



DEPARTMENT OF THE ARMY
US ARMY PUBLIC HEALTH COMMAND (PROVISIONAL)
5158 BLACKHAWK ROAD
ABERDEEN PROVING GROUND MD 21010-5403

MCHB-TS-RDE

11 MAR 2010

MEMORANDUM FOR Office of the Command Surgeon (LTC (b) (6)), US Central Command, 7115 South Boundary Boulevard, MacDill Air Force Base, FL 33621-5101

SUBJECT: Deployment Occupational and Environmental Health Risk Characterization, Ambient Air Particulate Matter Samples, Kandahar, Afghanistan, 21 August-27 October 2009, U_AFG_KANDAHAR_CM_A10-25_20091027

1. The enclosed assessment details the occupational and environmental health (OEH) risk characterization for ambient air particulate matter (PM) samples collected by 1st Preventive Medicine Division personnel, Kandahar, Afghanistan, 21 August-27 October 2009. All 22 filters submitted are valid samples.
2. The OEH risk estimate for exposure to PM less than 2.5 micrometers in diameter (PM_{2.5}) and analyzed metals in the ambient air at Kandahar, Afghanistan 12 and 27 October 2009 is **moderate** due to elevated levels of PM_{2.5}. Exposure to the ambient air during this sampling event may have degraded unit readiness; periods with similar ambient conditions are expected to cause similar health effects.
3. The OEH risk estimate for exposure to PM less than 10 micrometers in diameter (PM₁₀) and analyzed metals in the ambient air at Kandahar, Afghanistan 21 August-21 October 2009 is **moderate** due to elevated levels of PM₁₀. Exposure to the ambient air during this sampling event may have degraded unit readiness; periods with similar ambient conditions are expected to cause similar health effects.

FOR THE COMMANDER:

Encl

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(CONT)

MCHB-TS-RDE

SUBJECT: Deployment Occupational and Environmental Health Risk Characterization,
Ambient Air Particulate Matter Samples, Kandahar, Afghanistan,
21 August-27 October 2009, U_AFG_KANDAHAR_CM_A10-25_20091027

CF: (w/encl) (CONT)

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CJTF-82 (Command Surgeon Office/CPT (b) (6))

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MARFORCOM (Force Environmental Health Officer/LT (b) (6))

USAPHC-EUR (MCHB-AE-EE/CPT (b) (6))

U.S. Army Public Health Command (Provisional)

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
21 AUGUST-27 OCTOBER 2009
U_AFG_KANDAHAR_CM_A10-25_20091027

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DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
21 AUGUST-27 OCTOBER 2009
U_AFG_KANDAHAR_CM_A10-25_20091027

1. REFERENCES. See Appendix A for a list of references.

2. PURPOSE AND SCOPE. This occupational and environmental health (OEH) risk characterization addresses the analytical results for ambient air particulate matter (PM) less than 10 micrometers in diameter (PM_{10}), PM less than 2.5 micrometers in diameter ($PM_{2.5}$), and metals samples collected on 21 August-27 October 2009 at Kandahar, Afghanistan in accordance with U.S. Department of Defense medical surveillance requirements. All 22 filters submitted are valid samples. This sample set was assessed using the methodology described in Appendix B. This report should not be considered a complete assessment of the overall OEH hazards to which troops may be exposed at Kandahar, Afghanistan.

3. BACKGROUND AND EXPOSURE ASSUMPTIONS. Ambient air PM_{10} , $PM_{2.5}$, and metals samples were collected at the board walk, morale welfare and recreation center (MWR), burn pit, and south park, Kandahar, Afghanistan, 21 August-27 October 2009. There is no known industry present in the vicinity. No adverse weather conditions were reported for the sampling event. All personnel are expected to remain at this location for approximately 1 year. A conservative (protective) assumption used in this characterization is all personnel inhale the ambient air 24 hours/day for 365 days (1 year). In addition, it is assumed that control measures and/or personal protective equipment are not used.

4. SAMPLE COLLECTION AND ANALYSIS.

a. Sample Collection. This ambient air PM_{10} , $PM_{2.5}$, and metals sample set was collected using the Deployable Particulate Sampler (DPS™) apparatus. Appendix C presents an information summary of the PM filters submitted by 1st Preventive Medicine Division personnel. (DPS™ is a trademark of SKC, Inc.)

Use of trademarked names(s) does not imply endorsement by the U.S. Army but is intended only to assist in the identifications of a specific product.

b. Laboratory Analysis. The U.S. Army Public Health Command (Provisional) (USAPHC (Prov)), formerly U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), laboratory weighs the ambient air PM filters to determine PM mass and calculate a concentration. The USAPHC (Prov) laboratory analyzes the filters to determine metals concentrations. Metals detected above the laboratory reportable limit were compared to military exposure guidelines (MEGs) published in USACHPPM Technical Guide (TG) 230, while PM_{2.5} or PM₁₀ concentrations were assessed using the methodology described in Appendix B. Appendix C shows an information summary of the filters assessed in this report. Appendix D shows a sample results summary table. Appendices E through I show complete analytical results.

5. HAZARD IDENTIFICATION.

a. Particulate Matter. Since PM was measured at a concentration above the Air Quality Index good range, PM is identified as a potential health threat requiring further assessment. Air particulates include solid particles and liquid droplets, emitted directly into the air by sources such as power plants, motor vehicles, aircraft, generators, construction activities, fires, and natural windblown dust. Airborne particulates can include dust, silica, soil, metals, organic compounds, allergens, and compounds, such as, nitrates or sulfates formed by condensation or transformation of combustion exhaust. Particulate chemical composition and size vary considerably depending on the source.

b. Metals. No metals were found at concentrations greater than their respective MEGs. Therefore, the OEH risk estimate for exposure to metals in the ambient air at this location is considered **low**.

6. HAZARD ASSESSMENT.

a. Hazard Severity.

(1) The average concentration of PM_{2.5} was 151.20 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). This concentration falls within the range of concentrations believed to pose significant respiratory effects in generally healthy troops causing some operational impact, particularly if the exposures are repeated or continuous. Uniquely susceptible personnel, such as those with asthma have an even greater risk because exposures may induce asthma attacks. Heavy aerobic activity may exacerbate health effects caused by PM. Therefore, the hazard severity is considered marginal.

(2) The average concentration of PM₁₀ was 495.94 $\mu\text{g}/\text{m}^3$. This concentration falls within the range of concentrations believed to pose significant respiratory effects in generally healthy troops causing some operational impact, particularly if the exposures

are repeated or continuous. Uniquely susceptible personnel, such as those with asthma have an even greater risk because exposures may induce asthma attacks. Heavy aerobic activity may exacerbate health effects caused by PM. Therefore, the hazard severity is considered marginal.

b. Hazard Probability.

(1) When less than four samples are collected or less than four days are sampled and received for risk characterization, a hazard probability is not estimated; the hazard severity determines the risk estimate. A negligible severity represents a low risk and a marginal severity represents a moderate risk. Since the hazard severity was estimated to be marginal and eight samples were collected on two days, the risk from exposure to PM_{2.5} during the sampling event is assumed to be **moderate**.

(2) The hazard probability reflects the likelihood that the exposures at the location are represented by the concentrations used to determine the hazard severity. Although the average PM₁₀ sample concentration was within the marginal severity range, it is important to examine the individual samples to determine whether the average concentration is dominated by outliers or if it is representative of a typical exposure. The probability that the severity of a hazard is marginal is based on a comparison of individual sample concentrations to the lowest bound of the marginal category (350 µg/m³). During this sampling event, the range of PM₁₀ sample concentrations was 109.38-911.06 µg/m³, and 9 of 14 (64 percent) of samples were above 350 µg/m³; therefore, the probability that personnel in the sampled area(s) will be exposed to PM₁₀ greater than 350 µg/m³ is considered likely.

c. Risk Estimate and Confidence. Table 1 summarizes the risk estimate for each identified hazard.

Table 1. Risk Estimate Summary for Exposure to PM and Metals in Ambient Air, Kandahar, Afghanistan, 21 August-27 October 2009

Parameter	Hazard Severity	Hazard Probability	Hazard-Specific Risk Estimate	Confidence
PM _{2.5}	Marginal	Not applicable ¹	MODERATE	MEDIUM
PM ₁₀	Marginal	Likely	MODERATE	
Metals	No parameters detected above a MEG		LOW	

¹See Hazard Identification, paragraph 6b for explanation.

7. CONCLUSION.

a. The OEH risk estimate for exposure to PM_{2.5} and analyzed metals in ambient air at Kandahar, Afghanistan, 12 and 27 October 2009 is **moderate** due to elevated levels of PM_{2.5}. Exposure to the ambient air during this sampling event may have degraded unit readiness; periods with similar ambient conditions are expected to cause similar health effects.

b. The OEH risk estimate for exposure to PM₁₀ and analyzed metals in ambient air at Kandahar, Afghanistan, 21 August-27 October 2009 is **moderate** due to elevated levels of PM₁₀. Exposure to the ambient air during this sampling event may have degraded unit readiness; periods with similar ambient conditions are expected to cause similar health effects.

8. RECOMMENDATIONS AND NOTES.

a. Recommendations.

(1) Collect PM samples from Kandahar, Afghanistan at least once every 6 days (if possible) for the deployment duration (or as long as possible) to better characterize the ambient air PM and metals exposures.

(2) Restrict outdoor physical activities where possible during periods of visibly high particulate levels.

(3) Inform preventive medicine and medical personnel of potential health effects resulting from exposures to the measured levels of ambient PM and associated heavy metals. Disease Non-Battle Injury (DNBI) rates of respiratory diseases, particularly asthma, should be followed and assessed during periods of high PM levels. If elevated DNBI respiratory illness rates (that is, above two standard deviations), or an increase in the incidence or severity of asthma, are noted during periods of high PM levels, ensure appropriate medical surveillance-related items are documents. If assistance and/or information are needed on environmental health effects and/or medical implications from exposure to PM and associated heavy metals, please contact the USAPHC (Prov) Environmental Medicine Program at commercial (b) (6).

b. Notes.

(1) This OEH risk assessment is specific to the exposure assumptions identified above and the sample results assessed in this report. If the assumed exposure scenario changes or additional information is available, provide the updated information so the risk estimate can be reassessed. If additional samples from this site and/or area are collected, a new OEH risk assessment will be completed.

(2) As part of a Comprehensive Military Medical Surveillance Program, required by Department of Defense Directive 6490.02E and Department of Defense Instruction 6490.03, this report has been submitted to the Deployment Occupational and Environmental Health Surveillance (DOEHS)-Data Portal. You can view this and other archived DOEHS data at <https://doehrswww.apgea.army.mil/doehrs-oehs/>. If you have additional DOEHS data for Kandahar, Afghanistan it can also be submitted via this Web site.

9. POINTS OF CONTACT. The USAPHC (Prov) points of contact for this assessment are Mr. (b) (6) and Ms. (b) (6). Mr. (b) (6) may be contacted at e-mail (b) (6) and Ms. (b) (6) may be contacted at e-mail (b) (6), or DSN (b) (6) or commercial (b) (6).

(b) (6)

Supervisory Environmental Scientist
Deployment Environmental Surveillance
Program

Approved by:

(b) (6)

MAJ, MS
Program Manager
Deployment Environmental Surveillance

APPENDIX A

REFERENCES

1. Department of Defense Directive (DODD) 6490.02E, Comprehensive Health Surveillance, 21 October 2004.
2. Department of Defense Instruction (DODI) 6490.03, Deployment Health, 11 August 2006.
3. Department of the Army, Field Manual (FM) 5-19, Composite Risk Management, 21 August 2006.
4. U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) Technical Guide (TG) 230, Chemical Exposure Guidelines for Deployed Military Personnel, Version 1.3, May 2003 with the January 2004 addendum.
5. Memorandum, USACHPPM (MCHB-TS-RDE), 27 April 2007, Subject: Deployment Operational Risk Characterization Method for Particulate Matter.

APPENDIX B

METHODOLOGY

B-1. SCOPE OF RISK ASSESSMENTS. The U.S. Army Public Health Command (Provisional) (USAPHC (Prov)), formerly U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM), Deployment Environmental Surveillance Program characterizes deployment occupational and environmental health (OEH) risks which may impact mission capability (that is, operational risks). Each characterization is performed using risk management doctrine (Department of the Army, Field Manual (FM) 5-19), and the relatively conservative (protective) assumptions and methods provided in the USACHPPM Technical Guide (TG) 230, to facilitate decision making that can minimize the likelihood of significant risks. A risk estimate is generated for each sample or sample set sent to the USAPHC (Prov) laboratory for analysis. These risk estimates are provided to preventive medicine personnel with information about potential operational risks and associated health effects. Samples received are generally limited in time, area, and media. Therefore, any risk characterization based on a sample or sample set should not be considered a complete characterization of the overall OEH hazards to which troops may be exposed at a location.

B-2. RISK ASSESSMENT METHODOLOGY.

a. General. The USACHPPM TG 230 methodology (identification of the hazard(s), assessment of the hazard severity and probability, and determination of a risk estimate and confidence level), military exposure guidelines (MEGs), and National Ambient Air Quality Standards (NAAQS) are used to characterize the risk from identified OEH hazards. Each component of the methodology is described in more detail below.

b. Hazard Identification.

(1) Hazard Definition. For the purpose of conducting these risk assessments, an OEH hazard is any biological, chemical, or physical parameter detected in a medium by field testing or laboratory analysis. The detected parameter could pose a health threat if personnel are exposed to it at levels greater than its respective MEG.

(2) Screening the Hazards.

(a) General. The purpose of screening the hazards is to focus the risk assessment on the most important/credible health threats. Concentrations of identified hazards are screened against the long-term (1-year) MEGs. The 1-year MEGs

represent exposure concentrations at or below which no significant health effects (including delayed or chronic disease or significant increased risk of cancer) are anticipated even after 1 year of continuous daily exposures. For exposures that are known to be brief or intermittent (such as, 24 hours, less than 2 weeks, etc.), short-term MEGs can be used (when available).

(b) Ambient Air Particulate Matter. Particulate matter (PM) is one of six air pollutants for which the U.S. Environmental Protection Agency (USEPA) has promulgated NAAQS in the interest of protecting public health. In addition, the USEPA developed the Air Quality Index (AQI) to communicate daily air quality to the public using six descriptive categories ranging from “good” to “hazardous.” The AQI categories for PM are based on concentration ranges grouped according to health concern severity. The USAPHC (Prov) uses the AQI categories to characterize the operational risk from PM. Particulate matter sample concentrations are screened against the upper bound of the AQI good air quality concentration range. If any PM sample concentration is above this threshold, PM is identified as a hazard.

(3) Hazards that are Not Credible Health Threats. If concentrations of identified hazards are below the screening MEGs, it can be assumed that they do not pose a health threat. In these cases, a hazard assessment is not conducted and the estimated risk from exposure to these hazards is assumed to be low.

(4) Hazards that are Credible Health Threats. If concentrations of identified hazards are above the screening MEGs, they are considered credible health threats, and a hazard assessment is conducted for each one.

c. Hazard Assessment.

(1) Hazard Severity.

(a) General. When concentrations of an OEH hazard are greater than the screening MEG, the severity of the health threat associated with the hazard must be estimated. Determine whether the concentration of the hazard also exceeds short-term guidelines. Significant health and/or mission impacts may be anticipated when both long- and short-term guidelines are exceeded. Many OEH hazards with long-term guidelines have no parallel short-term guidelines. In such cases, professional judgment is necessary to estimate the hazard severity. Estimating the hazard severity involves determining the proportion of individuals within the population of interest that will experience effects and the severity of the effects. In practice, this can be difficult due to the limited and variable toxicological and epidemiological data available for most OEH hazards. Conclusions about the hazard severity must be made with an understanding

of the limitations of currently available data used to develop the MEGs and the risk assessment process in general.

(b) Multiple Samples. The average concentration of the OEH hazard is compared to the short- and long-term MEGs to determine hazard severity for sample sets where samples are collected on different days or multiple samples are collected on the same day from the same source.

(c) Ambient Air Particulate Matter. Hazard severity is determined by comparing the average PM concentration for a specific location and timeframe to PM concentration ranges identified as either negligible or marginal. This process is described in more detail in Appendix A, reference 5. Negligible concentration levels correspond to mild respiratory effects among generally healthy troops, with more significant effects among sensitive persons, such as asthmatics or those with existing cardiopulmonary disease. Marginal concentration levels are expected to pose more significant health effects among healthy personnel, and those with pre-existing sensitivities.

(2) Hazard Probability.

(a) General. The hazard probability represents the likelihood that individuals within a population of interest during a specified time period will actually be exposed to concentrations of an OEH hazard that are greater than a MEG. The MEGs were developed using certain conservative exposure assumptions that may not reflect actual exposure conditions. The primary factors in estimating the hazard probability are how closely actual exposure conditions match those used to develop the MEG, and what proportion of the population of interest will be exposed to the hazard.

(b) Ambient Air Particulate Matter. Hazard probability is based on the frequency that anticipated exposures are above a threshold that is representative of the hazard severity category. This process is described in more detail in Appendix A, reference 5. However, using USACHPPM TG 230 methodology and reference 4 to estimate the hazard probability for PM when a small number of samples are collected or numbers of days that are sampled often results in a risk estimate that is not consistent with actual exposure outcomes. Until a more refined assessment method can be published in USACHPPM TG 230, the method the USAPHC (Prov) DESP uses to characterize the risk from PM deviates slightly from USACHPPM TG 230 and reference 4. When less than four samples are collected or number of days are sampled and received for risk characterization, a hazard probability is not estimated; the hazard severity determines the risk estimate. A negligible severity represents a low risk and a marginal severity represents a moderate risk.

(3) Risk Estimate.

(a) The estimated hazard severity and probability levels are used with the Risk Assessment Matrix published in USACHPPM TG 230 and FM 5-19 to provide a risk estimate for exposure to each OEH hazard identified as a credible health threat. Therefore, communication of operational risks from OEH hazards can be made in the same context as other operational risks. The risk estimate is based on the highest estimated risk for the OEH hazards identified. Each level of operational risk has a defined mission impact and unit status description.

(b) Each risk estimate is specific to exposure assumptions derived from information on the field data sheets, communication with the collecting unit, and the associated sample results. If the assumed exposure scenario changes, additional/updated information should be provided so the risk estimate can be reassessed.

(c) If additional samples from Kandahar, Afghanistan and source are collected, a new risk estimate will be generated based upon exposure scenario information provided with the samples.

(4) Confidence. A confidence level is assigned to each risk estimate. The degree of confidence is particularly important when determining possible courses of action. The confidence level should integrate uncertainties associated with the hazard severity and probability determinations. Typical areas of uncertainty include: sampling or field data quality; actual exposure conditions and comparability to the exposure assumptions used to develop the MEGs or other comparison level; expected symptoms of exposure, including consideration of exposure to multiple hazards; and whether the predicted health outcome is plausible, given weight of evidence or real-world experiences. In general, confidence in risk estimates is usually low to medium.

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
 U_AFG_KANDAHAR_CM_A10-25_20091027

APPENDIX C

INFORMATION SUMMARY
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 21 AUGUST-27 OCTOBER 2009

DOEHS Sample ID	Field/Local Sample ID	Site	Start Date/Time	Sample Duration	Filter ID
00001HUZ	AFG_KANDAH_09233_PM10DPS	Burn Pit	2009/08/21 1053	1440.0 minutes	47-09-0706
00001HV0	AFG_KANDAH_09233_PM10DPS	South Park	2009/08/21 1345	1440.0 minutes	47-09-0746
00001HV2	AFG_KANDAH_09257_PM10DPS	Boardwalk	2009/09/14 1100	1440.0 minutes	47-09-0708
00001HV4	AFG_KANDAH_09257_PM10DPS	MWR	2009/09/14 1113	1440.0 minutes	47-09-0732
00001HV7	AFG_KANDAH_09257_PM10DPS	Burn Pit	2009/09/14 1145	1440.0 minutes	47-09-0723
00001HV9	AFG_KANDAH_09257_PM10DPS	South Park	2009/09/14 1202	1440.0 minutes	47-09-0730
00001HVE	AFG_KANDAH_09279_PM10DPS	Boardwalk	2009/10/06 1020	1440.0 minutes	47-09-0719
00001HVJ	AFG_KANDAH_09279_PM10DPS	MWR	2009/10/06 1040	1440.0 minutes	47-09-0748
00001HVK	AFG_KANDAH_09279_PM10DPS	Burn Pit	2009/10/06 1050	1440.0 minutes	47-09-0733
00001HVN	AFG_KANDAH_09279_PM10DPS	South Park	2009/10/06 1100	1440.0 minutes	47-09-0750
00001HVO	AFG_KANDAH_09285_PM25DPS	Boardwalk	2009/10/12 1140	1440.0 minutes	47-09-1527
00001HVR	AFG_KANDAH_09285_PM25DPS	MWR	2009/10/12 1158	1440.0 minutes	47-09-1529
00001I08	AFG_KANDAH_09285_PM25DPS	Burn Pit	2009/10/12 1215	1440.0 minutes	47-09-1533
00001I09	AFG_KANDAH_09285_PM25DPS	South Park	2009/10/12 1225	1440.0 minutes	47-09-1531
00001I0G	AFG_KANDAH_09294_PM10DPS	Boardwalk	2009/10/21 0936	1440.0 minutes	47-09-1541

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
 U_AFG_KANDAHAR_CM_A10-25_20091027

DOEHRS Sample ID	Field/Local Sample ID	Site	Start Date/Time	Sample Duration	Filter ID
00001I0H	AFG_KANDAH_09294_PM10DPS	MWR	2009/10/21 0948	1440.0 minutes	47-09-1550
00001I0M	AFG_KANDAH_09294_PM10DPS	Burn Pit	2009/10/21 1004	1440.0 minutes	47-09-1546
00001I0O	AFG_KANDAH_09294_PM10DPS	South Park	2009/10/21 1018	1440.0 minutes	47-09-1544
00001I0S	AFG_KANDAH_092300_PM25DPS	Boardwalk	2009/10/27 1042	1440.0 minutes	47-09-1516
00001I0T	AFG_KANDAH_092300_PM25DPS	MWR	2009/10/27 1055	1440.0 minutes	47-09-1501
00001I0W	AFG_KANDAH_092300_PM25DPS	South Park	2009/10/27 1055	1440.0 minutes	47-09-1548
00001I11	AFG_KANDAH_092300_PM25DPS	Burn Pit	2009/10/27 1113	1440.0 minutes	47-09-1518

LEGEND:

DOEHRS Sample ID = Defense Occupational and Environmental Health Readiness System Sample Identification Number

MWR = morale welfare recreation

APPENDIX D

RESULTS SUMMARY
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 21 AUGUST-27 OCTOBER 2009

Parameter ¹	Units	Concentration		Valid Samples		USACHPPM TG 230 Military Exposure Guidelines ³	
		Maximum	Average ²	#	# > Laboratory Reporting Limit	1-year	
						# > MEG	MEG
PM ₁₀	µg/m ³	911.06	495.94	14	14	14	50
PM _{2.5}	µg/m ³	332.23	151.20	8	8	8	15
Antimony	µg/m ³	0.24394	0.051093	22	3	0	12
Lead	µg/m ³	0.080372	0.03756	22	1	0	12
Manganese	µg/m ³	0.32008	0.14629	22	11	0	3.4

¹ Highlighted values indicate the parameter was detected at a concentration above a MEG.

² Where parameters are not detected in a sample during analyses, half of the laboratory reporting limit is used in the average.

³ This table was created from DOEHS on 30 November 2009. The MEGs in DOEHS are current as of June 2009.

LEGEND:

PM₁₀ = particulate matter less than 10 micrometers in diameter
 PM_{2.5} = particulate matter less than 2.5 micrometers in diameter
 µg/m³ = micrograms per cubic meter
 USACHPPM = U.S. Center for Health Promotion and Preventive Medicine
 TG = Technical Guide
 MEGs = military exposure guidelines

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
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APPENDIX E

ANALYTICAL SAMPLE RESULTS
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 12 AND 27 OCTOBER 2009

DOEHRs Sample ID			00001HVO	00001HVR	00001I08	00001I09	00001I0S	00001I0T
Field/Local Sample ID			AFG_KANDAH_09285_PM25DP S	AFG_KANDAH_09285_PM25 DPS	AFG_KANDAH_09285_PM25DP S	AFG_KANDAH_09285_PM25 DPS	AFG_KANDAH_092300_PM25D PS	AFG_KANDA H_092300_P M25DPS
Site			Boardwalk	MWR	Burn Pit	South Park	Boardwalk	MWR
Start Date/Time			2009/10/12 1140	2009/10/12 1158	2009/10/12 1215	2009/10/12 1225	2009/10/27 1042	2009/10/27 1055
Parameter	Class	Units	Concentration ^{1,2}					
Antimony	Metals	µg/m ³	< 0.071963	< 0.072338	0.075113	< 0.069793	< 0.072717	< 0.075896
Arsenic	Metals	µg/m ³	< 0.035982	< 0.036169	< 0.035431	< 0.034897	< 0.036358	< 0.037948
Cadmium	Metals	µg/m ³	< 0.035982	< 0.036169	< 0.035431	< 0.034897	< 0.036358	< 0.037948
Chromium	Metals	µg/m ³	< 0.035982	< 0.036169	< 0.035431	< 0.034897	< 0.036358	< 0.037948
Lead	Metals	µg/m ³	< 0.071963	< 0.072338	< 0.070862	< 0.069793	< 0.072717	< 0.075896
Manganese	Metals	µg/m ³	< 0.14393	< 0.14468	< 0.14172	< 0.13959	< 0.14543	< 0.15179
Nickel	Metals	µg/m ³	< 0.035982	< 0.036169	< 0.035431	< 0.034897	< 0.036358	< 0.037948
PM _{2.5}		µg/m ³	63.328	144.5	332.23	56.288	149.29	151.83
Vanadium	Metals	µg/m ³	< 0.14393	< 0.14468	< 0.14172	< 0.13959	< 0.14543	< 0.15179
Zinc	Metals	µg/m ³	< 0.35982	< 0.36169	< 0.35431	< 0.34897	< 0.36358	< 0.37948

¹ < X.XX = Below laboratory reporting limit (X.XX)

² Laboratory reporting limit is parameter and sample specific

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LEGEND:

DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

MWR = morale welfare recreation

$\text{PM}_{2.5}$ = particulate matter less than 2.5 micrometers in diameter

APPENDIX F

ANALYTICAL SAMPLE RESULTS
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 27 OCTOBER 2009

DOEHRS Sample ID			0000110W	00001111
Field/Local Sample ID			AFG_KANDAH_092300_PM25DPS	AFG_KANDAH_092300_PM25DPS
Site			South Park	Burn Pit
Start Date/Time			2009/10/27 1055	2009/10/27 1113
Parameter	Class	Units	Concentration ^{1,2}	
Antimony	Metals	µg/m ³	< 0.070146	0.12972
Arsenic	Metals	µg/m ³	< 0.035073	< 0.035251
Cadmium	Metals	µg/m ³	< 0.035073	< 0.035251
Chromium	Metals	µg/m ³	< 0.035073	< 0.035251
Lead	Metals	µg/m ³	< 0.070146	< 0.070502
Manganese	Metals	µg/m ³	< 0.14029	< 0.14100
Nickel	Metals	µg/m ³	< 0.035073	< 0.035251
PM _{2.5}		µg/m ³	89.506	222.61
Vanadium	Metals	µg/m ³	< 0.14029	< 0.14100
Zinc	Metals	µg/m ³	< 0.35073	< 0.35251

¹ < X.XX = Below laboratory reporting limit (X.XX)

² Laboratory reporting limit is parameter and sample specific

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
U_AFG_KANDAHAR_CM_A10-25_20091027

LEGEND:

DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

MWR = morale welfare recreation

$\text{PM}_{2.5}$ = particulate matter less than 2.5 micrometers in diameter

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
 U_AFG_KANDAHAR_CM_A10-25_20091027

APPENDIX G

ANALYTICAL SAMPLE RESULTS
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 21 AUGUST AND 14 SEPTEMBER 2009

DOEHRs Sample ID			00001HUZ	00001HV0	00001HV2	00001HV4	00001HV7	00001HV9
Field/Local Sample ID			AFG_KANDAH_09233_PM10DP S	AFG_KANDAH_09233_PM10 DPS	AFG_KANDAH_09257_PM10DP S	AFG_KANDAH_09257_PM10 DPS	AFG_KANDAH_09257_PM10DP S	AFG_KANDA H_09257_PM 10DPS
Site			Burn Pit	South Park	Boardwalk	MWR	Burn Pit	South Park
Start Date/Time			2009/08/21 1053	2009/08/21 1345	2009/09/14 1100	2009/09/14 1113	2009/09/14 1145	2009/09/14 1202
Parameter	Class	Units	Concentration ^{1,2}					
Antimony	Metals	µg/m ³	< 0.069793	< 0.070146	< 0.070502	< 0.071592	< 0.070502	< 0.070502
Arsenic	Metals	µg/m ³	< 0.034897	< 0.035073	< 0.035251	< 0.035796	< 0.035251	< 0.035251
Cadmium	Metals	µg/m ³	< 0.034897	< 0.035073	< 0.035251	< 0.035796	< 0.035251	< 0.035251
Chromium	Metals	µg/m ³	< 0.034897	< 0.035073	< 0.035251	< 0.035796	< 0.035251	< 0.035251
Lead	Metals	µg/m ³	< 0.069793	< 0.070146	< 0.070502	< 0.071592	< 0.070502	< 0.070502
Manganese	Metals	µg/m ³	< 0.13959	< 0.14029	< 0.14100	0.24628	0.19106	0.23336
Nickel	Metals	µg/m ³	< 0.034897	< 0.035073	< 0.035251	< 0.035796	< 0.035251	< 0.035251
PM ₁₀		µg/m ³	346.59	345.01	109.38	600.91	611.75	473.7
Vanadium	Metals	µg/m ³	< 0.13959	< 0.14029	< 0.14100	< 0.14318	< 0.14100	< 0.14100
Zinc	Metals	µg/m ³	< 0.34897	< 0.35073	< 0.35251	< 0.35796	< 0.35251	< 0.35251

¹ < X.XX = Below laboratory reporting limit (X.XX)

² Laboratory reporting limit is parameter and sample specific

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
U_AFG_KANDAHAR_CM_A10-25_20091027

LEGEND:

DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

MWR = morale welfare recreation

PM_{10} = particulate matter less than 10 micrometers in diameter

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
 U_AFG_KANDAHAR_CM_A10-25_20091027

APPENDIX H

ANALYTICAL SAMPLE RESULTS
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 6 AND 21 OCTOBER 2009

DOEHRs Sample ID			00001HVE	00001HVJ	00001HVK	00001HVN	00001I0G	00001I0H
Field/Local Sample ID			AFG_KANDAH_09279_PM10DP S	AFG_KANDAH_09279_PM10 DPS	AFG_KANDAH_09279_PM10 DPS	AFG_KANDAH_09279_PM10DP S	AFG_KANDAH_09294_PM10DP S	AFG_KANDA H_09294_PM 10DPS
Site			Boardwalk	MWR	Burn Pit	South Park	Boardwalk	MWR
Start Date/Time			2009/10/06 1020	2009/10/06 1040	2009/10/06 1050	2009/10/06 1100	2009/10/21 0936	2009/10/21 0948
Parameter	Class	Units	Concentration ^{1,2}					
Antimony	Metals	µg/m ³	< 0.071225	< 0.071963	< 0.070146	< 0.070862	< 0.070146	< 0.070502
Arsenic	Metals	µg/m ³	< 0.035613	< 0.035982	< 0.035073	< 0.035431	< 0.035073	< 0.035251
Cadmium	Metals	µg/m ³	< 0.035613	< 0.035982	< 0.035073	< 0.035431	< 0.035073	< 0.035251
Chromium	Metals	µg/m ³	< 0.035613	< 0.035982	< 0.035073	< 0.035431	< 0.035073	< 0.035251
Lead	Metals	µg/m ³	< 0.071225	< 0.071963	< 0.070146	< 0.070862	< 0.070146	< 0.070502
Manganese	Metals	µg/m ³	0.15527	0.23532	0.19921	0.1559	0.20903	0.32008
Nickel	Metals	µg/m ³	< 0.035613	< 0.035982	< 0.035073	< 0.035431	< 0.035073	< 0.035251
PM ₁₀		µg/m ³	413.03	622.7	530.23	312.25	487.93	843.31
Vanadium	Metals	µg/m ³	< 0.14245	< 0.14393	< 0.14029	< 0.14172	< 0.14029	< 0.14100
Zinc	Metals	µg/m ³	< 0.35613	< 0.35982	< 0.35073	< 0.35431	< 0.35073	< 0.35251

¹< X.XX = Below laboratory reporting limit (X.XX)

²Laboratory reporting limit is parameter and sample specific

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
U_AFG_KANDAHAR_CM_A10-25_20091027

LEGEND:

DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

MWR = morale welfare recreation

PM10 = particulate matter less than 10 micrometers in diameter

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
 U_AFG_KANDAHAR_CM_A10-25_20091027

APPENDIX I

ANALYTICAL SAMPLE RESULTS
 AMBIENT AIR PARTICULATE MATTER SAMPLES
 KANDAHAR, AFGHANISTAN
 21 OCTOBER 2009

DOEHRS Sample ID			00001I0M	00001I0O
Field/Local Sample ID			AFG_KANDAH_09294_PM10DPS	AFG_KANDAH_09294_PM10DPS
Site			Burn Pit	South Park
Start Date/Time			2009/10/21 1004	2009/10/21 1018
Parameter	Class	Units	Concentration ^{1,2}	
Antimony	Metals	µg/m ³	0.24394	< 0.069793
Arsenic	Metals	µg/m ³	< 0.035251	< 0.034897
Cadmium	Metals	µg/m ³	< 0.035251	< 0.034897
Chromium	Metals	µg/m ³	< 0.035251	< 0.034897
Lead	Metals	µg/m ³	0.080372	< 0.069793
Manganese	Metals	µg/m ³	0.31937	0.1689
Nickel	Metals	µg/m ³	< 0.035251	< 0.034897
PM ₁₀		µg/m ³	911.06	335.29
Vanadium	Metals	µg/m ³	< 0.14100	< 0.13959
Zinc	Metals	µg/m ³	< 0.35251	< 0.34897

¹< X.XX = Below laboratory reporting limit (X.XX)

²Laboratory reporting limit is parameter and sample specific

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 21 Aug-27 Oct 09,
U_AFG_KANDAHAR_CM_A10-25_20091027

LEGEND:

DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

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PM_{10} = particulate matter less than 10 micrometers in diameter