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

MCHB-TS-RDE

12 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, 7 July-7 September 2009, U_AFG_KANDAHAR_CM_A10-25_20090907

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 Detachment personnel, Kandahar, Afghanistan, 7 July-7 September 2009. All 31 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 29 July-7 September 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 (PM_{10}) and analyzed metals in the ambient air at Kandahar, Afghanistan 7 July-4 September 2009 is **moderate** due to elevated levels of PM_{10}. 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:

(b) (6)

Encl

Director, Health Risk Management

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U.S. Army Public Health Command (Provisional)

USAPHC

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
HEALTH RISK CHARACTERIZATION
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
7 JULY-7 SEPTEMBER 2009
U_AFG_KANDAHAR_CM_A10-25_20090907

Preventive Medicine Survey: 40-5f1

PHC FORM 433-E (MCHB-CS-IP), NOV 09

DEPLOYMENT OCCUPATIONAL AND ENVIRONMENTAL
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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 less than 10 micrometers in diameter (PM_{10}), particulate matter less than 2.5 micrometers in diameter ($PM_{2.5}$), and metals samples collected 7 July-7 September 2009 at Kandahar, Afghanistan in accordance with U.S. Department of Defense (DOD) medical surveillance requirements. All 31 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, 7 July-7 September 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 that 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 Deployment Particulate Sampler (DPS™) apparatus. Tables 1 and 2 present a summary of the PM filters submitted by the 1st Preventive Medicine Detachment. (DPS™ is a trademark of SKC, Inc.)

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

Table 1. Sample Summary Ambient Air $PM_{2.5}$ Samples, Kandahar, Afghanistan, 29 July-7 September 2009

Sample Identification		Date	Valid
Field ID	Site		
AFG_KANDAH_09213_PM2.5DPS	Board Walk	1 Aug 09	Yes
AFG_KANDAH_09234_PM2.5DPS	Board Walk	22 Aug 09	Yes
AFG_KANDAH_09238_PM2.5DPS	Board Walk	26 Aug 09	Yes
AFG_KANDAH_09250_PM2.5DPS	Board Walk	7 Sep 09	Yes
AFG_KANDAH_09211_PM2.5DPS	MWR	30 Jul 09	Yes
AFG_KANDAH_09234_PM10DPS	MWR	22 Aug 09	Yes
AFG_KANDAH_09238_PM2.5DPS	MWR	26 Aug 09	Yes
AFG_KANDAH_09257_PM2.5DPS	MWR	7 Sep 09	Yes
AFG_KANDAH_09257_PM2.5DPS	Burn Pit	31 Jul 09	Yes
AFG_KANDAH_09257_PM2.5DPS	Burn Pit	27 Aug 09	Yes
AFG_KANDAH_09250_PM2.5DPS	Burn Pit	7 Sep 09	Yes
AFG_KANDAH_09210_PM2.5DPS	South Park	29 Jul 09	Yes
AFG_KANDAH_09239_PM2.5DPS	South Park	27 Aug 09	Yes
AFG_KANDAH_09250_PM2.5DPS	South Park	7 Sep 09	Yes

Table 2. Sample Summary Ambient Air PM_{10} Samples, Kandahar, Afghanistan, 7 July-4 September 2009

Sample Identification		Date	Valid
Field ID	Site		
AFG_KANDAH_09189_PM10DPS	MWR	8 Jul 09	Yes
AFG_KANDAH_09213_PM10DPS	MWR	1 Aug 09	Yes
AFG_KANDAH_09231_PM10DPS	MWR	19 Aug 09	Yes
AFG_KANDAH_09247_PM10DPS	MWR	4 Sep 09	Yes
AFG_KANDAH_09209_PM10DPS	Burn Pit	28 Jul 09	Yes
AFG KANDAH 09216 PM20DPS	Burn Pit	4 Aug 09	Yes
AFG KANDAH 09273 PM10DPS	Burn Pit	25 Aug 09	Yes
AFG KANDAH 09247 PM10DPS	Burn Pit	4 Sep 09	Yes
AFG KANDAH 09188 PM10DPS	Board Walk	7 Jul 09	Yes
AFG KANDAH 09210 PM10DPS	Board Walk	29 Jul 09	Yes
AFG KANDAH 09217 PM10DPS	Board Walk	5 Aug 09	Yes
AFG KANDAH 09231 PM10DPS	Board Walk	19 Aug 09	Yes

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

Sample Identification		Date	Valid
Field ID	Site		
AFG KANDAH 09190 PM10DPS	South Park	9 Jul 09	Yes
AFG KANDAH 09209 PM10DPS	South Park	28 Jul 09	Yes
AFG KANDAH 09212 PM10DPS	South Park	31 Jul 09	Yes
AFG KANDAH 09237 PM10DPS	South Park	25 Aug 09	Yes
AFG KANDAH 09247 PM10DPS	South Park	4 Sep 09	Yes

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 230, while $PM_{2.5}$ or PM_{10} concentrations were assessed using the methodology described in Appendix B. Appendix C shows a summary of the filters assessed in this report. Appendix D shows a sample results summary table. Appendices E through J 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 131 micrograms per cubic meter ($\mu g/m^3$). This concentration falls within the range of concentrations believed to pose significant health concerns to susceptible groups, which in the military can include asthmatics or persons with pre-existing cardiopulmonary disease. Otherwise, generally healthy troops may have some eye, nasal, or throat irritation causing little or no impact on unit readiness. Therefore, the hazard severity is considered negligible.

(2) The average concentration of PM_{10} was 376 $\mu g/m^3$. This concentration falls within the range of concentrations that are believed to pose significant respiratory effects in generally healthy troops causing some operational impact (e.g. lost duty days), particularly if exposures are repeated or continuous. Uniquely susceptible personnel such as those with asthma have an even greater risk, as 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) 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 $PM_{2.5}$ sample concentration was within the negligible 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 negligible is based on a comparison of individual sample concentrations to the $PM_{2.5}$ 24-hour NAAQS of 35 $\mu g/m^3$. During this sampling event, the range of $PM_{2.5}$ sample concentrations was 75-211 $\mu g/m^3$, and 14 of 14 (100 percent) of samples were above 35 $\mu g/m^3$; therefore, the probability that personnel in the sampled area will be exposed to $PM_{2.5}$ greater than 35 $\mu g/m^3$ is considered frequent.

(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 PM_{10} 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 hazard probability reflects the likelihood that the exposures at the location are represented by the concentrations used to determine the hazard severity. 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 severity category

(350 µg/m^3). During this sampling event, the range of PM_{10} sample concentrations was 54-977 µg/m^3, and 10 of 17 (59 percent) samples were above 350 µg/m^3. Since the assumption is that all or most personnel at this location are equally exposed to the ambient air, the probability that personnel will be exposed to PM_{10} concentrations greater than 350 µg/m_3 is considered occasional.

c. Risk Estimate and Confidence. Table 3 summarize the risk estimate for each identified hazard.

Table 3. Risk Estimate Summary for Exposure to PM and Metals in Ambient Air, DFAC, Kandahar, Afghanistan, 7 July-7 September 2009

Parameter	Hazard Severity	Hazard Probability	Hazard-Specific Risk Estimate	Operational Risk Estimate	Confidence
$PM_{2.5}$	Negligible	Frequent	MODERATE	MODERATE	MEDIUM
PM_{10}	Marginal	Occasional	MODERATE		
Metals	No parameters detected above a MEG		LOW		

7. CONCLUSION.

a. The OEH risk estimate for exposure to $PM_{2.5}$ and analyzed metals in ambient air at Kandahar, Afghanistan, 29 July-7 September 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 PM_{10} and analyzed metals in ambient air at Kandahar, Afghanistan, 7 July-4 September 2009 is **moderate** due to elevated levels of PM_{10}. 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 this location 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.

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 Occupational and Environmental Health Surveillance-Data Portal. You can view this and other archived OEHS data at https://doehrswww.apgea.army.mil/doehrs-oehs/. If you have additional OEHS 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 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 (DESP) 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 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 TG 230 methodology and reference 1d 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 TG 230, the method the USAPHC (Prov) DESP uses to characterize the risk from PM deviates slightly from TG 230 and reference 1d. 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 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 this location 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.

APPENDIX C

INFORMATION SUMMARY
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
7 JULY-7 SEPTEMBER 2009

DOEHRS Sample ID	Field/Local Sample ID	Site	Start Date/Time	Sample Duration	Filter ID
000019O8	AFG_KANDAH_09213_PM2.5DPS	Board Walk	2009/08/01 1648	1440.0 min	000019O8
000019OA	AFG_KANDAH_09234_PM2.5DPS	Board Walk	2009/08/22 0940	1440.0 min	000019OA
000019P6	AFG_KANDAH_09238_PM2.5DPS	Board Walk	2009/08/26 1012	1440.0 min	000019P6
000019PA	AFG_KANDAH_09250_PM2.5DPS	Board Walk	2009/09/07 0940	1440.0 min	000019PA
000019PG	AFG_KANDAH_09211_PM2.5DPS	MWR	2009/07/30 1040	1440.0 min	000019PG
000019PH	AFG_KANDAH_09234_PM10DPS	MWR	2009/08/22 1003	1440.0 min	000019PH
000019PI	AFG_KANDAH_09238_PM2.5DPS	MWR	2009/08/26 1030	1440.0 min	000019PI
000019PL	AFG_KANDAH_09257_PM2.5DPS	MWR	2009/09/07 1042	1440.0 min	000019PL
000019PO	AFG_KANDAH_09257_PM2.5DPS	Burn Pit	2009/07/31 1147	1440.0 min	000019PO
000019PP	AFG_KANDAH_09257_PM2.5DPS	Burn Pit	2009/08/27 1033	1440.0 min	000019PP
000019PR	AFG_KANDAH_09250_PM2.5DPS	Burn Pit	2009/09/07 1027	1440.0 min	000019PR
000019PT	AFG_KANDAH_09210_PM2.5DPS	South Park	2009/07/29 0852	1440.0 min	000019PT
000019PV	AFG_KANDAH_09239_PM2.5DPS	South Park	2009/08/27 1020	1440.0 min	000019PV
000019PX	AFG_KANDAH_09250_PM2.5DPS	South Park	2009/09/07 1041	1440.0 min	000019PX
000019Q2	AFG_KANDAH_09189_PM10DPS	MWR	2009/07/08 1146	1440.0 min	000019Q2

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

DOEHRS Sample ID	Field/Local Sample ID	Site	Start Date/Time	Sample Duration	Filter ID
000019QE	AFG_KANDAH_09213_PM10DPS	MWR	2009/08/01 1842	1440.0 min	000019QE
000019QJ	AFG_KANDAH_09231_PM10DPS	MWR	2009/08/19 1113	1440.0 min	000019QJ
000019QN	AFG_KANDAH_09247_PM10DPS	MWR	2009/09/04 1052	1440.0 min	000019QN
000019QV	AFG_KANDAH_09209_PM10DPS	Burn Pit	2009/07/28 1317	1440.0 min	000019QV
00001AAO	AFG KANDAH 09216 PM20DPS	Burn Pit	2009/08/04 1140	1440.0 min	00001AAO
00001AAP	AFG KANDAH 09273 PM10DPS	Burn Pit	2009/08/25 1025	1440.0 min	00001AAP
00001AAQ	AFG KANDAH 09247 PM10DPS	Burn Pit	2009/09/04 1117	1440.0 min	00001AAQ
00001AAU	AFG KANDAH 09188 PM10DPS	Board Walk	2009/07/07 1030	1440.0 min	00001AAU
00001AAY	AFG KANDAH 09210 PM10DPS	Board Walk	2009/07/29 1531	1440.0 min	00001AAY
00001AB2	AFG KANDAH 09217 PM10DPS	Board Walk	2009/08/05 1520	1440.0 min	00001AB2
00001AB4	AFG KANDAH 09231 PM10DPS	Board Walk	2009/08/19 1125	1440.0 min	00001AB4
00001AB6	AFG KANDAH 09190 PM10DPS	South Park	2009/07/09 1239	1441.0 min	00001AB6
00001AB8	AFG KANDAH 09209 PM10DPS	South Park	2009/07/28 1004	1440.0 min	00001AB8
00001AB9	AFG KANDAH 09212 PM10DPS	South Park	2009/07/31 1715	1440.0 min	00001AB9
00001ABC	AFG KANDAH 09237 PM10DPS	South Park	2009/08/25 1036	1440.0 min	00001ABC
00001ABF	AFG KANDAH 09247 PM10DPS	South Park	2009/09/04 1137	1440.0 min	00001ABF

LEGEND:
DOEHRS Sample ID = Defense Occupational and Environmental Health Readiness System Sample Identification Number
MWR = Morale Welfare Recreation Center

APPENDIX D

RESULTS SUMMARY
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
7 JULY-7 SEPTEMBER 2009

Parameter[1]	Units	Concentration		Valid Samples		USACHPPM TG 230 Military Exposure Guideline[3] 1-year	
		Maximum	Average[2]	#	# > Laboratory Reporting Limit	# > MEG	MEG
PM_{10}	µg/m^3	977.76	376.46	31	31	31	50
$PM_{2.5}$	µg/m^3	218.58	131.56	31	31	31	15

[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 DOEHRS on 30 November 2009. The MEGs in DOEHRS are current as of June 2009.

LEGEND:
µg/m^3 = micrograms per cubic meter
USACHPPM = U.S. Center for Health Promotion and Preventive Medicine
TG = Technical Guide
MEG = Military Exposure Guideline

APPENDIX E

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
30 JULY-26 AUGUST 2009

DOEHRS Sample ID			000019O8	000019OA	000019P6	000019PA	000019PG	000019PH
Field/Local Sample ID			AFG_KANDAH_09213_PM2.5DPS	AFG_KANDAH_09234_PM2.5DPS	AFG_KANDAH_09238_PM2.5DPS	AFG_KANDAH_09250_PM2.5DPS	AFG_KANDAH_09211_PM2.5DPS	AFG_KANDAH_09234_PM10DPS
Country			Board Walk	Board Walk	Board Walk	Board Walk	MWR	MWR
Site			2009/08/01 1648	2009/08/22 0940	2009/08/26 1012	2009/09/07 0940	2009/07/30 1040	2009/08/22 1003
Start Date/Time			000019O8	000019OA	000019P6	000019PA	000019PG	000019PH
Parameter	Class	Units	Concentration					
Antimony	Metals	$\mu g/m^3$	< 0.072338	< 0.071963	< 0.076313	< 0.070502	< 0.071963	< 0.069793
Arsenic	Metals	$\mu g/m^3$	< 0.036169	< 0.035982	< 0.038156	< 0.035251	< 0.035982	< 0.034897
Beryllium	Metals	$\mu g/m^3$	< 0.036169	< 0.035982	< 0.038156	< 0.035251	< 0.035982	< 0.034897
Cadmium	Metals	$\mu g/m^3$	< 0.036169	< 0.035982	< 0.038156	< 0.035251	< 0.035982	< 0.034897
Chromium	Metals	$\mu g/m^3$	< 0.036169	< 0.035982	< 0.038156	< 0.035251	< 0.035982	< 0.034897
Lead	Metals	$\mu g/m^3$	< 0.072338	< 0.071963	< 0.076313	< 0.070502	< 0.071963	< 0.069793
Manganese	Metals	$\mu g/m^3$	< 0.14468	< 0.14393	< 0.15263	< 0.14100	< 0.14393	< 0.13959
Nickel	Metals	$\mu g/m^3$	< 0.036169	0.09787	< 0.038156	< 0.035251	0.049223	< 0.034897
$PM_{2.5}$		$\mu g/m^3$	90	87	161	75	122	104
Vanadium	Metals	$\mu g/m^3$	< 0.14468	< 0.14393	< 0.15263	< 0.14100	< 0.14393	< 0.13959
Zinc	Metals	$\mu g/m^3$	< 0.36169	< 0.35982	< 0.38156	< 0.35251	0.37781	< 0.34897

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

LEGEND:
DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number
$\mu g/m^3$ = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers in diameter

APPENDIX F

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
29 JULY-7 SEPTEMBER 2009

DOEHRS Sample ID			000019PI	000019PL	000019PO	000019PP	000019PR	000019PT
Field/Local Sample ID			AFG_KANDAH_09238_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09250_PM2.5DPS	AFG_KANDAH_09210_PM2.5DPS
Country			MWR	MWR	Burn Pit	Burn Pit	Burn Pit	South Park
Site			2009/08/26 1030	2009/09/07 1042	2009/07/31 1147	2009/08/27 1033	2009/09/07 1027	2009/07/29 0852
Start Date/Time			000019PI	000019PL	000019PO	000019PP	000019PR	000019PT
Parameter	Class	Units	Concentration					
Antimony	Metals	µg/m^3	< 0.070146	< 0.070862	0.10729	0.11082	< 0.070862	< 0.070502
Arsenic	Metals	µg/m^3	< 0.035073	< 0.035431	< 0.036743	< 0.036939	< 0.035431	< 0.035251
Beryllium	Metals	µg/m^3	< 0.035073	< 0.035431	< 0.036743	< 0.036939	< 0.035431	< 0.035251
Cadmium	Metals	µg/m^3	< 0.035073	< 0.035431	< 0.036743	< 0.036939	< 0.035431	< 0.035251
Chromium	Metals	µg/m^3	< 0.035073	< 0.035431	< 0.036743	< 0.036939	< 0.035431	< 0.035251
Lead	Metals	µg/m^3	< 0.070146	< 0.070862	< 0.073486	< 0.073877	< 0.070862	< 0.070502
Manganese	Metals	µg/m^3	< 0.14029	< 0.14172	< 0.14697	< 0.14775	< 0.14172	0.21644
Nickel	Metals	µg/m^3	< 0.035073	< 0.035431	< 0.036743	< 0.036939	< 0.035431	< 0.035251
$PM_{2.5}$		µg/m^3	180	101	219	185	211	117
Vanadium	Metals	µg/m^3	< 0.14029	< 0.14172	< 0.14697	< 0.14775	< 0.14172	< 0.14100

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

DOEHRS Sample ID			000019PI	000019PL	000019PO	000019PP	000019PR	000019PT
Field/Local Sample ID			AFG_KANDAH_09238_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09257_PM2.5DPS	AFG_KANDAH_09250_PM2.5DPS	AFG_KANDAH_09210_PM2.5DPS
Country			MWR	MWR	Burn Pit	Burn Pit	Burn Pit	South Park
Site			2009/08/26 1030	2009/09/07 1042	2009/07/31 1147	2009/08/27 1033	2009/09/07 1027	2009/07/29 0852
Start Date/Time			000019PI	000019PL	000019PO	000019PP	000019PR	000019PT
Parameter	Class	Units	Concentration					
Zinc	Metals	µg/m^3	< 0.35073	< 0.35431	< 0.36743	< 0.36939	< 0.35431	< 0.35251

LEGEND:
DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number
µg/m^3 = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers in diameter

APPENDIX G

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
27 AUGUST-7 SEPTEMBER 2009

DOEHRS Sample ID			000019PV	000019PX
Field/Local Sample ID			AFG_KANDAH_09239_PM2.5DPS	AFG_KANDAH_09250_PM2.5DPS
Country			South Park	South Park
Site			2009/08/27 1020	2009/09/07 1041
Start Date/Time			000019PV	000019PX
Parameter	Class	Units	Concentration	
Antimony	Metals	$\mu g/m^3$	< 0.070862	< 0.070862
Arsenic	Metals	$\mu g/m^3$	< 0.035431	< 0.035431
Beryllium	Metals	$\mu g/m^3$	< 0.035431	< 0.035431
Cadmium	Metals	$\mu g/m^3$	< 0.035431	< 0.035431
Chromium	Metals	$\mu g/m^3$	< 0.035431	< 0.035431
Lead	Metals	$\mu g/m^3$	< 0.070862	< 0.070862
Manganese	Metals	$\mu g/m^3$	< 0.14172	< 0.14172
Nickel	Metals	$\mu g/m^3$	< 0.035431	< 0.035431
$PM_{2.5}$		$\mu g/m^3$	101	89
Vanadium	Metals	$\mu g/m^3$	< 0.14172	< 0.14172
Zinc	Metals	$\mu g/m^3$	< 0.35431	< 0.35431

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

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

$\mu g/m^3$ = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
$PM_{2.5}$ = Particulate matter less than 2.5 micrometers in diameter

APPENDIX H

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
8 JULY-4 SEPTEMBER 2009

DOEHRS Sample ID			000019Q2	000019QE	000019QJ	000019QN	000019QV	00001AAO
Field/Local Sample ID			AFG_KANDAH_09189_PM10DPS	AFG_KANDAH_09213_PM10DPS	AFG_KANDAH_09231_PM10DPS	AFG_KANDAH_09247_PM10DPS	AFG_KANDAH_09209_PM10DPS	AFG KANDAH 09216 PM20DPS
Country			MWR	MWR	MWR	MWR	Burn Pit	Burn Pit
Site			2009/07/08 1146	2009/08/01 1842	2009/08/19 1113	2009/09/04 1052	2009/07/28 1317	2009/08/04 1140
Start Date/Time			000019Q2	000019QE	000019QJ	000019QN	000019QV	00001AAO
Parameter	Class	Units	Concentration					
Antimony	Metals	$\mu g/m^3$	< 0.075075	< 0.070146	< 0.069793	< 0.071592	< 0.070502	< 0.072717
Arsenic	Metals	$\mu g/m^3$	< 0.037538	< 0.035073	< 0.034897	< 0.035796	< 0.035251	< 0.036358
Beryllium	Metals	$\mu g/m^3$	< 0.037538	< 0.035073	< 0.034897	< 0.035796	< 0.035251	< 0.036358
Cadmium	Metals	$\mu g/m^3$	< 0.037538	< 0.035073	< 0.034897	< 0.035796	< 0.035251	< 0.036358
Chromium	Metals	$\mu g/m^3$	< 0.037538	< 0.035073	< 0.034897	< 0.035796	< 0.035251	< 0.036358
Lead	Metals	$\mu g/m^3$	< 0.075075	< 0.070146	< 0.069793	< 0.071592	< 0.070502	0.074898
Manganese	Metals	$\mu g/m^3$	< 0.15015	< 0.14029	0.19193	< 0.14318	0.22067	< 0.14543
Nickel	Metals	$\mu g/m^3$	< 0.037538	< 0.035073	< 0.034897	< 0.035796	< 0.035251	< 0.036358
PM_{10}		$\mu g/m^3$	470	301	455	158	544	492
Vanadium	Metals	$\mu g/m^3$	< 0.15015	< 0.14029	< 0.13959	< 0.14318	< 0.14100	< 0.14543

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

DOEHRS Sample ID			000019Q2	000019QE	000019QJ	000019QN	000019QV	00001AAO
Field/Local Sample ID			AFG_KANDAH_09189_PM10DPS	AFG_KANDAH_09213_PM10DPS	AFG_KANDAH_09231_PM10DPS	AFG_KANDAH_09247_PM10DPS	AFG_KANDAH_09209_PM10DPS	AFG KANDAH 09216 PM20DPS
Country			MWR	MWR	MWR	MWR	Burn Pit	Burn Pit
Site			2009/07/08 1146	2009/08/01 1842	2009/08/19 1113	2009/09/04 1052	2009/07/28 1317	2009/08/04 1140
Start Date/Time			000019Q2	000019QE	000019QJ	000019QN	000019QV	00001AAO
Parameter	Class	Units	Concentration					
Zinc	Metals	$\mu g/m^3$	< 0.37538	< 0.35073	< 0.34897	< 0.35796	0.61971	< 0.36358

LEGEND:
DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number
$\mu g/m^3$ = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
PM_{10} = Particulate matter less than 10 micrometers in diameter

APPENDIX I

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
7 JULY-4 SEPTEMBER 2009

DOEHRS Sample ID			00001AAP	00001AAQ	00001AAU	00001AAY	00001AB2	00001AB4
Field/Local Sample ID			AFG KANDAH 09273 PM10DPS	AFG KANDAH 09247 PM10DPS	AFG KANDAH 09188 PM10DPS	AFG KANDAH 09210 PM10DPS	AFG KANDAH 09217 PM10DPS	AFG KANDAH 09231 PM10DPS
Country			Burn Pit	Burn Pit	Board Walk	Board Walk	Board Walk	Board Walk
Site			2009/08/25 1025	2009/09/04 1117	2009/07/07 1030	2009/07/29 1531	2009/08/05 1520	2009/08/19 1125
Start Date/Time			00001AAP	00001AAQ	00001AAU	00001AAY	00001AB2	00001AB4
Parameter	Class	Units	Concentration					
Antimony	Metals	$\mu g/m^3$	< 0.071963	< 0.068757	< 0.073486	< 0.069793	< 0.075075	< 0.071592
Arsenic	Metals	$\mu g/m^3$	< 0.035982	< 0.034378	< 0.036743	< 0.034897	< 0.037538	< 0.035796
Beryllium	Metals	$\mu g/m^3$	< 0.035982	< 0.034378	< 0.036743	< 0.034897	< 0.037538	< 0.035796
Cadmium	Metals	$\mu g/m^3$	< 0.035982	< 0.034378	< 0.036743	< 0.034897	< 0.037538	< 0.035796
Chromium	Metals	$\mu g/m^3$	0.041091	< 0.034378	< 0.036743	< 0.034897	< 0.037538	< 0.035796
Lead	Metals	$\mu g/m^3$	< 0.071963	< 0.068757	< 0.073486	< 0.069793	< 0.075075	< 0.071592
Manganese	Metals	$\mu g/m^3$	0.54404	< 0.13751	0.18445	< 0.13959	< 0.15015	0.17111
Nickel	Metals	$\mu g/m^3$	0.058866	0.038641	< 0.036743	< 0.034897	< 0.037538	< 0.035796
PM_{10}		$\mu g/m^3$	978	214	391	328	124	377
Vanadium	Metals	$\mu g/m^3$	< 0.14393	< 0.13751	< 0.14697	< 0.13959	< 0.15015	< 0.14318

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

DOEHRS Sample ID			00001AAP	00001AAQ	00001AAU	00001AAY	00001AB2	00001AB4
Field/Local Sample ID			AFG KANDAH 09273 PM10DPS	AFG KANDAH 09247 PM10DPS	AFG KANDAH 09188 PM10DPS	AFG KANDAH 09210 PM10DPS	AFG KANDAH 09217 PM10DPS	AFG KANDAH 09231 PM10DPS
Country			Burn Pit	Burn Pit	Board Walk	Board Walk	Board Walk	Board Walk
Site			2009/08/25 1025	2009/09/04 1117	2009/07/07 1030	2009/07/29 1531	2009/08/05 1520	2009/08/19 1125
Start Date/Time			00001AAP	00001AAQ	00001AAU	00001AAY	00001AB2	00001AB4
Parameter	Class	Units	Concentration					
Zinc	Metals	$\mu g/m^3$	< 0.35982	< 0.34378	< 0.36743	< 0.34897	< 0.37538	< 0.35796

LEGEND:
DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number
$\mu g/m^3$ = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
PM_{10} = Particulate matter less than 10 micrometers in diameter

APPENDIX J

ANALYTICAL SAMPLE RESULTS
AMBIENT AIR PARTICULATE MATTER SAMPLES
KANDAHAR, AFGHANISTAN
9 JULY-4 SEPTEMBER 2009

DOEHRS Sample ID			00001AB6	00001AB8	00001AB9	00001ABC	00001ABF
Field/Local Sample ID			AFG KANDAH 09190 PM10DPS	AFG KANDAH 09209 PM10DPS	AFG KANDAH 09212 PM10DPS	AFG KANDAH 09237 PM10DPS	AFG KANDAH 09247 PM10DPS
Country			South Park	South Park	South Park	South Park	South Park
Site			2009/07/09 1239	2009/07/28 1004	2009/07/31 1715	2009/08/25 1036	2009/09/04 1137
Start Date/Time			00001AB6	00001AB8	00001AB9	00001ABC	00001ABF
Parameter	Class	Units	Concentration				
Antimony	Metals	$\mu g/m^3$	< 0.070097	< 0.070502	< 0.073486	< 0.072717	< 0.070862
Arsenic	Metals	$\mu g/m^3$	< 0.035049	< 0.035251	< 0.036743	< 0.036358	< 0.035431
Beryllium	Metals	$\mu g/m^3$	< 0.035049	< 0.035251	< 0.036743	< 0.036358	< 0.035431
Cadmium	Metals	$\mu g/m^3$	< 0.035049	< 0.035251	< 0.036743	< 0.036358	< 0.035431
Chromium	Metals	$\mu g/m^3$	< 0.035049	< 0.035251	< 0.036743	< 0.036358	< 0.035431
Lead	Metals	$\mu g/m^3$	< 0.070097	< 0.070502	< 0.073486	< 0.072717	< 0.070862
Manganese	Metals	$\mu g/m^3$	0.18225	< 0.14100	0.22193	0.32941	< 0.14172
Nickel	Metals	$\mu g/m^3$	0.044652	< 0.035251	< 0.036743	< 0.036358	< 0.035431
PM_{10}		$\mu g/m^3$	364	54	411	511	228
Vanadium	Metals	$\mu g/m^3$	< 0.14019	< 0.14100	< 0.14697	< 0.14543	< 0.14172

Deployment OEH Risk Characterization, Ambient Air PM Samples, Kandahar, Afghanistan, 7 Jul-7 Sep 09, U_AFG_KANDAHAR_CM_A10-25_20090907

DOEHRS Sample ID			00001AB6	00001AB8	00001AB9	00001ABC	00001ABF
Field/Local Sample ID			AFG KANDAH 09190 PM10DPS	AFG KANDAH 09209 PM10DPS	AFG KANDAH 09212 PM10DPS	AFG KANDAH 09237 PM10DPS	AFG KANDAH 09247 PM10DPS
Country			South Park	South Park	South Park	South Park	South Park
Site			2009/07/09 1239	2009/07/28 1004	2009/07/31 1715	2009/08/25 1036	2009/09/04 1137
Start Date/Time			00001AB6	00001AB8	00001AB9	00001ABC	00001ABF
Parameter	Class	Units	Concentration				
Zinc	Metals	µg/m^3	< 0.35049	< 0.35251	< 0.36743	< 0.36358	< 0.35431

LEGEND:
DOEHRS Sample ID = Deployment Occupational and Environmental Health Readiness System Sample Identification Number
µg/m^3 = micrograms per cubic meter
MWR = Morale Welfare Recreation Center
PM_{10} = Particulate matter less than 10 micrometers in diameter