# Military Deployment
# Periodic Occupational and Environmental Monitoring Summary (POEMS): Isa Air Base, Bahrain: January 2010 through December 2015

**AUTHORITY:** This Periodic Occupational and Environmental Monitoring Summary (POEMS) has been developed in accordance with Department of Defense (DOD) Instructions (DODI) 6490.03 and 6055.05, and Joint Staff memorandum MCM 0017-12, *See Section 11, References.*

**PURPOSE:** This POEMS documents the DOD assessment of occupational and environmental health (OEH) risk for Isa Air Base, Bahrain. 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 January 2010 through December 2015. This information includes OEH monitoring data.

This assessment assumes that environmental sampling at Isa Air Base 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 January 2010 through December 2015 unless stated otherwise in the discussions.

The POEMS can inform healthcare providers and others of environmental conditions experienced by individuals deployed to Isa Air Base during the period of this assessment; however, it does not represent an individual exposure profile. Individual exposures depend on many variables, including the duration, frequency, and location of the activities a person performs 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 potential OEH exposures while deployed should have exposure/treatment noted in their medical record on a Standard Form (SF) 600 (Chronological Record of Medical Care).

Health protective exposure assumptions are used in assessing all health risks. For example, individuals are assumed to be constantly exposed (24 hours/day, 7 days/week) to the environmental conditions measured. Small groups of U.S. Service members assigned to Isa Air Base may be at greater risk than the general population due to operational requirements; these groups are identified when appropriate.

**SITE DESCRIPTION:** Isa Air Base (formerly known as Sheikh Isa Air Base) is located in the southeastern portion of island nation of Bahrain, on the shore of the Persian Gulf where it serves as the home of the Royal Bahraini Fighter Wing. Isa Air Base was built between 1987 and 1990 with assistance from the United States. During Operations Desert Shield/Desert Storm, the base population grew to as much as 12,000 U.S. Service members; it served as the main operating base ashore for the 3rd Marine Aircraft Wing, the 1st Marine Expeditionary Force aviation combat element, and the headquarters for Marine Aircraft Group 70. In October 1991, Bahrain signed a ten year bilateral agreement, which expanded the U.S. military presence in Bahrain. During the initial phase of this agreement, Isa Air Base hosted several United States Air Force expeditionary air wings. Also during this phase, the U.S. Army installed Patriot Missile

batteries to provide ground air defense. Cooperative efforts between Bahrain the U.S. Military continue today with continued improvements and expansion of base facilities.

Since 1990, the base has developed from an expeditionary camp to a long-term base facility with living accommodations transitioning from tents to containerized living units (CLUs). All U.S. Service members are now housed in air conditioned CLUs. Tents, which are still present, are rarely used and remain only to support base surge capacity. Today, Isa Air Base houses approximately 2000 U.S. Service members on deployments of 6 to 12 months.

Facilities maintenance is provided by a base operations services (BOS) contractor. BOS provide food services, vehicle maintenance, laundry, janitorial service, water treatment, solid waste disposal, and other services. Bottled water is purchased from U.S. Army approved sources. Trucked water from two onsite reverse osmosis (RO) treatment systems, which deliver to point of use locations (e.g., the galley, medical clinics, and Navy Exchange facilities) are approved for drinking, cooking, and personal hygiene (this water is fit for human consumption). In addition, specific RO water piped and/or trucked to storage tanks within the logistics support area and Patriot Missile sites are approved only for showering, hand washing, and cleaning (this water is **not** fit for human consumption).

**CLIMATE:** The climate of Bahrain is typically dry and arid, with two primary seasons: an extremely hot summer and a relatively mild winter. During the summer months, from April to October, afternoon temperatures average 104°F and from June to July the temperature can reach 118°F. The combination of intense heat and high humidity makes this season uncomfortable. In addition, a hot, dry southwest wind, known locally as the Qaws, periodically blows sand clouds across the barren southern end of Bahrain toward Manama in the summer. Temperatures are moderate in the winter months. From November to March, the temperature ranges between 50 and 68°F. However, humidity often rises above 90% in the winter. From December to March, prevailing winds from the southeast, known as the Shamal, bring damp air over the islands. Overall, Bahrain receives little precipitation. The average annual rainfall is 2.8 inches/year, which is usually confined to the winter months. The winter rains tend to fall in brief, torrential downpours, flooding shallow ditches and other natural depressions that primarily remain dry for most of the year.

**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 Isa Air Base. As indicated in the detailed sections that follow Table 2, established controls that reduce health risk have been 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 and medical implications:***

The following may have caused acute health effects in some individuals ***during deployment*** at Isa Air Base.

Inhalation of dust: Fine particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$) is routinely present in the air in Bahrain at higher concentrations than would typically be experienced in the United States. Air sampling data for $PM_{2.5}$ for at least one 24-hour period during February 2010 and again during at least one brief period in December 2015, revealed a **Moderate** short-term health risk. Inhalation of $PM_{2.5}$ at these concentrations may have resulted in mild to more serious short-term health effects (e.g., eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath). It is likely that some individuals sought treatment for acute respiratory irritation during this period. Individuals who sought medical treatment for these symptoms while deployed should have exposure/treatment noted in their medical record.

Heat injury: The short-term health risk of heat injury for unacclimatized individuals (i.e., on site less than four weeks) and those with underlying health conditions is **moderate**. For all other individuals, the risk is **low**.

***Long-term health risks and medical implications:***

The following may be associated with long-term health effects in some individuals who deployed to Isa Air Base.

Inhalation of dust: The inhalation of fine particulate matter ($PM_{2.5}$) poses a potential long-term health risk to individuals deployed to Isa Air Base in 2010. Individuals who routinely worked outdoors and inhaled $PM_{2.5}$ at levels present at the base in 2010 may develop health conditions such as chronic bronchitis, reduced lung function, and asthma. Individuals with a history of asthma or pre-existing cardiopulmonary disease are likely at greatest risk. At this time, there are no specific recommended post-deployment medical surveillance evaluations for individuals with particulate exposures. Providers should consider health status (e.g., any underlying conditions/susceptibilities) and unique OEH exposures (such as welding fumes and burn pit smoke) when addressing individual concerns. Although short-term effects from exposure to dust should have resolved post-deployment, providers should be prepared to consider the relationship between potential deployment exposures and current complaints.

**Table 2: Population-Based Health Risk Estimates – Isa Air Base, Bahrain[1,2]**

| Source of Identified Health Risk[3] | Unmitigated Health Risk Estimate[4] | Control Measures Implemented[5] | Residual Health Risk Estimate[4] |
|---|---|---|---|
| **Air** | | | |
| Particulate matter less than 10 microns in diameter ($PM_{10}$) *(see paragraph 2.3)* | Short-term: **Low**. Daily levels vary. Acute health effects (e.g., eye and/or upper respiratory tract irritation) may be more pronounced during peak exposure days. More serious effects were possible in susceptible persons (e.g., those with asthma or existing respiratory diseases). | Most personnel live and work in air conditioned CLUs/buildings or tents.<br>For those not working in air conditioned spaces, minimizing time outdoors and keeping doors or tent flaps closed.<br>Use of water for dust control on unpaved roads and work areas. | Short-term: **Low**. |
| | Long-term: **No available health guidelines**. | | Long-term: **No available health guidelines**. |
| Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) *(see paragraph 2.4)* | Short-term: **Low**. Short-term health risks for typical exposures. There were at least two 24-hour periods, one in February 2010 and the other in December 2015 during which the acute risk was elevated to **moderate**. Mild acute (short-term) health effects such as eye, nose, or throat irritation were likely in individuals who spent much of their time outdoors during these periods of elevated health risk. Existing medical conditions (e.g., asthma or respiratory diseases) may have also been exacerbated. | Most personnel live and work in air conditioned CLUs/buildings or tents.<br>For those not working in air conditioned spaces, minimizing time outdoors and keeping doors or tent flaps closed.<br>Water is used for dust control on unpaved roads and work areas. | Short-term: **Low to Moderate**. |
| | Long-term: **Low to moderate**. Repeated exposures to airborne concentrations of $PM_{2.5}$ that carry a low to moderate long-term health risk may increase the possibility for development of chronic health conditions in some troops. These conditions include reduced lung function, chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, and other cardiopulmonary diseases. Those with a history of asthma or pre-existing cardiopulmonary disease have a higher risk for developing these chronic conditions. | | Long-term: **Low to moderate**. |
| Airborne metals *(see paragraph 2.5)* | Short-term: **None identified**.<br>Long-term: **None identified**. | Air-conditioned living and working spaces provided<br>For those not working in air conditioned spaces, time outdoors is minimized and keeping doors or tent flaps closed.<br>Water used for dust control on unpaved roads and work areas. | Short-term: **None identified**.<br>Long-term: **None identified**. |

| **Table 2: Population-Based Health Risk Estimates – Isa Air Base, Bahrain[1,2]** | | | |
|---|---|---|---|
| **Source of Identified Health Risk[3]** | **Unmitigated Health Risk Estimate[4]** | **Control Measures Implemented[5]** | **Residual Health Risk Estimate[4]** |
| Volatile Organic Compounds (VOC) *(see paragraph 2.6)* | Short-Term: **None identified**. All VOCs detected were below their respective short-term military exposure guidelines. | Locate living and working areas away from roadways, runways and other fuel combustion sources | Short-Term: **Low**. |
| | Long-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. | | Long-term: **Low**. |
| Semi-volatile organic compounds *(see paragraph 2.7)* | Short-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. | Locate living and working areas away from roadways, runways and other fuel combustion sources | Short-term: **None identified**. |
| | Long-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. | | Long-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. |
| Diesel exhaust *(see paragraph 2.8)* | Short-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. | Living and working areas located away from roadways, runways, and generators when possible. | Short-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. |
| | Long-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. | | Long-term: **Not Evaluated**; insufficient data exist upon which to base a health risk assessment. |
| **Soil** | | | |
| Soil exposures *(see paragraph 3)* | Short-term: **Not evaluated**. Short-term soil exposures do not typically pose a health risk. Consequently, no exposure guidelines exist. | Keep sleeves rolled down to limit skin contact.<br>Wash hands frequently especially before eating.<br>Shower after soil exposure to remove soil from skin. | Short-term: **Not evaluated.** |
| | Long-term: **None Identified**. | | Long-term: **None identified.** |
| **Water** | | | |
| Water used for other purposes *(See paragraph 4.2)* | Short-term: **None Identified**. | Water treated by reverse osmosis.<br>Active and ongoing drinking water surveillance program implemented. | Short-term: **None Identified**. |
| | Long-term: **None Identified**. | | Long-term: **None Identified**. |
| Consumed Water (Water Used for Drinking) *(see paragraph 4.3)* | Short-term: **None Identified** (for drinking water treated by reverse osmosis). **Not Evaluated**; insufficient data for bottled water upon which to base a health risk assessment. | Bottled water supplied from U.S. Army Veterinary Command approved source. | Short-term: **None Identified (**for drinking water treated by reverse osmosis). **Not Evaluated**; insufficient data for bottled water upon which to base a health risk assessment. |

| Table 2: Population-Based Health Risk Estimates – Isa Air Base, Bahrain[1,2] | | | |
|---|---|---|---|
| **Source of Identified Health Risk[3]** | **Unmitigated Health Risk Estimate[4]** | **Control Measures Implemented[5]** | **Residual Health Risk Estimate[4]** |
| | Long-term: **None Identified (**for drinking water treated by reverse osmosis). **Not Evaluated**; insufficient data for bottled water upon which to base a health risk assessment. | | Long-term: **None Identified (**for drinking water treated by reverse osmosis). **Not Evaluated**; insufficient data for bottled water upon which to base a health risk assessment. |
| **Endemic Disease** | | | |
| Gastrointestinal diseases *(See paragraph 6.2)* | Short-term: **Moderate**. If ingesting unapproved local food/water, the health effects can temporarily incapacitate personnel (diarrhea). Viral gastroenteritis can present at any time due to a high rate of personnel turnover, shared dining, berthing, bathroom facilities, and working spaces. | Standard Preventive Medicine measures: immunizations (hepatitis A and typhoid fever), the consumption of food and water from approved sources, and habitability inspections to ensure cleanliness/sanitation. | Short-term: **Low**. Based on disease incident reporting from Isa Air Base, bacterial, protozoal, and hepatitis E infections present a low risk. |
| | Long-term: **Low**. Most gastrointestinal diseases do not cause prolonged illness. | | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| Arthropod vector-borne diseases *(See paragraph 6.3)* | Short-term: **Low**. Vectors present in Bahrain (mosquitoes and sand flies) are capable of transmitting dengue fever, malaria, leishmaniasis, sandfly fever, and West Nile fever. Malaria was eradicated in Bahrain 20 years ago but imported cases in immigrants occasionally occur. Risk of Malaria associated with imported cases is low in Bahrain. | Standard Preventive Medicine measures: proper wear of insecticide-treated uniforms and the application of insect repellent to the skin, chemoprophylaxis and removal of vector harborages on the base. | Short-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| | Long-term: **Low**. It is possible to be infected during deployment with leishmaniasis, but not to have clinically evident disease until redeployed. | | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| Water contact diseases *(See paragraph 6.4)* | Short-term: **Low**. The occurrence of flooding after heavy rainfall facilitates the spread of leptospirosis already present in the soil. | Avoidance of fresh water sources, such as puddles/standing water, drainage areas, etc. | Short-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. | | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| Respiratory diseases *(See paragraph 6.5)* | Short-term: **Moderate**. For upper respiratory infections, such as influenza. The high rate of personnel turnover, shared dining, berthing, recreational facilities, and working spaces allow for easy | Influenza immunizations are given either before or during deployment. Local and third country national workers or contractors are required to complete health screening prior to | Short-term: **Low**. For upper respiratory infections. |

| **Table 2: Population-Based Health Risk Estimates – Isa Air Base, Bahrain[1,2]** | | | |
|---|---|---|---|
| **Source of Identified Health Risk[3]** | **Unmitigated Health Risk Estimate[4]** | **Control Measures Implemented[5]** | **Residual Health Risk Estimate[4]** |
| | transmission. **Low**. For tuberculosis and Middle East Respiratory Syndrome. | employment. Potential tuberculosis exposure is addressed in the Post Deployment Health Assessment. | |
| | Long-term: **Low**. Most respiratory diseases do not cause prolonged illness. | | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| Animal contact diseases *(See paragraph 6.6)* | Short-term: **Low**. Exposures to animals and/or locations where animals are kept (barnyards, slaughterhouses) are the primary infection sources. Incidence of animal rabies in Bahrain is low. Anthrax is not present. | Standard Preventive Medicine measures, as well as CCMD policy, generally prohibit contact with, adoption, or feeding of feral animals. Immunizations for anthrax and rabies (rabies vaccination and/or immune globulin given if clinically directed). | Short-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. | | Long-term: **Low**. Based on disease incident reporting from Isa Air Base. |
| **Venomous Animal/ Insects** | | | |
| Snakes, scorpions, and spiders *(See paragraph 7)* | Short-term: **Low**. | Standard Preventive Medicine measures, such as the reduction of harborages for these animals, as well as education on how to avoid them (shake out boots before donning, etc.), reduce the risk of exposure. | Short-term: **Low**. |
| | Long-term: **None identified**. | | Long-term: **None identified**. |
| **Heat/Cold Stress** | | | |
| Heat *(See paragraph 8)* | Short-term: **Moderate**. Moderate risk of heat injury in summer months for unacclimatized personnel. | Adequate periods of acclimation for newly reporting personnel. Adjustment of work-rest cycles based on monitoring of climatic conditions. | Short-term: **Low**. |
| | Long-term: **Low**. | | Long-term: **Low**. |
| Noise *(See paragraph 9)* | Short-term: **Low**. | Use of hearing protection. Labeling noise hazard areas. Leadership enforcement of compliance with available PPE. | Short-Term: **Low**. |
| | Long-term**: Moderate**. | | Long-Term: **Low**. |

**Table 2: Population-Based Health Risk Estimates – Isa Air Base, Bahrain[1,2]**

Footnotes:

[1] Table 2 provides a qualitative estimate of population-based short- and long-term health risks associated with the occupational environment conditions at Isa Air Base. It does not represent an individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may be present in the environment, if a person does not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may be no health risk. Alternatively, a person at a specific location may experience a unique exposure, such as at the burn pit, which could result in a significant individual exposure. Any such person seeking medical care should have their specific conditions of exposure documented on SF600.

[2] This assessment is based on specific environmental sampling data and reports obtained from January 2010 through December 2015. Sampling locations are assumed to be representative of exposure points for the base population but may not reflect all the fluctuations in environmental quality or capture unique exposure incidents.

[3] Table 2 is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at Isa Air Base. The health risks are presented as Low, Moderate, High or Extremely High for both acute and chronic health effects. The risk level is based on an assessment of both the potential severity of the health effects that could be caused and probability that exposure would occur at a level to produce such health effects. Details can be obtained from the Navy and Marine Corps Public Health Center. When no risk of either a specific acute or chronic health effects were determined, sources were excluded. More detailed descriptions of OEH exposures that were evaluated but determined to pose no health risk are discussed in the following sections of this report.

[4] Risks in Table 2 are based on quantitative surveillance thresholds (e.g., review of disease surveillance data) or screening levels (e.g., Military Exposure Guidelines (MEGs) for chemicals*).* Some previous assessment reports may provide slightly inconsistent 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 few samples.

[5] 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 in place. 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.

# 1 Discussion of Health Risks at Isa Air Base, Bahrain by Source

The following sections provide additional information about the OEH conditions summarized in Table 1 and Table 2 above. All risk assessments were performed using the methodology described in the U.S. Army Public Health Command Technical Guide 230, *Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel* (USAPHC TG230). 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 having preventive measures in place. For environmental exposures related to airborne dust, there are limited preventive measures available, and those that are have little efficacy in reducing exposure to ambient conditions.

# 2 Air

## 2.1 Site-Specific Sources Identified

The combination of multiple potential air pollution sources, climatic conditions and topographic features contribute to air quality degradation at Isa Air Base.

- Bahrain's hot, dry climate results in very dusty conditions throughout the year. During the months of June to September, gusting winds, known locally as the Qaws, blow sand clouds across the southern end of Bahrain. These hot winds persist 3 to 4 days at a time, gusting from the southeast at an average of 13 knots with peak gusts up to 50 knots, contributing even more airborne dust than is typically present.
- Emissions from military operations also contribute to degradation of ambient air quality. Vehicular traffic, water treatment, electrical power generation and aircraft operations on the site also contribute air pollutants.
- Emissions from host nation industrial source such as the Kingdom of Bahrain Electricity and Water Authority Power Plant at Al Dur (approximately 2 miles from the air base) and the Aluminum Bahrain aluminum smelter which is approximately 9 miles distant.

## 2.2 Particulate Matter

Particulate matter (PM) is a complex mixture of extremely small particles suspended in the air. 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. PM can include sand, soil, metals, volatile organic compounds, allergens, and other compounds such as nitrates or sulfates that are formed by condensation or transformation of combustion exhaust. PM composition and particle size vary considerably depending on the source. Generally particulate matter of health concern is divided into two fractions: $PM_{10}$ and $PM_{2.5}$. $PM_{10}$ includes coarse particles with a diameter of 10 micrometers or less (0.0004 inches or one-seventh the width of a human hair). $PM_{2.5}$ includes fine particles less than 2.5 micron, which can reach the deepest regions of the lungs when inhaled. Exposure to excessive PM is linked to a variety of potential negative health effects.

## 2.3 Particulate Matter, less than 10 microns ($PM_{10}$)

### 2.3.1 Exposure Guidelines

Short Term (24-hour) $PM_{10}$ ($mg/m^3$):

- Negligible MEG=0.250
- Marginal MEG=0.420
- Critical MEG=0.600

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

- Not defined and not available.

### 2.3.2 Sample Data/Notes

Only 4 $PM_{10}$ samples exist at Isa Air Base. One sample was taken in February 2010 and 3 in September 2014. Airborne $PM_{10}$ concentrations near the Arabian Gulf are routinely much higher than one would encounter in the United States. The limited data indicates that $PM_{10}$ levels typically peak from June through September when hot, gusty winds pick up sand and soil from the surrounding desert. This is consistent with PM sampling results from other countries in the region.

### 2.3.3 Short-term (Acute) Health Risk

**Approach**: To assess acute risk associated with $PM_{10}$, the highest concentration detected during each calendar quarter—commonly referred to as the quarterly peak concentration—was used to arrive at acute risk estimates for Isa Air Base. Peak concentrations ranged from a low of 0.0851 $mg/m^3$ to a high of 0.1082 $mg/m^3$. The risk estimate for the highest peak concentration is calculated first. If that risk is low, no further calculations are needed, as the acute risk for all periods is low. If the highest peak concentration yields a risk of moderate or higher, additional calculations are repeated on the next highest peaks until the risk characterization changes (e.g., risk changes from moderate to low).

**Risk Assessment**: The acute risk associated with $PM_{10}$ exposure at the concentrations found at Isa Air Base is **low**.

**Medical Implications**: At the low risk level, a small number of individuals may have experienced eye, nose, and throat irritation and may have sought medical attention. In most of these individuals, the symptoms would have been mild and temporary, requiring no medical treatment. During periods of moderate risk, more individuals may have been affected and the severity of symptoms increased. More individuals may have sought medical attention during these periods of elevated risk. Symptoms associated with exposure to $PM_{10}$ would be expected to resolve after exposure ceases. Health effects in persons with pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may be exacerbated.

**Confidence in the Risk Assessment**: Based on the limited data available, confidence in this risk assessment is low.

### 2.3.4 Long-term (Chronic) Health Risk

**Health Guidelines Not Defined for $PM_{10}$**. The U.S. Environmental Protection Agency (EPA) has retracted its long-term standard for $PM_{10}$ due to an inability to clearly link chronic health effects with $PM_{10}$ exposures.

*Return to Table 2*

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

### 2.4.1 Exposure Guidelines

Short-term (24-hour) $PM_{2.5}$ MEGs (mg/m3):
- Negligible MEG=0.065
- Marginal MEG=0.250
- Critical MEG=0.500

Long-term (1year) $PM_{2.5}$ MEGs (mg/m3):
- Negligible MEG=0.015
- Marginal MEG=0.065.

### 2.4.2 Sample Data/Notes

From January 2010 to December 2015, 7 ambient 24-hour air samples were collected for $PM_{2.5}$. Two samples were collected in February 2010, 4 in September 2015 and 1 in December 2015.

### 2.4.3 Short-term (Acute) Health Risk

**Approach**: To assess acute risk associated with $PM_{10}$, the highest concentration detected during each calendar quarter—commonly referred to as the quarterly peak concentration—was used to arrive at acute risk estimates for Isa Air Base. Peak concentrations ranged from a low of 0.0600 mg/m$^3$ to a high of 0.1208 mg/m$^3$. The risk estimate for the highest peak concentration is calculated first. If that risk is low, no further calculations are needed, as the acute risk for all periods is low. If the highest peak concentration yields a risk of moderate or higher, additional calculations are repeated on the next highest peaks until the risk characterization changes (e.g., risk changes from moderate to low).

**Risk Assessment**: Except for September 2010 and December 2015, the acute risk associated with $PM_{2.5}$ exposure at the concentrations found at Isa Air Base was **low**. During September 2010 and December 2015, there was at least a single 24-hour period when acute risk was elevated to **moderate**.

**Medical Implications**: At low to moderate short term risk, a small percentage of individuals may experience short-term health effects such as eye, nose, throat and lung irritation, coughing, sneezing, runny nose and shortness of breath. Some individuals might seek outpatient medical care, although most individuals will experience only mild effects, which will typically resolve when exposure ceases. A small number of individuals may experience more pronounced effects, such as decreased lung function and worsening of pre-existing medical conditions (e.g., asthma).

**Confidence in the Risk Assessment**: Confidence in the health risk assessment associated with potential $PM_{2.5}$ exposures from January 2010 to December 2015 is low. Only 7 $PM_{2.5}$ samples exist for this period and the sampling data did not cover a complete 12 month climatic cycle, which more accurately reflects the period of exposure.

### 2.4.4 Long-term (Chronic) Health Risk

**Approach**: For chronic health risk, it was assumed that the longest deployment lasted 12 months and that base residents were exposed to the same levels of dust 24 hours per day, over the full term of their deployment. Thus, the exposure assumptions employed likely represent a worst-case exposure scenario. To assess chronic health risk associated with $PM_{2.5}$, annual average concentrations for $PM_{2.5}$ were calculated for each 12 month period for which $PM_{2.5}$ data exist from January 2010 to December 2015. The use of the limited data that exist at Isa Air

Base may result in over- or underestimating the chronic health risk. Health risk associated with the highest annual average concentration is calculated first. If that health risk estimate is low, no further calculations are needed, as the chronic health risk for all years is low. If the highest annual average concentration yielded a health risk estimate of moderate or higher, additional calculations are repeated on the next highest annual averages until the risk characterization changes (e.g., the risk estimate changes from moderate to low). Annual average $PM_{2.5}$ concentrations for January 2010 through December 2015 ranged from 0.0538 mg/m$^3$ to 0.0828 mg/m$^3$.

**Risk Assessment**: The chronic health risk associated with $PM_{2.5}$ exposure for U.S. Service members at Isa Air Base is **moderate** in 2010 and **low** in 2015. There are no data available upon which to base a risk assessment for 2011, 2012, 2013 and 2014.

**Medical Implications**: Repeated exposures to airborne concentrations of $PM_{2.5}$ that carry a low to moderate long-term health risk may increase the probability for development of chronic health conditions in generally healthy troops. These conditions include reduced lung function, chronic bronchitis, chronic obstructive pulmonary disease (COPD), asthma, and certain cardiopulmonary diseases. Those with a history of asthma or pre-existing cardiopulmonary disease have a higher risk for exacerbating these chronic conditions.

**Confidence in the Risk Assessment**: Confidence in the health risk assessment associated with potential $PM_{2.5}$ exposures for 2010 and 2015 is low. Only 7 $PM_{2.5}$ samples exist for Isa Air Base and the sampling data does not cover a complete 12 month climatic cycle, which more accurately reflects the period of exposure.
*Return to Table 1*
*Return to Table 2*

## 2.5 Airborne Metals

### 2.5.1 Sample Data/Notes

From January 2010 to December 2015, metals analysis was performed on 11 ambient air samples collected at Isa Air Base. None of the metals were detected above their corresponding military exposure guidelines published in USAPHC TG 230.

### 2.5.2 Short-term (Acute) Health Risk

**Approach**: For screening purposes, all airborne metals detected from particulate matter sampling were compared to their corresponding 1 year Negligible MEGs. Metals without a single detection above that MEG were removed from further consideration. None of the metals detected from particulate matter sampling exceeded their respective 1 year Negligible MEGs.

**Risk Assessment**: Airborne metals are not a source of acute health risk based on available data.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Based on the available data, confidence in this risk assessment is high.

### 2.5.3 Long-term (Chronic) Health Risk

**Approach**: Annual average concentrations of airborne metals detected are used to assess the long-term risk associated with potential long-term exposures. When calculating the average concentration, a surrogate value of half the laboratory limit of quantitation for that metal is used for each sample where the specific metal is not detected. However, for screening purposes, all airborne metals detected are first compared to their corresponding 1 year Negligible MEGs. Metals without a single detection above that MEG are removed from further consideration. None of the metals detected from particulate matter sampling exceeded their respective 1 year Negligible MEGs.

**Risk Assessment**: Based on available data, airborne metals are **not a source of chronic health risk** based on available data.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in this risk assessment is low based on the limited amount of available data.
*Return to Table 2*

## 2.6 Volatile Organic Compounds

Volatile organic compounds (VOCs) are carbon-based chemicals that easily evaporate under normal atmospheric conditions. They can be naturally occurring or man-made. Man-made VOCs are emitted by a wide array of products that number in the thousands. Examples include paints and lacquers, paint strippers, industrial solvents, household cleaners, pesticides, building materials and furnishings, fuels and fuel combustion, and cigarette smoke.

There are several on and off-base sources of ambient VOCs at Isa Air Base, including motor vehicles, military flight operations, onsite electric power generation, on site water treatment, fuel storage and transfer, electric power generation at the Al Dur Power Plant and routine maintenance operations. Most of the VOCs detected at Isa Air Base are associated with fuels and/or fuel combustion.

### 2.6.1 Sample Data/Notes

From January 2010 to December 2015, 8 air samples were collected for VOC analysis. All samples were collected in September 2015.

### 2.6.2 Short-term (Acute) Health Risk

**Approach**: For screening purposes, all compounds detected were first compared to their corresponding 1 year Negligible MEGs. Compounds without a single detection above that MEG were removed from further consideration. Only acrolein was present at concentrations above its 1 year Negligible MEG value of 0.00014 mg/m$^3$. Acrolein was detected at concentrations greater than its 1-year Negligible MEG in all eight samples taken in September. Concentrations of acrolein detected in September 2015 ranged from 0.0023 mg/m$^3$ to 0.0078 mg/m$^3$ with an average concentration of 0.0051 mg/m$^3$. The peak concentration of acrolein was used to assess the short-term health risk associated with potential exposures. Risk estimates for the highest peak were calculated first. As with other airborne compounds if the highest peak concentration yielded a risk estimate of low, no further calculations were deemed necessary.

**Risk Assessment**: Based on the available data, **no short-term health risk** associated with potential VOC exposures was identified during September 2015. There are insufficient data upon which to base health risk assessments for other periods at Isa Air Base.

**Medical Implications**: Fuel combustion is the primary source of acrolein release to the atmosphere in the vicinity of Isa Air Base. Acrolein has a very disagreeable odor and breaks down rapidly in the air by reacting with other chemicals and sunlight. Most individuals can smell acrolein at a concentration of approximately 0.6 mg/m$^3$. Breathing small amounts of acrolein can cause watering of the eyes, burning of the nose and throat, and decreased breathing rate. These symptoms go away when exposure stops. Studies indicate that very slight eye irritation and annoyance/discomfort begin at about 0.2 mg/m$^3$, and nose/throat irritation and a decrease in respiratory rate at approximately 0.7 mg/m$^3$. Concentrations of acrolein detected at Isa Air Base were well below the threshold concentrations known to cause irritation, thus no health effects associated with short-term acrolein exposure would be expected.

**Confidence in the Risk Assessment**: Confidence in this risk assessment is low. Only 8 VOC samples exist and all those were obtained during a single sampling event in September 2015. Since existing data are not available to quantify the variability of VOC concentrations typically expected over a 12 month climatic cycle, health risk may over or under-stated.

### 2.6.3 Long-term (Chronic) Health Risk

**Not evaluated**; insufficient data exist upon which to base a health risk assessment.
*Return to Table 2*

## 2.7 Semi-Volatile Organic Compounds

Semi-volatile organic compounds (SVOCs) are compounds in ambient air formed during combustion. They are also present in the unburned portion of gasoline, diesel fuel, lubricating oils, wood, refuse, and other organic substances. Semi-volatile organic compounds include polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCBs), dioxin, and furans. They can be found in the air in minute concentrations everywhere, even the Antarctic. Semi-volatile organic compounds are present in air as vapors or adsorbed to the surface of small solid particles. Semi-volatile organic compounds in ambient air generally occur as complex mixtures rather than a single compound. There are several sources of SVOCs on and around Isa Air Base, including electric power generators, motor vehicle exhaust and jet engine exhaust.

### 2.7.1 Sample Data/Notes

In September 2015, Navy Environmental and Preventive Medicine Unit No. 2 employed a real-time photoelectric aerosol sensor capable of measuring total ambient particulate-bound PAH concentrations at Isa Air Base. Four days of continuous sampling from September 21–24 yielded 431 data points from a single sampling location selected to be as representative as possible of where base residents live, work, and recreate. Concentrations of particle bound PAH compounds ranged from 0.0005 micrograms/cubic meter (µg/m$^3$) to 0.6147 µg/m$^3$ with an average concentration of approximately 0.0299 µg/m$^3$. No military exposure guidelines or EPA risk-based screening levels currently exist for inhalation of total PAH compounds. Accordingly, health risk values for benzo(a)pyrene (the PAH with the highest potential for health impacts) published by the California Air Resources Board were used for health risk screening purposes. The California Air Resources Board risk-based concentrations assume lifetime residential

exposures (70 years), whereas exposures at Isa Air Base are typically 1 year or less. In addition, benzo(a)pyrene typically comprises less than 5% of the total amount of PAHs present in the atmosphere. To ensure a health protective assessment, however, all PAHs detected at the base were assumed to be benzo(a)pyrene. Total particle bound concentrations of PAH detected in the limited sampling data available were all well below this health protective screening value during the sampling period.

#### 2.7.2 Short-term (Acute) Health Risk

**Not evaluated**; insufficient data exist upon which to base a health risk assessment.

#### 2.7.3 Long-term (Chronic) Health Risk

**Not evaluated**; insufficient data exist upon which to base a health risk assessment.
*Return to Table 2*

### 2.8 Diesel Exhaust

Diesel exhaust is a complex mixture of gases, including oxides of nitrogen (NO and $NO_2$), sulfur dioxide ($SO_2$), carbon monoxide (CO), carbon dioxide $CO_2$), ozone, and diesel particulate matter. Diesel particulate matter consists of small solid particles formed by the incomplete burning of fuel in a diesel engine. Diesel particulate matter is composed of a solid core of elemental carbon with other substances such as inorganic carbon, metals ash, sulfates, and silicates attached to the surface. The primary source of diesel exhaust at Isa Air Base is from electricity generation by tactical generators and vehicular traffic.

#### 2.8.1 Sample Data/Notes

Continuous sampling for CO, $SO_2$ and $NO_2$ was conducted on 22–23 September 2015. The concentrations of the 3 gaseous components of diesel exhaust, for which a sampling method was available during the two days of sampling, were as follows; $NO_2$, none detected; $SO_2$, none detected and CO, none detected to 5.7 mg/$m^3$. All concentrations detected were less than their respective 1 year Negligible MEG during the sampling period.

#### 2.8.2 Short-term (Acute) Risk

**Not evaluated**; insufficient data exist upon which to base a health risk assessment.

#### 2.8.3 Long-term (Chronic) Health Risk

**Not evaluated**; insufficient data exist upon which to base a health risk assessment.
*Return to Table 2*

## 3 Soil

### 3.1 Surface Soil

#### 3.1.1 Sample Data/Notes

From January 2010 to December 2015, 11 surface soil samples were collected. According to field data sheets, the samples were collected from areas and/or activities where the potential for

soil exposure was the greatest. Laboratory analysis of soil samples includes SVOCs, heavy metals, pesticides, herbicides, and radionuclides. The primary exposure pathways associated with soil are dermal contact and incidental ingestion. Individuals involved in construction and maintenance activities are at greatest potential for exposure to soil. These individuals comprise a relatively small proportion of the overall base population.

#### 3.1.2 Short-term (Acute) Health Risk

**Not evaluated**. Exposure to soils does not generally pose short-term health risk. Consequently, no MEGs for short-term exposure to soils exist, and sampling data for soils are not evaluated for acute health risks**.**

#### 3.1.3 Long-term (Chronic) Health Risk

**Approach**: For screening purposes, all compounds detected in the soil samples were compared to their corresponding 1 year Negligible MEGs. Compounds without a single detection above that MEG were removed from further consideration. None of the compounds detected exceeded their respective 1 year Negligible MEGs.

**Risk Assessment**: Based on available data, surface soil is **not a source of health risk** at Isa Air Base.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is high despite the low number of samples. In the absence of a known or suspected source of pollution, release of hazardous materials in a specific area, or extensive use of fill material from remote locations during construction, the composition of native soils should be very similar across the base and should not change appreciably over time. Even with air deposition from known offsite sources such as the Al Dur Aluminum Plant and Al Dur Power Plant, changing the overall composition of surface soils would require several decades before sampling could detect minor differences in soil composition, especially given the base's distance from the plants and local climatologic phenomena.
*Return to Table 2*

## 4 Water

### 4.1 Site-Specific Sources Identified

Historically, 2 sources of drinking water have been available at Isa Air Base; bottled water from commercial vendors and on base reverse osmosis (RO) treated water. The source of the RO treated water is the Kingdom of Bahrain Electricity and Water Authority. The source water is transmitted to the on base RO treatment plant by the Royal Bahraini Air Force distribution system. RO treated water is delivered by tank truck to 6 drinking water storage tanks located at point of use locations (e.g., the galley, medical clinics and Navy Exchange). In addition, RO water is piped via the base distribution system and/or trucked to 9 non-drinking storage tanks within the logistics support and the Patriot Missile sites. This water is approved for showering, hand washing and cleaning only.

## 4.2 Water for Other Purposes (Non-Drinking Water)

### 4.2.1 Sample Data/Notes

Four RO-treated water samples and 2 disinfected fresh water samples were collected during the period January 2010 to December 2015.

### 4.2.2 Short-term (Acute) Health Risk

**Approach**: For screening purposes, any compound with a peak concentration less than or equal to 2.5 times the 14 day Negligible MEG for consuming 5-L/day is eliminated from further consideration. If a 14 day, 5-L/day Negligible MEG is not available, the more conservative 1 year, 5-L/day Negligible MEG is used for screening purposes. The 2.5 multiplier adjusts the 5 L/day MEG to a consumption rate of 2 L/day, which is equivalent to the consumption rate upon which the EPA Maximum Contaminant Levels (MCL) are established. This still provides a significant level of health protection when the primary route of exposure of non-drinking water is skin contact and incidental ingestion and when one considers that EPA MCL are based on 30 years of consumption.

**Risk Assessment**: **No short-term health risk** associated with the use of RO-treated water for cooking, showering, hand washing and cleaning was identified.

**Health Implications:** None identified based on the available sampling data.

**Confidence in the Risk Assessment**: Even though there few samples in the data set, confidence in this risk assessment is high based on the effectiveness of RO treatment technology and limited potential for ingestion in areas of Isa Air Base where RO-treated water use is restricted to non-ingestion uses.

### 4.2.3 Long-term (Chronic) Health Risk

**Approach**: To assess the health risk associated with the use of RO-treated water, the following assumptions were made:

- RO-treated water is supplied for cooking only from storage tanks that have been designated as “Fit for Human Consumption.”
- Use of RO-treated water in other areas of the base is supplied from tanks designated as “Not Fit for Human Consumption” and is restricted to showering and hand washing only.
- Deployments last a maximum of 12 months.
- The primary routes of exposure associated with RO-treated water are incidental ingestion through cooking and personal hygiene (i.e., brushing teeth/oral hygiene).
- Base residents ingest far less than 2 liters (L) (i.e., food preparation) of RO-treated water per day.

The average concentration of each constituent detected in all samples taken within a calendar year is used to estimate chronic health risk. If only a single sample exists during a calendar year, the concentrations detected in that sample are used and assumed to remain unchanged until a follow-on sample indicates that chemical concentrations have changed. For screening purposes, any compound with a peak concentration less than or equal to 2.5 times the 14 day Negligible MEG for consuming 5 L/day is eliminated from further consideration. If a 14 day, 5

L/day Negligible MEG is not available, the more conservative 1 year, 5 L/day Negligible is used for screening purposes.

**Risk Assessment**: **No long-term health risk** associated with the use of RO-treated water for cooking, showering, hand washing and cleaning was identified.

**Medical Implications:** None identified.

**Confidence in the Risk Assessment**: Even though there few samples in the data set, confidence in this risk assessment is high based on the effectiveness of RO treatment technology and limited potential for ingestion in areas of Isa Air Base where RO-treated water use is restricted to non-ingestion uses.
*Return to Table 2*

## 4.3 Consumed Water

### 4.3.1 Sample Data/Notes

Bottled drinking water has been purchased at Isa Air Base from U.S. Army Veterinary Corps personnel approved suppliers since the base was first occupied by U.S. forces. Most bottled water was procured from sources in Bahrain, with limited quantities originating in the United Arab Emirates (UAE). In addition, RO-treated water is produced and distributed to 6 drinking water storage tanks located at point of use locations (e.g., the galley, medical clinics and Navy Exchange). From January 2010 to December 2015, 2 bottled water samples and 4 RO-treated water samples were submitted for analysis. Both bottled water samples were collected in September 2015; no exceedances were identified in either of these samples. All Water samples were analyzed for inorganic compounds, VOC, SVOC and various physical characteristics. In addition, preventive medicine surveillance for microbiological contaminants (coliforms/*E.coli*) is standard operating procedure, but data associated with bacteriological analyses was not available.

### 4.3.2 Short-term (Acute) Health Risk

**Approach**: For screening purposes, any compound with a peak concentration less than or equal to 14-day Negligible MEG for consuming 15 L/day is eliminated from further consideration. If a 14 day, 15 L/day Negligible MEG is not available, the more conservative 1 year, 5 L/day Negligible MEG is used for screening purposes. To determine the short-term health risk associated with drinking bottled water, the following assumptions were made:

- Base residents ingest less than 15 L/day of - water.
- Consumption of RO-treated water is limited to that sourced from water storage tanks designated as “Fit for Human Consumption.”

**Risk Assessment**:

- Bottled water consumption: **Not evaluated**. There are insufficient data upon which to base a health risk assessment.
- RO-treated water consumption: Based on available data, **no short-term health risk** associated with consuming RO-treated water at Isa Air Base was identified.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is medium. Potential vulnerabilities associated with the method of distribution and storage of RO-treated water degrades overall confidence in the health risk assessment.

#### 4.3.3 Long-term (Chronic) Health Risk

**Approach**: To assess the health risk associated with drinking water at Isa Air Base, the following assumptions were made:

- RO-treated water is supplied for drinking only from storage tanks that have been designated as "Fit for Human Consumption."
- RO-treated water in other areas of the base is supplied from tanks designated as "Not Fit for Human Consumption" and is restricted to showering and hand washing only.
- Deployments last a maximum of 12 months.
- Base residents ingest 15 L or less of water daily.

The average concentration of each constituent detected in all samples taken within a calendar year is used to estimate chronic health risk. If only a single sample exists during a calendar year, the concentrations detected in that sample are used and assumed to remain unchanged until a follow-on sample indicates that chemical concentrations have changed. For screening purposes, any compound with a peak concentration less than or equal to the 1 year Negligible MEG for consuming 5 L/day is eliminated from further consideration. If a 1 year, 5 L/day Negligible MEG is not available, the more conservative 1 year, 15 L/day Negligible MEG is used for screening purposes.

**Risk Assessment**:

- RO-treated water consumption: Based on available data, **no long-term health risk** is associated with consuming RO-treated water at Isa Air Base was identified.
- Bottled water consumption: **Not evaluated**. There are insufficient data upon which to base a health risk assessment.

**Medical Implications:** None identified.

**Confidence in the Risk Assessment**: Confidence is the health risk assessment is medium as only four RO-treated samples exist for Isa Air Base. However, the effectiveness of RO treatment technology and existence of ongoing drinking water surveillance activities enhance confidence in the risk assessment.
*Return to Table 2*

## 5 Military Unique

### 5.1 Chemical, Biological, Radiological, Nuclear (CBRN) Weapons

There were no specific hazard sources or exposure incidents documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS) or the Military Exposure Surveillance Library (MESL) during the period January 2010 through December 2015.

### 5.1.1 Short-term (Acute) and Long-term (Chronic) Health Risk

**Not Evaluated.** No data were available upon which to base a health risk assessment.

## 5.2 Depleted Uranium (DU)

There were no specific hazard sources or exposure incidents documented in the DOEHRS or MESL during the period January 2010 through December 2015.

### 5.2.1 Short-term (Acute) and Long-term (Chronic) Health Risk

**Not Evaluated.** No data were available upon which to base a health risk assessment.

## 5.3 Ionizing Radiation

No specific hazard sources or exposure incidents documented in the DOEHRS or MESL from the January 2010 through December 2015.

### 5.3.1 Short-term (Acute) and Long-term (Chronic) Health Risk

**Not Evaluated.** No data were available upon which to base a health risk assessment.

## 5.4 Non-Ionizing Radiation

There were no specific hazard sources or exposure incidents documented in the DOEHRS or MESL during the period January 2010 through December 2015.

### 5.4.1 Short-term (Acute) and Long-term (Chronic) Health Risk

**Not Evaluated.** No data were available upon which to base a health risk assessment.
*Return to Table 2*

# 6 Endemic Diseases

## 6.1 Sample Data/Notes:

**Assessed risk is the residual risk that exists in the presence of preventive measures.**

- Department of Defense Directive 6490.02 series, Comprehensive Health Surveillance, establishes policy for routine health surveillance of all DOD personnel throughout their military service.
- The Armed Forces Health Surveillance Center (AFHSC) maintains archives of medical event reports for all the Services.
- Endemic diseases present in Bahrain were identified using the “Destinations” section of the Centers for Disease Control and Prevention (CDC) Travelers’ Health website, **http://wwwnc.cdc.gov/travel/destinations/Bahrain.htm**.
- Additional health information was identified based on the World Health Organization (WHO) UAE Country Profile, **http://www.who.int/gho/countries/bhr/country_profiles/en/**.

- Where effective vaccines are in place, such as those for Hepatitis A and B, risk to individuals is effectively reduced to none and these endemic diseases were excluded from further assessment.
- Actual disease prevalence in the local population is unknown due to inconsistent surveillance in the host nation.
- Overall, few disease reports associated with Isa Air Base were identified. Disease reports associated with other locations within Bahrain were generally routine reports related to illnesses, which do not have the potential to cause severe disease.

## 6.2 Gastrointestinal Diseases

Typhoid fever and Hepatitis A may pose a risk to travelers in Bahrain, especially those visiting smaller cities or rural areas. U.S. Service members are routinely vaccinated against these diseases. Those deployed to Isa Air Base consume the majority of their meals in dining facilities on base, where food is purchased from approved sources and prepared under U.S. public health oversight (certificate of sanitation, health screening of food service workers, periodic inspections, etc.). However, a small population of service members select off base dining options (U.S. Service members deployed to Isa Air Base are permitted to leave the base during off duty hours). Service members who frequent off base restaurants may be at a greater risk of food and waterborne diseases due to the potential presence of other disease causing organisms, as well as cultural differences in food handling and preparation practices of the local area. Viral gastroenteritis, which is spread through contact or fomites (any inanimate object or substance capable of carrying infectious organisms), presents a recurrent risk at Isa Air Base.

### 6.2.1 Short-term (Acute) Health Risk

**Approach**: The health risk for fomite-borne gastrointestinal infections and endemic food- and waterborne diseases to individuals deployed to Isa Air Base during the period of this assessment was epidemiologically assessed based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to Isa Air Base, and direct communication with military public health personnel.

**Risk Assessment**:

- The short-term risk for viral gastroenteritis is **low.** Risk due to a high rate of personnel turnovers, shared dining halls, berthing spaces, bathing facilities, and working spaces, which are not substantially different than those found in similar settings within the United States.
- The short-term risk associated with food borne and waterborne diseases (i.e., bacterial or viral gastroenteritis, protozoal diarrhea, cholera, brucellosis, and hepatitis E) at Isa Air Base is **low**.

**Medical Implications**: Gastroenteritis, particularly from viral agents, can cause periodic outbreaks despite preventive measures. A small number of infections may require greater than 72 hours convalescence and/or hospitalization.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is medium. Food and water borne diseases, especially those with short convalescence and lack of long-term health effects, are often underreported for deployed U.S. Service members.

### 6.2.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 6.2.1 above.

**Risk Assessment**: The long-term risk associated with food and waterborne diseases is **low** for protozoal diarrhea and brucellosis.

**Medical Implications**: Long-term health effects resulting from infection with food and waterborne diseases are rare.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is high.
*Return to Table 2*

## 6.3 Arthropod Vector-Borne Diseases

The climate and ecological habitat found in Bahrain support populations of arthropod vectors, including mosquitoes, ticks, and sand flies. Diseases, such as sand-fly fever, dengue fever, cutaneous leishmaniasis, Congo Crimean hemorrhagic fever and West Nile virus, are present on the Arabian Peninsula, but there is no current evidence of ongoing transmission in Bahrain. Malaria was eradicated in Bahrain approximately 20 years ago; however, due to a large immigrant population, cases of imported malaria exist.

### 6.3.1 Short-term (Acute) Health Risk

**Approach**: The health risk for endemic vector-borne diseases to individuals deployed to Isa Air Base during the period of this assessment was epidemiologically assessed based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to Isa Air Base, and direct communication with military public health personnel.

**Risk Assessment**: The short-term risk for the vector-borne diseases dengue fever, malaria, leishmaniasis (both visceral and cutaneous), sand-fly fever, West Nile fever, Crimean-Congo hemorrhagic fever, is **low**. Individuals who forward deploy from Isa Air Base to other areas on the Arabian Peninsula may experience an increase in short term risk.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is high. No vector-borne disease reports for individuals who resided at Isa Air Base were identified.

### 6.3.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 6.3.1 above.

**Risk Assessment**: The long-term risk for leishmaniasis, dengue fever and sand-fly fever is **low**.

**Medical Implications**: Both visceral and cutaneous leishmaniasis may have extended incubation periods, ranging from a week to years. Although rare, it is possible to be infected during deployment, but not to have clinically evident disease until redeployed. Leishmaniasis should be considered in the differential diagnosis for any unusual skin lesions or chronic, systemic disease.

Certain vector-borne diseases have the potential to cause long-term health effects. Individual history of infection with a vector borne disease should be considered when evaluating patients with chronic symptoms such as prolonged fatigue, depression, arthralgia or myalgia.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high. Incidence of leishmaniasis, particularly visceral, in the post deployment military population is known to be extremely low.
*Return to Table 2*

## 6.4 Water Contact Diseases

Leptospirosis is reportedly present in Bahrain but its prevalence and distribution are unknown. Operations or activities that involve extensive fresh water contact may result in individuals being exposed to leptospirosis. The occurrence of flooding after heavy rainfall facilitates the spread of leptospirosis; as water saturates the environment, leptospirosis present in the soil pass directly into surface waters. Activities such as wading or swimming in fresh water sources may result in exposures to enteric diseases such as diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact also may lead to the development of a variety of skin conditions, such as bacterial or fungal dermatitis. Elimination of standing, and/or open, bodies of fresh water protects against the spread of water contact diseases.

### 6.4.1 Short-term (Acute) Health Risk

**Approach:** The health risk for endemic water contact diseases to individuals deployed to Isa Air Base during the period of this assessment was epidemiologically assessed based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to Isa Air Base, and direct communication with military public health personnel stationed at Isa Air Base.

**Risk Assessment**: The short-term risk for leptospirosis is **low**.

**Medical Implications**: Leptospirosis, which has an incubation period of 5-14 days, presents as acute fever with nonspecific symptoms that last for 1 week to several months. Physicians should consider leptospirosis in their differential diagnosis whenever a patient presents with high fever, chills, headache, abdominal symptoms and a history of contact with surface water, soil or domestic animals within the surrounding countryside.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is high. No reported cases of water contact diseases were identified from Isa Air Base during the assessment period.

### 6.4.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 6.4.1 above.

**Risk Assessment**: The long-term risk for leptospirosis infection is **low**.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high. Incidence of water contact diseases in the post deployment military population is very low.
*Return to Table 2*

## 6.5 Respiratory Diseases

U.S. Service members living and working in close-quarter conditions are at risk for substantial person-to-person spread of upper respiratory infections such as the common cold and influenza. Primary exposure pathways for tuberculosis and Middle East Respiratory Syndrome (MERS), both present on the Arabian Peninsula, are prolonged close contact (generally several hours per day for greater than 3 days/week in a closed space) with the local population or third country national contractors. U.S. Service members who remain on Isa Air Base have limited contact with the local population, and local and third country nationals/contractors are required to complete health screening prior to employment.

### 6.5.1 Short-term (Acute) Health Risk

**Approach**: The health risk for respiratory diseases to individuals deployed to Isa Air Base during the period of this assessment was epidemiologically assessed based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to Isa Air Base, and direct communication with military public health personnel.

**Risk Assessment**:

- The short-term risk for upper respiratory infections is **low.** Risk is due to a high rate of personnel turnover, shared dining halls, berthing spaces, bathing and recreational facilities, and working spaces, which are not substantially different than those found in similar settings within the United States.
- The short-term risk for tuberculosis is **low**.
- The short-term risk for MERS is **low**.

**Medical Implications**:

- Upper respiratory infections, particularly from viral agents, can cause periodic outbreaks despite preventive measures. A small proportion of infections may require greater than 72 hours convalescence and/or hospitalization.
- **Tuberculosis**: Symptoms of tuberculosis, including fever, weight loss, night sweats and cough, typically start within 1-6 months of infection. The lifetime risk for tuberculosis disease after becoming infected is 5-10%; half of this risk occurs in the first two years following infection.
- **MERS**: MERS is a viral respiratory illness first reported in Saudi Arabia in 2012. Symptoms of MERS include fever, cough, and shortness of breath. The incubation period is typically 2-14 day.

**Confidence in the Risk Assessment**: Confidence in risk assessment is medium. Upper respiratory infections, especially those with short convalescence and lack of long term health effects, are not reportable for deployed military populations. WHO health statistics indicate low incidence of tuberculosis in the local population; no reports of tuberculosis were identified for individuals at Isa Air Base during the assessment period.

### 6.5.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 6.5.1 above.

**Risk Assessment**: The long-term risk for tuberculosis and MERS is **low**.

**Medical Implications**:

- **Tuberculosis:** Symptoms of tuberculosis can be delayed by two or more years following infection. Tuberculosis should be considered in assessing symptoms of fever accompanied by night sweats and cough.
- **MERS**: MERS should be included in the differential diagnosis for any patient with a history of travel from countries in or near the Arabian Peninsula within 14 days before symptom onset, or close contact with a symptomatic traveler who developed fever and acute respiratory illness (not necessarily pneumonia) within 14 days after traveling from countries in or near the Arabian Peninsula.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high. WHO health statistics indicate low incidence of tuberculosis in the local population; prevalence of tuberculosis in the post deployment military population is known to be extremely low.
*Return to Table 2*

## 6.6 Animal-Contact Diseases

Bahrain requires all cats and dogs to be vaccinated against rabies. For this reason, rabies is not common in Bahrain, but it can still be present stray in dogs, cats, bats, and other mammals. Anthrax is not present in Bahrain. Serologic evidence suggests the presence of Q-fever in humans throughout the Arabian Peninsula.

### 6.6.1 Short-term (Acute) Health Risk

**Approach:** The health risk for endemic animal contact diseases to individuals deployed to Isa Air Base during the period of this assessment was epidemiologically assessed based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to Isa Air Base, and direct communication with military public health personnel.

**Risk Assessment**: The short-term risk for rabies and Q-fever is **low**.

**Medical Implications**:

- **Rabies**: All unprovoked dog or wild animal bites should be medically evaluated for possible post-exposure rabies treatment.

- **Q-fever**: Acute Q-fever is usually a nonspecific febrile illness, often with atypical pneumonia or transient hepatitis. Sero-conversion without symptoms is common. As a rule, Q-fever is self-limiting and resolves without treatment, but some untreated cases may progress to chronic Q-fever (e.g., endocarditis, granulomatous hepatitis, osteomyelitis, interstitial pulmonary fibrosis).

**Confidence in the Risk Assessment**: Confidence in risk assessment is high. No reports of any animal contact diseases were identified during the risk assessment period.

6.6.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 6.6.1 above.

**Risk Assessment**: The long-term risk for rabies and Q-fever is **low**.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high. While actual disease prevalence in the local animal population is unknown the incidence of animal contact diseases in the post deployment military population is known to be extremely low.
*Return to Table 2*

## 7 Venomous Animals/Insects

The species listed below reside within and around Bahrain, and may present a health risk if encountered.

7.1 Short-term (Acute) Health Risk

**Approach:** The following information was obtained from Clinical Toxinology Resources via **http://www.toxinology.com/index.cfm**. The search consisted of looking for animals and/or insects present on the Arabian Peninsula and/or specifically in Bahrain. The following list should not be considered inclusive; other venomous scorpions and snakes may be present in the region. See Section 10 for more information about pesticides and pest control measures.

**Risk Assessment**:

- Spiders: Numerous species of spiders are found in Bahrain. None pose a health risk to humans. **No health risk associated** with spiders was identified.
- Scorpions: Three species of scorpion are found in Bahrain, including *Buthacus yotvatensis, Buthacus leptochelys and Orthochirus innesi.* Stings by these scorpions are likely to cause only short lived local effects, such as pain, without systemic involvement. Health risk is **low**.
- Snakes: Eleven species of snakes are found in Bahrain and in the surrounding waters of the Persian Gulf. Only the sea snakes are venomous. The following are known to be present in the waters surrounding Bahrain and could pose a health risk, if encountered*: Hydrophis cyanocinctus, Pelamus platurus, Astrotia stokesii, Enhydrina schistose, Hydrophis gracilis, Hydrophis lapemoides Hydrophis ornatus, Hydrophis spiralis,*

*Hydrophis viperina, and Lapemus curtus*. Overall, the health risk associated with snakes is **low**.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high.

7.2 Long-term (Chronic) Health Risk

**Approach**: Application of the same approach referenced in Section 7.2 above.

**Risk Assessment**: No chronic health risk associated with venomous animals or insects was identified.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Confidence in risk assessment is high.
*Return to Table 2*

## 8 Heat/Cold Stress

8.1 Site-Specific Conditions

Bahrain is classified as a desert climate with hot and very dry weather conditions. During the summer months, from April to October, afternoon temperatures average 104°F and can reach 118.4°F during June and July. Temperatures are moderate in the winter months; from November to March, when the range is between 50 and 68°F. Although, humidity often rises above 90%.

### 8.2 Heat

8.2.1 Exposure Guidelines

U.S. military doctrine requires that heat advisory conditions are communicated to the base population by displaying color-coded flags based on Wet Bulb Globe Temperature (WBGT) measurements. Wet Bulb Globe Temperature measurements are a composite temperature used to estimate the effect of temperature, humidity, wind speed, and solar radiation on individuals. The WBGT reading drives preventive measures, such as adjusting work/rest cycles and limiting outdoor activities, to reduce the risk of heat injury. The range of WBGT measurements and their corresponding color-coded flags are as follows:

- Less than 80 White
- 80 – 84.9 Green
- 85 – 87.9 Yellow (Amber)
- 88 – 89.9 Red
- 90 or above Black

### 8.2.2 Sample Data/Notes

Per the 2015 baseline industrial hygiene survey, preventive medicine personnel assigned to the clinic at Isa Air Base monitor heat stress conditions hourly until Black Flag conditions are reached. Once the WBGT reaches 90°F, Black Flag conditions are set for the remainder of the work day. No heat stress monitoring data available for Isa Air Base.

### 8.2.3 Short (Acute) and Long-term (Chronic) Health Risk

**Approach**: No heat casualty, medical event reports involving heat injuries or heat stress monitoring data were available in the DOEHRS or MESL for Isa Air Base. Risk estimates are based strictly on climatologic data.

**Risk Assessment**:

- Short-term health risk of heat injury for unacclimatized individuals (i.e. on site less than four weeks) and those with underlying health conditions is **moderate**. For all other individuals, the risk is **low**.
- Long-term health risk is l**ow.**

**Medical Implications:** Severity of heat illness can range from mild clinical signs (such as clamminess, nausea, disorientation or headache) to life threatening symptoms requiring hospitalization. Long-term medical implications from heat injuries are rare but can occur, especially from more serious injuries such as heat stroke. Individuals with a history of heat injury, even when medical attention was not sought, are at increased risk for future heat injury; repeat heat injury may have increased severity.

**Confidence in the Risk Assessment**: Based on available information on climatic conditions and the heat stress prevention program, the confidence in risk assessment is high. An underestimation of risk may occur with individuals that fail to seek medical attention when experiencing mild symptoms of heat illness.
*Return to Table 2*

## 8.3 Cold

### 8.3.1 Short (Acute) and Long-term (Chronic) Health Risk

**Approach**: No cold casualty, medical event reports involving cold injuries or cold stress monitoring data were available in the DOEHRS or MESL for Isa Air Base. Risk estimates are based strictly on climatologic data.

**Risk Assessment**: **None identified** due to Bahrain's arid climate comprised of an extremely hot summer and a relatively mild winter.

**Medical Implications**: None identified.

**Confidence in the Risk Assessment**: Based on available information on climatic conditions, the confidence in risk assessment is high.

# 9 Noise

## 9.1 Continuous

### 9.1.1 Exposure Guidelines

The Services have established occupational exposure limits (OEL) for continuous or intermittent noise at 85 decibels on the A-weighted scale (dbA) focused on occupational noise exposures and the prevention of noise-induced hearing loss. These standards may be adjusted for longer work shifts, up to a maximum of 16 hours (see table below). A minimum eight-hour recovery time is required between shifts.

| 8 Hour | 12 Hour | 16 Hour |
|---|---|---|
| 85 | 82.375 | 82 |

### 9.1.2 Site Specific Conditions

Sources of potential noise include flight line operations, associated with both fixed and rotary wing aircraft, tactical generators, forklifts and various hand tools in maintenance shops. Support personnel working in the flight line area of the aircraft operations are exposed to significant noise hazard with noise levels ranging from 100 to 110 dbA, during intermediate and full power runs by fixed wing aircraft. Due to the potential noise hazard, inherent in flight line operations, personnel are required to wear dual hearing protection. Hand tools capable of producing hazardous noise are labeled and hearing protection for individuals potentially exposed are readily available.

Sound level measurements were taken for various potential noise generating activities, including flight line operations and hand tool use, during the August 2015 Baseline Industrial Hygiene Survey conducted by Naval Branch Medical Clinic, Bahrain. Sound levels exceeded the OEL on several instances including measurements of 103 dbA during aircraft takeoff.

### 9.1.3 Short (Acute) and Long-term (Chronic) Health Risk

**Approach:** Knowledge of the Service hearing conservation programs and sound pressure level measurements from various potential noise generating areas obtained during the baseline industrial hygiene surveys completed in 2015 were evaluated to complete the health risk assessment.

**Risk Assessment**:

- Short-term health risk: The short-term risk of noise induced hearing loss with the use of appropriate hearing protection use is **low**. Few exposed individuals are expected to experience noticeable short term health effects such as annoyance, speech interference, fatigue and temporary hearing threshold shifts during deployment.
- Long-term health risk: The long-term risk of noise induced hearing loss with appropriate hearing protection use is **low**.

**Medical Implications**: U.S. Service members routinely exposed to noise levels in excess of 85 dbA require enrollment in hearing conservation program. This includes periodic monitoring audiograms to detect temporary and/or permanent changes in hearing thresholds.

**Confidence in the Risk Assessment**: Confidence in the health risk assessment is medium. The services have well established hearing conservation programs; hearing protection is readily available and generally worn by individuals with known occupational exposures. However, the limited availability of noise exposure data diminishes confidence that all potential hazardous noise sources have been identified.

## 9.2 Impulse

### 9.2.1 Site Specific Conditions

Several hundred U.S. Service members on base are required to maintain their small arms qualification up to four times per year. Consequently, they are periodically exposed to impulse noise associated with small arms fire at the base's weapons range. Sound levels associated with weapons firing have been known to exceed peak sound pressure levels of 140 dbA.

### 9.2.2 Short (Acute) and Long-term (Chronic) Health Risk

**Approach:** Knowledge of the Service hearing conservation programs and the safety/health procedures used during weapons qualification were used to complete the health risk assessment.

**Risk Assessment**:

- The short-term risk of noise induced hearing loss with the use of appropriate hearing protection use is **low**. Few exposed individuals are expected to experience noticeable short term health effects such as annoyance, speech interference, fatigue and temporary hearing threshold shifts during deployment.
- The long-term risk of noise induced hearing loss with appropriate hearing protection use is **low**.

**Medical Implications**: U.S. service members routinely exposed to impulse noise require enrollment in hearing conservation program. This includes periodic monitoring audiograms to detect temporary and/or permanent changes in hearing thresholds.

**Confidence in the Risk Assessment**: Confidence in the health risk assessment is medium. The services have well established hearing conservation programs; hearing protection is readily available and generally worn by individuals with known occupational exposures.
*Return to Table 2*

# 10 Unique Concerns

## 10.1 Asbestos and Lead-Based Paint

### 10.1.1 Site Specific Conditions

No asbestos containing material (ACM) or peeling lead-based paint was identified in the baseline industrial hygiene survey for Isa Air Base, which was completed in August 2015.

### 10.1.2 Short-term (Acute) and Long-term (Chronic) Health Risk

**Approach**: No asbestos and lead-based paint identified in baseline industrial hygiene survey.

**Risk Assessment**:

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

**Confidence in the Risk Assessment**: While there is limited industrial hygiene data available, the overwhelming majority of the structures on site have been recently renovated or are under new construction; confidence in health risk assessment is medium.

## 10.2 Potential Environmental Contamination Sources

### 10.2.1 Site Specific Conditions

In addition to environmental exposures discussed above, there may be specific occupational exposure pathways associated with vehicle, aircraft and site maintenance. Typical chemicals of concern associated with potential occupational exposures are petroleum, oils, and lubricants. Limited industrial hygiene data exists to document the significance of occupational exposures. Procedures are in place for storage, handling, use and disposal of hazardous materials for Isa Air Base, which generally minimizes health risk.

### 10.2.2 Short-term (Acute) and Long-term (Chronic) Health Risk

**Approach**: Review of existing industrial hygiene data for Isa Air Base.

**Risk Assessment**:

- Short-term health risk is **low**.
- Long-term health risk is **low**.

**Confidence in the Risk Assessment**: Due to limited industrial hygiene sampling data, confidence in the health risk assessment is low.

## 10.3 Pesticides/Pest Control

### 10.3.1 Site Specific Conditions

Pest control services on Isa Air Base are provided through contract services. Contract personnel are required to meet DOD certification requirements or hold an active state pest control operator license. Pest management services include the control of arthropod and vertebrate pests in and around buildings. Sanitation, glue traps, and exclusion are the primary means of non-chemical control in and around structures. Low toxicity insecticidal baits are used effectively for cockroaches and ants. Most pesticides used on site consist of contact chemicals or those that degrade rapidly in the environment.

### 10.3.2 Short term (Acute) and Long-term (Chronic) Health Risk

**Approach**: Knowledge of Department of Defense (DOD) and Department of the Navy (DON) policies, which require that contractor provided pest control services be reviewed for compliance with DOD and DON policy. In addition, the Navy Entomology Center of Excellence was consulted for their knowledge of pest management activities at Isa Air Base.

**Risk Assessment**:

- Short-term health risk: **None identified**.
- Long-term health risk: **None identified**.

**Confidence in the Risk Assessment**: Confidence in the risk assessment is high. The integrated pest management plan emphasizes non-chemical control over the use of chemical pesticides. The potential for base residents to come in contact with improperly formulated insecticides is remote.

## 11 References

*POEMS developed according to:*

1. DoDI 6490.03, *Deployment Health*, September 2011.
2. MCM 0017-12, *Procedures for Deployment Health Surveillance,* December 2012.
3. DoDI 6055.05, Occupational and Environmental Health, 2010.
4. Klaassen, C.D. *Casarett & Doull's Toxicology: the Basic Science of Exposures*, Chapter 2, Principles of Toxicology; Fifth Edition, McGraw Hill, New York.

*Site description and baseline information obtained from:*

5. Occupational and Environmental Health Site Assessment, Sheik Isa Air Base, September 2014.
6. Occupational and Environmental Health Site Assessment, Sheik Isa Air Base, September 2015.
7. Bahrain Post Report – eDiplomat – Area, Geography and Climate, December 2005
8. US Navy Overseas Water Quality Oversight Council (WQOC) Sanitary Survey of the Drinking Water System at Isa Air Base, Bahrain (Draft), April 2015
9. Integrated Pest management Plan – Isa Air Base, Bahrain: December 2010

*Sampling data were obtained from the:*

10. Defense Occupational and Environmental Health Readiness System at https://doehrs-ih.csd.disa.mil/Doehrs/. Baseline Industrial Hygiene Survey Report, Isa Air Base Detachment, Bahrain, September 28, 2015.

*Additional environmental health reports/survey documents are from the:*

11. Military Exposure Surveillance Library: https://mesl.apgea.army.mil/mesl/.

*Chemical hazards (air, water, soil) evaluated based on military exposure guidelines (MEGs) and risk assessment methodology in:*

12. USAPHC Technical Guide (TG230), Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel, December 2013 Revision. For further information, contact USAPHC Environmental Health Risk Assessment Program at: commercial 410-436-2953 or DSN 584-2953.
13. USACHPPM, Particulate Matter Factsheet No. 64-009-0708, 2010.
14. Department of the Army Technical Bulletin Medical (TB MED) 577, *Sanitary Control and Surveillance of Field Water Supplies*, TB Med 577, NAVMED P-5010-10, AFMAN 48-138, 1 May.

*Regional/country information on endemic/infectious disease and heat/cold from the:*

15. Centers for Disease Control and Prevention (CDC) Travelers' Health website (http://wwwnc.cdc.gov/travel/destinations/Bahrain.htm), "Destinations" section, Bahrain.
16. World Health Organization Country Profiles/Bahrain (http://www.who.int/countries/bhr/en/)
17. Clinical Toxinology Resources, University of Adelaide, Australia; http://www.toxinology.com/index.cfm.

*NOTE. The DOEHRS-EH database was queried to obtain the available sample data for air, soil, and drinking and nondrinking water sources at Isa Air Base, Bahrain. The data are currently assessed using the TG230 December 2013 Revision as described above contains, the general method involves an initial check of the data which eliminates all chemical substances not detected above 1-year 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 health risk). This is performed by deriving separate short-term and long-term population exposure level estimates (referred to as population exposure*

*point concentrations) that are compared to MEGs derived for similar exposure durations. If exposure point concentrations are less than or equal to Negligible MEGs, the risk is low. If levels are higher than the respective Negligible MEG, then a chemical-specific toxicity and exposure evaluation is completed by appropriate subject matter experts, which includes comparison to any available marginal, critical, or catastrophic MEGs. For drinking water, 15-L/day MEGs are used for screening while site specific 5–15L/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 USEPA regulatory limits), which is derived by multiplying the 5-L/day MEG by a factor of 2.5. This value is used to conservatively assess nondrinking 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.

**Army Public Health Center** Phone: (800) 222-9698. **http://phc.amedd.army.mil/**

**Navy and Marine Corps Public Health Center (NMCPHC)** Phone: (757) 953-0700. **http://www-nmcphc.med.navy.mil/**

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

**DOD Health Readiness Policy and Oversight** Phone: (800) 497-6261. **https://health.mil/Military-Health-Topics/Health-Readiness**