Draft Final
Prescribed Burn Supplemental Report
Ranges 43-48
Former Fort Ord, California

Prepared for

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1.0 INTRODUCTION

In October 2003, the U.S. Army completed a prescribed burn as part of an Interim Action to address munitions and explosives of concern (MEC) at Ranges 43-48 at the former Fort Ord in Monterey County, California (Plate 1). The prescribed burn program included air monitoring to: 1) confirm or refine the conclusions of the Air Emissions Technical Memorandum (*MACTEC, 2001*) that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn would be well below human health-protective regulatory screening levels, and 2) provide data to help assess the adequacy of the burn prescription relative to smoke dispersion and downwind impacts.

This Prescribed Burn Air Monitoring Supplemental Report summarizes the 2003 prescribed burn program and discusses unresolved issues identified in the *Draft Final Ranges 43-48 Prescribed Burn Air Monitoring Report* (*MACTEC, 2004*) and the *Draft Final Summary After-Action Report: Ranges 43-48 Prescribed Burn* (*Fort Ord BRAC, 2004*) regarding the detected concentrations of acrolein and aldehydes.

Based on conclusions in the Draft Final Ranges 43-48 Prescribed Burn Air Monitoring Report (*MACTEC, 2004*) and results of research described below, the following is recommended for air monitoring programs during future prescribed burns at munitions response sites (MRSs) at the former Fort Ord:

- Retain future monitoring at receptor locations for particulate matter less than 10 microns (PM_{10});
- Eliminate monitoring at or adjacent to burn areas;
- Eliminate future monitoring for energetic compounds and their likely breakdown products, particulate metals, and dioxins/furans; and
- Eliminate future air monitoring for acrolein and aldehydes (formaldehyde and acetaldehyde).

2.0 SUMMARY OF THE 2003 PRESCRIBED BURN AND AIR MONITORING PROGRAM

The Army, as the lead agency, determined that an Interim Action was appropriate to protect human health from the imminent threat posed by MEC at three Interim Action sites at the former Fort Ord (Ranges 43-48, Range 30A, and MRS-16 (formerly Site OE-16) while an ongoing comprehensive study of MEC cleanup needs at former Fort Ord is conducted under the Basewide Munitions Response Remedial Investigation/Feasibility Study (MR RI/FS).

The Army's Interim Action OE RI/FS Record of Decision (*DA, 2002*) identified prescribed burning as the preferred alternative to clear vegetation prior to MEC remedial action for the three Interim Action sites. The Army proceeded with developing the planning documents for Ranges 43-48, because that site carried the highest priority of the three Interim Action sites. The following paragraphs summarize the prescribed burn and air monitoring activities performed for this program.

2.1 Prescribed Burn Program

The prescribed burn operations at Ranges 43-48 were performed by Fire Stop of Granite Bay, California and began the morning of October 24, 2003. The original area to be burned was 490 acres. During the prescribed burn, two spot fires breached the site's western primary control boundary. An escape was declared and contingency operations were implemented to contain the fire. The fire burned an additional 1,000 acres west and southwest of Ranges 43-48 before being contained (Plate 1). As part of the contingency operations, several patches of unburned vegetation were actively burned on October 25 and 26, 2003. The contingency operations concluded on October 31, 2003 and the fire resources demobilized on November 1, 2003.

2.2 Air Monitoring Program

Air samples were collected during the Ranges 43-48 prescribed burn event in October 2003 to confirm or refine the conclusions of the Air Emissions Technical Memorandum (*MACTEC, 2001*) that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn would be well below human health-protective regulatory screening levels. While the air sampling program was focused on detection and quantification of MEC-related emissions, the data were also used to help assess the adequacy of the burn prescription and to assess downwind concentrations of selected vegetation-related emissions. The air sampling program focused on combustion products unique to MEC detonation because the Air Emissions Technical Memorandum indicated MEC would not contribute measurably to the type of emissions that are typically generated by burning vegetation (*MACTEC, 2001*).

Under the air monitoring program, emissions data were collected during the active ignition and smolder phases of the prescribed burn, as well as before and after the prescribed burn to provide baseline data. Real-time data and smoke observations during the burn were also collected to provide feedback to the burn contractor for input to decisions regarding modification of the burn tactics. The Army collected air samples from two (2) burn area stations (BA1 and BA2), three (3) on-base stations (OB1, OB2, and OB3), nine (9) public stations (PS1 through PS9), and one (1) mobile station (MS1) (Plate 1). In addition, the Monterey Bay Unified Air Pollution Control District (MBUAPCD) and U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) collected air samples during and after the burn at additional locations and/or for additional analytes that complemented those collected by the Army. The sampling locations were determined in consultation with the Army, United States Environmental Protection Agency (USEPA), Department of Toxic Substances Control (DTSC), and the MBUAPCD in September 2002.

Air samples were analyzed by both "real time" methods that used direct-read instruments in the field, and "integrated" methods that collected air samples on a filter or other sampling media over many hours, for which time-weighted averages (TWAs) were calculated. The air samples were analyzed for the following chemicals of potential concern (COPCs): aldehydes and acrolein; energetic materials and their likely breakdown products; inhalable particulate matter (PM_{10}); particulate metals; and dioxins and furans.

2.3 Air Monitoring Program Results and Conclusions

This section summarizes the results and conclusions presented in the *Draft Final Ranges 43-48 Prescribed Burn Air Monitoring Report* (*MACTEC, 2004*). The evaluation of the presence and concentrations of the COPCs was complicated by the unplanned size and duration of the burn as it extended beyond the original perimeter.

Sampling results from all on-base and public monitoring stations were below the limits of detection and the applicable regulatory screening levels for all MEC-related chemicals, including the burn area sampling station (BA1) most heavily impacted by smoke during the active ignition phase of the burn. Therefore, a conclusion of the investigation in 2003 was that MEC-related chemical signatures were not observed at any sampling sites during the prescribed burn (both active ignition and smolder phases).

Elevated concentrations of a few particulate metals were observed at one station, but all are common to native soil and plant tissue and their presence would be expected in smoke from vegetation burning. Based on the energetics and particulate metals data, contribution to air emissions attributable to incidental detonations of MEC during a prescribed burn is negligible.

The data from the investigation show that PM_{10} concentrations (the best overall measure of smoke impacts) on the active ignition day were significantly above the 24-hour California Ambient Air Quality

Standards (CAAQSs) at nearly every monitoring site. Elevated PM_{10} concentrations on the second (smolder) day were even more widespread, with every site essentially at or above the 24-hour CAAQS.

Other than at the burn area sampling locations (BA1 and BA2, Plate 1), acetaldehyde and formaldehyde were not detected above the screening level, except acetaldehyde at station OB2 on the active ignition day. These three stations were not located in receptor areas. Acrolein concentrations were elevated above screening levels on both the active ignition and smolder days at several sites. However, acrolein concentrations were also recorded above the regulatory screening level at five stations during baseline sampling when prescribed burn smoke was not present at all.

The Air Monitoring Report (*MACTEC, 2004*) concluded that investigation of possible ubiquitous sources of acrolein or the appropriateness of the screening level may be warranted. In addition, the *Draft Final Summary After-Action Report: Ranges 43-48 Prescribed Burn* (*Fort Ord BRAC, 2004*) recommended a reevaluation of the need to conduct further monitoring for acrolein and aldehydes (formaldehyde and acetaldehyde). The remainder of this report presents the results of this additional investigation and provides recommendations for air monitoring to support future prescribed burns at the former Fort Ord.

3.0 RESEARCH OF AMBIENT ACROLEIN AND ALDEHYDES SOURCES, EXPOSURE GUIDELINES, AND AMBIENT CONCENTRATIONS

MACTEC conducted a literature search to identify (1) known sources of acrolein and aldehydes in ambient air, and (2) other exposure guidelines or screening levels which may be more appropriate for comparison to observed concentrations of those chemicals. MACTEC also searched for other air monitoring studies in which ambient concentrations of acrolein, formaldehyde, and acetaldehyde were measured and reported, and which would provide a frame of reference for comparison to the concentrations measured during the prescribed burn at Ranges 43-48. The results of these efforts are described below.

3.1 Acrolein

The chemical acrolein can be produced as a byproduct of fires. Other sources include combustion of fossil fuels, tobacco smoke, and pyrolyzed animal and vegetable fats (*Cal/EPA, 2001*).

MACTEC identified the following regulatory-based exposure guidelines for acrolein:

- Cal/EPA Office of Environmental Health Hazard Assessment (OEHHA) has published an acute (1-hour) Reference Exposure Level (REL) of 0.19 $\mu g/m^3$ for acrolein, based upon mild eye irritation (*Cal/EPA, 2004*)

- The American Conference of Governmental Industrial Hygienists (ACGIH) 8-hour time weighted average (TWA) for acrolein is 230 $\mu g/m^3$ (*ACGIH, 1995*)

- National Institute of Occupational Safety and Health (NIOSH) has published an 8-hour recommended exposure limit of 250 $\mu g/m^3$ and in addition has promulgated a 15-minute short term exposure limit of 800 $\mu g/m^3$ (*NIOSH, 2003*).

The Air Monitoring Report (*MACTEC, 2004*) adopted the OEHHA acute REL of 0.19 $\mu g/m^3$ as the screening level for comparison to the observed concentrations. The ACGIH and NIOSH occupational

exposure limits noted above are 1,000 times greater than the OEHHA screening level. No other regulatory-based exposure guidelines were identified.

Three sets of acrolein air monitoring data were collected during the prescribed burn at Ranges 43-48 at the former Fort Ord:

1. Baseline (background)

2. Active Ignition (active burning)

3. Smolder Phase (post burn).

Acrolein concentrations for each of these data sets were measured over an 8- to 10-hour sampling interval, and as such cannot be directly compared to the OEHHA acute REL, which is a 1-hour value. To account for this difference in averaging periods and to provide a direct comparison, the Air Monitoring Report (*MACTEC, 2004*) estimated a range of 1-hour acrolein concentrations based on peak-to-mean concentrations of PM_{10}. For the purpose of this supplemental investigation, however, the actual measured acrolein concentrations are used for discussion to provide comparability with data reported from other ambient studies. Comparison here of these ambient data to the OEHHA acute REL is therefore qualitative in nature and does not impute regulatory significance (i.e., if the 8- to 10-hour average concentration is greater than the OEHHA acute REL, then it follows that the acute REL was exceeded during one or more hours of the sampling interval; however, if the sampling period average was less than the acute REL, it does not follow that every hour of the interval was below the acute REL).

The method detection limit for the Fort Ord samples is reported between 2.1 and 2.5 $\mu g/m^3$, which is more than 10 times greater than the OEHHA acute REL. During active ignition and smolder days of the prescribed burn, acrolein was detected at several locations at concentrations above the OEHHA screening level. During baseline sampling, acrolein was also detected above the screening level at concentrations up to 20.4 $\mu g/m^3$ (more than 100 times the screening level).

Table 1 provides a comparison of the former Fort Ord data to measured ambient concentrations from various locations. The data shown for Fort Ord are calculated from time-weighted-averages over the sampling interval (typically 8 to 10 hours). Because monitoring stations BA1, BA2, and OB2 were located within or adjacent to the burn area and not in a receptor location, data from these stations on ignition and smolder days were excluded from the calculations. It was assumed for the other studies shown (based upon typical practice for ambient studies) that the reported concentrations are based upon 8- to 24-hour intervals, and therefore are considered here to be on the same time scale for direct comparison to the Fort Ord data. The data in Table 1 show that the mean and 95% upper confidence limit (UCL) values for the former Fort Ord are indistinguishable from values measured in various urban areas throughout the United States and the world.

On a station-by-station comparison, only the burn area station BA1 (at 56 $\mu g/m^3$, during the active ignition phase) and the public station PS9 (at 77 $\mu g/m^3$, during the smolder phase) recorded acrolein concentrations substantially higher than the mean and 95% UCL shown in Table 1. The burn area station was located intentionally to capture extreme smoke impacts and is not of concern here because it is not representative of potential public exposure. The acrolein concentration at location PS9 (77 $\mu g/m^3$) may be an anomaly caused by an unknown local source, as the PM_{10} data for that site does not suggest an unusually high smoke impact. For that reason, data from Station PS-9 on the smolder day was not used in the comparisons in Table 1. All other public stations during the prescribed burn recorded acrolein concentrations similar to ambient concentrations in the ambient air studies shown in Table 1.

It should be noted that the acrolein concentrations reported from all of the ambient studies shown in Table 1 are all above the OEHHA acute REL, which suggests that the OEHHA acute REL is too conservative for use as a meaningful screening level. Therefore, there is no compelling technical reason that acrolein monitoring be conducted during future prescribed burns at the former Fort Ord.

3.2 Formaldehyde

The largest sources of directly emitted formaldehyde are from combustion of fuels from mobile sources and process emissions from oil refineries (*Cal/EPA, 1992*).

MACTEC identified the following regulatory-based exposure guidelines for formaldehyde:

- Cal/EPA OEHHA has published an acute (1-hour) REL of 94 $\mu g/m^3$ for formaldehyde, based upon eye irritation and respiratory system effects (*Cal/EPA, 2004*)
- ACGIH has promulgated a 15-minute ceiling value of 370 $\mu g/m^3$ (*ACGIH, 1995*)
- NIOSH has published an 8-hour recommended exposure limit of 20 $\mu g/m^3$ and a 15-minute ceiling value of 123 $\mu g/m^3$ (*NIOSH, 2003*).

The Air Monitoring Report (*MACTEC, 2004*) adopted the OEHHA acute REL of 94 $\mu g/m^3$ as the screening level for comparison to the observed concentrations. The ACGIH and NIOSH occupational exposure limits noted above are only slightly greater than the OEHHA screening level. No other regulatory-based exposure guidelines were identified.

Three sets of formaldehyde air monitoring data were collected during the prescribed burn at Ranges 43-48 at the former Fort Ord:

1. Baseline (background)
2. Active Ignition (active burning)
3. Smolder Phase (post burn).

Formaldehyde was detected in all of the air samples collected during the baseline, active ignition, and smolder days for the Range 43-48 prescribed burn at the former Fort Ord. However, although the fire expanded from its original planned extent of 490 acres to approximately 1,500 acres (three times larger),

concentrations of formaldehyde exceeding the OEHHA acute REL were not observed at any of the monitoring stations outside of the immediate burn area.

Table 2 provides a comparison of the former Fort Ord data to measured ambient concentrations from various locations. The data shown for Fort Ord are calculated from time-weighted-averages over the sampling interval (typically 8 to 10 hours). Because monitoring stations BA1, BA2, and OB2 were located within or adjacent to the burn area and not in a receptor location, data from these stations on ignition and smolder days were excluded from the calculations. It was assumed for the other studies shown (based upon typical practice for ambient studies) that the reported concentrations are based upon 8- to 24-hour sampling intervals, and therefore are considered here to be on the same time scale for direct comparison to the Fort Ord data. The data in Table 2 show that the mean and 95% UCL values for the former Fort Ord are indistinguishable from values measured in various urban areas throughout the United States and the world.

Therefore, there is no compelling technical reason that formaldehyde monitoring be routinely conducted during future prescribed burns at the former Fort Ord.

3.3 Acetaldehyde

Acetaldehyde can be produced through incomplete combustion from such sources as stacks, tailpipe exhaust, and fires. The largest sources statewide of directly emitted acetaldehyde are from combustion of fuels from mobile sources, agricultural burning, and wildfires (*Cal/EPA, 1993*).

MACTEC identified the following regulatory-based exposure guidelines for acetaldehyde:

- Cal/EPA OEHHA has published a chronic (long term) REL of 9.0 $\mu g/m^3$ for acetaldehyde, based on respiratory system effects (*Cal/EPA, 2004*)

- ACGIH has promulgated a 15-minute ceiling value of 45,000 $\mu g/m^3$ (*ACGIH, 1995*)

- NIOSH lists an 8-hour Permissible Exposure Level (PEL) of 360,000 μg/m^3 (*NIOSH, 2003*).

The Air Monitoring Report (*MACTEC, 2004*) adopted the OEHHA chronic REL of 9.0 μg/m^3 as the screening level for comparison to the observed concentrations. The ACGIH and NIOSH occupational exposure limits noted above are 5,000 to 40,000 times greater than the OEHHA screening level. No other regulatory-based exposure guidelines were identified.

Three sets of acetaldehyde air monitoring data were collected during the prescribed burn at Ranges 43-48 at the former Fort Ord:

1. Baseline (background)
2. Active Ignition (active burning)
3. Smolder Phase (post burn).

Acetaldehyde was detected in all of the air samples collected during the baseline, active ignition, and smolder days for the Range 43-48 prescribed burn at the former Fort Ord. However, although the fire expanded from its original planned extent of 490 acres to approximately 1,500 acres (three times larger), concentrations of acetaldehyde exceeding the OEHHA chronic REL were not observed at any of the public monitoring stations.

Table 3 provides a comparison of the former Fort Ord data to measured ambient concentrations from various locations. The data shown for Fort Ord are calculated from time-weighted-averages over the sampling interval (typically 8 to 10 hours). Because monitoring stations BA1, BA2, and OB2 were located within or adjacent to the burn area and not in a receptor location, data from these stations on ignition and smolder days were excluded from the calculations. It was assumed for the other studies shown (based upon typical practice for ambient air studies) that the reported concentrations are based upon 8- to 24-hour sampling intervals, and therefore are considered here to be on the same time scale for

direct comparison to the Fort Ord data. The data in Table 3 show that the mean and 95% UCL values for the former Fort Ord are indistinguishable from values measured in various urban areas throughout the United States and the world.

Therefore, there is no compelling technical reason that acetaldehyde monitoring be routinely conducted during future prescribed burns at the former Fort Ord.

4.0 RECOMMENDATIONS

The recommendations for future air monitoring during prescribed burns in support of munitions response are based on the results of the monitoring performed during the Ranges 43-48 prescribed burn, and subsequent research related to ambient concentrations of acrolein, formaldehyde, and acetaldehyde presented in this report.

4.1 Quantity and Locations of Monitoring Locations

1. Eliminate monitoring at or adjacent to burn areas in future burns.

It is acknowledged that smoke impacts may be significant within and immediately adjacent to the burn areas during active ignition and likely during the post ignition or "smolder" phase. However, data from samples collected in the burn area (BA1 and BA2) and adjacent to the burn area (OB2) do not represent levels of smoke exposure in smoke-sensitive (public) areas. Therefore, monitoring locations should be placed where samples are expected to reflect conditions pertaining to potentially impacted receptor populations.

4.2 Analytical Program

1. Retain future monitoring at receptor locations for particulate matter less than 10 microns (PM_{10}).

Monitoring for PM_{10} in potential smoke sensitive areas should be conducted in accordance with the California Clean Air Act (Title 17, CCR §80100 et. seq.) and the MBUAPCD Smoke Management Program. The number and locations of monitoring points will be determined in cooperation with regulatory agencies and presented in future sampling and analysis plans.

2. Eliminate future monitoring for energetic compounds and their likely breakdown products.

Energetics were not detected in any of the samples collected and analyzed from the 2003 monitoring event, even though: 1) the total area burned was three times the original acreage identified for burning and two of the stations (BA1 and BA2) were within the burn area (Plate 1), which was the most heavily smoke-impacted area, and 2) the burn area is considered to have the highest concentration of MEC (more than 6,000 MEC items have been recovered from the surface of Ranges 43-48).

3. Eliminate future monitoring for particulate metals.

Outside of the burn area, particulate metals were either not detected or were detected on the burn and smolder days at levels less than the regulatory screening levels with one exception; the estimated peak hourly aluminum concentration at station PS2 (Fitch Middle School, Plate 1). Although this exceedance occurred outside of the burn area, it should be noted that the total area burned was three times greater than planned, and that all metals detected are common to native soil and plant tissue and their presence would be expected in smoke from vegetation burning. Concentrations of aluminum are not likely to exceed regulatory screening levels for much smaller future burns (500 acres or less); however, monitoring for aluminum should be considered for burns planned to be larger than 500 acres.

4. Eliminate future monitoring for dioxins/furans.

Dioxins/furans were either not detected, or were present at concentrations below air screening levels in all samples collected and analyzed from the 2003 monitoring event, even though the total area burned was three times the original acreage identified for burning and two of the stations (BA1 and BA2) were within the burn area and most heavily impacted by smoke.

5. Eliminate air monitoring for acrolein.

Except for the burn area during ignition and smolder days, and an anomalous occurrence at location PS9 (Aquarium) on the smolder day, acrolein concentrations measured during the prescribed burn program appear similar to ambient concentrations presented in various ambient air studies. Therefore, there is no compelling technical reason that acrolein monitoring be conducted during future prescribed burns at the former Fort Ord.

6. Eliminate air monitoring for aldehydes (formaldehyde and acetaldehyde).

Concentrations of aldehydes during the burn and smolder days did not exceed screening levels in public areas, even though the area burned was three times the original planned extent. Therefore, there is no compelling technical reason that aldehydes monitoring be conducted during future prescribed burns at the former Fort Ord.

5.0 REFERENCES

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TABLES

Table 1. Ambient Acrolein Concentrations and Fort Ord Monitoring Results

Concentration ($\mu g/m^3$)	Value	N	Location	Date	Reference	Notes
16.0	mean	42	Los Angeles, CA	1961-76	1*	
32.6	maximum	--	Los Angeles, CA	1961-68	2*	Typical detect range: 9.2-16 $\mu g/m^3$
34.0	maximum	--	Claremont, CA	1979	3*	Samples collected May-Sept
16.5	mean	--	Tokyo, Japan	--	4*	
0.7	mean	19	Edison, NJ	1961-76	1*	Detects in five samples
1.1	mean	--	Netherlands	--	4*	
1.3	mean	--	Sao Palo, Brazil	1988	2*	
0.3	mean	--	Salvador, Brazil	1988	2*	
40.0	maximum	--	Los Angeles, CA	1968	5*	Typical detect range: 2-20 $\mu g/m^3$
1.2 5.7 2.6	mean maximum 90^{th} percentile	715	California-wide	2003-04	7	Every 12 days at 18 sites. Detect range: 0.7-5.7 $\mu g/m^3$
2.4 (3.7)	mean (95% UCL)	8	Ft. Ord Baseline	2003	6	Detect range: 2.2-5.9 $\mu g/m^3$
3.6 (5.7)	mean (95% UCL)	11**	Ft. Ord Ignition	2003	6	Detect range: 2.5-11 $\mu g/m^3$
3.2 (5.7)	mean (95% UCL)	9**	Ft. Ord Smolder	2003	6	Detect range: 2.5-11 $\mu g/m^3$ ***

-- Data not provided

* Data taken from HSDB, reference cited therein

** Stations BA1, BA2, and OB2 were not in receptor areas and are not included in calculations.

*** Data from Station PS-9 at 77 $\mu g/m^3$ appears to be an anomaly based on a lack of coincident elevated PM_{10} results at the site, and was therefore not included in the mean or 95% UCL calculations.

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Table 2. Ambient Formaldehyde Concentrations and Fort Ord Monitoring Results

Concentration ($\mu g/m^3$)	Value	N	Location	Date	Reference	Notes
20.4 - 37	observed range	--	--	--	1	
<0.5 - 27.5	observed range	3842 (total)	Canada, 8 urban sites	8/89-8/98	2	3810 detects, 24-hr samples, rural, suburban, urban
<0.5 - 12.03	observed range	3842 (total)	Canada, 2 suburban sites	8/89-8/98	2	3810 detects, 24-hr samples, rural, suburban, urban
<0.5 - 9.11	observed range	3842 (total)	Canada, 2 rural sites	8/89-8/98	2	3810 detects, 24-hr samples, rural, suburban, urban; urban/industrial influence
<0.5 - 9.88	observed range	3842 (total)	Canada, 4 rural sites	8/89-8/98	2	3810 detects, 24-hr samples, rural, suburban, urban
0.7-2.7	observed range	5	Baltic sea coast	--	3	
0.1-0.5	observed range	5	Irish West Coast	--	3	
<1-14	observed range	63	Eastern Indian ocean	--	3	
0.1 - 0.8	observed range	7	Central pacific	--	3	
0.3 - 1.0	observed range	5	South Africa	--	3	
0.1 - 0.6	observed range	5	Irish west coast	--	3	
0.05 - 2.3	observed range	85	Bursenburg, Austria	--	3	
<18.5	maximum	--	Los Angeles, CA	1979	3	emissions higher from cars w/out catalytic converters
4.67 - 8.12	observed range	--	New Jersey, 4 cities	1977	3	emissions higher from cars w/out catalytic converters
4.625	median	1358	U.S., 58 locations	1994	4	SF Bay area formaldehyde vehicle emissions increased 13% w/in 2 months after average oxygenate content in fuels increased from 0.3 to 2.0%
1.85 - 57.4	observed range	--	Schenectady, NY	1983	4	significant daily variation correlated to vehicle traffic
3.7 - 74	observed range	--	Cal State Campus, Los Angeles, CA	5/8--6/80	4	
4.44 – 88.8	observed range	--	Claremont, CA	9/19/80-10/8/80	4	
20.9	mean	--	St. Louis, MO	6/5/80-6/7/80	4	

Concentration ($\mu g/m^3$)	Value	N	Location	Date	Reference	Notes
4.3	mean	--	Denver, CO	6/23/80-6/24/80	4	max = 10.2 $\mu g/m^3$
35.2	mean	--	Riverside, CA	7/8/80-7/10/80	4	
26.5	mean	--	Staten Island, NY	4/3/81-4/4/81	4	
34.2	mean	--	Pittsburg, PA	4/15/81-4/16/81	4	
20.9	mean	--	Chicago, IL	4/27/81-4/28/81	4	
28.7	mean	--	Downey, CA	2/28/84-3/1/84	4	max = 125 $\mu g/m^3$
7.1	mean	--	Houston, TX	3/18/84-3/19/84	4	
3.7 32 6.9	mean maximum 90th percentile	4825	California-wide	1996-2004	6	Every 12 days at 18 sites. Detect range: 0.1-32 $\mu g/m^3$
1.8 (2.1)	mean (95% UCL)	8	Ft. Ord Baseline	2003	5	Detect range: 1.4-2.6 $\mu g/m^3$
4.5 (5.6)	mean (95% UCL)	11**	Ft. Ord Ignition	2003	5	Detect range: 2.0-7.6 $\mu g/m^3$
4.9 (5.9)	mean (95% UCL)	10**	Ft. Ord Smolder	2003	5	Detect range: 2.8-7.6 $\mu g/m^3$

-- Data not provided

** Stations BA1, BA2, and OB2 were not in receptor areas and are not included in calculations.

1 USEPA Technology Transfer Network Air Toxics Website, http://www.epa.gov/ttnatw01/hlthef/formalde.html

2 World Health Organization, IPCS INCHEM, Concise International Assessment Document 40, Formaldehyde, 2002

3 World Health Organization, IPCS INCHEM, Environmental Health Criteria 89, Formaldehyde, 1989.

4 ATSDR, Toxicological Profile, Formaldehyde, 1999.

5 MACTEC Engineering and Consulting, Inc. Draft Final, Ranges 43-48 Prescribed Burn Air Monitoring Report, Former Fort Ord, California. June 16, 2004.

6 California Air Resources Board, Annual Statewide Toxics Summary http://www.arb.ca.gov/adam/toxics/statepages/hchostate.html

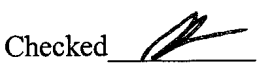
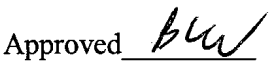
Checked  Approved 

Table 3. Ambient Acetaldehyde Concentrations and Fort Ord Monitoring Results

Concentration ($\mu g/m^3$)	Value	N	Location	Date	Reference	Notes
57.6	maximum	--	Los Angeles, CA	--	1	
5.0	mean	--	--	--	2	
0.36-4.68	observed range	--	Pittsburg, PA	Apr-81	3	
1.62-6.12	observed range	--	Chicago, IL	Apr-81	3	
5-124	observed range	--	various	1975-1978	3	Seven non-specified locations
0.36-1.44	observed range	--	Schenectady, NY	6/83-8/83	3	
			Whiteface Mt, NY			
5.2	mean	--	Upton, NY	7/82-5/83	3	winter max 1.8, summer max 15.1
14.9	maximum	--	Tulsa, OK	Jul-78	3	
16.9	maximum	--	Rio Blanco, CO	Jul-78	3	
23.9	maximum	--	Smoky Mtns, TN	Sep-78	3	
2.2-7.3	observed range	--	Tokyo, Japan	1985-86	3	
0.9-22	observed range	--	Japan	Jun-05	3	Various unspecified locations
23.3	maximum	--	Los Angeles, CA	9/88-9/89	3	Every 6th day at 6 locations
5.2-8.6	mean	--	Los Angeles, CA	9/88-9/89	3	Range of means at 6 locations
2.39	mean	--	California	1/96-12/96	4	Various unspecified California locations
2.1 14.6 4.1	mean maximum 90th percentile	4825	California-wide	1996-2004	6	Every 12 days at 18 sites. Detect range: 0.2-14.6 $\mu g/m^3$
1.4 (1.6)	mean (95% UCL)	8	Ft. Ord Baseline	2003	5	Detect range: 1.1-1.9 $\mu g/m^3$
3.9 (5.5)	mean (95% UCL)	11**	Ft. Ord Ignition	2003	5	Detect range: 1.4-7.4 $\mu g/m^3$
4.7 (5.9)	mean (95% UCL)	10**	Ft. Ord Smolder	2003	5	Detect range: 2.4-8.5 $\mu g/m^3$

-- Data not provided

** Stations BA1, BA2, and OB2 were not in receptor areas and are not included in calculations.

1 USEPA Technology Transfer Network Air Toxics Website http://www.epa.gov/ttnatw01/hlthef/acetalde.html

2 World Health Organization, IPCS INCHEM, Health and Safety Guide, Acetaldehyde, 1991.

3 World Health Organization, IPCS INCHEM, Environmental Health Criteria 167, Acetaldehyde, 1995.

4 California Air Resources Board www.arb.ca.gov/toxics/tac/factshts/acetalde.pdf

5 MACTEC Engineering and Consulting, Inc. Draft Final, Ranges 43-48 Prescribed Burn Air Monitoring Report, Former Fort Ord, California. June 16, 2004.

6 California Air Resources Board, Annual Statewide Toxics Summary http://www.arb.ca.gov/adam/toxics/statepages/acchostate.html

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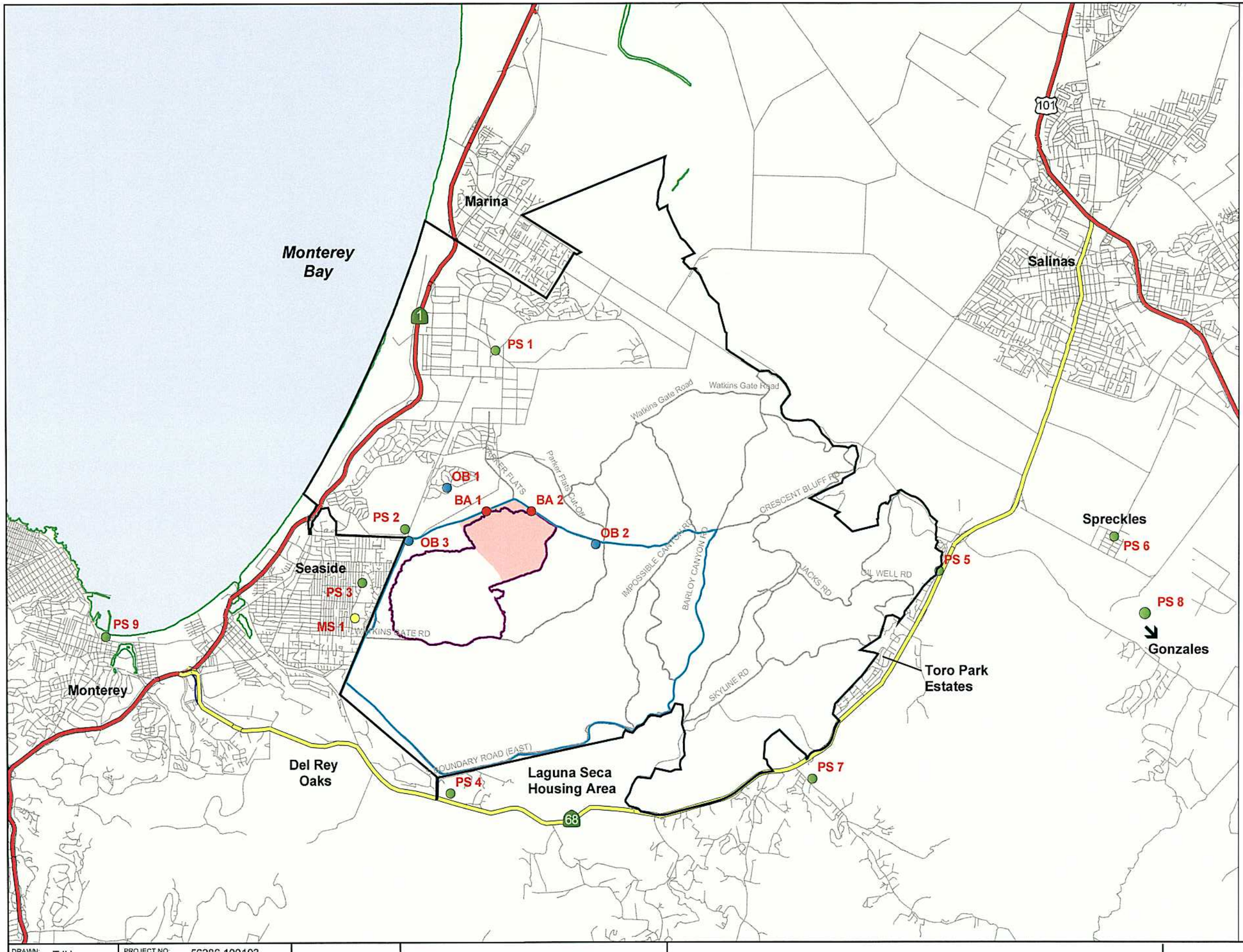
PLATE



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CHECKED:	APPROVED: BLW				
DATE: 6/2005	DATE:				

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APPENDIX A

RESPONSE TO COMMENTS

Responses to Comments
Draft Prescribed Burn Supplemental Report
Ranges 43-48, Former Fort Ord, California
Dated June 14, 2005

U.S. Environmental Protection Agency (USEPA), Comments dated July 21, 2005

Comment 1: **Tables 1-3 and text where these tables are referenced and discussed. EPA is concerned that the Army has compared the Fort Ord air data to very old (1960s, 1970s, 1980s) air quality data in Los Angeles and other cities (e.g., Tokyo) to justify the Fort Ord levels as acceptable. The Army should use current, more recent data. It has surely been collected – particularly in Los Angeles, which has its own pollution control district. Please get current/more recent data and revise Tables 1-3. Once you have the new data, if it still supports your arguments, then EPA can concur with your report conclusions and recommendations for decreased monitoring as presented in Section 4 of the report.**

Response 1: Additional data on California-wide concentrations of acrolein, formaldehyde, and acetaldehyde have been identified in the California Air Resources Board website. Summaries of these data have been added to Tables 1-3. These data are entirely consistent with the other data presented, and do not affect the conclusions and recommendations of the Report.

U.S. Environmental Protection Agency (USEPA) Additional comments dated October 6, 2005 (Mr. Christopher Cora)

Comment 1: **I am working on getting more current information on the levels of acrolein, Formaldehyde, and Acetaldehyde detected by ambient air monitoring in California, per EPA's task from the BCT meetings. The following Cal/EPA Air Resources Board Annual Statewide toxics summaries are current through 2004:**

Acrolein (only 2 years):
http://www.arb.ca.gov/adam/toxics/statepages/acrostate.html

Acetaldehyde (15 years):
http://www.arb.ca.gov/adam/toxics/statepages/acchostate.html

Formaldehyde (15 years):
http://www.srb.ca.gov/adam/toxics/statepages/hchostate.html

I don't know if we can compare them directly to the 3/18/04 MACTEC study

because they are for entire years, but the "raw" data should be available showing the sampling periods.

Response 1: The information is appreciated. The results of the study referenced in your comment have been incorporated into the draft final version of the report. These data are entirely consistent with the other data presented, and do not affect the conclusions and recommendations of the Report.

Comment 2: Also, I would suggest we consider conducting a risk assessment, or at least risk screening, on the levels to determine potential acute and chronic effects of exposure to sensitive populations (elderly, children, asthmatics, etc….. This would provide a better justification under CERCLA for determining whether continued monitoring is appropriate or not. Besides the OEHHA REL's for the three compounds, The Draft Prescribed Burn Supplemental Report utilizes values for workers. This is useful for screening, but may not be protective of others in the population. (This may have been done in the IA ROD, but I'm still looking at that). It will also address the Short-term Effectiveness criteria we shall have to discuss in the Final ROD. (Short-term effectiveness considers how fast a remedial action reaches the cleanup goal and the risk that the remedial action poses to workers, residents, and the environment during the construction or implementation of the remedial action.)

Response 2: The air screening levels identified for the air monitoring program were developed through the cooperative efforts of the Army, USEPA, DTSC, CARB, and MBUAPCD. The analytical results for the air monitoring program indicate that air screening levels for formaldehyde and acetaldehyde were not exceeded in any receptor area on any of the monitoring days. Therefore, a risk assessment for those compounds is unnecessary. With regards to acrolein, which is an acute irritant (not identified as a carcinogen), the levels seen in receptor areas are comparable to ambient levels seen in the studies listed in Table 1 of the report. Therefore, there is no technical justification to perform a risk assessment. The purpose of providing various exposure levels (e.g., for workers) within the report was to show that higher permissible levels exist under specific circumstances. However, when making conclusions regarding the air monitoring program, the agreed-upon screening levels are used.

Monterey Bay Unified Air Pollution Control District (MBUAPCD), Comments dated July 18, 2005

General Comments

Comment 1. The District would still welcome a joint report that would include the validated analytical results form all participants.

Response 1: The Army is interested in discussing your request for a joint report in greater detail.

Comment 2:. Given the many peculiarities surround the issue of acrolein, the challenge of monitoring that particular compound, as well as the vintage of many of the key references used to support the REL, it no longer seems necessary to include this smoke-related irritant species in any future monitoring. The PM_{10} would serve adequately as a surrogate for other smoke-related emissions.

Response 2: Additional data on California-wide concentrations of acrolein, formaldehyde, and acetaldehyde have been identified in the California Air Resources Board website (see response to USEPA Comment 1 above). Summaries of these data have been added to Tables 1-3. These data are entirely consistent with the other data presented, and do not affect the conclusions and recommendations of the Report. It is agreed that it is unnecessary to include these smoke-related irritant species in any future monitoring, and that PM_{10} would serve as an adequate surrogate for other smoke-related compounds.

Comment 3 The mobile station, which was to hopefully be mobilized to be in an area of highest impact during the ignition phase, actually ended up monitoring in an area of fairly low concentrations. We would suggest trying to make better use of any future mobile station by locating it in the impact corridor.

Response 3: The mobile station for the Ranges 43-48 prescribed burn air sampling program was outfitted with high-volume sampling equipment for energetic compounds, high-volume sampling equipment for dioxins and furans, low-volume sampling equipment for PM_{10} and particulate metals, a real-time aerosol monitor, a real-time CO_2 monitor, a low-volume sample pump for collecting aldehyde samples, and a SUMMA canister for acrolein. This equipment was mounted in a trailer behind the tow vehicle, and the tow vehicle carried a gasoline-powered AC electric generator. While this configuration was mobile, because of its complexity it did take nearly an hour to set up and initiate collection of the air samples once a suitable location was identified. During that time, the smoke plume had moved and the selected location was no longer in a high impact area.

Since the submittal of this comment, the Army has coordinated with the Monterey Naval Postgraduate School Department of Meteorology and MBUAPCD to utilize

the CALMET/CALPUFF model as part of the design process for a future burn. It is anticipated that this model will used to determine the placement of several fixed sampling stations the day before the planned burn. The air sampling program for future prescribed burns is proposed to be limited to just low-volume sampling for PM_{10}, so the set-up time for the stations will be on the order of 10-15 minutes.

Comment 4: Numerous exceedances of the state ambient air quality standard for PM_{10}, as well as one exceedance of the federal standard, were recorded at the public site monitoring locations during the event. These included schools, residential areas, and tourist locations. We would suggest adding those results to the appendix, since they help to illustrate the second objective of the air monitoring program. We have attached a table summarizing these values.

Response 4: The objective of the Burn Supplemental Report is to assess the need for and/or scope of air monitoring for future prescribed burns at the former Fort Ord. The Report stipulates that exceedances of the CAAQS for PM_{10} were observed during the prescribed burn at Ranges 43-48, and that PM_{10} monitoring for future prescribed burns should be considered. Adding the PM_{10} table provided by the District would not affect the conclusions or recommendations of the report.

Comment 5: We would hope that the rich data base developed by this program can be used to help establish a better approach for future burn projects. The second objective of the program is to "provide data to help assess the adequacy of the burn prescription relative to smoke dispersion and downwind impacts." The CALMET/CALPUFF model developed by the MBUAPCD with funding from the Army successfully identified the impact corridor resulting from the Range 43-48 burn. We would encourage further developing this resource by with the rich field data base acquired by this monitoring program so that the model could be used to help assess the adequacy of future burn prescriptions.

Response 5: Since the submittal of this comment, the Army has coordinated with the Monterey Naval Postgraduate School Department of Meteorology and MBUAPCD to utilize the CALMET/CALPUFF model as part of the design process for a future burn.

<u>MBUAPCD – Specific Comments</u>

Comment 1: Section 2.3, page 5, paragraph 1: There was also one exceedance of the federal 24-hour ambient air quality standard for PM_{10}.

Response 1: Acknowledged. The federal standard of $150 ug/m^3$ for PM_{10} was exceeded on the burn day at PS-3 (Manzanita School). This location was the only one of ten

stations in receptor areas that experienced an exceedance of that standard on the burn day.

Comment 2: Section 3.1, page 8, paragraph 2: Not having the original references, it is not clear if the data from other urban areas were collected during poor air quality events.

Response 2: Information as to the nature of the sampling programs is provided in the Notes section of Tables 1 though 3 where such information could be gleaned from the references. Certainly many of the referenced sampling programs were multi-year or multi-site, or both, and so do not represent single air quality events.

Comment 3: Section 4.1, page 12, paragraph 2: Based on the analytical results, the District agrees with the recommendation to focus future particulate monitoring on potentially impacted receptor populations. We would suggest that the locations and number of receptor stations would be determined based on the specific location and prescription for any future burn project.

Response 3: It is agreed that the process of determining the locations and number of receptor stations should take into consideration the specific location and prescription for any future burn project. A sampling and analysis plan providing the details of monitoring station selection for the next burn will be made available for public and regulatory agency review and comment.

Comment 4: Section 4.2.1, page 12: The District will cooperate with other agencies to determine the number and locations of monitoring points for future projects.

Response 4: Comment accepted.

Comment 5: Section 4.2.2, page 12: Based on the analytical results presented, the District agrees with the recommendation to eliminate future monitoring for energetic compounds and their breakdown products.

Response 5: Comment accepted.

Comment 6: Section 4.2.3, page 13: The District would prefer that monitoring for a basic suite of chemical analyses for the PM_{10} samples be continued for all future burns.

Response 6: The Army will consider the need for and value of including additional chemical analyses in consultation with USEPA and CalEPA/DTSC on a case-by-case basis as future prescribed burns are planned.

Comment 7: Sections 4.2.4-4.2.6: Based on the analytical results, the District agrees with the recommendation to eliminate future analysis for dioxins/furans, acrolein,

and aldehydes. As mentioned above, PM_{10} seems to be an adequate surrogate for many of the chemical species of note.

Response 7: Comment accepted.

Fort Ord Environmental Justice Network (FOEJN), Comments dated July 22, 2005

Comment 1: The proposed changes to air monitoring requirements are not protective of human health and the reasons for these changes are not well founded. The Army is proposing to eliminate monitoring of the compounds that pose the greatest long term threat to human health; this proposal is unacceptable. Particulate metals and dioxins are both capable of causing long-term adverse health effects even at very low doses. Because these compounds are so dangerous, monitoring should continue regardless of past monitoring levels. Site specific characteristics could potentially increase levels of dioxins or particulate metals drastically. In most cases, the emissions and sources of the metals and dioxins cannot be predicted. The elimination of monitoring for these compounds would cast serious doubts on any future evaluations of risks to public health from burns and create further distrust among citizens.

Response 1: The reasons for eliminating these chemicals from future air sampling during prescribed burns at the former Fort Ord are technically sound and are well documented in the Prescribed Burn Air Monitoring Report and the Burn Supplemental Report. Including these chemicals for no valid reason would unnecessarily complicate the deployment of future sampling programs and would detract the focus from the more important measure of smoke impact, PM_{10}.

Comment 2: The elimination of monitoring for other compounds such as energetic compounds, their breakdown products, acrolein, and acetaldehyde is also ill advised. These chemicals are all compounds that the public may potentially be exposed to during burns such as the one that took place at Ranges 43-48. The concentrations to which the public would be exposed are highly variable and difficult to predict regardless of experiences with prior burns. Simply because screening levels were not exceeded during the escaped burn of 2003 that covered such a large area does not mean that screening levels cannot be exceeded during smaller burns. Many variables will effect these concentrations, including the amount of vegetation burning at a particular time and the munitions or other items that may be consumed in the fire. Uncertainties regarding burn rates and other factors affecting the concentrations of these compounds provide a sufficient technical basis to continue monitoring these compounds, contrary to what this report claims.

Response 2: The surface density of munitions and explosive compounds (MEC) at Ranges 43-48 was very high. The air sampling program was designed to place sampling equipment for energetic compounds in a high smoke impact area as close as possible to the burn in order to determine if energetic compounds were present in the smoke. The Burn Area (BA) monitoring sites did experience very significant smoke impacts during the burn, yet no energetic compounds were detected. Unless a future burn area has a greater surface density of MEC and/or is larger in

size than the Range 43-48 burn, there is no reason to sample for MEC-related constituents.

Comment 3: The Army claims in this document that because ambient urban concentrations of acrolien and acetaldehyde are comparable with those recorded during the burn of Ranges 43-48, monitoring for these compounds can be eliminated. This position is not protective of human health. If burns are to be conducted near population centers, then it is even more important to monitor these compounds because the public is already being exposed to significant levels. Furthermore, if the acrolein and acetaldehyde from the burn is equivalent to all the sources that contribute to ambient air pollution, combined, then the burn is the largest single source of air emissions and as such, must be measured.

Response 3: The Report documents that concentrations of these compounds in the public areas surrounding the former Fort Ord, including the contribution from the burn, are comparable to ambient urban concentrations.

Comment 4: Prior to any such decrease in ambient air monitoring, the Army should conduct a cumulative risk assessment to determine the combined impacts of ambient air pollution, the burn, stress from the clean up activities and other factors.

Response 4: With the exception of PM_{10}, concentrations of other measured compounds during the prescribed burn at Ranges 43-48 did not exceed health-protective regulatory screening levels. Consequently, a risk assessment is not warranted.

Comment 5: The removal of monitoring stations adjacent to burn areas is also opposed by FOEJN. During the last burn, portions of the burn that escaped were in close proximity to residential areas. No monitoring stations were near these homes which made predicting adverse health effects from the fire more difficult. The monitoring stations adjacent to the burn area provided the most accurate representation of conditions near those homes. In case future burns escape, monitoring should continue in areas directly adjacent to the burn, with special attention to the areas closest to residences.

Response 5: Monitoring station locations for future burns will emphasize residential areas and sensitive receptors (e.g., schools) as the highest priority. The Army has coordinated with the Monterey Naval Postgraduate School Department of Meteorology and MBUAPCD to utilize the CALMET/CALPUFF model as part of the design process for a future burn. It is anticipated that this model will used to determine the placement of several fixed sampling stations the day before the planned burn.

Comment 6: This report implies a great degree of certainty in regards to the behavior and consequences of prescribed burns when the experience at Ford Ord is quite

the opposite. It should be noted that despite a great deal of planning, the burn of Ranges 43-48 escaped the control of both the Army and its contractors. Fires by their nature are difficult to predict, and to assume that conditions from one burn to the next will be the same only invites disaster. *Based on these uncertainties, FOEJN again states that citizens are unequivocally opposed to any future prescribed burns at the former Fort Ord*. If any additional burns are performed, citizens expect the maximum amount of monitoring available to protect their health. We are disappointed that this report did not take a more candid look at the air monitoring program to evaluate its flaws such as poor selection of reference sites and suggest ways in which to better protect human health during prescribed burns.

Response 6: Monitoring station locations for future burns will emphasize residential areas and sensitive receptors (e.g., schools) as the highest priority. The Army has coordinated with the Monterey Naval Postgraduate School Department of Meteorology and MBUAPCD to utilize the CALMET/CALPUFF model as part of the design process for a future burn. It is anticipated that this model will used to determine the placement of several fixed sampling stations the day before the planned burn.

DISTRIBUTION

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Prescribed Burn Supplemental Report
Ranges 43-48
Former Fort Ord, California

January 27, 2006

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