/injury than environmental factors alone (Reference 12).

8.1.1 Short-term health risk:

High, mitigated to Low: High health 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) personnel from May – October, and Low for all other months. 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 global temperature (WBGT). Because the occurrence of heat stress/injury was strongly dependent on operational factors (work intensity and clothing), confidence in the health risk estimate is low (Reference 9, Table 3-6).

8.1.2 Long-term health risk:

Low: Long-term health implications from heat injuries were rare but could occur, especially from more serious injuries such as heat stroke. However, the health 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. The long-term health risk was Low; confidence in the health risk estimates is medium (Reference 9, Table 3-6).

8.2 Cold

Winter (December – March) temperatures ranged from 41.2 °F to 49.3 °F. Even on warm days

there could be a significant drop in temperature after sunset by as much as 40 °F. There was a risk of cold stress/injury when temperatures fell below 60 °F, which could occur from November – April. The health risk assessment for non-freezing cold injuries (chilblain, trench foot, and hypothermia) was Low based on historical temperature and precipitation data. Frostbite was unlikely to occur because temperatures rarely dropped below freezing. However, personnel may have encountered significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries were largely dependent on operational and individual factors instead of environmental factors alone. With protective measures in place the health risk assessment was low for cold stress/injury; confidence in the health risk estimate is medium.

8.2.1 Short-term health risks:

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

8.2.2 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:

There were several stand-alone generators located throughout the Green Zone. There were also helicopters and constant traffic caused by a large number of vehicles that contributed to noise levels. Helicopter flights occasionally caused peak noise exposures. In 2011 at FOB Prosperity, it was noted that soldiers were not exposed to noise levels in excess of 85 decibels (dBA) on a routine basis or while in living areas. There were limited data for previous years and other specific locations within the Green Zone.

Short-term and Long-term risks: High, mitigated to Low. High for individuals working near major noise sources without proper hearing protection. Risk is reduced to low through use of proper hearing protection. Confidence in risk estimate is medium.

9.2 Impulse:

No impulse noise evaluations conducted, not evaluated.

Short-term and Long-term risks: Not evaluated-no available impulse noise evaluation. No identified health risks.

10 Other Unique Occupational Hazards

DoD personnel were exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depended on the mission of the unit and the operations and tasks, which the personnel were required to perform to complete their mission. The health risk associated with these hazards depended on a number of elements including what materials were used, how long the exposure lasted, what was done to the material, the environment where the task or operation was performed, and what controls were used. The hazards could 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 occurred when performing maintenance task such as painting, grinding, welding, engine repair, or movement through contaminated areas. Exposures to these occupational hazards could occur through inhalation (air), skin contact, or ingestion; however, exposures through air were generally associated with the highest health risk.

10.1 Fuel/petroleum products/industrial chemical spills

There were 5,000 gallon trucks and 10,000 gallon bladders used to store gas, diesel, and JP8 at FOB Prosperity. These petroleum distribution points were operated by both contractors and U.S. Army personnel according to the Occupational Environmental Health Site Assessment (OEHSA) for FOB Prosperity November 2008. At FOB Freedom Rest, POL was temporarily stored in the maintenance garage until it was removed by contractors and taken to the hazardous material yard located on FOB Liberty.

Short-term and Long-term risks: Insufficient quantity and quality of data were available for an accurate health risk assessment.

10.2 Waste Sites/Waste Disposal:

Lack of proper sanitation throughout the camps in the living quarters contributed to the mice, rodents, and feral cat populations at the locations associated with the Green Zone. Trash and food debris were often found in sleeping areas. Lids were missing from trashcans throughout the camps and flies were prevalent.

The 2008 FOB Prosperity OEHSA indicated an internal storage yard, maintained by contractors, was used to temporarily collect hazardous materials from all other bases in the Green Zone while awaiting final disposition. Solid waste on FOB Prosperity was collected in dumpsters and trucked out by contractors. Regulated medical waste on FOB Prosperity was transported to the Ibn Sina Hospital incinerator. The medical waste incinerator was operated by U.S. Army personnel and located at the Ibn Sina Hospital.

Short-term and Long-term health risks: Insufficient quantity and quality of data were available for an accurate health risk assessment.

10.3 Asbestos:

The OEHSAs for FOB Prosperity (November 2008), FOB Freedom Rest and the International Zone (June 2008) did not note any asbestos at the site. However, there were two specific asbestos sampling events performed within the Green Zone. One was at FOB Freedom on 1 February 2007 where two ceiling material samples were collected from two different rooms in Building 19 for analyses. No asbestos fibers were detected in the samples.

There was another specific asbestos sampling event done at FOB Prosperity on 27 August 2007. Two bulk samples of potential asbestos containing materials collected from a sidewall and ceiling of the Brigade Medical Supply Office (BMSO) Building 84. No asbestos fibers were detected in the samples.

Short-term and Long-term risks: No identified risks from the samples taken.

10.4 Lead Based Paint:

There is no specific information available to assess this hazard.

Short-term and Long-term risks: No data to support a health risk assessment.

10.5 Food Sanitation

A search of the DOEHRS-IH (EH) and the MESL from 19 March 2003 to 31 May 2011 yielded limited food sanitation inspection records in the locations associated with the Green Zone for 2003, 2004, 2005, 2006, 2010 and 2011. Food sanitation deficiencies found in the locations associated with the Green Zone are summarized below.

At the time of the food sanitation inspections, there was improper time and temperature control of potentially hazardous foods. Potentially hazardous foods were kept longer than four hours after being placed in insulated containers. There were missing or inaccurate thermometers. Improper glove use and hand washing between janitorial and food-handling tasks were common. Flies and mosquitoes were prevalent due to standing water inside food facilities, missing screens, air curtains, or other barriers to control access to the facility and poor general sanitation. Use of unapproved food sources was listed among the sanitation deficiencies.

10.5.1 Short-term and Long-term health risks

Not evaluated. Insufficient quantity and quality of data were available for an accurate health risk assessment.

10.6 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 were 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 the DOEHRS-IH (EH) or the MESL data portal. Vector control was conducted by contractors within the Green Zone. A total of 13 monthly pesticide application reports in the MESL data portal for FOB Honor (January 2005 to July 2006), a total of 4 monthly pesticide application reports in the MESL data portal for FOB Prosperity (February 2005 to July 2006), and one vector surveillance report in the MESL data portal for the Green Zone, listed 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).

10.6.1 Rodenticides

Rodenticides included various types of traps. The main chemicals in these were Brodifacoum, and Bromadiolone.

10.6.2 Insecticides

Methods used to control mosquitoes, ants, roaches, and spiders at the Green Zone included: d-trans Allethrin, Bifenthrin, Bromadiolone, DEET (95%), β -cyfluthrin, fipronil, Hydramethylnon, Imidacloprid, lambda-cyhalothrin, methomyl, (S)-methoprene, (z)-9- tricosene, phenothrin, piperonyl butoxide, pyrethrins, and resmethrin.

10.6.3 Short-term and Long-term health risks

Low: Short- and long-term health risk was Low. Confidence in the health risk assessment is medium (Reference 9, Table 3-6).

10.7 Burn Pits:

The January 2006 Environmental Health Site Assessment for FOB Honor stated a burn pit was previously located on site and was reportedly only used to burn paper and wood. It was closed and covered with six inches of soil but was not marked. The exact geographic location of the burn pit is classified; if needed; additional details can be coordinated with points of contact listed in section 12. It was noted there were several burn pits located outside of the Green Zone but there was no other documentation available of other burn pits located within the Green Zone.

Short-term and Long-term risks:

While not specific to the Green Zone, the consolidated epidemiological and environmental sampling studies on burn pits that have been conducted to date 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 per the 2011 Institute of Medicine (IOM) report (Reference 13). The IOM Committee's review of the literature and the data suggests that service in Iraq (i.e., a broader consideration of air pollution than exposure only to burn pit emissions) might 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.

There are no data to support a health risk assessment on burn pits at the Green Zone.

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. Environmental Health Site Assessment FOB Freedoms Rest
3. Occupational and Environmental Health Site Assessment FOB Prosperity, 23-26 November 2008.
4. Occupational and Environmental Health Site Assessment International Zone (includes Freedom Rest, Freedom, Blackhawk, Ibn Sina Hospital, Camp Hope, and Union III, 15 June 2008 – 15 April 2009.
5. 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.
6. DoDI 6055.05, Occupational and Environmental Health, 2008.
7. Military Environmental Surveillance Library (MESL): <https://doehsportal.apgea.army.mil/doehrs-oehs/>. Some of the data and reports used may be classified or otherwise have some restricted distribution.
8. JCSM (MCM) 0028-07, Procedures for Deployment Health Surveillance, 2007.
9. USA PHC TG230, June 2010 Revision, Version 13
10. USACHPPM 2008 Particulate Matter Factsheet; 64-009-0708, 2008
11. 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.
12. IOM (Institute of Medicine). 2011. Long-term health consequences of exposure to burn pits in Iraq and Afghanistan. Washington, DC: The National Academies Press.
13. Modification 11 to United States Central Command Individual Protection and Individual Unit Deployment Policy, 2 December 2011.
14. CDC. 2012. Morbidity and Mortality Weekly Report. Imported Human Rabies in a U.S. Army Soldier. May 4, 2012. 61(17); 302-305.

¹ NOTE. The data are currently assessed using the TG230 2010. The general method involves an initial review of the data, which eliminates all chemical substances not detected above 1-yr negligible MEG. 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 and water (soil is only evaluated for long term risk). This is performed by deriving separate short-term and long term population exposure level 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 non-drinking 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 DoD Force Health Protection and Readiness (FHP & R).

U.S. Army Public Health Command (USAPHC)

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>