Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS): Prince Sultan Air Base (PSAB), Kingdom of Saudi Arabia (KSA)
Calendar Years: January 1, 2021 – December 31, 2022

AUTHORITY: The USAF Bioenvironmental Engineering (BEE) section at PSAB authored this POEMS in accordance with Department of Defense Instructions (DODI) 6490.03, 6055.05, and JCSM (MCM) 0028-07. See REFERENCES.

PURPOSE: This POEMS documents the Department of Defense (DoD) assessment of Occupational and Environmental Health (OEH) risk for PSAB, KSA. It includes PSAB and other military camps in the immediate vicinity where US Personnel live or work. We based this report on information collected from July 2019 to December 2022 such as OEH 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. It presents a qualitative estimate of population-based health risks identified at this location and their potential medical implications.

The environmental sampling at PSAB during this period occurred at exposure points selected to characterize health risks at the *population–level.* Due to the nature of environmental sampling, the data in this report does not represent all the fluctuations in the environment 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, this health risk assessment is limited to January 2021 – December 2022.

The POEMS informs healthcare providers and others of OEH conditions experienced by individuals deployed to PSAB during this assessment period. However, it does not represent an individual exposure profile. Individual exposures depend on variables such as duration, frequency, where and what someone is doing when spending time outside. Environmental sampling cannot identify individual outdoor activities and associated routes of exposure as these are extremely variable over time and space. Individuals who sought medical treatment related to OEH exposures while deployed should have exposures & treatments in their medical record on a Standard Form (SF) 600 – Chronological Record of Medical Care.

Health protective exposure assumptions are used in the assessment of all health risks, i.e. the resident population is assumed to be constantly exposed to environmental conditions. Small groups of personnel assigned to PSAB or the local vicinity addressed in this summary may be at greater risk than the general population due to operational requirements; these groups are identified when appropriate.

SUMMARY: Table 1 summarizes conditions with an estimated health risk of Moderate or greater. Table 2 provides population based risk estimates for OEH conditions at PSAB and/or camps in the vicinity. As indicated in the sections that follow Table 2, we factored controls established to reduce health risk into this assessment. In some cases, e.g. ambient air, specific controls are noted but not routinely available or feasible.

Table 1: Summary of Occupational and Environmental Conditions with MODERATE or Greater Health Risk
Short-term health risks & medical implications: Exposures associated with the following environmental stressors may be associated with potential acute health effects in some personnel during deployment at PSAB and other military facilities in the immediate vicinity. <u>Food/Waterborne Diseases:</u> For personnel that consume non-approved local food, ice or water, there is a varying potential for food/waterborne diseases, such as Diarrhea-bacterial (High Risk) and Hepatitis A (Medium Risk), Typhoid fever (Medium Risk) and Diarrhea-protozoal (Medium Risk). The health effects of these diseases can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (Hepatitis A, Typhoid fever, Hepatitis E). Personnel can reduce risks from food or waterborne diseases with preventive medicine controls and mitigation, such as Hepatitis A and Typhoid fever vaccinations, drinking and eating only from approved sources in accordance with standing CENTCOM policy year round. <u>Endemic Diseases:</u> Leishmaniasis, Middle East Respiratory Syndrome Coronavirus (MERS-CoV), Sand Fly fever, Typhoid, Leptospirosis, Tuberculosis (TB), Meningococcal meningitis, Rabies, Q fever, H5N1 avian influenza <u>Vector-Borne Endemic Diseases</u>: Leishmaniasis – cutaneous (Medium Risk), Sand Fly fever (Low), West Nile fever (Low). These diseases may constitute a significant risk year round, peaking from April through October 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, efforts by Pest Management to minimize the biting vectors, and appropriate chemoprophylaxis. <u>Respiratory Diseases:</u> Coronavirus disease 2019 (COVID-19) (Medium risk), Tuberculosis (Low risk). There is sustained transmission of COVID-19 in the KSA and even short interactions can cause disease transmission. Tuberculosis occurs in the KSA and is more common in the nations that many of our OCNs come from. Personnel in close-quarter conditions are at risk for person-to-person spread of TB. <u>Animal Contact Diseases:</u> Q Fever, rabies, and H5N1 Avian influenza are low-risk all year. For venomous animals (vipers, scorpions) and insects, effects of venom vary with species from mild localized swelling to potential lethal effects; risks reduced by avoiding contact and proper and timely treatment. <u>Heat Stress</u>: (High Risk) Probability of exposure is certain and effects of exposure (stroke/death) are critical. Risk can be greater for susceptible persons including those older than 45, of low fitness level, un-acclimatized, or with underlying medical conditions. Personnel can reduce risks from heat stress with preventive medicine controls, work-rest cycles, and mitigation. <u>Air Quality</u>: (Moderate Risk) 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. Certain subgroups of deployed forces, such as those with pre-existing Asthma/COPD/confounding deployment exposure are at greatest risk of developing notable health effects such as cardiovascular and respiratory effects.
Long-term health risks & medical implications: Exposures associated with the following environmental stressors may be associated with potential chronic health effects in some personnel during deployment at PSAB and the local vicinity: <u>Food/Waterborne Diseases:</u> People do not fully understand the long-term effects of foodborne and waterborne diseases, and ongoing research is producing new findings. Illnesses caused by bacteria also increase the risk of developing irritable bowel syndrome. <u>Endemic Diseases:</u> Mucosal leishmaniosis usually becomes clinically evident within several years (sometimes as long as decades) of the original cutaneous lesions. Several studies have shown that many patients suffer from persistent fatigue after acute Q-fever. Post Q-fever Fatigue Syndrome has symptoms that can last up to 10 years. <u>Respiratory Diseases:</u> When TB goes untreated for a long duration, it might lead to permanent damage of the lungs and respiratory tracts. COVID-19 is still a new disease, and the long-term effects are unknown. Documented cases of long-term disability from COVID-19 (> 1 year) are reported in the literature. <u>Heat Stress</u>: NIOSH reports that some researchers believe long-term heat exposure causes heart, kidney, and liver damage. However, the evidence supporting these associations is not conclusive. Heat exposure has been associated with temporary infertility in both women and men, with the effects more pronounced in men. Sperm density, motility, and the percentage of normally shaped sperm can decrease significantly when the temperature of the groin is too high. <u>Air Quality</u>: Control measures have limited efficacy for particulate matter (PM). During this deployment, sampling of outdoor conditions compared to indoors have shown that moving work indoors and utilizing the cardio tent vs running outdoors during

poor air quality days will reduce exposure significantly (on average by 43%). The residual risk is not similar to unmitigated risk if adequate monitoring and mitigation tools are given to the community.

Air Quality: For particulate matter (PM), it has been reported that control measures have limited efficacy, but during this deployment sampling of outdoor conditions compared to indoors have shown that moving work indoors and utilizing the cardio tent vs running outdoors during poor air quality days will reduce exposure significantly (on average by 43%). Thus the residual risk is not similar or identical to unmitigated risk if adequate monitoring and mitigation tools are given to the community. Although most effects from exposure to particulate matter should have diminished post-deployment, providers should be prepared to consider the relationship between deployment exposures and current complaints. Additionally, providers should be aware of evidence based health effects of ultra-fine ($PM_{2.5}$), supported by the EPA, and how exposures can have acute and chronic cardiovascular and respiratory effects.[6] Some individuals may have sought treatment for acute respiratory irritation during their time at PSAB. Personnel who reported with symptoms or required treatment while at this site should have exposure/treatment noted in medical record (e.g., electronic medical record and/or on a Standard Form (SF) 600 (Chronological Record of Medical Care).

Table 2: Population-Based Health Risk Estimates – PSAB – KSA[1]

Source of Identified Health Risk[2]	Unmitigated Health Risk Estimate[3]	Control Measures Implemented[4]	Residual Health Risk Estimate[3]
Air			
Particulate matter less than 10 microns in diameter (PM_{10}) (see paragraph 2.3)	**Short-term:** Low Risk BEE collected over 50 air samples for measuring PM_{10} at the old PSAB. However, these are not representative of the current PSAB location or exposure level due to intense construction and dust producing activities. The peak concentration did not exceed TG 230's Short Term (< 24 Hr) Negligible MEG. Long Term MEGs are not defined. Due to not collecting PM10 data and current focus on health effects coming from PM2.5, we estimate this health risk as low. Monitoring and controls used to mitigate PM2.5 can be beneficial in controlling exposure to PM10 as well. **Long-term:** Health guidelines not defined.	Base Weather sends out an Air Quality Health Advisory through Signal, AtHoc, email, and posts to PSABs app. The advisory states, "Be aware, the 378th Expeditionary Medical Squadron recommends that you limit or eliminate outdoor exposure as much as feasible during low visibility dust storms. If you are required to be outdoors, wear eye goggles and a facemask or balaclava to reduce fine particulate matter exposure to eyes, nose, and lungs. Recommend eliminating outdoor physical exercise." Most personnel live and work in air-conditioned tents for comfort purposes. Setup and advocated use of cardio tent with doors kept closed for those seeking cardiovascular exercise during days with ongoing dust storms and/or reduced visibility.	Short-term: **Low Risk;** For particulate matter (PM), it is debatable if control measures have efficacy.[4] **Long-term:** Health guidelines not defined.
Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) (see paragraph 2.4)	**Short-term:** Moderate Risk The primary sources are dust from onsite construction, dust storms, onsite diesel generators, and $PM_{2.5}$ kicked up from the soil by natural weather conditions. We do not expect Al-Kharj vehicle traffic to be a major source of $PM_{2.5}$. Al-Kharj	Base Weather sends out an Air Quality Health Advisory on Signal, AtHoc, e-mail, and posted to PSABs app. The advisory states: "Be aware, the 378th Expeditionary Medical Squadron recommends that you limit or eliminate outdoor exposure as much as feasible during low	**Short-term:** Low Risk for particulate matter (PM) if personnel stay inside during windy conditions. It is debatable if other control measures have efficacy.[4]

Table 2: Population-Based Health Risk Estimates – PSAB – KSA[1]

Source of Identified Health Risk[2]	Unmitigated Health Risk Estimate[3]	Control Measures Implemented[4]	Residual Health Risk Estimate[3]
	industrial plants may contribute to $PM_{2.5}$ concentrations. Currently DOEHRS has $PM_{2.5}$ sample data available at PSAB from 2020 and 2021. We are awaiting results from 2022 sampling. Of the 82 published sample results, all detected PM2.5. Five samples exceeded the marginal limit for 24-hour exposure, and 43 samples exceeded the marginal limit for 1-year exposure. The one sample collected during a dust storm was above the Critical 24 Hour MEG. Reporting of acute health effects to the eye, nose or throat irritation from exposure were minimal from July 2019 until the present. Sustained dust storms with low visibility causes a few patients per day to the clinic with corneal abrasions, increased allergies, and respiratory irritation. This dust can exacerbate existing medical conditions such as asthma or respiratory diseases for a small segment of the deployed population.	visibility dust storms. If you are required to be outdoors, wear eye goggles and a face mask or balaclava to reduce fine particulate matter exposure to eyes, nose, and lungs. Recommend eliminating outdoor physical exercise." Most personnel live and work in air-conditioned tents for comfort purposes. Advocated use of indoor cardio tent with doors kept closed for those seeking cardiovascular exercise during days with ongoing dust storms and/or reduced visibility. Monthly $PM_{2.5}$ sampling is needed to fully support health risk estimate. This and future risk assessments at all AOR locations need to consider evidence based health effects of ultra-fine ($PM_{2.5}$), supported by the EPA, and how exposures can contribute to chronic effects like cardiovascular symptoms later in life.	
	Long-term: same as above		**Long-term:** Moderate; For particulate matter (PM), it is debatable if control measures have efficacy.[4] $PM_{2.5}$ data collected in 2020 suggest limiting outdoors activities during poor air quality days can significantly reduce exposure.
Airborne Metals & Chemicals (see paragraph 2.5)	**Short-Term:** Low Risk. BEE personnel collect 1-2 air samples per month and ship to USAPHC to analyze for presence of metals, organics and particulate matter. Historically, these samples show no heavy metals. One sample collected in November 2021 recorded lead at the Limit of Detection. We are waiting for the USAPHC to publish the 2022 samples in DOEHRS.	Specific controls not implemented due to no known metal or chemical airborne health concerns. Most personnel live and work in air-conditioned tents for comfort purposes. Advocated use of indoor cardio tent with doors kept closed for those seeking cardiovascular exercise during days with ongoing dust storms and/or reduced visibility.	**Short-Term:** Low Risk if personnel remain inside during windy conditions. The only personnel at medium risk are Security Forces at the Entry Control Points during windy conditions. **Long-Term:** Same as Short-Term.

Table 2: Population-Based Health Risk Estimates – PSAB – KSA[1]			
Source of Identified Health Risk[2]	**Unmitigated Health Risk Estimate[3]**	**Control Measures Implemented[4]**	**Residual Health Risk Estimate[3]**
	Data going back to 2020 detects multiple organics. These include acetone, toluene, isopropanol, methylene chloride and other chemicals commonly used in aircraft maintenance processes such as corrosion control. Sampling also detected common refrigerants such as Dichlorodifluoromethane and Trichlorofluoromethane. Their presence is probably due to the large number of air conditioning and gasoline powered generator units on PSAB. The detected chemicals are present at a fraction of their OSHA action levels, and do not pose a health risk. **Long-Term:** Low Risk for the same rationale as above.		
Soil			
Soil (see paragraph 3)	**Long-term and Short-Term:** Low Risk as the 10 samples collected since March 2020 indicate no major contamination concerns in rock/sand mixture used to construct the LSA, the Host Nation Firing Range, or sand sampled at the Army sites on PSAB. These results are in DOEHRS. Future rotations should expand on this sampling as needed. DOEHRS IDs are UL50, UK3P, UK3S, UK3H, RFSD, RFSC, RFRZ, RFSF, RFSE, and RFSG.	Personnel quickly clean fuel spills or hydraulic leaks if they occur, or are allowed to evaporate during high temperatures as it is quicker and does not generate HAZWASTE. ECES personnel cover overflow from solid-waste lift stations with calcium hydroxide (lime) and left to sit for 24 hours. After 24 hours, they remove the excess lime from the soil surface to mitigate contact and inhalation hazards.	Short-Term: **Low Risk** Long-term: **Low Risk**
Water			
Consumed Water (Water Used for Drinking) (see paragraph 4.2)	**Long-term and Short-Term:** Low Risk as base provides bottled water approved by U.S. Army Veterinarian Service, and packaged water from the Expeditionary Water Packaging System for drinking. DFAC coffee drinkers may consume small volumes of water each day. PSAB uses Point of Entry (P OE) Treatment systems in the LSA, OPS Town, and Boardwalk DFACs for use in cooking, washing food, and some beverages. POE systems use 5-	US Army obtains water samples at bottled water vendors prior to approving the vendor. The USAPHC analyzes water samples for LTP standards and posts results in DOEHRS. PSAB only purchases bottled water approved by U.S. Army VETCOM. BE samples each new lot of bottled water for bacteria, pH and chlorine levels upon delivery to PSAB. If bottled water from the same lot arrives at PSAB > 30 days	**Long-term and Short-Term:** Low Risk as long as base personnel observe water vendor approval and water sampling procedures. See the SAM plan that BE updates every rotation for details.

Table 2: Population-Based Health Risk Estimates – PSAB – KSA[1]			
Source of Identified Health Risk[2]	**Unmitigated Health Risk Estimate[3]**	**Control Measures Implemented[4]**	**Residual Health Risk Estimate[3]**
	micron filter, granulated activated carbon and UV treatment to treat water. ECES conducts maintenance monthly. One time during Jan – Jul 2021 the OPS Town tested positive for coliforms, and negative for E. Coli. Personnel implemented corrective actions and sampling results returned to normal within 2 duty days. The water samples in the 'Water used for other purposes (non-drinking)' section below is the same water prior to entering the filtration system. While the bulk water is of drinking water quality, personnel do not use it as the primary drinking water source.	since the last delivery, BE will sample that lot again. Once a rotation, BE sends bottled water samples for LTP testing at USAPHC. BE personnel sample the water from POE systems weekly for in-house testing for bacteria, pH and Cl. EFSS personnel monitor POE systems daily. ECES personnel routinely replace POE treatment filters.	
<u>Water used for other purposes (non-drinking)</u> (see paragraph 4.3)	**Short-term and Long-term:** Low Risk as water samples from taps and showers consistently test negative for fecal and total coliforms, and within acceptable range of pH and Cl. PSAB has contracted with multiple water vendors in the past. As of 23 September 2022, ECES has a bulk water contract with two separate contractor, the Arwadh contracts expired in July 2022, while the SNS contract expires in November of 2022. Results should be available in DOEHRS in early 2023. Sha's Company obtains water from two water treatment plants, one in Riyadh and one in Al Kharj. BEE obtained water samples from both plants in August 2022 and delivered them to USAPHC for analysis. Results should be available in DOEHRS in early 2023	Base personnel collects water samples to measure LTP parameters every rotation (6 months). USAPHC analyzes the samples for VOCs, SVOCs, inorganics, metals and radio nucleotides, and publishes results to DOEHRS. The concentrations of most parameters are below detection limits. The few detected parameters are below MEGs. Water surveillance: BE collects ~32 samples per month. BE works closely with 378 ECES to maintain residual chlorine levels IAW AFMAN 48-138 standards. BE chairs monthly Water Working Group along with ECES. BE established an SAM Plan that samples for required parameters IAW with BE Field Guide.	**Short-term and Long-term:** Low Risk as water samples always test negative for fecal and total coliforms, and within acceptable range of pH and Cl. DOEHRS ID RT14 is representative of Royal Saudi Air Force (RSAF) water from their treatment plant. This one representative sample is high in chloride, magnesium, sulfate, and total dissolved solids (TDS). PSAB does not use RSAF water, as it is only available via an MOA in case of emergency loss of water from contractor deliveries.
Military Unique			
<u>Chemical Biological, Radiological Nuclear (CBRN) Weapons</u> (see paragraph 5.1)	**Long-term and Short-term:** Low Risk as current intelligence has not identified a CBRN threat to PSAB.	MOPP Level posturing, if needed	**Long-term and Short-term:** Low Risk as current intelligence has not identified a CBRN threat to PSAB.
<u>Ionizing Radiation</u> (see paragraph 5.3)	**Long-term and Short-Term:** Low Risk as only low-level x-rays and check sources present.	Administrative controls (training, IRSO directed guidance for X-ray machines used in un-shielded	**Long-term and Short-Term:** Low Risk as only low-level x-rays and check sources present.

Table 2: Population-Based Health Risk Estimates – PSAB – KSA[1]

Source of Identified Health Risk[2]	**Unmitigated Health Risk Estimate[3]**	**Control Measures Implemented[4]**	**Residual Health Risk Estimate[3]**
		locations, clearing areas when x-ray equipment activated, personal dosimetry, etc.) Engineering controls (leaded barriers, leaded vests, kill switches)	
Non-ionizing Radiation (see paragraph 5.4)	**Long-term and Short-Term:** Low Risk due to multiple sources throughout U.S. areas. EMF levels not detectable outside of barrier tape. Radars located on PSAB proper have potential to cause an exposure above the upper tier MPE.	Administrative controls (angling of emitter, signage, barrier tape, entry control points)	**Long-term and Short-Term:** Low Risk due to multiple sources throughout U.S. areas. EMF levels not detectable outside of barrier tape. Radars located on PSAB proper have potential to cause an exposure above the upper tier MPE.
Endemic Disease			
Gastrointestinal (same as Food borne/Waterborne (e.g., diarrhea-bacteriological) (see paragraph 6.2)	**Short-term:** Moderate Risk if ingesting unapproved local food/water, the health effects can temporarily incapacitate personnel (diarrhea) or result in prolonged illness (hepatitis A, typhoid fever, brucellosis, hepatitis E). Viral gastroenteritis can be present due to a high rate of personnel turnover and shared dining, berthing, bathroom facilities, and working spaces.	Standard Preventive Medicine measures: Hand washing, immunizations (hepatitis A and typhoid fever), the consumption of food and water from approved sources, and habitability inspections to ensure cleanliness and sanitation.	**Short-term:** Low Risk based on disease incident reporting in KSA. Bacterial and protozoal gastrointestinal diseases, cholera, brucellosis, and hepatitis E infections present a low risk. Norovirus and other potential risk were mitigated effectively through implementation of adequate hygiene practices.
	Long-term: Low Risk as most gastrointestinal diseases do not cause prolonged illness.		Long-term: **Low Risk**; based on disease incident reporting from KSA.
Arthropod Vector Borne (see paragraph 6.3)	**Short-term:** Moderate Risk; Competent vectors and reservoirs for disease are present. Risk is for Sand Fly fever, West Nile fever, Crimean-Congo hemorrhagic fever, rickettsioses (tick-borne spotted fever group and murine typhus).	Standard Preventive Medicine measures: proper wearing of insecticide-treated uniforms and the application of insect repellent to the skin, removal of vector harborages within camps, and the application of pesticides.	**Short-term:** Low Risk based on efficacy of control measure as evidenced by lack of disease(s) reported in various medical surveillance data bases e.g. DRSi.
	Long-term: Low Risk; It is possible to be infected during deployment with leishmaniosis, but not to have clinically evident disease until redeployed.		**Long-term:** Low Risk based on disease incident reporting from KSA.
Respiratory (see paragraph 6.5)	Short-term: **Moderate Risk;** for COVID-19 and TB **Low Risk** for upper respiratory infections such as influenza.	Personnel receive influenza immunizations either before or during deployment. Local and third country national workers & contractors are required to complete health screening prior to employment. The Post Deployment Health Assessment addresses	Short-term: **Low Risk;** For upper respiratory such as influenza. **Low to Moderate Risk** for COVID-19 and TB. Based on efficacy of control measure as evidenced by lack of disease(s) reported in various medical surveillance databases e.g, DRSi.

	Long-term: **Low Risk**; The majority of respiratory diseases do not cause prolonged illness.	potential COVID-19 and tuberculosis exposure.	Long-term: **Low Risk** based on disease incident reporting from KSA.
Animal Contact (see paragraph 6.6)	Short-term: **Low Risk;** There are a significant number of vectors within the living areas. The vectors tend to be more of an issue during the fall/winter season. Rabies based on disease incident reporting from KSA is **moderate risk**.	Standard Preventive Medicine measures, as well as COCOM policy, generally prohibit contact with, adoption, or feeding of feral animals. Immunizations for rabies (rabies vaccination and/or immune globulin given if clinically directed).	Short-term: **Low to Moderate Risk** based on disease incident reporting from KSA.
	Long-term: **Low Risk** based on disease incident reporting from KSA.		Long-term: **Low Risk** based on disease incident reporting from KSA.
Venomous Animal/ Insects			
Snakes, scorpions, and spiders (see paragraph 7)	**Long Term and Short-term:** Medium Risk based on disease incident reporting from KSA and the average of 1 incident per month on PSAB.	Standard Preventive Education on how to avoid them, such as shaking out boots before donning. Anti-venom is available at this Host Nation Hospital. Providers can issue this with critical care treatment to offset side effects of the anti-venom/venin.	**Long Term and Short-term:** Moderate Risk as the installation is in an area where snakes, scorpions and spiders are common. CE Pest Management controls them on the LSA.
Heat/Cold Stress			
Heat (see paragraph 8.2)	Short-term: **High Risk** of heat injury in summer months of May-September for all personnel.	7 days acclimatization for new or returning personnel. Adjust work-rest cycles based on temperature monitoring. Personnel receive PSAB administrative training (Thermal Injury Prevention Program Quick Reference Guide) covering acclimatization, hydration, heat illness signs and symptoms, and body cooling. BEE updates WBGT Flag conditions at least 3 times per day and post on AtHoc and Signal Chat. Weather Flight sends out the FITS Zone for aircrew personnel of appropriate aircraft.	Short-term: **Moderate Risk;** Based on efficacy of control measure and incidence of heat/cold injury reported in various medical surveillance databases
	Long-term: **Moderate Risk** as temperatures cool down from October to April.		Long-term: **Low Risk**
Cold (see paragraph 8.3)	Short-term: **Variable Risk;** Per measured seasonal data. The risk for cold stress/injuries largely depends on clothing/equipment worn, work intensity and individual factors rather than environmental factors alone.	Provision of adequate cold weather clothing gear. Appropriate work/rest cycles during cold weather months.	Short-term: **Low Risk**
	Long-term: **Low Risk**		Long-term: **Low Risk**

Noise			
Noise (Continuous) (Flight-line, Construction, Power Production) (see paragraph 9.1)	**Long-term and Short-term:** Moderate Risk due to construction in PSAB, with hazardous noise sources such as generators, jackhammers, saws, motors, drills, etc. Noise surveys have identified sound levels of 92 dBA at 20 feet from the source. HVAC units near tents present a constant noise source. Ear pain anecdotally reported. Dosimetry not available.	Non-Occupational: Reduce time of exposure and increase distance from noise source, when possible. Occupational: Use of hearing protection. Label hazardous noise areas. Leadership enforcement of compliance with available PPE.	**Long-term and Short-term:** Moderate Risk difficulty with communicating in areas with hazardous noise levels tend to drive voluntary use of non-occupational controls. Hearing exams pre- and post-deployment can support or refute this risk assessment.
Impulse (see paragraph 9.2)	**Long-term and Short-term:** Not evaluated: No/insufficient data exist upon which to base a risk assessment. ECES Heavy Repair use a multitude of noise producing and impact equipment.		**Long-term and Short-term:** Not evaluated
Unique Concerns			
Special Incidents or Spills (Fuel): (see paragraph 10.1)	Short-term: **Low Risk** due to a large number of fuel spills (JP-8 and diesel), mostly small, acutely affected specific personnel who handle fuels as part of their job. MTF documents exposures in members' medical records. Most personnel do not encounter spills. Long-term: **Low Risk**	Personnel quickly clean fuel spills or hydraulic leaks.	Short-term: **Low Risk** Long-term: **Low Risk**
Special Incidents or Spills [Toxic Industrial Chemical/Toxic Industrial Material (TIC/TIM) Releases]: (see paragraph 10.1)	**Long-term and Short-term:** Moderate risk as there are no air samples conducted during oil drilling to quantify inhalation hazards. Oil drilling has begun on PSAB proper approximately 3 miles from LSA 1 and LSA 3. Multiple members report smelling substances similar to fuel/gasoline (petroleum distillates). Some odors were pervasive enough to wake members during their sleep cycle.	Appropriate HAZMAT storage and handling. See classified TIC/TIM Vulnerability Assessment for more details.	**Long-term and Short-term:** Moderate risk as there are no air samples conducted during oil drilling to quantify inhalation hazards. Oil drilling has begun on PSAB proper approximately 3 miles from LSA 1 and LSA 3. Multiple members report smelling substances similar to fuel/gasoline (petroleum distillates). Some odors were pervasive enough to wake members during their sleep cycle.
Waste Sites/Waste Disposal (see paragraph 10.2)	**Long-term and Short-term:** Low Risk as the contractor disposes of the waste at The Department of Operations (Saudi) located 35km from PSAB. The 378 EMDG Logistics section has contracted for disposal of medical waste. CE Environmental has contracted for disposal of all other hazardous waste (460-2319).	Base personnel have minimal contact with waste. Overflow from solid-waste lift stations are covered with calcium hydroxide (- lime) and allowed to work for a 24 hour period. After 24 hours, ECES removes the excess lime from the soil surface to mitigate contact and inhalation hazards.	Short-term: **Low Risk** Long-term: **Low Risk**

Pesticides/Pest Control (see paragraph 10.3)	**Long-term and Short-term:** Low Risk as minimal pesticides are applied, and none are industrial grade. Base personnel have minimal contact with these chemicals.	Base personnel have minimal contact with pesticides.	**Long-term and Short-term:** Low Risk as minimal pesticides are applied, and none are industrial grade. Base personnel have minimal contact with these chemicals.
Burn Pits (see paragraph 10.4)	Short-term: **Low risk** Members have reported headaches that went away with OTC. Not authorized at PSAB, but potential exposure from RSAF burning activities. Members have reported smelling of burning in middle of the night. Long-term: **Not evaluated:** No/insufficient data exist upon which to base a risk assessment	Not required.	Short-term: **Low Risk** Long-term: **Not evaluated.**

[1] This Summary Table provides a qualitative estimate of population-based short-term and long-term health risks associated with the occupational and environment conditions at PSAB and other locations frequented by U.S. military personnel in the nearby vicinity. 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 minimum amount of it 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 a fuel spill, which can cause a significant individual exposure. Any such person seeking medical care should have their specific conditions of exposure documented on Form SF600.

[2] This Summary Table is organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at PSAB. The health risks are presented as Low, Moderate, High or Extremely High for both acute (short-term) and chronic (long-term) 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 Army/AF/Navy/DHA Public Health Center. The following sections of this report provide evaluations of OEH exposures at PSAB.

[3] Risks in this Summary Table are based on quantitative surveillance thresholds (e.g. review of disease surveillance data) or screening levels (e.g. MEGs for chemicals). Some previous assessment reports may provide 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.

[4] All OEH risk estimates represent residual risk after accounting for existing preventive controls. Preventive measures greatly reduce occupational exposures and exposures to endemic diseases. There are limited preventive measures available for environmental exposures to airborne dust.

[5] This assessment is based on information found in this report, which analyzes environmental samples taken prior to the deactivation of PSAB in 2003: Caravello, C., Long, C., Wireman, J. (2000), *Human Health Risk Assessment, Prince Sultan Air Base, KSA*, Air Force Institute for Environment, Safety, and Occupational Health Risk Analysis Directorate. (IERA-RS-BR-TR-2000-0007).

[6] United States Environmental Protection Agency (USEPA) "Particle Pollution and Your Patient's Health: Evidenced-based Training for Healthcare Professionals" Pulled form site on 26 July 2020: https://www.epa.gov/pmcourse

[7] The following publications were referenced to assess the risk of grey/black water waste being dumped near the LSA:

- Brenner, K. P., P. V. Scarpino, and C. S. Clark. 1988. Animal viruses, coliphages, and bacteria in aerosols and wastewater at a spray irrigation site. Appl. Environ. Microbiol. 54:409–415. https://aem.asm.org/content/aem/54/2/409.full.pdf

- Pillai, S.D., Widmer, K.W., Dowd, S.E., and Ricke, S.C. 1996. Occurrence of Airborne Bacteria and Pathogen Indicators during Land Application of Sewage Sludge. Appl. Environ. Microbiol. 296-299. https://aem.asm.org/content/aem/62/1/296.full.pdf
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SITE DESCRIPTION:

PSAB, KSA: Prince Sultan Air Base (PSAB) is located in Saudi Arabia, (138 km) 85 miles southeast of Riyadh, Saudi Arabia and 30 km (19 miles) from Al-Kharj. The Royal Saudi Air Force (RSAF) owns PSAB, which covers 125,000 acres. The U.S. occupied areas on base cover ~1000 acres, including Living Support Areas (LSA) 1 & 3, areas for flight line support operations (OPs/ACE Town), and US Army Patriot Missile and AFCENT3 sites.

Local Climate: Temperatures range from 30 to 124 degrees F. December through March tend to have the coldest lows (30-37 deg F). June through August tend to have the hottest highs (117-124 deg F). Rainfall is limited with a maximum annual precipitation of 15.4 inches, with average annual precipitation of 4.5 inches. March and April are the rainiest months, averaging > one inch of precipitation. Humidity ranges from 5.3 to 64.7%. May through September has the lowest average humidity. December and January have the highest average humidity. Prevailing winds are from the north at 9.4 mph.

Meteorological data was obtained from 378 EOSS Weather, who referenced Riyadh averages (found at https://climate.af.mil/OCDS-II/defaultreport.htm?reportType=html&locationID=ICAO_OERY), as this is the closest location with recent information.

1 Discussion of Health Risks at PSAB, KSA by Source

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

2 Air

2.1 Area-Specific Sources Identified

a. At PSAB, KSA - The general condition of the local ambient air is often dusty with a high potential for air particulate due to the lack of vegetation and soil moisture content. Visibility can significantly decrease (<1 mile) during high winds and dust storms. When the weather is such, potential exists for respiratory irritation and eye injury caused by wind-blown debris. The dust during these storms is so fine that small piles of dust will accumulate inside of buildings and is difficult to seal out.

Vehicles kick up particulate matter and dust debris into the air on both paved and unpaved roads. Even paved roads can get covered by sand and dust such that vehicles driving on it can cause dust cloud forming behind. Sand drifts also form a cross roadways deep enough to hinder driving, though the host nation strives to prevent this.

Other factors that introduce potential ambient air hazards include second-hand smoke, diesel generator farms, diesel generators to support DFAC operations, vehicle and aircraft exhaust, industrial chemical fumes/gases, welding fumes, and other industrial operations as described in individual shop surveys.

b. Al Kharj Industrial City is located approximately 17 miles north-northwest of the PSAB LSA. Multiple factories and manufacturing centers operate in that location. Specific operations and chemical storage are unknown, but west and southwest winds tend to bring a noticeable odor of burning.

c. Vehicle and aircraft emissions can be other major contributors to air pollution. Emissions from military vehicles and aircrafts as well as vehicles in surrounding communities, especially in developing countries, may have significant impacts on air quality.

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, tactical 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 formed by condensation or transformation of combustion exhaust. PM composition and particle size vary considerably depending on the source. There are two PM classes of health concern: PM_{10}, which includes coarse particles with diameter ≤ 10 micrometers (0.0004 inches or 1/7 the width of a human hair), and fine particles < 2.5 microns ($PM_{2.5}$), which can reach the deepest regions of the lungs when inhaled. Exposure to excessive PM may cause a variety of potential health effects.

The level of protection provided by the short-term PM MEGs is uncertain due to a lack of directly relevant data and the limitations of the available data. Unfortunately, long-term PM MEGs are uncertain, and their use should be associated with a low confidence ranking. Both sets of MEGs are likely to be revised pending continued USAPHC experience, new data or scientific analyses, and future recommendations of national scientific panels.

The annual National Ambient Air Quality Standards (NAAQS) for PM_{10} cite a lack of evidence linking health problems to long-term exposure to coarse particle pollution. Therefore, the current PM_{10} MEGs are for short-term exposures only. When we assess PM_{10} exposures, we evaluate the data to provide an acute health risk estimate for individual days and not averaged over a year. This is consistent with the current USEPA position, which considers the health risks of long-term exposures to PM to be primarily associated with the $PM_{2.5}$ fraction. The following table provides both MEGs and NAAQS for both PM10 and PM2.5.

Guidelines	Contaminant	Type	Averaging Time	Level (µg/m3)	Additional Notes
EPA National Ambient Air Quality Standards (NAAQS)	PM2.5	primary	1 year	12	annual mean, averaged over 3 years
	PM2.5	secondary	1 year	15	annual mean, averaged over 3 years
	PM2.5	primary	24 hours	35	98th percentile, averaged over 3 years
	PM2.5	secondary			
	PM10	primary	24 hours	150	Not to be exceeded more than once per year on average over 3 years
	PM10	secondary			
USAPHC Military Exposure Guidelines (MEG)	PM2.5	Critical	24 hours	500	
	PM2.5	Marginal	24 hours	250	
	PM2.5	Negligible	24 hours	70	
	PM2.5	Negligible	1 year	20	
	PM2.5	Marginal	1 year	70	
	PM10	Critical	24 hours	600	
	PM10	Marginal	24 hours	420	
	PM10	Negligible	24 hours	250	

NAAQS values are either primary or secondary. Primary NAAQS are defined for public health protection, and values exceeding these are known to cause health issues such as respiratory distress. Secondary NAAQS values are for public welfare protection, and values exceeding these can damage vegetation, farmland, buildings, and reduce visibility, thereby endangering traffic conditions.

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

2.3.1 Exposure Guidelines: See table in section 2.2.

2.3.2 Sample data:

Range – 0.029 – 0.218 mg/m^3

We have not collected PM_{10} air samples after the establishment of the current PSAB location in July 2019. BEE collected ~ 50 PM_{10} samples in October through December of 1996, with results ranging from 0.029 to 0.218 mg/ concentrations during the summer months due to higher wind speeds. This data is not directly m^3. We expect higher representative of current US Forces exposure at the new PSAB location. The location sampled was different and was not under constant construction.

2.3.3 Short-term (acute) health risk for PM_{10}:

Approach: Compare results to MEGs and other available exposure standards and evidenced based references available.

Risk Summary: Based on historical samples and average wind speeds, we evaluate worst-case acute risks as **moderate**.

Medical implications: At the **moderate** risk level, a majority of personnel will experience notable eye, nose, and throat irritation and some respiratory effects. Some lost-duty days are expected. This was supported by symptoms reported to medical personnel. Significant aerobic activity will increase risk. Those with a history of asthma or cardiopulmonary disease are expected to experience increased symptoms.

Confidence in the risk assessment: We have low confidence in the risk assessment based on the limited PM_{10} air sampling data available.

2.3.4 Long-term (chronic) health risk for PM_{10}:

Health guidelines are not defined for PM_{10}. The United States Environmental Protection Agency has retracted its long-term standard (NAAQS) for PM_{10} due to an inability to clearly link chronic health effects with PM_{10} exposures.

Confidence in the risk assessment: We have low confidence in the risk assessment based on the limited PM_{10} air sampling data available.

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

2.4.1 Exposure Guidelines: See table in section 2.2

2.4.2 Sample data:

Range: 80 - 900 µg/m^3

Average – 94 µg/m^3

BEE personnel have collected 104 samples using the DPS at different locations of PSAB from the January 2020 until September 1, 2022. Of those, 82 have data published in DOEHRS. The rest are either waiting for lab analysis (2022 samples) or were invalidated due to various reasons such as incomplete sample documentation, incorrect equipment setup, equipment failure, etc... The most recent samples show an average PM2.5 concentration of 50 - 100 µg/m^3. The following table breaks down PM2.5 data by sample location, including the average for each location. We shaded the cells containing the average values from highest (red) to lowest (green).

SAMPLE LOCATION	Number of Samples	Average of PM2.5 (µg/m^3)
Army PAT Site 14	6	98
Army PAT Site 15	4	61
Army THAAD AFCENT Site 3	6	131
Bravo 37 Water Point	2	66
Community Walkway	1	81
DFAC	2	41
Fence-line Near Dumpster	1	49
Food Tent	1	42
LSA AF Living Area B Block Rock	2	74
LSA Army Living area Rock by Area C and D	3	70
LSA Cardio Tent	5	55
LSA Clinic	6	107
LSA Gym Outside pad	21	98
LSA POE worst case for vehicle traffic	3	57
LSA Tent B42	5	35
Medical CC Trailer	5	32
MWR	1	73
Ops Town ATC	8	224
Grand Total	**82**	**94**

The majority of samples were collected in 2020; see figures 1-3 below. Figure 4 compares the data from 14 indoor samples to a matching set of 14 outdoor samples, to determine exposure variation between being indoors and outdoors. Indoor exposures averaged 43% less than outdoor exposures.

Risk assessments at all AOR locations should consider evidence-based health effects of ultra-fine $PM_{2.5}$, supported by the EPA, and how exposures can have chronic effects like contributing to acute and chronic cardiovascular and respiratory effects. Inhalation of PM2.5 can exacerbate conditions such as cardio vascular or respiratory diseases, for a small segment of the deployed population. We need additional $PM_{2.5}$ sampling to improve our health risk estimate.

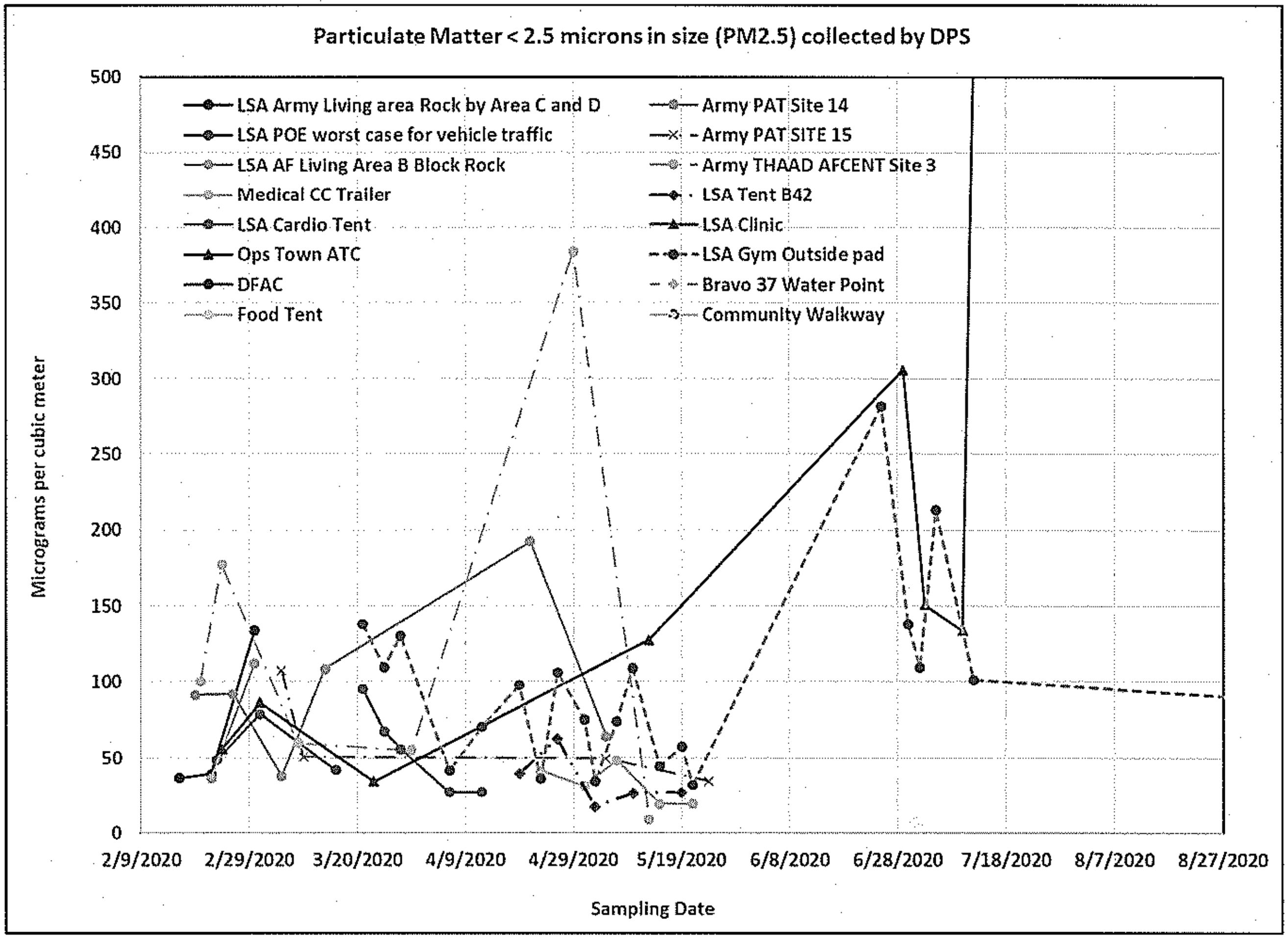


Figure 1: Breakdown of PSAB $PM_{2.5}$ samples by location for 2020

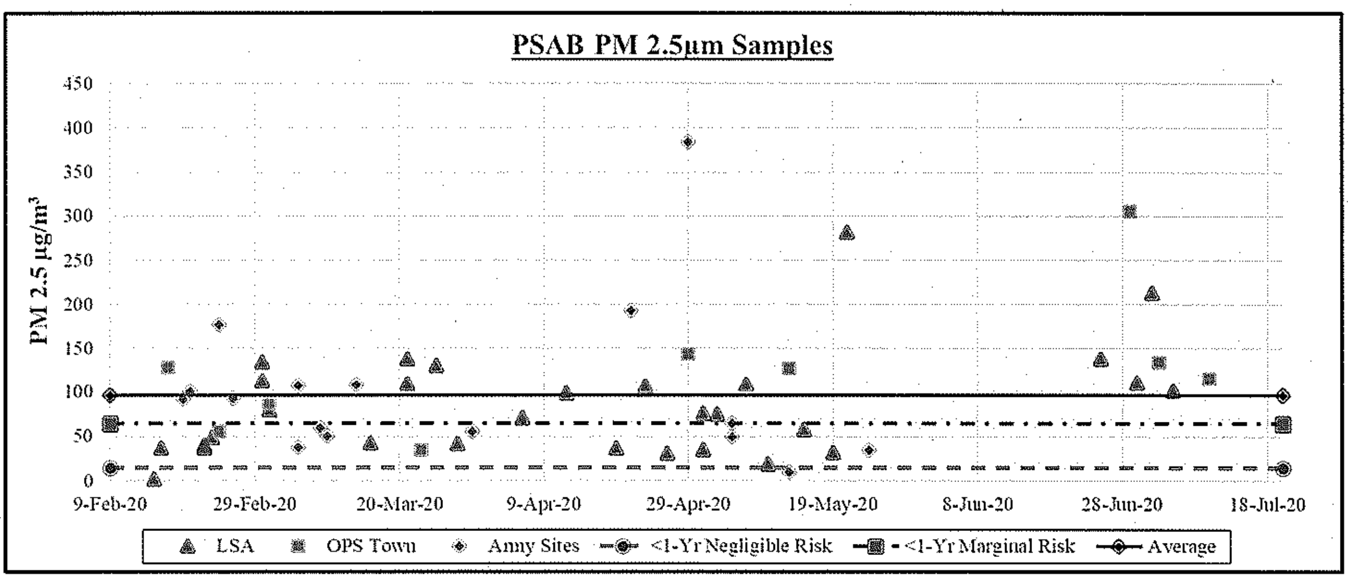


Figure 2: PSAB $PM_{2.5}$ Samples by area of PSAB

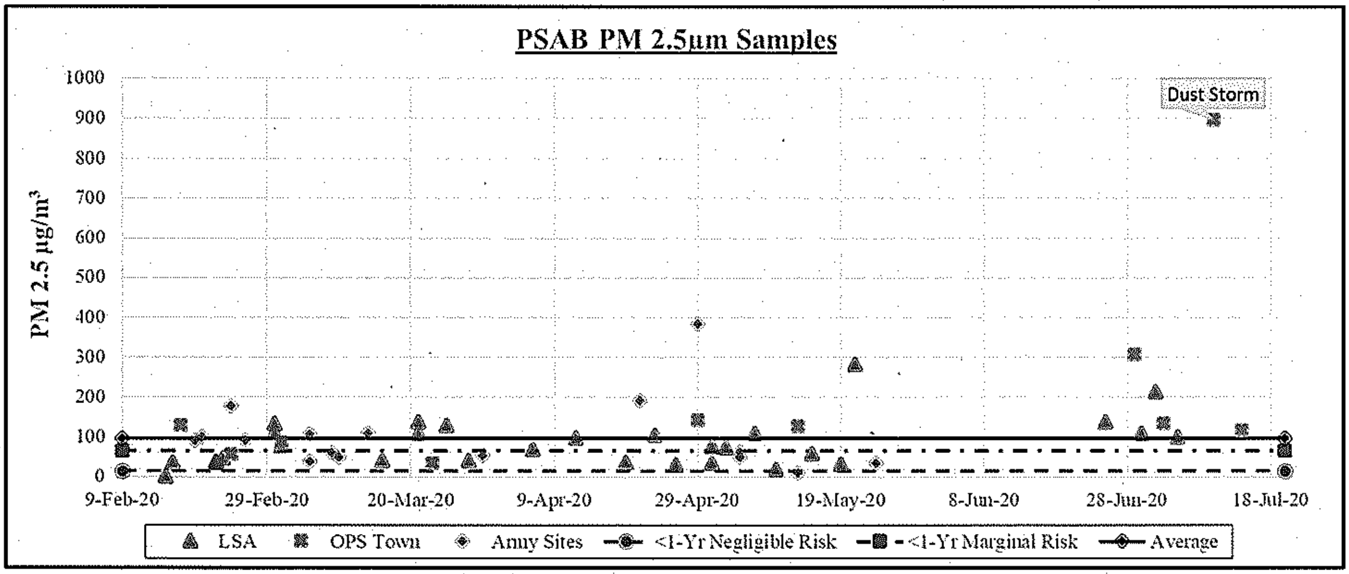


Figure 3: PSAB $PM_{2.5}$ Samples Compared to Risk Levels

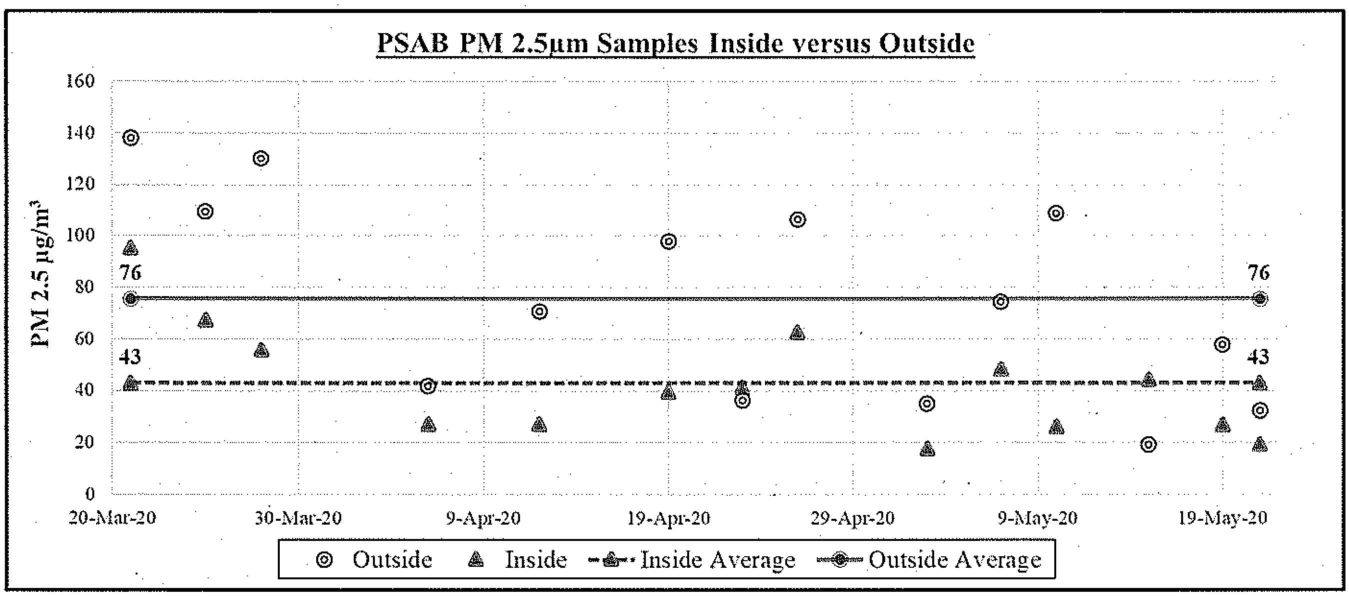


Figure 4: PSAB $PM_{2.5}$ Samples Inside versus Outside

2.4.3 Short-term (acute) health risk for $PM_{2.5}$:

Approach: Compare results to MEGs and other available exposure standards and evidenced based references available.

Risk Summary: We evaluate the risk as **moderate** based on historical samples and average wind speeds.

Medical implications: At the **moderate** risk level, a majority of personnel will experience notable eye, nose, and throat irritation and some respiratory effects, which was supported by symptoms reported to medical personnel. Some lost-duty days are expected. Significant aerobic activity will increase risk. Those with a history of asthma or cardiopulmonary disease might experience increased symptoms.

Confidence in the risk assessment: Confidence in the risk assessment is **moderate** based on available $PM_{2.5}$ air sampling data. The USAPHC has not reported samples collected in 2022. We need to collect more samples, especially from different parts of PSAB, such as the Entry Control Points where personnel work outside 24/7.

2.4.4 Long-term (chronic) health risk for $PM_{2.5}$:

Approach: Compare results to MEGs and other available exposure standards and evidenced based references available.

Risk Summary: Based on historical samples and average wind speeds, we evaluated worst-case chronic risks as **moderate.**

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 risk assessment is **moderate** based on available $PM_{2.5}$ air sampling data. The USAPHC has not reported samples collected in 2022. We need to collect more samples, especially from different parts of PSAB, such as the Entry Control Points where personnel work outside 24/7.

2.5 Airborne Metals and Chemicals

2.5.1 Sample data:

The USAPHC analyzes DPS samples for the presence of 10 metals: Sb, As, Be, Cd, Cr, Pb, Mn, Ni, V and Zn. Most samples collected from January 2020 to December 2021 have no trace of any of these metals. Occasionally a sample will record a metal at just above the limit of detection (LOD). For example, the sample taken on 12 November 2021 had lead present at the LOD of 0.069 ug/m3, which is two orders of magnitude below the OSHA exposure limit of 0.00015 ug/m3. Therefore, this level of lead in the air does not pose a health risk to the base population.

Approach: Compare results to MEGs and other available exposure standards and evidenced based references available.

Risk Summary: Data collected to this point indicates a **Low** risk, but more data needs to be collected

2.5.2 Short-term (acute) health risk: Based on historical samples we evaluate the acute risks as **low.**

Medical implications: None

Confidence in the risk assessment: We have medium confidence in this risk assessment. We have a large number of samples from different parts of PSAB. However, they all used one sampling method. We would have a higher confidence if we had data using multiple sampling methods.

2.5.3 Long-term (chronic) Health risk: We evaluate the health risk as **low** based on historical samples.

Medical implications: None

Confidence in the risk assessment: We have medium confidence in this risk assessment. We have a large number of samples from different parts of PSAB. However, they all used one sampling method. We would have a higher confidence if we had data using multiple sampling methods.

3 Soil

3.1 Site-Specific Sources Identified

3.1.1 Sample data:

Historical sampling data, while limited, indicate personnel assigned and/or deployed to PSAB for up to two years should not have a negative impact to their health due to soil contamination. 10 Samples sites collected since March 2020 indicate no significant contamination concerns in rock/sand mixture used to construct the LSA, the Host Nation Firing Range, or sand sampled at the Army sites on PSAB. These results are in DOEHRS. Future rotations should expand on this sampling as needed.

DOEHRS IDs are UL50, UK3P, UK3S, UK3H, RFSD, RFSC, RFRZ, RFSF, RFSE, and RFSG.

Individuals involved in construction and maintenance were at greatest potential for exposure to soil. These individuals comprise a relatively small proportion of the overall camp population.

Approach: Compare results to MEGs and other available exposure standards and evidenced based references available.

Risk Summary: Data collected to this point indicates a **Low** risk, but more data needs to be collected

3.1.2 Short-term (acute) health risk: We evaluate a low risk based on historical samples.

Medical implications: None

Confidence in the risk assessment: Confidence in this risk assessment is **moderate** based on limited sampling data.

3.1.3 Long-term (chronic) Health risk: We evaluate a low risk based on historical samples.

Medical implications: None

Confidence in the risk assessment: Confidence in this risk assessment is **moderate** based on limited sampling data.

4 Water

In order to assess the health risk to US personnel from exposure to water in theater, the USAPHC 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. Bottled water is the primary source of drinking water for all deployed personnel in KSA. Desalinated seawater is the primary source of potable water in KSA. The water distribution system on PSAB is used for hygiene and dishwashing. The Water and Fuels Systems Maintenance flight treats water again with chlorine once it enters the U.S. water distribution system.

4.1 Site-Specific Sources Identified

The potable water (non-drinking water) distribution systems (currently 2 separate systems) are supplied via two bulk water contracts. Each contractor delivers via 10K-gallon water trucks. The contractors deliver this water to the filling point of each water distribution systems.

KBR provides commercial bottled water for personnel to drink at PSAB. US personnel have drank the following brands of bottled water at PSAB from July 2020 through September 2022: Nova, Nestle-PureLife, Aqua Gulf, Nestle-Al Manhal and Aquafina. USAPHC has approved all of these brands of bottled water. BEE tests the water for coliforms, pH, and Cl for every lot received.

The USARCENT Command Veterinarian has not deemed ice potable in the KSA as it they do not consider it a food item for transportation purposes, and hence it can be contaminated in transport.

No standing water is present on PSAB, and hence this does not pose a health risk.

4.2 Consumed Water (Water for drinking or cooking consumption)

The USAPHC approves the distributors and all brands of bottled water used by U.S. personnel on PSAB. BEE tests each lot of bottled water delivered to PSAB upon receipt IAW AFMAN 48-138. The monitoring includes total coliform presence/absence and *E. coli* for 4 bottles per lot.

4.2.1 Sample data/notes:

BEE collected bottled water samples from 500-600 mL and 5-gal bottles every 6-month rotation starting in July 2019. None of the samples tested positive for coliforms.

4.2.2 Short-term (acute) health risk for drinking bottled water:

Approach: Water must meet all EPA requirements in order for the USAPHC to approve its use on PSAB. Bacteriological sampling conducted by BE after delivery helps determine if contamination occurred during transport.

Risk Summary: Based on the above approach, the short-term risk associated with consumption of bottled water is **low**.

Medical implications: None

Confidence in the risk assessment: high because USAPHC personnel performed audits of all bottled water suppliers to ensure consistent quality throughout the combat operation.

4.2.3 Long-term (chronic) health risk:

Approach: Water must meet all EPA requirements in order for the USAPHC to approve its use on PSAB. Bacteriological sampling conducted by BE after delivery helps determine if contamination occurred during transport.

Risk Summary: Based on the above approach, the long-term risk associated with consumption of bottled water is **low**.

Medical implications: None

Confidence in assessment: Confidence in the risk assessment is **high** because USAPHC personnel performed audits of all bottled water suppliers to ensure consistency of quality throughout of the combat operation.

4.3 Water for Non-Drinking/Other Purposes

The PSAB BE personnel monitoring for pH, chlorine residual, total and fecal coliform presence/absence and *E. coli*. They perform lab analysis in-house and load all results in the DOEHRS 'DoD Deployment Surveillance' program office. BE ships water samples to USAPHC for measuring of Long Term Potability. This occurs every rotation from January 2020 to October 2022 rotation and most results were below MEGs. Water in the system is only approved to be used for washing hands, washing clothes, washing dishes, washing pilot's oxygen masks, taking showers and cooking and cleaning food after Point of Use treatment (UV, 5 micron filtration and GAC filtration) at the LSA DFAC. Complete exposure pathways should include brushing teeth, as not all personnel follow directions to use bottled water (briefed at Right Start and posted by every sink).

Although the primary route of exposure for most microorganisms is ingestion of contaminated water, dermal and inhalation exposure to some microorganisms, chemicals, and biological contaminants are also possible.

4.3.1 Sample data/notes: No positive coliforms or fecal coliforms identified July 2020 through December. During the January 2021 – July 2021 rotation, there was only one set of positive coliforms, but negative for *E. Coli*. BEE identified this positive set through routine sampling. A dirty micron filter in the POE system at the OPS Town DFAC caused the positive results. ECES disinfected the system and the storage tank and replaced the filters (micron and GAC). Repeat samples after a 24-hour disinfection period were negative. The DFAC remained operational, but used 5-gallon bottled jugs instead of the distribution system water until BEE personnel obtained consecutive negative samples. There were no reported illnesses from this positive event. There were a few positive coliform samples from November 2021 thru April 2022. All results are in DOEHRS. The positives were due to technician error or dirty sampling point. All positives were negative for E. Coli.

4.3.2 Short-term (acute) health risks:

Approach: We made the following assumptions in order to assess the health risk associated with water uses other than drinking.

- Personnel use treated water for personal hygiene purposes.
- Deployments lasted is service specific (Army personnel 9 months, AF personnel 6 months).
- Primary routes of exposure associated with treated water were incidental ingestion through personal hygiene (i.e., brushing teeth/oral hygiene) and dermal contact when showering.
- Camp residents ingest far less than 1 liter of water per day.

Risk Summary: Low

Medical Implications: Increased risk of infection and gastrointestinal distress.

Confidence in Assessment: Confidence in this risk assessment is **high**.

4.3.2 Long-term (chronic) health risks:

Approach: We made the following assumptions in order to assess the health risk associated with water uses other than drinking.

- Personnel use treated water for personal hygiene purposes.
- Deployment durations are service specific (Army personnel 9 months, AF personnel 6 months).

- Primary routes of exposure associated with treated water were incidental ingestion through personal hygiene (i.e., brushing teeth/oral hygiene) and dermal contact when showering.
- Camp residents ingest far less than 1 liter of water per day.

Risk Summary: Bacteriological contamination is not tied to a chronic health risk in this population, so long-term health risk is **low**.

Medical Implications: None.

Confidence in Assessment: Confidence in this risk assessment is **high.**

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons

There were no specific hazard sources identified by Intelligence.

5.1.1 Short and long-term health risks:

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

Risk Summary: None - insufficient data exists upon which to base a risk assessment.

Medical Implications: None - insufficient data exists upon which to base a risk assessment.

Confidence in Assessment: N/A - No data were available upon which to base a risk assessment.

5.3 Ionizing Radiation

5.3.1 Medical and Industrial Radiography

The 378 EMDS Clinic utilizes medical radiography. The scatter survey is current. The Non-Destructive Inspection (NDI) back shops in Ops Town can perform industrial radiography, however the current rotation of airplane squadrons as of 1 September 2022 do not perform NDI in theater. BE approved various sites and monitored personnel via Electronic Personal Dosimeter (EPD) and Optically Stimulated Luminescence (OSL) program. Exposures were kept As Low As Reasonable Achievable (ALARA) and risk was **Low** with controls in place. BEE approved an additional site for NDI, and placed these surveys in DOEHRS or the shared drive.

The 378 ESFS has two x-ray emitters. The first is a Rapiscan Secure 1000 located at the LSA ECP. ESFS personnel scan incoming contractor personnel using this device. Second is a backscatter van (ZBV). ESFS personnel use this device to scan incoming contractor vehicles. Field Service Representatives conducted backscatter surveys of both devices, and the measured radiation levels are below any action level requiring dosimetry or PPE. Both survey reports are stored in DOEHRS.

5.3.2 Radioactive Material

All ionizing radioactive materials are limited to check sources for BEE, EOD, and EM equipment.

5.3.3 Short and long-term health risks:

Scatter surveys of medical radiology and NDI shops indicate no exposures above the public exposure limit are likely if personnel follow in-place procedures.

Risk Summary: The risk is **low** based upon radiation scatter surveys and administrative procedures in place to maintain exposures ALARA.

Medical Implications: None.

Confidence in Assessment: Confidence in this risk is **high** due to the limited number of ionizing radiation sources and low level of use for all sources.

5.4 Non-Ionizing Radiation

Multiple sources of electromagnetic frequency (EMF) exist throughout LSA and Army Aerial Defense Artillery (ADA) sites. Due to bare-base operations, controls are minimal such as barrier tape demarcating hazard zones. To reduce potential exposure to personnel, all high-powered emitters point upwards, sit atop towers or hardened structures, or are located in separate, controlled areas (ADA sites). BE investigates individual exposure incidents and records findings in their medical record on a SF 600.

5.4.1 Short and long-term health risks:

Risk Summary: The risk is **medium** due to the following reasons. First, many EMF sites do not have adequate signage warning of EMF hazards. Adequate signage means large, hardened signs that are visible day and night, and fixed to a surface visible to all incoming foot and vehicular traffic. Second, many EMF emitters do not have barriers that visibly prevents personnel from accessing the emitter, such as gates or barbed wire. Instead, these emitters are in hard-to reach areas, such as atop towers, which do not prevent personnel from approaching them. Third, many of the EMF emitters at PSAB do not look like radar dishes, and personnel can mistake them for vehicles or other equipment. For example, the Raytheon AN/TPY-2 radar located in AFCENT3 looks like a trailer for a truck. We have recorded at least four instances where personnel have walked in front of or near the beam of the radar it. The beam strength was determined to have the potential for deadly health effects. Recommended controls include remedial training for signage, roping off areas, tighter screening at entry control points and an updated unescorted entry roster.

Medical Implications: None

Confidence in Assessment: Confidence in this risk assessment is **medium**, as emitters and locations changed as different units rotate in and out of PSAB.

6 Endemic Diseases

6.1 Sample data/notes:

The assessed risk for endemic diseases addressed below represents 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 Services.

Medical event reports identified related to deployment in KSA did not identify specific locations within the country, nor did they describe the probable site of the exposure; therefore, epidemiological analysis of medical event data was limited to the country level.

We assessed endemic diseases in the KSA by using the Infectious Disease Risk Assessment Database for CENTCOM: KSA hosted by the Defense Intelligence Agency. See: https://www.ncmi.detrick.army.mil/product/idra_db.php?co=KWT and the "Destinations" section of the Centers for Disease Control and Prevention (CDC) Travelers' Health website, http://wwwnc.cdc.gov/travel/destinations/traveler/none/Saudi Arabia.

The usage of effective vaccines, such as those for Hepatitis A and B, effectively reduces risk to individuals to none. We excluded these endemic diseases from further assessment. Reporting of medical events from deployed environments is inconsistent. We assume identified reports of endemic disease associated with deployment to KSA do not represent all cases of reportable endemic disease events among service personnel deployed to KSA. Where available; additional relevant reports were used to supplement reportable medical event data for this assessment.

6.2 Gastrointestinal Diseases

U.S. Service members have little or no immunity to the food and waterborne diseases present in KSA. To prevent food and waterborne diseases among individuals deployed to KSA, PSAB purchases food and water from approved sources. Food is prepared in facilities where there is public health oversight (certificate of sanitation, health screening of food service workers, periodic inspections, etc.). Due to the potential presence of disease causing organisms, as well as the high prevalence of improper food handling and preparation, local food and water were not approved for consumption. Viral gastroenteritis that is spread through contact or fomites (any inanimate object or substance capable of carrying infectious organisms) presents a recurrent risk due to a high rate of personnel turnover, and shared dining, bathroom facilities, and working spaces.

Approach: We assessed the health risk for fomite-borne gastrointestinal infections and endemic food and waterborne diseases to individuals deployed to KSA using the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to KSA and review of military public health reports.

6.2.1 Short-term health risks:

Risk assessment: The short-term risk for viral gastroenteritis was **moderate.** Risk due to a high rate of personnel turnover, shared dining & bathroom facilities, and working spaces is not substantially different from that expected in similar settings within the United States.

The short-term risk associated with food borne and waterborne diseases in KSA was **high** (bacterial or viral gastroenteritis, protozoal diarrhea, cholera, brucellosis, hepatitis E).

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

Confidence in 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 military populations.

6.2.2 Long-term (chronic) health risks:

Risk assessment: The long-term risk for food and waterborne diseases was **low** for protozoal diarrhea and brucellosis.

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

Confidence in assessment: High as the incidence of protozoal diarrhea and brucellosis in the post deployment military population is extremely low.

6.3 Arthropod Vector-Borne Diseases

The climate and ecological habitat in KSA support populations of arthropod vectors, such as ticks and sand flies. Risk for arthropod-borne disease is higher during warmer months of June – August, with variable rates of disease transmission. Vector-borne diseases occur at low or unknown levels throughout the country. Personnel maybe exposed to ticks and sand flies, or other biting vectors during the day or night. Risk is higher in urban and other densely populated areas, or near animals such as farms. Removing vector harborages, spraying for vectors within base camps, avoiding areas with animals, proper wearing of insecticide-treated (permethrin) uniforms, use of bed nets in field conditions, and the application of insect repellent to the skin (DEET) were the main protective measures against vector-borne diseases.

Approach: We assessed the health risk for endemic vector-borne diseases to individuals deployed to KSA during the period of this assessment based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment, and review of military public health reports.

6.3.1 Short-term (acute) health risks:

Risk assessment: The short-term risk for the vector-borne diseases Sand Fly fever, West Nile Fever, Crimean-Congo hemorrhagic fever, typhus, and plague was **low**. Individuals who deploy from PSAB, KSA or rural outlying areas may experience increased short-term risk. The short-term risk for cutaneous Leishmaniasis was **moderate**.

Medical implications: Sand Fly fever, West Nile Fever, Crimean-Congo hemorrhagic fever, typhus, and plague present in KSA have short incubation periods ranging from days to weeks. Any of these diseases will initially present as acute fever and malaise, sometimes accompanied by rash, and can then lead to acute, sometimes severe illness. Cutaneous Leishmaniasis typically presents as skin lesions, single or multiple, that start as a papule and enlarge into an ulcer.

Confidence in assessment: Confidence in the risk assessment is **moderate**. Reports of vector borne disease, including malaria and Leishmaniasis, were received through official DoD medical event reporting systems.

6.3.2 Long-term (chronic) health risks:

Risk assessment: The long-term risk for Leishmaniasis, cutaneous and visceral, was **low**. The long-term risk for *vivax* (relapsing) malaria was **low**.

Medical implications: Both visceral and cutaneous Leishmaniasis may have extended incubation periods, ranging from a months to years. Although rare, personnel can be infected during deployment, without clinically evident disease until redeployed. Leishmaniasis should be considered in the differential diagnosis for any unusual skin lesions, or chronic, systemic disease. According to the 9 AF (AFCENT) Pre-Deployment Medical Screening Procedures of 30 Jun 2014, malaria was not a concern in the PSAB area of KSA. If any, Plasmodium v*ivax* and P. *falciparum* malaria would be the predominate species of malaria found in KSA. Relapses following *vivax* blood stage treatment are possible due to hypnozoites that remain dormant in the liver.

Confidence in assessment: Moderate as incidence of visceral Leishmaniasis in the post deployment military population is low. Cases of cutaneous Leishmaniasis were detected and treated post deployment at other locations within the AOR. There have been no cases at Prince Sultan Air Base. The military medical community is aware of the presence of Leishmaniasis in KSA, and skin lesions in individuals with a history of time spent in KSA were/are evaluated with that in mind. No cases of relapsing malaria have been reported in the Service-mandated reporting systems.

6.5 Respiratory Diseases

U.S. military populations living and working in close-quarter conditions were at risk for substantial person-to-person spread of respiratory virus infections such as the common cold, COVID-19, and influenza. Primary exposure pathways for tuberculosis include prolonged close contact (generally several hours per day > three days per week in a closed space) with the local population or other country national contractors. U.S. personnel who remained on base had limited to no contact with the local population, and local and other country national workers/contractors were required to complete health screening prior to employment.

Approach: We assessed the health risk for respiratory diseases to individuals deployed to KSA based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to KSA, and review of military public health reports.

6.5.1 Short-term (acute) health risks:

Risk assessment: The short-term risk for upper respiratory infections was **moderate.** Risk due to a high rate of personnel turnover, shared dining, berthing, recreational facilities, and working spaces.

Medical implications: Upper respiratory infections, particularly from viral agents, can cause periodic outbreaks in spite of preventive measures. COVID-19 infections may require greater than 72 hours convalescence and/or hospitalization and possible aeromedical evacuation. Most other respiratory illness cause 72 hours of convalescence. Symptoms of tuberculosis, including fever, weight loss, night sweats and cough, typically start within 1-6 months of infection. The lifetime risk for tuberculosis after becoming infected is 5-10%. Half of this risk occurs in the first two years following infection.

Confidence in 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. COVID-19 is reportable. Tuberculosis prevalence in the local population is widespread, but we had no reports of tuberculosis for individuals deployed to KSA during the assessment period.

6.5.2 Long-term (chronic) health risks:

Risk assessment: The long-term risk for tuberculosis was **low.**

Medical implications: Symptoms of tuberculosis can appear take two or more years following infection to appear. Medical personnel need to consider tuberculosis when assessing symptoms of fever accompanied by night sweats and cough.

Confidence in the risk assessment: High as prevalence of tuberculosis in the local population is widespread, but prevalence of tuberculosis in the post deployment military population is extremely low.

6.6 Animal-Contact Diseases

The local population of KSA do not routinely vaccinate animals for vaccine preventable diseases such as rabies or anthrax. Q-fever, anthrax, and rabies are present in KSA. Exposure to animals, and/or locations where animals were kept (stray dogs/cats, barnyards, slaughterhouses), were the primary infection sources for all these diseases, and avoidance of companion and farm animal contacts was the primary prevention strategy. Preventive measures in place include anthrax vaccination, which is effective in preventing both cutaneous and inhalation anthrax, and rabies post exposure prophylaxis, which is effective for preventing onset of rabies in exposed individuals.

Approach: We assessed the health risk for endemic animal contact diseases to individuals deployed to KSA during the period of this assessment based on the combination of identified endemic diseases, knowledge of preventive measures in place, review of medical event reports associated with deployment to KSA, and review of military public health reports.

6.6.1 Short-term (acute) health risks:

Risk assessment: The short-term risk for anthrax (naturally acquired), rabies and H5N1 avian influenza was **low**. The risk for Q-fever was **low**.

Medical implications: Naturally occurring anthrax (non-weaponized) is an acute disease that usually affects the skin, while inhalation anthrax has mild and non-specific initial symptoms among unimmunized individuals.

Symptoms of acute Q-fever, which may present one week to greater than one month after exposure, include fever, chills and weakness.

Rabies presents as an acute, viral encephalomyelitis and is almost invariably fatal.

Confidence in assessment: **High**.

6.6.2 Long-term (chronic) health risks:

Risk assessment: The long-term risk for Q-fever and rabies was **low**. However, Q-fever was diagnosed in a small number of personnel after they returned to the U.S.

Medical implications: Q-fever is generally an acute febrile disease with considerable variation in severity and duration. Infections may be unapparent or present as a nonspecific undifferentiated febrile syndrome or as pneumonia. Health care providers should consider Q-fever in the differential diagnosis of an undifferentiated febrile syndrome when personnel mention a history of being near or in areas where animals live or had lived.

The incubation period for rabies is typically 1–3 months, but may be more than one year.

Confidence in assessment: Confidence in risk assessment is **high**.

7 Venomous Animals/Insects

The species listed below have home ranges that overlap the KSA, and may present a health risk if encountered. We utilized information from USAPHC, Armed Forces Pest Management Board Living Hazards Database, and personal communication from previously deployed preventive medicine personnel. Little to no regional animal range information was available within the country of KSA. The below list is not all-inclusive; other venomous scorpions and snakes may be present in the region. See Section 10 for more information about pesticides and pest control measures.

7.1 Short-term (acute) health risk:

7.1.1 Spiders: KSA is home to numerous species of spiders. The Black Widow Spider (*Latrodectus lugubris*), samsum ants (*Brachyponera sennaarensis*) and camel spiders (*Solifugae*) have bites that present a threat. Widow spider bites are mostly minor and even significant envenomation is unlikely to be lethal. Victims usually feel their bite as a "sting", with delayed (10+min) local pain, and sweating. More severe envenomation may produce regional pain, tender draining lymph nodes, nausea, hypertension, and malaise. Camel spider bites are very painful and may cause a localized reaction but global reaction is rare. Brown recluse spider bites often go unnoticed initially because they are usually painless bites. Occasionally, victims notice some minor burning that feels like a bee sting at the time of the bite. Symptoms usually develop 2-8 hours after a bite. Keep in mind that most bites cause little tissue destruction. Initially the bite site is mildly red and upon close inspection may reveal fang marks. Within a few hours, the redness gives way to pallor with a red ring surrounding the area, or a "bull's-eye" appearance. The lesion will often appear to flow downhill over the course of many hours. The center area will then often blister, which over 12-48 hours can sink, turning bluish then black as this area of tissue dies. Health risk was **low**.

7.1.2 Scorpions: Numerous species of scorpion live in KSA. The majority of scorpions here have stings that cause only temporary local effects, such as pain, without systemic effects. Serious envenomation may result in numbness, frothing at mouth, difficulty breathing, and convulsions. Various factors influence the severity of the envenomation to include health and age of patient, sting site, and size and age of scorpion. Most scorpion venom is neurotoxic with a mixture of other substances. If the patient is allergic to bee and wasp stings, personnel must use extreme caution to prevent excessive morbidity and even possibly death. The following species are present in KSA and have known detrimental health effects:

- *Androctonus amoreuxi* (Fat-tailed scorpion).
- *Androctonus crassicauda (Arabian fat-tailed scorpion)*
- *Leiurus quinquestriatus (Death Stalker)*
- *Hemiscorpius lepturus* (highly cytotoxic venom that can cause serious wounds, inflammation, blisters, and necrosis. No anti-venom is currently available).
- *Hottentotta alticola* (Black scorpion), *Hottentotta saulcyi, Hottentotta scaber,Hottentotta schach, Mesobuthus eupeus, and Odontobuthus doriae*

Overall health risk from scorpions was **high**.

7.1.3 Snakes: Numerous species live in KSA including several poisonous snakes. The following vipers and cobras are the most significant venomous snakes encountered in PSAB.

- *Macrovipera lebetina* (Levantine Viper): Bites may cause mild to severe local effects, including shock and coagulopathy.
- *Cerastes cerastes gasperetti* (Desert Horned Viper): Cause the majority of the bites. Envenomation causes deep local tissue damage accompanied by stomach pain, sweating, nausea, possible fever in conjunction with gangrene
- *Echis carinatus* (Saw-scaled Viper): Bites are typically moderate to severe, with potentially lethal envenoming, requiring urgent assessment and treatment, including IV fluids, IV antivenom and good wound care. Antivenom is key for the treatment of systemic envenoming.
- *Pseudocerastes persicus fieldi (Field's Sand* Viper): venom characterized as neurotoxic; little pain at bite site general weakness followed by paralysis
- *Walterinnesia aegyptia* (Desert Black Snake/Desert Cobra): venom strongly neurotoxic with lesser anticoagulant activity.

Overall, the health risk associated with snakes was **low**. Snake sightings and reports of snakes within the living areas were rare.

No long-term health risks identified based on available data.

Risk assessment: There is a low long-term risk of snakebites based on KSA disease incident reporting.

Medical implications: Long-term health effects resulting from interaction with snakes is **low** Based on efficacy of control measure as evidenced by lack of disease(s) reported in various medical surveillance databases such as TMDS, MERS, DRSi as per incident reporting from KSA.

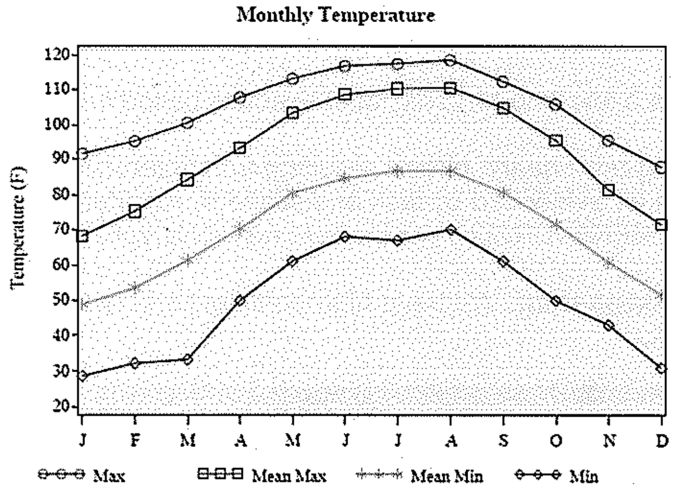
Confidence in the risk assessment: We have high confidence in risk assessment based on disease incident reporting from KSA.

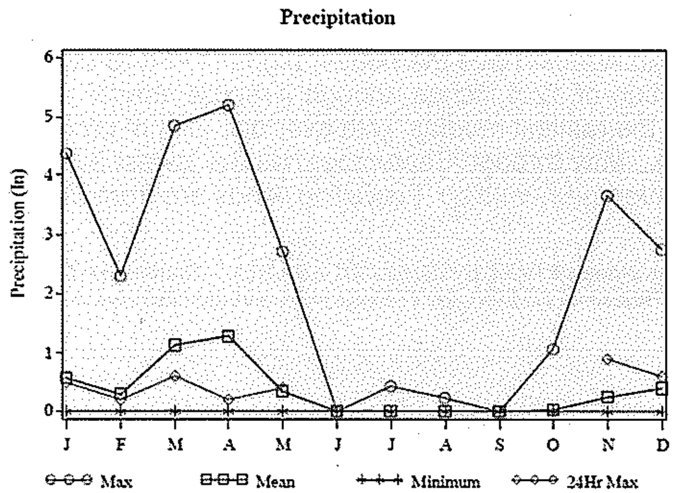
8 Heat/Cold Stress

8.1 Site-Specific Conditions

Temperatures ranges from 28 to 118 degrees F. December through March have the coldest lows (28-32 deg F), and June through August have the hottest highs (117-118 deg F). Rainfall is limited, with a maximum annual precipitation of 12.5 inches, though average annual precipitation is only 4.5 inches. March and April tend to be the rainiest months, with over one inch of precipitation on average. Humidity ranges from 6.6% to 65.7%. May through September has the lowest average humidity. December and January have the highest average humidity. Prevailing winds are from the north at 9.4 mph.

Station Name: RIYADH AB, SAUDI ARABIA Station ID: ICAO OERY
Lat=24.710 Lon=46.725 Elev=2082 Ft Means POR=2001-2010 Extremes POR=1958-2018





8.2 Heat

8.2.1 Heat Exposure Guidelines

We base the risk of heat injury on the Wet Bulb Globe Temperature Index as follows:

- **Low** (80-84.9 °F)
- **Moderate** (85-87.9°F)
- **High** (88-89.9°F)
- **Extremely High** (≥ 90°F)

Approach: Several heat casualties presented to 378 EMDS from each summer. However, none of these casualties met the 'Armed Forces Reportable Medical Events.' BEE personnel record Wet Bulb Globe Temperature (WBGT) readings and relay to base personnel using the Signal application on cell phones. The Command Post sends out updated WBGT Flag Conditions that are provided by BE via PSAB CP AtHoc. BEE authored and distributed a 20-slide Power Point to all occupational shop supervisors and conducted 1-1 training with high-risk shops in the ECES, EMXS, and ESFS squadrons. PA also pushed out weekly BE's Thermal Injury Prevention Program Quick Reference Guide during summer months (April-July).

8.2.2 Short (acute) health risk:

Risk Summary: High risk of heat injury for un-acclimatized personnel May through September, and **Low** November through March.

Medical implications: Severity of heat injury can range from mild clinical signs such as clamminess, nausea, disorientation or headache to life threatening symptoms requiring hospitalization.

Confidence in risk assessment: Based on generally available information on climate, measured WBGT, and the presence of reported heat injuries during summer months, confidence in risk assessment is **high**.

8.2.3 Long-term (chronic) health risk:

Risk Summary: There is a low risk of long-term health implications from heat injuries, but they can occur. The health risk may be greater to certain susceptible persons: those older > 45 years, in lesser physical shape, or with underlying medical/health conditions.

Medical implications: Long-term health effects 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 if they received medical care, have a higher risk for future heat injury. Repeat heat injury may have increased severity.

Confidence in risk assessment: Based on generally available climate information, measured WBGT, and the presence of reported heat injuries during summer months, confidence in risk assessment is **high**.

8.3 Cold

8.3.1 Short (acute) and long-term (chronic) health risks*:*

Approach: There were no cold injuries reported to medical personnel at PSAB current as of September 2022. Climatologic data is available.

Risk Summary: The local climate produces a low acute and chronic risk for non-freezing cold injuries, such as chilblain, trench foot, and hypothermia. However, several E-3 AWACS maintenance personnel do work with liquid oxygen on a weekly basis and can suffer frostbite on their hands during this work.

Medical implications: The cooling of body parts may result in various cold injuries - nonfreezing injuries, freezing injuries and hypothermia, which is the most serious. Toes, fingers, ears and nose are at greatest risk because these areas do not have major muscles to produce heat. In addition, the body will preserve heat by favoring the internal organs and thus reducing the flow of blood to the extremities under cold conditions. The most severe cold injury is hypothermia, which occurs from excessive loss of body heat and the consequent lowering of the body's core temperature.

Confidence in risk assessment: Based on generally available information on climatic conditions and the absence of reported cold injuries, confidence in risk assessment is **high**. Individuals who experienced mild symptoms of cold injury may not have sought medical attention; this may lead to an underestimation of the risk.

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). This is an eight-hour time-weighted average (TWA). We use the A-weighted scale of noise measurement because it mimics the human ear's response to sound.

OSHA now requires employers to enroll in the hearing conservation program any worker exposed to noise levels greater than the OEL for even one day per year.

9.1.2 Site Specific Conditions:

Sources of hazardous noise include fixed and rotary wing aircraft, generators, heavy equipment, motor vehicles, and various hand tools in maintenance shops. PSAB is a bare-base environment built from the ground up starting in mid-2019. Each US location (LSA, ADA sites, and Ops/Maintenance Town) was essentially a large construction site in which personnel worked, and in the case of the LSA, lived. Inherent in this situation came occupational-type exposures to hazardous noise, even to those not actively working on the physical base buildup. Noise surveys measured sound levels of 92 dB(A) at 20 feet from the source. Ear pain anecdotally reported. Dosimetry not available due to lack of noise dosimeters.

9.1.3 Short-term (acute) health risk:

Approach: We assessed this health risk using knowledge of the Service hearing conservation programs, and typical noise measurements associated with the various potential noise generating sources.

Risk Summary: The risk to personnel for short-term exposure is **low** as difficulty with communicating in areas with hazardous noise levels tend to drive voluntary use of non-occupational controls.

Medical implications: Loud noise can create physical and psychological stress, reduce productivity, interfere with communication and concentration, and contribute to workplace accidents and injuries by making it difficult to hear warning signals. Short-term exposure to loud noise can also cause a temporary change in hearing (ears feeling stuffed up) or a ringing in the ears (tinnitus). These short-term problems may go away within a few minutes or hours after leaving the noise. However, repeated exposures to loud noise can lead to permanent tinnitus and/or hearing loss.

Confidence in risk assessment: Confidence in risk assessment is **moderate** due to lack of dosimetry combined with reported acute hearing issues.

9.1.4. Long-term (chronic) health risk:

Approach: We assessed this health risk using knowledge of the Service hearing conservation programs, and typical noise measurements associated with the various potential noise generating sources.

Risk Summary: There is a moderate risk to personnel for long-term exposure as difficulty with communicating in areas with hazardous noise levels can drive voluntary use of non-occupational controls.

Medical implications: Exposure to high noise levels of noise can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss.

Confidence in risk assessment: Confidence in risk assessment is **Moderate** due to lack of dosimetry and lack of post-deployment hearing test results.

9.2 Impulse

No information about potential sources of impulse noise (140 dbA) or greater) was available.

9.2.1 Short-term (acute) and Long-term (chronic) health risks:

Not evaluated: Insufficient data exist upon which to base a health risk assessment.

10 Unique Concerns

10.1 Special Incidents or Spills:

10.1.1 Fuel Spills - Site Specific Conditions:

A large number of fuel spills (JP-8 and diesel), mostly small, acutely affected specific personnel who handle fuels as part of their job. Documentation of these exposures are in those members' medical records. Most base personnel do not encounter spills.

10.1.2 Fuel Spills - Short-term (acute) health risk:

Approach: Data on the number of spills and the specific populations affected by those spills were used to access risk.

Risk Summary: Low for base populace based on available information. **High** for personnel whose duties include working with fuels.

Medical implications: Cutaneous exposures to JP-8 have the potential to cause skin irritation and sensitization.

Confidence in the Risk Assessment: High, as most base personnel do not encounter spills. The personnel who do usually have received training to respond to a fuel spill.

10.1.3 Fuel Spills - Long-term (chronic) health risk:

Approach: We assessed risk by using data on the number of spills and the specific populations affected by those spills.

Risk Summary: Low for base populace based on available information. **High** for personnel whose duties include working with fuels.

Medical implications: Cutaneous exposures to JP-8 have the potential to cause skin cancer.

Confidence in the Risk Assessment: High, as most base personnel do not encounter spills. The personnel who do usually have received training to respond to a fuel spill.

10.1.4 TIC/TIM Releases - Site Specific Conditions:

Though the risk of a spill that affects personnel occurring is low, effects could be catastrophic. In addition, chemical storage cabinets are not currently available in most cases. See classified TIC/TIM Vulnerability Assessment for details.

10.1.5 TIC/TIM Releases - Short-term (acute) Long-term (chronic) and health risk:

Approach: See classified TIC/TIM Vulnerability Assessment for details. Exact chemicals used in Al Kharj Industrial City are unknown, so we made assumptions using a list of the most common TIC/TIMs in general and those used specifically in those industries shown to be operating in the area on Google Earth™.

Risk Summary: Moderate though the risk of a spill that affects personnel occurring is low, effects could be catastrophic

Medical implications: Various, depending on chemical released.

Confidence in the Risk Assessment: **Low**, due to assumptions regarding what TIC/TIMs are in the area.

10.2 Waste Sites/Waste Disposal

10.2.1 Site specific sources identified:

Four sources of waste exist on base: medical, non-hazardous solid waste, hazardous industrial waste, and sanitary sewer/latrine waste. Base personnel have minimal contact to waste. Hazardous medical waste (red-bagged or sharps containers) generated by the medical Squadron is staged in an outdoor locked Conex controlled by medical staff. Medical personnel double bag medical waste, seal it within boxes, and place it in the outdoor Conex. Medical Logistics personnel transfer sealed waste to a Hazardous Waste Company twice a week, where contractors transfer it off base.

Non-hazardous solid waste generated by base residents is disposed of in various trash bins throughout the base, and brought by residents to dumpsters. A host nation contractor empties the dumpsters daily.

Currently, work centers coordinate the handling, storage, and disposal of industrial waste generated on base. Personnel turn this waste into the central short-term storage hazardous material/waste satellite storage site managed by 378 ECES. Host nation contract personnel remove the waste.

The sanitary sewer is a plumbed system from all dining facility, latrine, shower, and laundry tents within the LSA. The sewage disposal system automatically pumps it into underground storage containers on the southwest corner of the LSA where contract sewage trucks routinely collect and dispose of it outside PSAB.

10.2.2 Short-term (acute) and Long-term (chronic) health risks:

Approach: Knowledge of CENTCOM and Service specific policies and procedures served as the basis of this risk assessment. We reviewed online sources to determine the risk posed by wastewater dumped near the LSA.

Risk Summary: Short and long-term risk is **low** based on available data.

Medical Implications: None

Confidence in the risk assessment: Confidence in the risk assessment is **medium** as there is minimal contact with hazardous waste, but the LSA is constantly changing.

10.3 Pesticides/Pest Control:

10.3.1 Site Specific Conditions:

Military vector control personnel mitigated pests and vectors in accordance with mandated integrated pest management practices. The overwhelming majority of efforts at PSAB were in the reduction of filth flies, rodents, and ants. Non-chemical measures such as exclusion measures and sanitation were first and primary efforts. Secondary measures included the use of targeted bait applications for flies and rodents and chemical application for ants.

10.3.2 Short-term (acute) and Long-term (chronic) health risk:

Approach: Discuss risks of chemicals to the population with personnel from 378 ECES Entomology.

Risk Summary: Low due to minimal pesticides application. Base personnel have minimal contact with these chemicals.

Medical Implications: None

Confidence in the risk assessment: Confidence in the risk assessment is **medium**. Integrated Pest Management does not exist on PSAB, however the potential for base residents to come in contact with improperly formulated insecticides is remote.

10.4 Burn Pit

10.4.1 Site-Specific Conditions: Smells of burning coming from PSAB proper occur 2-3 times per week. Hazard characterization is difficult due to the burning coming from industrial and/or RSAF operations.

PSAB US controlled areas do not have any burn pits.

10.4.2 Short-term (acute) health risks: Headaches, nausea and nuisance smells.

Risk Summary: Moderate due to unknown substances being burned off US controlled areas.

Medical Implications: Historical data on burn pits from other deployed locations.

Confidence in the Risk Assessment: Confidence in assessment is **low** based on available data.

11 References

POEMS developed according to:
1. DoDI 6490.03, *Deployment Health*, 2019.
2. JCSM (MCM) 0028-07, *Procedures for Deployment Health Surveillance*, 2007.
3. DoDI 6055.05, *Occupational Medical Examination and Surveillance Manual*, 2018.
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 for PSAB, KSA, Survey ID: 717881, January 2019.

Sampling data were obtained from the:
6. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRS-EH database) at https://doehrs-ih.csd.disa.mil/Doehrs/. Some of the data may be classified or otherwise have some restricted distribution. See discussion below.
7. Military Exposure Surveillance Library: https://mesl.apgea.army.mil/mesl/. Some of the data and reports used may be classified or otherwise have some restricted distribution.

Chemical hazards (air, water, soil) evaluated based on MEGs and risk assessment methodology in:
8. USACHPPM 2013 Revision, Technical Guide (TG230), "Environmental Health Risk Assessment and Chemical Exposure Guidelines for Deployed Military Personnel". For further information, contact USAPHC Environmental Health Risk Assessment Program at: commercial 410-436-2953 or DSN 584-2953.
9. 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 2010.

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

10. Centers for Disease Control and Prevention (CDC) Travelers' Health website (http://wwwnc.cdc.gov/travel/destinations/traveler/none/XXXcountry), "Destinations" section, KSA.
11. U.S. AFCENT Pre-Deployment Medical Screening Procedures, 30 Jun 2014
12. Defense Intelligence Agency Infectious Disease Risk Assessment Database, CENTCOM: KSA (https://www.ncmi.detrick.army.mil/product/idra_db.php?co=KWT)

The DOEHRS-EH database was queried to obtain the available sample data for air, soil, and drinking and nondrinking water sources at PSAB, KSA. The data are currently assessed using the TG 230 2013 Revision as described above. 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 (PEPC) that are compared to MEGs derived for similar exposure durations. If ≤ negligible MEG, the risk is Low. If levels are higher than negligible, then there is a chemical-specific toxicity and exposure evaluation by appropriate subject matter experts, which includes comparison to any available marginal, critical, or catastrophic MEGs. For drinking water, 15 liters/day (L/day) MEGs are used for the screening while site specific 5–15 L/day are used for more detailed assessment. For nondrinking water (such as that used for personal hygiene or cooking) the 'consumption rate' is limited to 2L/day (similar to the US Environmental Protection Agency (USEPA)), 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 the Deputy Assistant Secretary of Defense (DASD) for Force Health Protection and Readiness (FHP&R).

Army Institute of Public Health Phone:
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
https://hpws.afrl.af.mil/dhp/OE/ESOHSC/

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