Draft
Ranges 43–48 Prescribed Burn
Air Monitoring Report
Former Fort Ord, California

Prepared for

United States Army Corps of Engineers
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March 19, 2004

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LIST OF ACRONYMS AND ABBREVIATIONS

agl	above ground level
Army	United States Department of the Army
BA	burn area
Basewide MR	Basewide Military Munitions Response Program
CAAQS	California Ambient Air Quality Standard
CDQMP	Chemical Data Quality Management Plan
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CO_2	carbon dioxide
COPC	chemical of potential concern
DQOs	data quality objectives
DTSC	Department of Toxic Substances Control
EPA	Environmental Protection Agency
GPS	Global Positioning System
Harding ESE	Harding ESE, Inc. (formerly Harding Lawson Associates; now MACTEC)
HE	high explosive
HLA	Harding Lawson Associates (now MACTEC)
HMX	cyclotetramethylene tetranitramine
IA	Interim Action
LAW	Light Antitank Weapon
MACTEC	MACTEC Engineering and Consulting, Inc. (formerly Harding ESE, Inc. and HLA)
MBUAPCD	Monterey Bay Unified Air Pollution Control District
MEC	Munitions and Explosives of Concern
MR	Munitions Response
MR RI/FS	Munitions Response Remedial Investigation/Feasibility Study

MS	mobile station
OB	on-base
OE RI/FS	Ordnance and Explosives Remedial Investigation/Feasibility Study
PETN	pentaerythritol tetranitrate
PM	particulate matter
PM_{10}	particulate matter less than 10 microns
POM	polycyclic organic material
PS	public station
PUF	polyurethane foam
RDX	cyclotrimethylene trinitramine
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
TACs	Toxic Air Contaminants
TEQ	Toxicity Equivalent
TSP	Total Suspended Particulates
TWA	Time Weighted Average
$\mu g/m^3$	micrograms per cubic meter of air
USACE	United States Department of the Army, Corps of Engineers
USACHPPM	United States Army Center for Health Promotion and Preventive Medicine
USEPA	United States Environmental Protection Agency

EXECUTIVE SUMMARY

This Air Monitoring Report describes the results of air sampling conducted to assess the potential impacts to air resulting from prescribed burn operations required to complete the interim action cleanup for munitions and explosives of concern (MEC) at Ranges 43–48 at the former Fort Ord in Monterey County, California.

Prescribed Burning Selected to Clear Vegetation as Part of MEC Interim Action

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 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). Interim Action remedial activities were evaluated in three parts: vegetation clearance, MEC remedial action, and MEC detonation, as described in the Interim Action Ordnance and Explosives (0E) RI/FS for Ranges 43–48, Range 30A, and Site OE-16.

The Army's Interim Action OE RI/FS Proposed Plan and Record of Decision 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 this site carries the highest priority of the three Interim Action sites. For the Ranges 43–48 Interim Action, four separate plans were prepared to detail task-specific interrelated work activities for implementing the Interim Action MEC remedial activities as follows:

(1) **Fort Ord Prescribed Burn Plan of Ranges 43–48 (*Fire Stop, 2002, 2003*) –** Described the objectives of the prescribed burn; the burn area; the range of environmental conditions under which the burn will be conducted; the manpower and equipment resources required to ignite, manage, and contain the fire; a smoke management plan; establishment of communication

procedures for the fire crew and to the public and other affected agencies; and an escaped fire contingency plan.

(2) **Voluntary Relocation Plan (*Creighton & Creighton, 2003*) –** Described the Army's actions that will be implemented for Monterey County residents who wish to temporarily relocate when the Army uses prescribed burns to clear vegetation in preparation of MEC cleanup.

(3) **Prescribed Burn Air Sampling and Analysis Plan (*MACTEC, 2003*) –** Outlined procedures for the collection and analysis of air samples during a prescribed burn to (1) confirm or refine conclusions drawn from other studies that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn will be below human health-protective regulatory screening levels, and (2) provide data to assess the adequacy of the of the burn prescription relative to smoke dispersion and downwind impacts.

(4) **Ranges 43–48 Site-Specific Work Plan (*Parsons, 2003*) –** Described the procedures, methods and resources that the Army's contractors will use while performing subsurface MEC removal and MEC detonation with engineering controls. An appendix to the Site-Specific Work Plan addressed site preparation activities to be performed prior to a prescribed burn to reduce smoke emissions during the prescribed burn and ensure the prescribed burn is contained within the site boundaries.

Estimated Air Emissions from Prescribed Burning

When prescribed burning is conducted at the Interim Action sites, the intense fire may result in the incidental detonation of surface or near-surface MEC items. Detonation of MEC has the potential to release air pollutants to the atmosphere. These air emissions may potentially include combustion products, volatile or semivolatile organic compounds, unburned or incompletely burned energetic material, and particulate metals and metal compounds from chemical components of the MEC items.

Available models and studies described in the Air Emissions Technical Memorandum for Ranges 43–48 suggested that no significant amounts of criteria air pollutants or toxic air contaminants (TACs) would be released from the incidental MEC detonations during prescribed burn activities conducted at the former Fort Ord. The assessment concluded all MEC-related air emission impacts would be well below human health-protective regulatory screening levels.

In addition to possible MEC-related air emissions, the smoke generated from prescribed burning of vegetation may also contain air pollutants which could be a concern to adjacent populated areas. Inhalable particulate matter (suspended particles less than 10 microns in diameter [PM_{10}]) and other products of combustion can cause temporary respiratory distress to sensitive populations during the burn event. Smoke management techniques as described in the Prescribed Burn Plan for Ranges 43–48 are employed by the Army to minimize public exposure to smoke from the prescribed burn at Ranges 43-48 at the Former Fort Ord.

Sampling of Air Emissions from Prescribed Burning at Ranges 43–48

Air samples were collected during a prescribed burn event in Ranges 43–48 in October 2003 to confirm or refine the conclusions of the Air Emissions Technical Memorandum that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn will 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 was also used to 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.

Under the air sampling 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, three (3) on-base stations, nine (9) public stations, and one (1) mobile station. 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.

Results of Air Monitoring Conducted During Prescribed Burning at Ranges 43–48

The primary objectives of the air sampling program were to (1) confirm or refine conclusions drawn from other studies that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn will be below human health-protective regulatory screening levels, and (2) provide data to assess the adequacy of the of the burn prescription relative to smoke dispersion and downwind impacts.

The conclusion of this investigation was that MEC-related chemical signatures were not observed at any site during the prescribed burn (both active ignition and smolder phases). At the sampling station most heavily impacted by smoke during the active ignition phase of the burn, COPC concentrations were below the limits of detection and the applicable regulatory screening levels for all MEC-related chemicals. 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. Sampling results from all on-base and public monitoring stations were all below the limits of detection and the applicable regulatory screening levels for all MEC-related chemicals.

With regard to the second objective, the data from this investigation will be considered along with visual observations and photographic records from the burn to allow the Army and its contractors to assess the adequacy of the burn prescription and to identify modifications, as necessary, for future work. This evaluation is complicated by the unplanned size and duration of the burn as it extended beyond the original perimeter. The data from this 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.

Aldehyde and acrolein concentrations, other measures of smoke impact, were also 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. Further investigation of possible ubiquitous sources of acrolein or the appropriateness of the screening level may be warranted.

1.0 BACKGROUND

This section describes the location and historical use of former Fort Ord, the use of Ranges 43–48 and the resulting hazards related to munitions and explosives of concern (MEC) that may remain, and potential impacts to air resulting from the prescribed burn operation required to complete the interim cleanup action for Ranges 43–48.

1.1 Facility History and Description

The following sections describe the facility in terms of location, history, and types of MEC known or suspected to be present.

1.1.1 Location

The former Fort Ord is adjacent to Monterey Bay in northwestern Monterey County, California, approximately 80 miles south of San Francisco (Plate 1). The former Army base consists of approximately 28,000 acres adjacent to the cities of Seaside, Sand City, Monterey, and Del Rey Oaks to the south and Marina to the north. The Southern Pacific Railroad and Highway 1 pass through the western part of Fort Ord, separating the beachfront portions from the rest of the former base. Laguna Seca Recreation Area and Toro Regional Park border former Fort Ord to the south and southeast, respectively, as well as several small communities such as Toro Park Estates and San Benancio.

1.1.2 Historical Use

Military training on the former Fort Ord began in approximately 1917 and continued until base closure in 1994. At its founding in 1917, the former Fort Ord served primarily as a training and staging facility for infantry troops. From 1947 to 1974, the Installation was a basic training center. After 1974, the 7th Infantry Division occupied the Installation. The 7th Infantry Division was converted to a light division in 1983; light infantry troops operate without heavy tanks or armor. The former Fort Ord was selected in 1991 for base realignment and closure (BRAC), and the base was officially closed in September 1994.

In 1917, the Army bought a portion of the present-day Main Garrison and East Garrison and nearby lands on the east south central side of the former Fort Ord to use as a maneuver and training ground for field artillery and cavalry troops stationed at the Presidio of Monterey. Before the Army's acquisition of the property, the area was agricultural, as is much of the surrounding land today. No permanent improvements were made until the late 1930s, when administrative buildings, barracks, mess halls, tent pads, and a sewage treatment plant were constructed.

In 1940, additional agricultural property was purchased for further development of the Main Garrison. At the same time, beachfront property was donated to the Army. Building construction in the Main Garrison began in 1940 and continued into the 1960s, starting in the northwest corner of the base and expanding southward and eastward. During the 1940s and 1950s, the Army constructed and maintained a small airfield within the Main Garrison in what became the South Parade Ground. In the early 1960s, when the Fritzsche Army Airfield was completed, the Main Garrison airfield was decommissioned and its facilities were redeveloped as motor pools and other facilities.

1.1.3 History of Military Munitions Use

Since 1917, portions of the former Fort Ord were used by infantry units for maneuvers, target ranges, and other purposes. Military Munitions that have been fired into and upon, or used on the facility include artillery and mortar projectiles, rockets and guided missiles, rifle and hand grenades, practice land mines, pyrotechnics, and demolition materials. A wide variety of conventional munitions and explosives of concern (MEC) items have been located at sites throughout the former Fort Ord, including pyrotechnics and explosives.

In November 1998, the Army agreed to evaluate MEC at former Fort Ord in a basewide Ordnance and Explosives Remedial Investigation/Feasibility Study (now known as Munitions Response) remedial investigation/feasibility study (MR RI/FS) consistent with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process. The Army is preparing the basewide MR RI/FS for

former Fort Ord to address MEC-related hazards, which will include input from the community and require regulatory agency review and approval.

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 Ranges 43–48, Range 30A, and Site OE-16 while the basewide MR RI/FS is being conducted. The Army completed an interim action (IA) ordnance and explosives (OE) RI/FS (*Harding ESE, 2002*) that summarized the investigation and presented an evaluation of cleanup alternatives for the areas described above, and a proposed plan (*Army, 2002a*) that presented the Army's proposed methods to address the above-mentioned areas. In September 2002, the Army issued the approved IA OE RI/FS Record of Decision (ROD; *Army, 2002b*) for Ranges 43–48, Range 30A, and Site OE-16 at former Fort Ord. The ROD summarized information in the IA OE RI/FS and other documents in the Administrative Record and presented the selected alternatives for each area. Prescribed burning was the alternative selected for vegetation clearance at Ranges 43–48 as well as the other two areas.

1.2 Ranges 43–48 History and Site Description

The following sections describe the location of Ranges 43–48, the history of MEC use, and risks from MEC known or suspected to have remained on the ranges.

1.2.1 Location

Ranges 43–48 cover approximately 483 acres to the south of Eucalyptus Road in the south-central portion of the former Fort Ord (Plate 2). Future reuse of the northern portion is designated as development (11 acres). The southern portion is designated as habitat reserve and will remain undeveloped (472 acres).

These ranges were part of former Fort Ord's Impact Area and are categorized as firing ranges where personnel were trained in the use of live ammunition. The Impact Area is fenced and posted with signs

warning of the dangers associated with MEC. Vegetation at Ranges 43–48 mainly consists of Central Maritime Chaparral with some grassland areas.

1.2.2 History of Military Munitions Use at Ranges 43–48

Training facilities maps indicate these ranges were used for a variety of live fire exercises from the 1940s through the 1990s. Records and recent field investigations indicate the ammunition used at these ranges included 4.2-inch, 60mm, and 81mm mortars; 14.5mm subcaliber projectiles; 35mm subcaliber rockets; 90mm recoilless rifle rounds; 84mm incendiary projectiles; 40mm High Explosive (HE) grenades; 66mm light antitank weapon (LAW); small arms; anti-personnel mines; dragon guided missiles; and fragmentation hand grenades (*Harding ESE, 2002*).

1.2.3 Risks from MEC at Ranges 43–48

In general, risks from physical contact with MEC are acute and potentially catastrophic in nature, and may result in crippling injuries or death.

Areas in and around the former firing ranges contain sensitively fuzed, highly dangerous MEC present on the ground surface or at shallow depths below the ground. As described above, numerous types of MEC ranging from hand grenades to 90mm recoilless rifle rounds are known or suspected to be present on these ranges. In limited investigations prior to the prescribed burn, thousands of unexploded and expended items were recovered at Ranges 43–48.

1.3 Problem Definition: Potential Impacts to Air

The Army determined in the IA OE RI/FS for Ranges 43–48, Range 30A, and Site OE-16 that prescribed burning to clear vegetation prior to MEC remedial action was the preferred alternative (*Harding ESE, 2002*). After conducting prescribed burns to support MEC removals in the past, the Army recognized that smoke produced by prescribed burn events had the potential to create short-term impacts on local air quality and potential impacts on public health downwind of the smoke, and worked with the regulatory agencies, local air pollution control agency and the public to develop effective smoke

management measures. The Army also implemented procedures to inform the local communities prior to conducting prescribed burn events, and a provision for temporary relocation of smoke-sensitive individuals. A detailed Burn Plan was prepared by the Army's burn contractor, Fire Stop (*Fire Stop,2002, 2003*). The Burn Plan described the operational aspects of the proposed burn at Ranges 43–48, including all considerations for smoke management.

1.3.1 Incidental Detonation of MEC

A concern raised during the evaluation of cleanup alternatives in the IA OE RI/FS was that prescribed burn activities in MEC areas at the former Fort Ord may result in the incidental detonation of surface or near-surface MEC items (*Harding ESE, 2002*). Detonation of MEC has the potential to release air pollutants to the atmosphere. These air emissions may potentially include combustion products, volatile or semivolatile organic compounds, unburned or incompletely burned energetic material, and particulate metals and metal compounds from chemical components of the MEC. Available models and studies described in the *Final Prescribed Burn Sampling and Analysis Plan* (*MACTEC, 2003*) suggested that no significant amounts of criteria air pollutants or toxic air contaminants (TACs) would be released from the incidental MEC detonations during prescribed burn activities conducted at the former Fort Ord.

1.3.1.1 Contaminants of Potential Concern

The results of the Air Emissions Technical Memorandum (*Harding ESE, 2001*) concluded that maximum downwind concentrations from MEC emissions during a prescribed burn on Ranges 43–48 would occur approximately 3,285 meters downwind and would be well below health-protective regulatory screening levels. This study also showed that emissions of all MEC-related combustion products would be many orders of magnitude less than emissions of the same pollutant produced exclusively from vegetation burning where no MEC is present. For this reason, it would be impossible to distinguish the contribution of MEC emissions from the combustion products which are also produced from the burning vegetation itself.

In addition to vegetation-related combustion compounds, the Prescribed Burn Air Monitoring Program, therefore, focused on those combustion products which are unique to MEC detonation as follows and shown on Table 1:

- energetic materials
- particulate metals
- dioxins and furans.

Energetic materials and their likely breakdown products are the primary pollutant species which were shown in studies described in the Air Emissions Technical Memorandum (*Harding ESE, 2001*) to be clear signatures of MEC emissions.

The other possible candidate for MEC signature emissions are particulate metals. The previous studies mentioned above indicated that MEC detonation may result in the release of particulate metals. Because of uncertainties regarding particulate metals identified in those studies, the Air Emissions Technical Memorandum relied on reasonable upper bound assumptions regarding particulate metal emissions from MEC detonation. They were then included in the Air Monitoring Program to determine if further assessment was warranted (*Harding ESE, 2001*).

Dioxins and furans were estimated to occur in very low amounts from MEC detonation, and only from certain types of MEC with plastic components. However, dioxins and furans were included in this air sampling program because of the uncertainty in the emission estimate for those compounds. The MEC-related compounds included in the Prescribed Burn Air Monitoring Program are described further in Section 2.3.

1.3.2 Burning of Vegetation

Emissions from prescribed burning of vegetation are extremely diverse depending on the source and are therefore difficult to quantify. The diversity in the type and quantity of combustion products is due to many factors, including fuel (vegetation) type, moisture content, and the diversity of combustion processes which occur simultaneously within a fire. The primary combustion processes include flaming, smoldering, and glowing combustion.

Despite the wide variation in combustion emissions, prescribed burning is generally recognized as a significant source of particulate matter emissions. Emissions of criteria pollutants are less understood, but can include nitrogen oxides, hydrocarbons, sulfur oxides, and polycyclic organic material (POM), which contains hundreds of other compounds in small quantities (*Peterson and Ward, 1989*). The Air Emission Technical Memorandum (*Harding ESE, 2001*) and Prescribed Burn Sampling and Analysis Plan (*MACTEC, 2003*) discuss each of these emissions related to prescribed burning and provide the rationale for the selection of specific analytes included in the Prescribed Burn Air Monitoring Program.

Table 1 summarizes the complete list of target analytes for this investigation, including MEC-specific compounds and smoke signature compounds. Table 2 summarizes the applicable regulatory screening levels that were used for comparison to the sampling results.

2.0 PROJECT DESCRIPTION

This section describes the project objectives and summarizes the prescribed burn operations and sampling program.

2.1 Objectives

The Final Prescribed Burn Air Sampling and Analysis Plan (*MACTEC, 2003*) outlined procedures for collection and analysis of air samples in areas potentially affected by air emissions from a prescribed burn at Ranges 43–48. The objectives of the sampling and analysis program described therein was to:

1) Confirm or refine conclusions drawn from other studies that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn will be below human health-protective regulatory screening levels, and

2) Provide data to assess the adequacy of the burn prescription relative to smoke dispersion and downwind impacts.

The Final Prescribed Burn Air Monitoring Program therefore focused on detection and quantification of MEC-related emissions and selected vegetation-related combustion products (Table 1). 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 results of the air sampling program investigation are intended to facilitate conclusions regarding public health that may be applied to the entire prescribed burn program at the former Fort Ord.

2.2 Summary of Prescribed Burn Operations

The prescribed burn operations at Ranges 43–48 were performed by Firestop of Granite Bay, California and began the morning of October 24, 2003. The original extent of the 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 1000 acres west and southwest of Ranges 43-48 (Plate 2) before being contained. 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.

2.3 Summary of Sampling Program

This section describes the location of sampling stations and sampling activities completed for the prescribed burn air sampling program. To meet the Army's project objectives, the investigation included pre- or post-burn baseline sampling, sampling during the burn (the day of active ignition), and sampling the day after active ignition was completed. The *Final Prescribed Burn Air Sampling and Analysis Plan* (*MACTEC, 2003*) provides additional details regarding the rationale for sampling locations and selection of specific analytes. Table 3 summarizes the sampling and analytical methods, type of equipment, and sampling media used, and the analysis performed for each analyte. Table 4 summarizes the sampling locations and identification numbers for each of the sampling stations. Analytical results for the Prescribed Burn Air Monitoring Program are presented in Tables 5 through 53.

2.3.1 Sampling Locations

A total of fifteen (15) sampling locations were used during the investigation: fourteen (14) fixed stations, and one (1) mobile station (Table 4 and Plate 2). These sampling locations were determined in consultation with the Army, USEPA, DTSC, and the MBUAPCD in September 2002. Two (2) burn area (BA) fixed stations, BA 1 and BA 2, were installed immediately adjacent to the burn area at Ranges 46 and 43, respectively, and were collocated with the two meteorological stations operated by the burn contractor (Plate 2). Three (3) on-base (OB) stations, OB 1, OB 2, and OB 3 were installed in on-base locations to characterize possible smoke impacts relatively close to the burn area (Plate 2). The remaining nine (9) public site (PS) stations, PS 1 through PS 9, were located in residential areas surrounding the base to characterize any smoke impacts to the public (Plate 2). Of the public stations, PS 1, PS 3, and PS 9 were established by the Army. The remaining stations are permanent monitoring

locations made available to the Army in cooperation with the MBUAPCD. Because the areas that would actually be impacted by smoke during the burn could not be predicted in advance, one (1) mobile air sampling station (MS 1) was dispatched after the burn had progressed (Plate 2). The exact coordinates of each sampling location used was recorded using Global Positioning System (GPS) technology.

2.3.2 Baseline Air Sampling

This section summarizes the baseline air sampling activities completed for this study. Baseline samples were necessary because some of the target list of chemicals of potential concern (COPCs) are ubiquitous in urban environments (*MACTEC, 2003*). Baseline air sampling was performed by MACTEC and USACHPPM on November 18, 2002 (Appendix E), by the MBUAPCD on October 23, 2003 (Appendix F), and by MACTEC on November 12, 2003 (Tables 34 through 42).

On November 12, 2002, MACTEC began the baseline air sampling process in anticipation of a prescribed burn on the following day. However, the prescribed burn event was cancelled and no burn was performed in 2002. Because baseline air samples for energetic analytes were collected by USACHPPM during the 2002 burn season, baseline sampling for those analytes were not repeated in 2003 by mutual agreement with the regulatory agencies.

On October 23, 2003, the day before the prescribed burn, the MBUAPCD performed baseline air sampling at their permanent monitoring locations, which included PS 2, and PS 4 through PS 8 (Plate 2).

On November 12, 2003, sixteen days after all fire suppression was completed, baseline air samples were collected by MACTEC at eight locations (BA 1, BA 2, OB 1 through 3, PS 1, PS 3, and PS 9; Plate 2). Baseline air sampling was not performed at the remaining public stations (PS 2, and PS 4 through PS 8) because results were provided by the MBUAPCD from the October 23, 2003 baseline sampling event.

2.3.3 Prescribed Burn Air Sampling

This section summarizes the prescribed burn air sampling activities completed for this study. The activities included air sampling during the active ignition phase and the day after active ignition, or the "smolder" phase.

Prescribed burn air sampling was performed by MACTEC and USACHPPM on October 24, 2003 during the active ignition phase and on October 25, 2003 during the smolder phase. Samples were collected at stations BA 1, BA 2, OB 1 through OB 3, and PS 1 through PS 9 (Tables 5-33). The mobile sampling station (MS 1) was dispatched to a location near the intersection of Yosemite and Sonoma Streets in the City of Seaside (Plate 2). The location was chosen according to selection criteria defined in the *Final Prescribed Burn Air Sampling and Analysis Plan* (*MACTEC, 2003*) and based on observed smoke impacts after the burn was underway. MBUAPCD also performed sampling at their permanent monitoring stations during those days and through the completion of fire suppression activities.

Air samples for the COPCs included both "real-time" samples using direct-reading instrumentation, and "integrated" time weighted average (TWA) samples where samples were collected on or in a specific media for subsequent laboratory analysis. All TWA samples were collected over the duration of active ignition, beginning at the initiation of the burn and terminating approximately 8 to 10 hours later (baseline and smolder phase samples for these methods were collected over a similar duration). Real-time, continuous air samples were collected for selected vegetation-related combustion compounds to indicate the presence or absence of smoke impacts at the sampling locations. Visual observations and photographs were used to document the presence or absence of smoke. All samples were collected at approximately two (2) meters above ground level (agl), which is at or near the human adult breathing zone and within the probe siting criteria recommended by the USEPA (*USEPA, 1987*). The analytical methods used in this investigation are summarized in Table 3 and are described in the following sections.

3.0 RESULTS

This section summarizes the results of the air sampling conducted for the former Fort Ord Prescribed Burn Air Sampling Program.

3.1 Analytical Test Methods

This section presents a brief description of the sample collection methods, analytical methods, and laboratories used for each analysis in the Prescribed Burn Air Monitoring Program. A more detailed discussion of each analytical method is included in Section 6.0 of *Final Prescribed Burn Air Sampling and Analysis Plan (Final Prescribed Burn Air SAP), Ranges 43–48, Former Fort Ord, California,* (MACTEC, 2003). As described in Section 2.3.3, both "real time" samples were collected using direct-read instruments in the field, and "integrated" TWA samples were collected and submitted for laboratory analysis. Real time data and integrated laboratory analytical results are presented in Tables 5 though 42. Results of all analyses are presented in units of micrograms per cubic meter of air (ug/m^3), which were calculated by applying flow volumes to the original laboratory reported results as shown in the conversion tables presented in Appendix A.

3.1.1 Real Time Data

Real time data was collected for total suspended particulates (TSP) using an MIE Personal DataRAM PDM 1000 real time aerosol monitor and a Solomat Surveyor Pro fitted with a 1260GSS Smart Four Function Probe for detecting carbon dioxide (CO_2). The instruments were programmed to continuously collect data using five-minute averages. Each DataRAM was zeroed out on a daily basis per the manufacturer's recommended procedures. All Surveyor Pro instruments were factory calibrated to National Institute of Standards and Technologies traceable standards prior to delivery. Prior to deployment, the Surveyor Pro instruments were also initialized and operated simultaneously in the same environment, and the readings were compared to each other. The one instrument whose reading deviated the greatest from the mean of all other instruments was then recalibrated against a series of gas standards

and re-compared to the other instruments. The instruments all displayed values with variations within 1% or less as compared to the recalibrated instrument.

3.1.2 Energetic Analytes

Integrated air samples for analysis of energetic compounds were collected by USACHPPM personnel on polyurethane foam (PUF) cartridges, consisting of a quartz fiber particulate pre-filter followed by a sorbent bed (consisting of XAD-2 resin) separated by PUF layers. The samples were collected via a high-volume sampling system, as described in Table 3. The samples were analyzed by the USACHPPM Laboratory by USACHPPM Standard Operating Procedure (SOP) CAD 26.2 and CAD 26.3 for the following target compounds: 1,3,5-Trinitrobenzene, 1,3-Dinitrobenzene, 2,4,6-Trinitrotoluene, 2,4-Dinitrotoluene, 2,6-Dinitrotoluene, cyclotetramethylene tetranitramine (HMX), Nitrobenzene, pentaerythritol tetranitrate (PETN), and cyclotrimethylene trinitramine (RDX). Sample results for data collected by USACHPPM are provided as Appendix E. Raw data generated from analysis performed by USACHPPM is available on request.

3.1.3 Particulate Matter (PM_{10} and TSP)

Integrated TWA air samples for particulate matter less than 10 microns (PM_{10}) and total suspended particulates (TSP) were collected at the two burn area sites (BA 1 and BA 2) on 8 by 10 inch quartz fiber filter media using volumetric-flow-controlled high-volume samplers with a size-selective inlet, as described in Table 3. Samples for PM_{10} analyses in the three on-base sites (OB 1, OB 2, and OB 3), nine public sites (PS 1 through PS 9), and the mobile station (MS 1) were collected on teflon filter media using low volume sampling equipment. Samples for PM_{10} analysis from the three on-base sites and nine public sites were collected during day-time hours and over-night periods of the active ignition phase, smolder phase and baseline. All samples for PM_{10} and TSP were analyzed by Data Chem Laboratories, in Cincinnati, Ohio, with the exception of public sites PS 2 and PS 4 through PS 8, which were collected and analyzed by the MBUAPCD laboratory. Sample results for data collected by MBUAPCD are provided as Appendix F.

3.1.4 Particulate Metals (PM_{10} and TSP)

The quartz fiber filter and teflon media used to collect samples for PM_{10} and TSP analyses described above were also analyzed for the following list of target particulate metals: aluminum, antimony, barium, beryllium, cadmium, chromium, cobalt, copper, lead, manganese, molybdenum, nickel, zinc and mercury. Metals analysis was performed on the quartz fiber and teflon filter media by Data Chem Laboratories in Cincinnati, Ohio using 40 Code of Federal Regulations (CFR), Part 60, Appendix A, Method 12M (8 by 10 quartz fiber filters), NIOSH 7300 (teflon filters) and NIOSH 6009 (teflon filters - mercury only). The analytical test methods performed by Data Chem laboratories are compatible with the USEPA Compendium Methods IO 2.1 and IO 3.4 specified in the Final Prescribed Burn Air SAP (*MACTEC, 2003*). As described in the Final Prescribed Burn Air SAP, metals analysis was not performed on samples from the over-night sampling periods from OB 1, OB 2, OB 3, PS 1, PS 3, and PS 9 (*MACTEC, 2003*).

3.1.5 Aldehydes

Integrated air samples for acetaldehyde and formaldehyde were collected on low-pressure drop DNPH (2,4-dinitrophenylhydrazine) impregnated cartridges via low-volume sampling pumps, as described in Table 3. Analysis for target analytes acetaldehyde and formaldehyde was performed by Data Chem Laboratories in Cincinnati, Ohio by USEPA Compendium Test Method TO-11A.

3.1.6 Acrolein

Integrated air samples for acrolein were collected in 6-liter SUMMA canisters equipped with mass flow controllers pre-set for a 10-hour sample duration, as described in Table 3. Samples for acrolein were analyzed by Air Toxics, LTD in Folsom, California using USEPA Compendium Method TO-14.

3.1.7 Dioxins/Furans

Integrated air samples were collected in the two burn area sites and the mobile station for analysis of Total Dioxin and Furan Toxicity Equivalent (TEQ) using a polyurethane foam (PUF) cartridge and

particulate pre-filter. The samples were collected using a high-volume sampling system, as described in Table 3, and were analyzed by Frontier Analytical, in El Dorado Hills, California using USEPA Compendium Method TO-9A.

3.2 Analytical Results

This section presents a summary of all analytical results generated from the three phases of the Prescribed Burn Air Monitoring Program. Also included in this section are field observations as to smoke impacts observed at each of the monitoring stations. Field sampling forms and field notes from each site are included as Appendix B and C. Laboratory data was subject to USEPA Level III and Level IV validation, and the findings of the data validation are presented in Section 5.1 and Appendix D. A discussion of these results, including a comparison to screening levels and peak-to-mean ratios is presented in Section 4.0

3.2.1 Active Ignition Phase Sampling Results

3.2.1.1 Burn Area Sites (BA 1 and BA 2)

The suite of analyses performed on the samples collected during the active ignition phase on October 24, 2003 from BA 1 and BA 2 included: Real time data collection for total particulate matter and laboratory analysis of energetic compounds, aldehydes, acrolein, dioxins and furans, particulate matter (PM_{10} and TSP), and particulate metals.

Real time monitoring data for total particulate matter at BA 1 and BA 2 indicate that peak particulate concentrations occurred during the noon and 3:00 PM hours, respectively (Tables 5 and 6 figures). Field personnel did not remain at these stations during the Active Ignition phase, so field observations were not recorded at either of the two burn area sites.

Analytical results indicate that none of the target energetic compounds described in Section 3.1.2 were detected at either of the burn area sites during the active ignition phase. Acetaldehyde, formaldehyde, and acrolein were detected in the samples collected from BA 1 at 230, 88, and 56 ug/m^3, respectively.

Acetaldehyde and formaldehyde were detected in the sample from BA 2 during this monitoring period at 5.6 and 5.5 ug/m^3, respectively, while acrolein was non-detected. Results from the dioxins and furans analysis indicated that the calculated TEQ at BA 1 was 5.7E-06 ug/m^3, and non- detect at the BA 2 site. Several target metals including aluminum, antimony, barium, copper, manganese, zinc, and mercury were detected in the samples from BA 1. Target metals in the sample from BA 2 were either non-detected or at low levels during this monitoring period. Tables 5 and 6 present the analytical data from BA 1 and BA 2, during the active ignition phase sampling period.

3.2.1.2 On-Base Sites (OB 1, OB 2, OB 3)

Analyses of samples collected from on-base sites OB 1, OB 2, and OB 3 included energetic compounds, aldehydes, acrolein, particulates (PM_{10}), and particulate metals, in addition to collection of real-time data and field observations. A summary of analytical results are presented in Tables 7 through 9.

Evaluation of real-time data for the active ignition phase (Tables 7 through 9 figures) indicates peak particulate concentrations during the 1:00 PM, 3:00 PM, and 9:00 AM hours at OB 1, OB 2, and OB 3, respectively. CO_2 peak concentrations occurred at coinciding times with the peak particulate concentrations at OB 1 and OB 2. At OB 3, however, peak CO_2 concentrations occurred much later in the day, with the highest values recorded during the 5:00 PM hour. In general throughout the day, onsite field personnel reported light visual and olfactory evidence of smoke at OB 1; substantial olfactory and visual evidence of smoke and particulates at OB 3; and substantial olfactory, visual, and respiratory evidence of smoke and particulates at OB 2. Field observations of peak smoke impacts occurred at approximately the same times as those indicated by the real-time data.

Sample analyses detected no target energetic compounds or target particulate metals during the active ignition phase at any of the OB sites. Acetaldehyde, formaldehyde, and acrolein were reported in samples from all three OB sites. Total PM_{10} results were reported as nondetectable for both daylight and overnight samples at OB 1, and for the daylight sample at OB 2. However, the sampling devices for the

daylight sample at OB 2 (OB1PTF470101) and the overnight sample at OB 1 (OB2PTF470103) malfunctioned and shut down prematurely, which resulted in minimal sample volumes collected over a short period of time. The minimal sample volumes collected resulted in elevation of the minimum reporting limit for each of the affected samples. Analytical results for the overnight sample collected at OB 2 detected a particulate volume of 84 $\mu g/m^3$. Total reported PM_{10} particulates for OB 3 daylight and overnight samples were 50 $\mu g/m^3$ and 410 $\mu g/m^3$, respectively.

3.2.1.3 Public Sites (PS 1 – PS 9)

The suite of analyses for all public sites during the active ignition phase on October 24, 2003 included PM_{10}, particulate metals, aldehydes, and acrolein, with the exception of the Gonzales site (PS 8). As prescribed in the Final Prescribed Burn Air SAP, the suite of analysis for the Gonzales site included PM_{10} and particulate metals only (*MACTEC, 2003*). Data collection and analysis for PM_{10} was performed by MBUAPCD personnel at sites PS 2 and PS 4 through PS 8. Real time monitoring for total particulate matter was also performed at PS 1 and PS 3. As described in Section 3.1.3, two sets of data are reported for PM_{10} analyses from each site (except PS 8), representing day-time hours and an overnight sampling period. Two sets of metals data, representing day-time hours and the overnight sampling period were also reported from sites PS 2, and PS 4 through PS 7.

3.2.1.3.1 Equipment Staging Area (PS 1)

Evaluation of real-time data for the active ignition phase (Table 10 figure) indicates peak particulate concentrations occurred during the 5:00 PM hour of the active burn phase. The total particulate (PM_{10}) volume in the sample collected during the same (daylight) period was 34 $\mu g/m^3$, and the overnight sample concentration was 46 $\mu g/m^3$. Acetaldehyde and formaldehyde were reported at 2.3 $\mu g/m^3$ and 2.8 $\mu g/m^3$, respectively, but acrolein and target metals were not detected. Visual and olfactory evidence of smoke onsite were not reported during the sampling period by field personnel.

3.2.1.3.2 Fitch Middle School (PS 2)

Samples collected during active ignition at PS 2 resulted in reported PM_{10} concentrations of 70.7 $\mu g/m^3$ for the daylight sample, and 118.5 $\mu g/m^3$ for the overnight sample (Table 11). Within these samples, aluminum was detected at 9.7 $\mu g/m^3$ and 1.1 $\mu g/m^3$, respectively. No other target metals were detected. Acrolein, acetaldehyde and formaldehyde were detected at 2.5 $\mu g/m^3$, 2.3 $\mu g/m^3$, and 3.3 $\mu g/m^3$, respectively.

3.2.1.3.3 Manzanita School (PS 3)

Evaluation of real-time data collected during active ignition indicates that the highest particulate matter densities were present during the 10:00 AM hour (Table 12 figure). PM_{10} concentrations were reported at 70 $\mu g/m^3$ in the daylight sample, and 337 $\mu g/m^3$ in the overnight sample. Aluminum was detected in the daylight particulate sample, but no other target metals were detected. Acrolein, acetaldehyde, and formaldehyde were reported at concentrations of 4.1, 7.4, and 7.6 $\mu g/m^3$, respectively.

3.2.1.3.4 MBUAPCD District Office (PS 4)

Total PM_{10} concentrations reported in samples from PS 4 were 58.8 and 74 $\mu g/m^3$ in the daylight and overnight samples, respectively (Table 13). Low concentrations of aluminum were also reported, but no other target metals were detected. Field personnel noted that particulates were visible in the air from about 1:45 PM to 3:30 PM, and olfactory evidence of smoke was detectable beginning at about 2:00 PM. Acetaldehyde and formaldehyde were detected (3.0 and 4.3 $\mu g/m^3$, respectively), but acrolein was not detected.

3.2.1.3.5 Salinas Rural Fire District Office (PS 5)

PM_{10} concentrations in samples collected at PS 5 were reported at 90.2 and 77.4 ug/m^3 for daylight and overnight samples, respectively (Table 14). Low concentrations of aluminum were reported, but no other target metals were detected. Field personnel reported olfactory and visual evidence of smoke onsite

beginning at approximately 3:30 PM. Acrolein, acetaldehyde, and formaldehyde were detected in samples at concentrations of 3.7, 4.9, and 5.4 μg/m^3, respectively.

3.2.1.3.6 Spreckles School (PS 6)

Particulate matter (PM_{10}) ranged from 79.1 ug/m^3 during the daylight period of the active ignition phase to 73.9 ug/m^3 during the overnight period. Detections of acetaldehyde and formaldehyde were reported at 2.6 ug/m^3 and 2.9 ug/m^3, respectively. All other target analytes were non-detect, with the exception of aluminum at 2.5 ug/m^3 during the daylight period, and 1.4 ug/m^3 during the overnight period. Table 15 presents the analytical results generated from PS 6. Field observations recorded throughout the day indicate that smoke was not detected at site PS 6 during the active ignition phase through visual or olfactory means.

3.2.1.3.7 Ingham School (PS 7)

Particulate matter (PM_{10}) ranged from 85 ug/m^3 during the daylight period of the active ignition phase to 97 ug/m^3 during the over-night period. Detections of acetaldehyde, formaldehyde and acrolein were reported at 7.2, 7.0, and 11 ug/m^3, respectively. All other target analytes were non-detect, with the exception of aluminum at 1.7 ug/m^3 during the daylight period and 1.0 ug/m^3 during the overnight period. Table 16 presents the analytical results generated from PS 7. Smoke was observed as present and low to the ground at site PS 7 from approximately 2:25 PM until the technician left the site at approximately 4:10 PM.

3.2.1.3.8 Gonzales (PS 8)

Particulate matter (PM_{10}) was measured during the daylight period only at this site, and was detected at a concentration of 64 ug/m^3. No target particulate metals were detected, with the exception of aluminum at 1.5 ug/m^3. Table 17 presents the analytical data for PS 8. Field observations were not recorded at this site.

3.2.1.3.9 Monterey Aquarium (PS 9)

Particulate matter (PM_{10}) ranged from 21 ug/m^3 during the daylight period of the active ignition phase to 95 ug/m^3 during the overnight period. Detections of acetaldehyde and formaldehyde were reported at 1.4 and 2.0 ug/m^3. Acrolein and target particulate metals were non-detected. Table 18 presents the analytical data for PS 9. Field observations were not recorded at this site.

3.2.1.4 Mobile Station (MS 1)

The suite of analyses for the mobile station (MS 1) included energetic compounds, particulate matter (PM_{10}), particulate metals, aldehydes, acrolein, and dioxins and furans. Real-time, direct read data was also collected for total particulate matter and carbon dioxide (CO_2). Since MS 1 was designed to mobilize to areas of heavy smoke impact during the active burn, samples were collected from MS 1 on the active ignition day only.

Real time data collected during the active burn phase indicate that the highest concentrations of total particulate matter occurred during the noon hour, and that CO_2 concentrations were elevated from 2:00 PM through the 4:00 PM hour (Table 19 figures).

Acetaldehyde, formaldehyde, and acrolein were detected in the samples collected from MS 1 at 7.6, 7.6, and 6.6 ug/m^3, respectively. Target energetic compounds, PM_{10}, particulate metals, and dioxins and furans were all non-detected. Table 19 presents the analytical data from MS 1. Field observations indicate that smoke was present at the sampling site during sample collection.

3.2.2 Smolder Phase Sampling Results

3.2.2.1 Burn Area Sites (BA 1 and BA 2)

The suite of analyses performed on the samples collected from burn area sites during the smolder phase on October 25, 2003 from BA 1 and BA 2 included: Real time data for total particulate matter, laboratory analysis of energetic compounds, aldehydes, acrolein, dioxins and furans, particulate matter (PM_{10} and

TSP), and particulate metals. Field personnel did not remain at these stations during the smolder phase, so field observations were not recorded at either of the two burn area sites.

Real time data collected at the two burn area sites indicate that the peak total particulate matter concentrations occurred during the 8:00 AM hour at BA 1 and during the 2:00 PM hour at BA 2 (Tables 20 and 21 figures).

Analytical results indicate that none of the energetic compounds described in Section 3.1.2 were detected at either of the burn area sites during the smolder phase. Acetaldehyde, formaldehyde, and acrolein were detected in the samples collected from BA 1 at 10, 8.6, and 8.1 ug/m^3, respectively. Acetaldehyde, formaldehyde, and acrolein were also detected in the samples from BA 2 during this monitoring period at 36, 26, and 6.0 ug/m^3, respectively. Results from the dioxins and furans analysis indicated the calculated TEQ at BA 1 was 1.2E-07 ug/m^3, and 2.6E-06 at the BA 2 site. Low levels of target particulate metals including aluminum, copper, manganese, and zinc, were detected in the samples from both sites. Tables 20 and 21 present the analytical data from BA 1 and BA 2, respectively, from the smolder phase sampling period.

3.2.2.2 On Base Sites (OB 1, OB 2, OB 3)

Analyses of samples collected from on-base sites OB 1, OB 2, and OB 3 included energetic compounds, aldehydes, acrolein, particulates (PM_{10}), and particulate metals, in addition to collection of real-time data and field observations. A summary of analytical results are presented in Tables 22 through 24.

Evaluation of real-time data for the smolder phase indicate that total particulate matter concentrations remained relatively constant throughout the day at OB 1 at 20 to 30 ug/m^3. Peak particulate concentrations were recorded at OB 2 and OB 3 during the 2:00 PM and 9:00 AM hours, respectively. Peak CO_2 concentrations at OB 1 and OB 3 occur during the 9:00 AM and 5:00 PM hours respectively, while the peak concentration of CO_2 OB 2 occurs at approximately the same time as the particulate peak, during the 2:00 PM hour (Tables 22 through 24 figures). Onsite field personnel reported olfactory, visual,

and respiratory evidence of smoke and particulates at OB 2 with peaks occurring at approximately the same times as the peaks indicated by the real-time data.

Analyses of smolder phase samples detected no target energetic compounds (Tables 22 through 24). Acrolein was reported in samples from OB 2 and OB 3, but was not detected in the OB 1 sample. Acetaldehyde and formaldehyde were detected at all three sites, with concentrations at OB 1 and OB 3 being consistent with values detected on the active ignition day. However, the concentrations in samples from OB 2 were an order of magnitude less than those detected at the site on the active ignition day.

Total PM_{10} concentrations for samples from OB 2 were higher for the daylight sample than for the overnight sample (94 $\mu g/m^3$ and 48 $\mu g/m^3$, respectively), but concentrations were higher in overnight samples than daylight samples at OB 1 (59 $\mu g/m^3$ and 79 $\mu g/m^3$, respectively) and OB 3 (67 $\mu g/m^3$ and 361 $\mu g/m^3$, respectively). Aluminum was reported in samples from all three sites (at less than 1.5 $\mu g/m^3$), but no other target metals were detected at any of the three sites.

3.2.2.3 Public Sites (PS 1 – PS 9)

The suite of analyses for all public sites during the smolder phase on October 25, 2003 included PM_{10}, particulate metals, aldehydes and acrolein with the exception of the Gonzales site (PS 8). The suite of analysis for the Gonzales site included PM_{10} and particulate metals only. Real time data was also collected for total particulate matter at PS 1 and PS 3. Data collection and analysis for PM_{10} was performed by MBUAPCD personnel at sites PS 2 and PS 4 through PS 8. Unlike the active ignition phase sampling, the MBUAPCD collected samples for PM_{10} on one filter over a 24-hour period, so only one set of PM_{10} and particulate metals data is reported for sites PS 2 and PS 4 through PS 8. Two sets of data are reported for PM_{10} analyses from sites PS 1, PS 3 and PS 9, representing one day-time and one overnight sampling period.

3.2.2.3.1 Equipment Staging Area (PS 1)

Evaluation of real-time data for the smolder phase (Table 25 figure) indicates a peak particulate concentrations during the 10:00 AM hour and the 4:00 PM hour during the monitoring period. The total particulate (PM_{10}) volume in the sample collected during the same (daylight) period was 64 $\mu g/m^3$, and the overnight sample concentration was 32 $\mu g/m^3$. Aluminum was reported at a concentration of 1.17 $\mu g/m^3$, but no other target metals were detected. Acetaldehyde and formaldehyde were reported at 2.4 $\mu g/m^3$ and 2.8 $\mu g/m^3$, respectively, but acrolein was not detected.

3.2.2.3.2 Fitch Middle School (PS 2)

Analysis of particulate samples collected during the smolder phase at PS 2 resulted reported PM_{10} concentrations of 73.2 $\mu g/m^3$ (Table 26). Within this sample, aluminum was detected at 1.2 $\mu g/m^3$. No other target particulate metals were detected. Acrolein, acetaldehyde and formaldehyde were detected at 11 $\mu g/m^3$, 4.0 $\mu g/m^3$, and 4.6 $\mu g/m^3$, respectively.

3.2.2.3.3 Manzanita School (PS 3)

Evaluation of real-time data collected during the smolder phase indicates that the highest particulate matter densities were present during the 8:00 AM hour (Table 27 figure). Total particulate (PM_{10}) concentrations were reported at 124 $\mu g/m^3$ in the daylight sample, and 99 $\mu g/m^3$ in the overnight sample. Aluminum was reported in the sample (1.32 $\mu g/m^3$), but no other target metals were detected. Acrolein, acetaldehyde, and formaldehyde were reported in samples at concentrations of 3.0, 8.5, and 7.6 $\mu g/m^3$, respectively.

3.2.2.3.4 MBUAPCD District Office (PS 4)

The total particulate concentration (PM_{10}) in the sample from PS 4 was reported at a concentration of 85.4 $\mu g/m^3$ (Table 28). Concentration results for metals could not be calculated because complete sample

volume information was unavailable. Detections of acetaldehyde and formaldehyde were reported (5.7 and 6.2 $\mu g/m^3$, respectively) but acrolein was not detected.

3.2.2.3.5 Salinas Rural Fire District Office (PS 5)

The PM_{10} concentration in the sample collected at PS 5 was reported at 58.5 $\mu g/m^3$[1] (Table 29). Low concentrations of aluminum were reported, but no other target metals were detected. Acrolein, acetaldehyde, and formaldehyde were detected in the samples from the smolder phase at concentrations of 3.5, 3.7, and 3.7 $\mu g/m^3$, respectively.

3.2.2.3.6 Spreckles School (PS 6)

Particulate matter (PM_{10}) was detected at 70.4 ug/m^3 during the smolder phase sampling period. Detections of acetaldehyde, formaldehyde, and acrolein were reported at 3.4, 3.8, and 2.5 ug/m^3, respectively. All other target analytes were non-detect, with the exception of aluminum at 1.5 ug/m^3. Table 30 presents the analytical results generated from PS 6. Field observations recorded throughout the day indicate that smoke was not detected at site PS 6 during the smolder phase until 3:00 PM, at which time a faint smell of smoke was reported in the air.

3.2.2.3.7 Ingham School (PS 7)

Particulate matter (PM_{10}) was detected at 49 ug/m^3 during the smolder phase sampling period. Detections of acetaldehyde and formaldehyde were reported at 7.8, and 7.6 ug/m^3, respectively, while acrolein was non-detected. All other COPCs were non-detect, with the exception of aluminum at 0.99 ug/m^3. Table 31 presents the analytical results generated from PS 7. Field observations recorded throughout the day indicate that smoke was not detected at the site until approximately 3:18 PM, at which time smoke was reported to be above the location. Ash was reportedly falling at approximately 4:02 PM, but subsided at approximately 4:36 PM, when the smoke was reported to clear. Field notes are presented in Appendix C.

3.2.2.3.8 Gonzales (PS 8)

Particulate matter (PM_{10}) was detected at a concentration of 67 ug/m^3. No target particulate metals were detected, with the exception of aluminum at 1.5 ug/m^3. Table 32 presents the analytical data for PS 8. Field observations were not recorded at this site.

3.2.2.3.9 Monterey Aquarium (PS 9)

Particulate matter (PM_{10}) concentrations ranged from 88 ug/m^3 during the daylight period of the smolder phase to 72 ug/m^3 during the over-night period. Detections of acetaldehyde, formaldehyde, and acrolein were reported at 2.6, 4.0, and 77 ug/m^3. Target particulate metals were non-detected, with the exception of aluminum at 1.1 ug/m^3. Table 33 presents the analytical data for PS 9. Field observations were not recorded at this site.

3.2.3 Baseline Sampling Results

3.2.3.1 Burn Area Sites (BA 1 and BA 2)

Baseline sampling at the BA 1 and BA 2 sites occurred in two stages. Sampling for energetic compounds was performed by USACHPPM personnel on November 18, 2002 (Appendix E), and baseline sampling for real-time particulate matter data and aldehydes, acrolein, dioxins and furans, particulate matter (PM_{10} and TSP), and particulate metals was performed by MACTEC personnel on November 12, 2003. Field observations were not recorded during the baseline phase.

Evaluation of the real time data collected at the two burn area sites during the baseline phase indicate that peak particulate matter concentrations were recorded during the 8:00AM hour at BA 1, and during the 7:00 AM and 8:00 AM hours at site BA 2 (Tables 34 and 35 figures).

Analytical results indicate that none of the energetic compounds described in Section 3.1.2 were detected at either of the burn area sites during the baseline sampling. USACHPPM analytical data did not report concentrations for target compound PETN for the baseline sampling event (Appendix E), although the data was subsequently evaluated for this compound, and was determined to be non-detected

(Appendix E). Acetaldehyde, and formaldehyde were detected in the samples collected from BA 1 at 1.2, and 1.4 ug/m^3, respectively. Acrolein and target particulate metals were non-detected at BA 1, with the exception of copper at 0.042 ug/m^3. Acetaldehyde, formaldehyde, and acrolein were detected in the samples from BA 2 during this monitoring period at 1.4, 2.1, and 5.9 ug/m^3, respectively. Target particulate metals were also non-detected at BA 2, with the exception of copper and zinc at 0.072 and 0.032 ug/m^3, respectively. Results from the dioxins and furans analysis indicated that the calculated TEQ at BA 1 was 1.9E-11 ug/m^3, and 1.5E-11 at the BA 2 site. Tables 34 and 35 present the analytical data from BA 1 and BA 2, respectively, from the baseline sampling period.

3.2.3.2 On-Base Sites (OB 1, OB 2, OB 3)

Real time data collected for total particulate matter from the three OB sites indicate that peak particulate concentrations were observed during the 8:00 AM hour at OB 1, the 11:00 AM hour at OB 2, and the 4:00 PM hour at OB 3. Real time monitoring of CO_2 concentrations at the OB sites indicates that CO_2 concentrations remained relatively consistent throughout the day, ranging from 300 ug/m^3 to slightly under 400 ug/m^3.

Analyses of baseline phase samples collected at the OB sites detected no target energetic compounds (Tables 36 through 38). USACHPPM analytical data did not report concentrations for target compound PETN for the baseline sampling event (Appendix E), although the data was subsequently evaluated for this compound, and was determined to be non-detected (Appendix E). Acrolein was detected in samples from OB 1 and OB 2, but was not detected in the OB 3 sample. Acetaldehyde and formaldehyde were detected at all three sites, with maximum concentrations detected in samples from OB 3 (1.4 µg/m^3 and 1.9 µg/m^3, respectively).

Total particulate concentrations (PM_{10}) were reported at 23 µg/m^3 for the OB 1 daylight sample, but were not detected in either the OB 2 or OB 3 daylight samples. Results for overnight samples were reported at 16 µg/m^3 for OB 1, 20 µg/m^3 for OB 2, and 30 µg/m^3 for OB 3. Aluminum was reported at a

concentration of 1.05 µg/m^3 in the OB 1 sample, but was not detected in samples from either OB 2 or OB 3. No other target particulate metals were detected in samples from any of the OB sites.

3.2.3.3 Public Sites (PS 1 – PS 9)

Baseline sampling was performed at public sites PS 2 and PS 4 through PS 8 by MBUAPCD personnel on October 23, 2003. The suite of analyses performed on samples from these sites included PM_{10} and particulate metals. Baseline sampling for public site PS 1, PS 3, and PS 9 was performed on November 12, 2003 by MACTEC personnel, and included the following analyses: PM_{10}, particulate metals, aldehydes, and acrolein. Real time particulate matter data was also collected at sites PS 1 and PS 3. As with the smolder phase sampling, the MBUAPCD collected baseline samples for PM_{10} on one filter over a 24-hour period, so only one set of PM_{10} and particulate metals data was reported for sites PS 2 and PS 4 through PS 8. Two sets of data were reported for PM_{10} analyses from sites PS 1, PS 3 and PS 9, representing one day-time and one overnight sampling period. Field observations were not recorded during the baseline sampling.

3.2.3.3.1 Equipment Staging Area (PS 1)

Real time particulate matter data collected at PS 1 indicated that the highest concentrations of particulate matter were recorded during the 9:00 AM and 4:00 PM hours at approximately 17 ug/m^3 (Table 39 figure).

Total particulates (PM_{10}) in samples from PS 1 (Table 39) were reported at concentrations of 26 µg/m^3 and 32 µg/m^3 for daylight and overnight samples, respectively. No target particulate metals were detected. Acrolein, acetaldehyde, and formaldehyde were reported at concentrations of 2.4, 1.2, and 1.4 µg/m^3, respectively.

3.2.3.3.2 Fitch Middle School (PS 2)

The sample collected at PS 2 during the baselune sampling period included a PM_{10} concentration of 30.6 µg/m^3, and a detection of aluminum at 0.64 µg/m^3. No other target particulate metals were detected.

3.2.3.3.3 Manzanita School (PS 3)

Real time data collected at PS 3 during the baseline sampling period indicate that the highest concentrations of particulate matter were recorded during the 10:00 AM hour (Table 40 figure).

PM_{10} concentrations reported in samples from PS 3 were 27 µg/m^3 in the overnight sample, and non-detected with an elevated reporting limit of 18 µg/m^3 in the daylight sample. Aluminum was detected at a concentration of 3.69 µg/m^3, however no other target metals were detected. Acrolein was not detected, but acetaldehyde and formaldehyde were detected at 1.6 µg/m^3 and 1.8 µg/m^3, respectively. Table 40 presents the analytical results from PS 3.

3.2.3.3.4 MBUAPCD District Office (PS 4)

Detected anayltes in the samples from PS 4 include PM_{10} at 27.8 µg/m^3 and aluminum at 0.61 µg/m^3. No other target metals were detected. The analytical data from PS 4 is presented in Table 42.

3.2.3.3.5 Salinas Rural Fire District Office (PS 5)

Detected analytes in the samples from PS 5 include PM_{10} at 24.9 µg/m^3, and aluminum at 0.86 µg/m^3. No other target metals were detected. The analytical data from PS 5 is presented in Table 42.

3.2.3.3.6 Spreckles School (PS 6)

Particulate matter (PM_{10}) was detected at 48.4 ug/m^3 during the baseline sampling period. Target particulate metals were non-detected, with the exception of aluminum at 1.1 ug/m^3. Table 42 presents the analytical results generated from PS 6.

3.2.3.3.7 Ingham School (PS 7)

Particulate matter (PM_{10}) was detected at 25 ug/m^3 during the baseline sampling period. Target particulate metals were non-detected, with the exception of aluminum at 0.60 ug/m^3. Table 42 presents the analytical results generated from PS 7.

3.2.3.3.8 Gonzales (PS 8)

Particulate matter (PM_{10}) was detected at a concentration of 44 ug/m^3. No target particulate metals were detected, with the exception of aluminum at 1.1 ug/m^3. Table 42 presents the analytical data for PS 8.

3.2.3.3.9 Monterey Aquarium (PS 9)

Particulate matter (PM_{10}) ranged from 31 ug/m^3 during the daylight period of the baseline sampling period to 33 ug/m^3 during the over-night period. Detections of acetaldehyde, formaldehyde, and acrolein were reported at 1.9, 2.6, and 2.9 ug/m^3, respectively, while target particulate metals were non-detected. Table 41 presents the analytical data for PS 9.

4.0 DATA ANALYSIS

This section describes how the validated analytical results summarized in Tables 5 through 42 were used to make comparisons to human health-protective regulatory screening levels presented in Table 2.

Regulatory screening levels for chemicals in ambient air are generally expressed as either acute (on order of 1-hour peak exposures) or long term (on order of annual average exposures). Because public exposure to smoke from prescribed burns at the former Fort Ord would typically be no more than a few days per year, the most appropriate time scale for examining the potential significance of exposure to compounds in the smoke from prescribed burns at the former Fort Ord is as acute exposure. However, for most of the chemicals of interest in this investigation, there are no sampling and analysis methods with detection/reporting limits low enough to collect discrete 1-hour samples for direct comparison to an acute screening level. So a longer sampling interval (generally eight to nine hours) was used to achieve lower reporting limits, and concurrent real-time data were collected for surrogate compounds to provide an indication of how 1-hour concentrations were likely to have varied over the longer sampling interval.

For the majority of analytes with acute screening levels, it was necessary to convert the sampling period (generally eight to nine hours) average to an estimated peak 1-hour average for comparison. This process involved first calculating hourly peak-to-mean ratios from the real-time data collected during this investigation, and then applying those peak-to-mean values to estimate a range of hourly concentrations for each analyte. For those few analytes where acute (1-hour) regulatory screening levels do not exist and only long-term screening levels are available, a direct comparison to the reported analytical results can be made.

4.1 Peak-to-Mean Ratios

Two types of real-time data were collected during this investigation. Total particulate matter (PM) real-time data were collected at eight sites and CO_2 real-time data were collected at four sites. The specific equipment used and the sites where these data were collected were described in Section 2.3.

The data from each of these real-time instruments were used to calculate (1) the mean over the entire sampling period at each site and (2) discrete 1-hour averages for each hour of the sampling period. The ratio of each 1-hour average to the mean for the sampling period was then calculated and tabulated. The results of these calculations are presented by site in Tables 43 through 50.

Using the data in Table 43 as an example, it can be seen that the 1-hour PM concentrations on October 24, 2003 at site BA 1 varied from a low of 11.9 $\mu g/m^3$ to a high of 20,105.0 $\mu g/m^3$; and the mean PM concentration for the sampling period was 3,018.9 $\mu g/m^3$. The ratios of these low and high 1-hour PM concentrations to the mean are 0.00 and 6.66, respectively. Similar data are presented in the table for each day of sampling at site BA 1, and in Tables 44 through 50 for the other seven sites where real-time data were collected. For those sites where both PM and CO_2 real-time data were collected, both sets of ratios are presented.

It can be seen from these tables that where both PM and CO_2 real-time data are available, the PM data consistently show higher peak-to-mean ratios than the CO_2 data. This occurs because normal levels of CO_2 in the atmosphere are high relative to the variation that occurs when smoke from the prescribed burn impacted the site, thus the hourly concentrations do not differ greatly from the mean. For this reason, and to ensure a health-protective assessment, it is the PM peak-to-mean ratios that were used in this investigation to estimate hourly concentrations for the other analytes of interest.

4.2 Comparison of Sampling Results to Regulatory Screening Levels

As described in the previous section, peak-to-mean ratios calculated from real-time PM data were used to estimate the range of (low to high) hourly analyte concentrations for those chemicals with established

acute regulatory screening levels. Real-time data were collected at the mobile station and seven (7) of the fourteen (14) fixed monitoring stations. For those other seven (7) fixed monitoring stations without site-specific real-time data, peak-to-mean ratios were assigned from a monitoring station that recorded a similar mean PM_{10} concentration on the same day. The table below summarizes the source of the peak-to-mean ratios that were assigned to the monitoring stations without real-time data:

Monitoring Station w/o Real-Time Data	Source of Peak-to-Mean Ratios		
	Active Ignition Day	Smolder Day	Baseline Day
PS 2	PS 3	OB 3	PS 1
PS 4	PS 3	OB 2	PS 1
PS 5	PS 3	OB 1	PS 1
PS 6	PS 3	OB 3	PS 1
PS 7	PS 3	OB 1	PS 1
PS 8	PS 1	OB 1	PS 1
PS 9	PS 1	OB 2	PS 1

The analytical results presented in Section 3.2 of this report showed that the vast majority of the analytical data were reported as non-detect. While this demonstrates that these chemicals were not present on average over the sampling interval (typically eight to nine hours) at very low reporting limits, it presents a challenge for the process of using peak-to-mean ratios to estimate the range of discrete hourly concentrations for those non-detect chemicals. For the purpose of this report, the limit of detection for each non-detect sample was applied with the peak-to-mean ratios to estimate the range of discrete hourly concentrations for that chemical at a particular site. It should be emphasized that this approach is likely to provide a gross overestimate of the hourly concentrations for non-detected chemicals. For those few chemicals that were reported above the analytical reporting limits, applying the peak-to-mean ratios provides a reasonable estimate of what the range of discrete hourly concentration are likely to have been for that chemical at a particular site. Also, for those chemicals with only a long-term regulatory screening level for comparison, no adjustment with peak-to-mean ratios was necessary.

The following sections present the results of this investigation in the appropriate time scale for comparison to the regulatory screening level. A graphical representation of PM_{10} concentrations relative to the Air Quality Index (*USEPA, 2003*) is provided on Plate 3.

4.2.1 Active Ignition Phase Sampling Results

The monitoring data collected during the active ignition day (October 24, 2003) are summarized in Table 51 along with the appropriate regulatory screening level for comparison. Several notes regarding the data collected on this day are described below:

- PM_{10} data at all sites except BA 1, BA 2, PS 8, and MS 1 were collected in two intervals: the first interval was approximately 8 hours during the day that included the period of active ignition, and the second interval was the overnight period from the end of the first interval to the following morning (approximately 16 hours). The PM_{10} concentrations reported for all sites except BA 1, BA 2, PS 8, and MS 1 are 24-hour time-weighted-averages calculated from the two intervals.

- The PM_{10} data reported for sites BA 1, BA 2, and MS 1 are the sampling period averages (9 hours for BA 1 and BA 2 and 5 hours for MS 1).

- The PM_{10} data reported for the MBUAPCD-operated site PS 8 (Gonzales) is a 24-hour average collected on a single filter.

- The particulate metals data shown in the table for all sites except BA 1 and BA 2 are from the first interval (daytime) PM_{10} filter sample (for PS 8, the particulate metals data are from the single 24-hour filter sample).

- The particulate metals data shown in Table 51 for BA 1 and BA 2 are from the TSP filter samples.

- The first interval (daytime) PM_{10} filter sample from site OB 2 was invalid due to sampling equipment failure; consequently, there are no particulate metals data reported for that site and a 24-hour PM_{10} concentration could not be calculated.

- The second interval (nighttime) PM_{10} filter sample from site OB 1 was invalid due to sampling equipment failure; the reported PM_{10} concentration is from the first interval only.

For those chemicals with only long-term regulatory screening levels for comparison, the results in Table 51 are the sampling period averages. For those chemicals with acute regulatory screening levels for comparison, the results shown in Table 51 are the sampling period average multiplied by the low and high peak-to-mean ratios for that site. Any analytical result that was reported by the laboratory as non-detect is shown in the table as ND followed by the limit of detection. Where peak-to-mean ratios were applied to a non-detect result, the range of low to high hourly concentrations is preceded by ND.

The yellow highlighted data in Table 51 are the results that exceed the corresponding regulatory screening level for that chemical and were reported above the limit of detection. It should be noted that for some non-detected chemicals, some of the hourly values calculated using the limit of detection are also shown to be above the regulatory screening level. However, these data are not flagged because the original sample was reported as non-detect.

The results of the comparison to regulatory screening levels for the active ignition day are summarized below:

- PM_{10} concentrations were reported above the 24-hour California Ambient Air Quality Standard (CAAQS) at sites BA 1, BA 2, OB 3, and all of the PS sites except PS 1.

- Acetaldehyde concentrations were reported above the regulatory screening level only at sites BA 1 and OB 2.

- Peak hourly formaldehyde concentrations are estimated to be above the screening level only at site BA 1.

- Hourly acrolein concentrations are estimated to be above the screening level at site BA 1, all three OB sites, public sites PS 2, PS 3, PS 5, PS 7, and the mobile station (MS 1).

- All nine of the energetic compounds were reported below the limits of detection at all five sites where those data were collected. Site BA 1, which was heavily impacted by smoke from the prescribed burn, had no detection of energetic compounds.

- Except for sites BA 1 and BA 2, the only particulate metal observed above the limit of detection at any site was aluminum. The estimated peak hourly concentration of aluminum exceeded the regulatory screening level at only one site, PS 2 (Fitch Middle School). Aluminum is a common element found in soil and taken up by plants (*Harding ESE, 2001*), so its elevated presence at PS 2 where smoke impacts were observed is not unexpected.

- At site BA 1, eight particulate metals (aluminum, antimony, barium, copper, lead, manganese, mercury, and zinc) were reported above the limit of detection, and six of those (aluminum, antimony, barium, lead, manganese, and zinc) were shown to have estimated maximum hourly concentrations above the regulatory screening levels. The reported lead concentration of 2.6 $\mu g/m^3$ is higher than the regulatory screening level used for comparison, but it should be noted that the screening level of 1.5 $\mu g/m^3$ is a 30-day average CAAQS whereas the reported value at site BA 1 is over a 9-hour period. Because of the very high particulate concentrations experienced at BA 1, it is not unexpected that these particulate metals, all of which are trace elements in soil and plants, were observed above their limits of detection.

- At site BA 2, three particulate metals (copper, manganese, and zinc) were observed above their limits of detection, but none were estimated to be above the regulatory screening levels.

- Dioxin and furan TEQ (toxicity equivalent) concentrations were either not detected or were below the regulatory screening level at the three sites where those data were collected.

Site BA 1 warrants further discussion. As intended, the location of this site immediately adjacent to the burn area caused it to be heavily impacted by smoke during the sampling interval. PM_{10} and TSP concentrations were very high (2,256 and 2,663 µg/m^3, respectively), indicating substantial impact by smoke from the prescribed burn. Acetaldehyde was reported to be significantly above the screening level (230 µg/m^3 compared to the screening level of 9 µg/m^3). Similarly, the maximum estimated hourly concentrations for formaldehyde (586 µg/m^3) and acrolein (373 µg/m^3) were significantly above the screening levels for those compounds (94 and 0.19 µg/m^3, respectively). Even with this substantial degree of impact by smoke during the prescribed burn, there are no signatures of MEC chemical impacts at this site. All of the energetic compounds were reported below the limits of detection. The few particulate metals detected are those common as trace elements in soil and plant tissue, and their elevated detection would not be unexpected with such high particulate matter from the smoke.

4.2.2 Smolder Phase Sampling Results

The monitoring data collected during the smolder day (October 25, 2003) are summarized in Table 52 along with the appropriate regulatory screening level for comparison. Several notes regarding the data collected on this day are described below:

- PM_{10} data at all MACTEC-operated sites except BA 1 and BA 2 were collected in two intervals: the first interval was approximately 8 hours during the day, and the second interval was the overnight period from the end of the first interval to the following morning (approximately 16 hours). The PM_{10} concentrations reported for sites OB 1, OB 2, OB 3, PS 1, and PS 9 are 24-hour time-weighted-averages (TWAs) calculated from the two intervals.

- The PM_{10} data reported for sites BA 1 and BA 2 are the sampling period averages (approximately 8 hours).

- The PM_{10} data reported for all MBUAPCD-operated sites (PS 2 and PS 4 though PS 8) are 24-hour averages.

- The particulate metals data shown in Table 52 for all sites except BA 1 and BA 2 are from the first interval (daytime) PM_{10} filter sample (for the MBUAPCD-operated sites, the particulate metals data are reported from the 24-hour filter samples).

- The particulate metals data shown in the table for BA 1 and BA 2 are from the TSP filter samples.

For those chemicals with only long-term regulatory screening levels for comparison, the results in Table 52 are the sampling period averages. For those chemicals with acute regulatory screening levels for comparison, the results shown in Table 52 are the sampling period average multiplied by the low and high peak-to-mean ratios for that site. Any analytical result that was reported by the laboratory as non-detect is shown in the table as ND followed by the limit of detection. Where peak-to-mean ratios were applied to a non-detect result, the range of low to high hourly concentrations is preceded by ND.

The yellow highlighted data in Table 52 are the results that exceed the corresponding regulatory screening level for that chemical and were reported above the limit of detection. It should be noted that for some non-detected chemicals, some of the hourly values calculated using the limit of detection are also shown to be above the regulatory screening level. However, these data are not flagged because the original sample was reported as non-detect.

The results of the comparison to regulatory screening levels for the active ignition day are summarized below:

- PM_{10} concentrations were reported above the 24-hour California Ambient Air Quality Standard (CAAQS) at every site except for PS 1 and PS 7. Even those two sites are only slightly below the CAAQS.

- Acetaldehyde concentrations were reported above the regulatory screening level only at sites BA 1 and OB 2.

- Peak hourly formaldehyde concentrations are estimated to be above the screening level only at site BA 2.

- Hourly acrolein concentrations are estimated to be above the screening level at burn area sites BA 1, BA 2, on-base sites OB 2, OB 3, and public sites PS 2, PS 3, PS 5, PS 6, and PS 9.

- All nine of the energetic compounds were reported below the limits of detection at all five sites where those data were collected.

- Except for sites BA 1 and BA 2, the only particulate metal observed above the limit of detection at any site was aluminum. The estimated peak hourly concentration of aluminum did not exceed the regulatory screening level at any of the non-BA sites.

- At site BA 1, five particulate metals (aluminum, barium, copper, manganese, and zinc) were reported above the limit of detection, and only one of those (manganese) was shown to have estimated maximum hourly concentrations above the regulatory screening level. Because of the high particulate concentrations experienced at BA 1, it is not unexpected that these particulate metals, all of which are trace elements in soil and plants, were observed above their limits of detection.

- Site BA 2 exhibits a very similar particulate metal profile as BA 1, indicative of similar smoke impacts on that day.

- Dioxin and furan TEQ (toxicity equivalent) concentrations were below the regulatory screening level at the two sites (BA 1 and BA 2) where those data were collected.

Compared to the active ignition day, PM_{10} concentrations on the smolder day were generally not as high at the most-impacted sites but were elevated above the CAAQS over a much wider area. Acrolein

concentrations were similar in magnitude at all of the non-BA sites during the smolder day except for PS 9, the Monterey Aquarium site. This site recorded the highest acrolein concentration of any site on this day by a wide margin. The laboratory re-verified this analytical result, but the value was still inconsistent with the low recorded concentrations of acetaldehyde and formaldehyde previously measured at the Monterey Aquarium.

Sites BA 1, BA 2, and OB 3 experienced the highest PM_{10} impacts on the smolder day, but none of these sites exhibited MEC chemical signatures. All of the energetic compounds were reported below the limits of detection. The few particulate metals detected were those common as trace elements in soil and plant tissue, and their elevated detection would not be unexpected with such high particulate matter from the smoke.

4.2.3 Baseline Sampling Results

The monitoring data baseline samples are summarized in Table 53 along with the appropriate regulatory screening level for comparison. Several notes regarding the baseline data are described below:

- Baseline data for energetic compounds were collected during an aborted burn mobilization on November 18, 2002. By regulatory agency agreement, these data were considered valid for energetic compound baseline determination for this investigation.

- Baseline data for all MBUAPCD-operated sites (PS 2 and PS 4 though PS 8) were collected on October 23, 2003, the day before the prescribed burn.

- Baseline data for all MACTEC-operated sites were collected on November 12, 2003, several weeks after the prescribed burn.

- PM_{10} data at all MACTEC-operated sites except BA 1 and BA 2 were collected in two intervals: the first interval was approximately 8 hours during the day, and the second interval was the overnight period from the end of the first interval to the following morning (approximately 16 hours). The

PM_{10} concentrations reported for sites OB 1, OB 2, OB 3, PS 1, and PS 9 are 24-hour time-weighted-averages (TWAs) calculated from the two intervals.

- The PM_{10} data reported for sites BA 1 and BA 2 are the sampling period averages (approximately 8 hours).
- The PM_{10} data reported for all MBUAPCD-operated sites (PS 2 and PS 4 though PS 8) are 24-hour averages.
- The particulate metals data shown in Table 53 for all sites except BA 1 and BA 2 are from the first interval (daytime) PM_{10} filter sample (for the MBUAPCD-operated sites, the particulate metals data are reported from the 24-hour filter samples).
- The particulate metals data shown in the table for BA 1 and BA 2 are from the TSP filter samples.

For those chemicals with only long-term regulatory screening levels for comparison, the results in Table 53 are the sampling period averages. For those chemicals with acute regulatory screening levels for comparison, the results shown in Table 53 are the sampling period average multiplied by the low and high peak-to-mean ratios for that site. Any analytical result that was reported by the laboratory as non-detect is shown in the table as ND followed by the limit of detection. Where peak-to-mean ratios were applied to a non-detect result, the range of low to high hourly concentrations is preceded by ND.

The yellow highlighted data in Table 53 are the results that exceed the corresponding regulatory screening level for that chemical and were reported above the limit of detection. It should be noted that for some non-detected chemicals, some of the hourly values calculated using the limit of detection are also shown to be above the regulatory screening levels. However, these data are not flagged because the original sample was reported as non-detect.

The results of the comparison to regulatory screening levels for the baseline data are summarized below:

- No PM_{10} concentrations were reported above the 24-hour California Ambient Air Quality Standard (CAAQS).
- No acetaldehyde concentrations were reported above the regulatory screening level.
- Peak hourly formaldehyde concentrations are all estimated to be below the screening level.
- Hourly acrolein concentrations are estimated to be above the screening level at site BA 2, OB 1, OB 2, and public sites PS 1, and PS 9.
- All of the energetic compounds were reported below the limits of detection at all five sites where those data were collected.
- Except for sites BA 1 and BA 2, the only particulate metal observed above the limit of detection at any site was aluminum. The estimated peak hourly concentration of aluminum exceeded the regulatory screening level only at site PS 3 (Manzanita Elementary School).
- At site BA 1, copper was reported above the limit of detection, but is shown to have an estimated maximum hourly concentration below the regulatory screening level.
- Site BA 2 exhibits a similar particulate metal profile as BA 1, except that zinc was also reported above the limit of detection (but below the screening level).
- Dioxin and Furan TEQ (toxicity equivalent) concentrations were below the regulatory screening levels at the two sites (BA 1 and BA 2) where those data were collected.

Compared to the active ignition and smolder days, PM_{10} concentrations on the baseline days were much lower over the entire study area. Acetaldehyde, formaldehyde, energetic compounds, particulate metals (except for aluminum at site PS 3), and dioxin/furan TEQ were all either non-detect or well below the regulatory screening levels. Interestingly, estimated hourly acrolein concentrations were measurably

above the regulatory screening level at several sites. The presence of acrolein has been identified in sources as ubiquitous as gasoline and diesel exhaust (*NLM, 2004*); therefore, a further investigation into such sources of acrolein or the appropriateness of the screening level may be warranted.

5.0 SUMMARY OF DATA QUALITY ASSESSMENT

This section presents a summary of data validation procedures and results, quality control inspections conducted, and data quality objectives of the Prescribed Burn Air Monitoring Program.

5.1 Data Validation

This section summarizes the data validation results for the air sampling conducted.

5.1.1 Summary of Data Validation Results

Data validation was performed by MACTEC's subcontractor Data Val, Inc on analytical results generated by MACTEC from the Prescribed Burn monitoring program. USEPA Level III and Level IV validation was performed on the data reported from the following laboratories: Frontier Analytical, El Dorado Hills, California (USEPA Test Method TO-9A, Dioxins and Furans), Data Chem Laboratories, Cincinnati, Ohio (Particulate Matter [PM_{10} and TSP], USEPA Test Method 12, NIOSH 6009 and NIOSH 7300, Particulate Metals, and USEPA Test Method TO-11A, Aldehydes), and Air Toxics, Ltd, Folsom California (USEPA Test Method TO-14A, Acrolein). Data validation was not performed by MACTEC on analytical results reported from the USACHPPM Laboratory (energetic compounds) or the MBUAPCD Laboratory (PM_{10} data from PS 2 and PS 4 through PS 8).

Data validation of USEPA Levels III and IV laboratory data packages was performed according to the following guidelines: the *U.S. Environmental Protection Agency Analytical Operations/Data Quality Center National Functional Guidelines for Chlorinated Dioxin/Furan Data Review*, August 2002; *U.S. Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Organic Data Review*, October 1999; and the *U.S. Environmental Protection Agency Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, July 2002. Protocols for the analysis methods provided additional guidance during the data validation effort.

USEPA Level III data validation included a review of all data for compliance with analytical holding times, Gas Chromatography/Mass Spectrometry tunes, initial calibrations, continuing calibration verification standards, internal standard and Inductively Coupled Plasma interference check standard acceptance criteria. The data were also reviewed for compliance with accuracy limits for surrogate recoveries, laboratory control samples, matrix spikes, and matrix spike duplicate recoveries. Matrix spike duplicate samples and co-located field samples were evaluated to assess compliance with precision requirements. Laboratory method blank and field blank results were reviewed for evidence of contamination and potential impacts on the project sample results. As described in the Final Prescribed Burn Air SAP, a minimum of 10% of the analytical data was evaluated under USEPA Level IV data validation criteria, which includes a review of all raw data and an evaluation of compound identification and quantitation (*MACTEC, 2003*). USEPA Level IV validation was performed on the data at the following frequency: Dioxins and Furans – 23%; Acrolein – 19%; Aldehydes – 19%; Particulate Matter (PM_{10} and TSP); and Metals – 10%.

The following section presents a summary of the data validation findings. The complete data validation report is presented as Appendix D.

5.1.1.1 Analytical Holding Times

Technical holding time criteria were met for the analyses performed on the project samples.

5.1.1.2 Initial and Continuing Calibration Standards

Acceptance criteria were met for the initial and continuing calibration standards for target compounds in all analyses.

5.1.1.3 Surrogate Recoveries

Surrogate recoveries were within acceptance limits for all applicable analyses with the exception of the following:

USEPA Test Method TO-14A (Acrolein): The percent recovery for surrogate 4-bromofluorobenzene was outside the 70% – 130% project acceptance criteria in sample PS1P25315 at 131%. Acrolein was non-detect in this sample, and qualification was not required.

5.1.1.4 Laboratory Control Samples

Spike recoveries for target analytes were within acceptance limits for all applicable analyses.

5.1.1.5 Matrix Spike and Matrix Spike Duplicate Samples

Matrix spike and matrix spike duplicate analyses were performed for particulate metals analyses only. Acceptance criteria were met for the matrix spike and matrix spike duplicates associated with project samples.

5.1.1.6 Field and Laboratory Blanks

Target compounds were not observed in field or laboratory blanks associated with the project samples with the exception of the following:

USEPA Test Method 12 (Particulate Metals): The laboratory method blank associated with field samples BA2PQ0116287, BA2PQ0116283, BA1PQ0116278, and BA2PQ0116285 had a reported detection of aluminum at 350 ug/filter. Each of these field samples had a reported detection of aluminum at a concentration less than five times the amount detected in the method blank. The reported values for aluminum in these field samples were qualified as non-detected as a result of the laboratory method blank contamination.

5.1.1.7 Compound Identification and Quantitation

For samples subject to USEPA Level IV data validation, the sample results were re-calculated and a review was performed of target compound identification. The level IV review indicated that all reported target compounds were correctly identified and quantitated by the laboratories.

5.1.1.8 Co-Located Field Samples

One co-located sample was collected for each analysis during each of the three air sampling/monitoring days. Co-located samples were collected to evaluate both field and analytical precision. As described in the Final Prescribed Burn Air SAP, the following co-located samples were collected at the following monitoring stations (*MACTEC, 2003*):

Site Number	Site Name	Co-located Analyses
BA 1	Range 46	Energetics TSP Particulate Metals
BA 2	Range 43	PM_{10} (Hi Vol) Particulate Metals Dioxins and Furans
OB 1	Fitch Park	Aldehydes Acrolein
OB 3	MWD Injection Well	PM_{10} (Mini Vol) Particulate Metals

The duplicate precision of each of the co-located samples was evaluated by calculating the relative percent difference (RPD) between the detected results in the primary sample and its associated co-located sample. A standard control limit for field duplicate samples of 50% RPD was used for the evaluation. All co-located samples met the 50% RPD control limit with the exception of the following:

USEPA Test Method TO-9A: The RPD between the dioxin/furan TEQ values was greater than the 50% control limit at 200% in the co-located sample pair BA2PPUFF5 (2301-002-SA) and BA2CPUFF7 (2301-003-SA). A review of the laboratory orders data and field notes did not indicate a potential source for the RPD exceedances.

USEPA Test Method 12: The RPD was greater than the 50% control limit in co-located sample pair BA1PQ0142653 (03-33621) and BA1CQ0116295 (03-33622) for copper (70%) and zinc (200%). Review of the sample results within the sample delivery group showed a possible sample mix-up as the cause of the RPD failures.

Since the source and effect of imprecision in co-located sample results on the quality of the data is not known, it is not included in EPA Level 3 or Level 4 review and is not qualified for co-located field duplicate failure. Table D3 presents the co-located sample results.

5.1.1.9 Overall Data Usability

Based upon the findings of the USEPA Level III and Level IV data validation, the data are considered valid and useable as reported by the laboratories, with the exception of the four results that were qualified as non-detect as described in Section 5.1.1.6.

5.2 Quality Control Inspections

This section discusses the quality control (QC) process performed for the project. The QC process is described in detail in the project Chemical Data Quality Management Plan (CDQMP) (*HLA, 1997*). In general, the QC process is comprised of a preparatory phase, initial phase, follow-up phase, and completion/acceptance inspection; compliance to these processes is summarized below.

The preparatory phase of the program consisted of: technical review of the project requirements by team members (e.g., the Work Plan, SAP, and Health and Safety Plan); confirming that all clearance, permits, and site access issues were addressed (by the Army); confirming that all equipment was in place and in working order; and completion of appropriate project kick-off meetings with subcontractors. Kick-off meetings were completed with the analytical laboratories prior to the start of the field program and are documented under separate cover.

The initial phase was performed at the beginning and during the early stages of the field program implementation. The process included: confirmation that the initial phase was completed correctly, a review of the execution of the field activities and compliance with the project plans, and review of field documentation for adequacy (e.g., daily logs, chains of custody, sampling forms, and checklists).

The follow-up phase was performed from the early stages to the completion of the field program. This phase focused on continued compliance to appropriate plans and identification and correction of unsatisfactory/nonconforming conditions.

A completion/acceptance inspection will be performed prior to the project close-out to verify that project requirements relevant to the to the field program were satisfied. This phase will also include identification and correction of unsatisfactory/nonconforming conditions. Client acceptance of the work performed will be confirmed before project close-out.

5.3 Data Quality Objectives

The following section discusses the elements the Prescribed Burn Air Sampling Program relative to the data quality objectives (DQOs) identified in the Final Prescribed Burn Air SAP (*MACTEC, 2003*).

5.3.1 Statement of the Problem

The problem identified in the Final Prescribed Burn Air SAP (*MACTEC, 2003*) was that, prior to the completion of air monitoring performed for this study, the identity and quantity of products and residues emitted to the air from prescribed burn activities at the former Fort Ord could only be estimated from previous studies. Fort Ord-specific measurements of air pollutant concentrations from previous studies were not adequate for the objectives of this program.

5.3.2 Identification of Decisions

The primary decisions related to this project are to (1) evaluate whether prescribed burns at the former Fort Ord result in downwind ambient concentrations of MEC-related air pollutants that exceed human health-based screening levels, and (2) evaluate the adequacy of the burn prescription relative to smoke dispersion and downwind impacts to the public.

5.3.3 Identification of Inputs to Decisions

Inputs to decisions necessary for evaluating prescribed burn activities at former Fort Ord such as the identification of a target list and appropriate screening levels for COPCs in air were completed in the Final Prescribed Burn Air SAP (*MACTEC, 2003*). Identification of appropriate criteria for modifying burn tactics based upon real-time data collected during the burn was coordinated between the burn contractor and the regulatory agencies. Other inputs were implemented during the completion of the burn, such as measurement of COPCs in air, and instrument-based and visual field observations. The assessment of baseline concentrations was performed upon completion of the Air Sampling Program and is discussed in Section 3.0.

5.3.4 Definition of Study Boundaries

The study boundary is defined as the area downwind of the prescribed burn event that received smoke impacts. Air samples were collected to address baseline conditions, and conditions on the day of and the day after (smolder phase) the prescribed burn event. A discussion of results relative to smoke impacts and conclusions are presented in Section 6.0.

5.3.5 Development of Decision Rules

Decision rules developed for the Prescribed Burn Program applied to the completed burn event and applies to future events. Rules applying to alteration of burn tactics during the prescribed burn were addressed jointly by the Army's burn contractor and the regulatory agencies. Other decision rules affecting modifications to future prescribed burn operations and the need for a human health risk assessment will be addressed in the future.

5.3.6 Specification of Limits on Decision Errors

The specification of limits on decision errors discussed in the Final Prescribed Burn Air SAP (*MACTEC, 2003*) focused on potential outcomes of selected decisions regarding modifications to future

prescribed burns. Decisions regarding future prescribed burns are currently being developed and will be identified at a later date.

5.3.7 Optimization of Investigation Design for Obtaining Data

The investigation performed for the prescribed burn was implemented according to criteria described in the Final Prescribed Burn Air SAP (*MACTEC, 2003*) to optimize the data collection effort. Because the downwind COPC concentration distribution was nonrandom within the study area, a judgmental sampling design was implemented.

The rationale supporting the investigation design focused on the following objectives:

- Obtain samples that confirm the presence or absence of MEC-related COPCs
- Obtain samples that characterize the maximum vegetation-related COPC concentrations in air near the prescribed burn event and in downwind populated areas
- Collect real-time data for selected vegetation-related combustion products to document the temporal variation of smoke impact at selected sampling locations.

Another element of the optimization process was to consider and respond to, if necessary, the possibility that the location of the highest concentrations of COPCs in air may vary during the event as meteorological conditions evolve throughout the day. This issue was addressed by dispatching the mobile sampling station MS 1 to an area identified as receiving smoke impacts after the prescribed burn was underway.

6.0 CONCLUSIONS

The primary objectives of this investigation were to (1) confirm or refine conclusions drawn from other studies that ground-level concentrations of MEC-related air pollutants downwind of the prescribed burn will be below human health-protective regulatory screening levels, and (2) provide data to assess the adequacy of the of the burn prescription relative to smoke dispersion and downwind impacts.

With regard to the first objective, it is the conclusion of this investigation that MEC-related chemical signatures were not observed at any site during the prescribed burn (both active ignition and smolder phases). The design of the study was successful in placing at least one sampling station in a location that was heavily impacted by smoke during the active ignition phase of the burn. The data collected at the most heavily impacted site, BA 1, were below the limits of detection and the applicable regulatory screening levels for all MEC-related chemicals. Elevated concentrations of a few particulate metals were observed at site BA 1, but all are common to native soil and plant tissue and their presence would be expected in smoke from vegetation burning where no MEC is present (*Harding ESE, 2001*). Sampling results from all on-base and public monitoring sites were all below the limits of detection and the applicable regulatory screening levels for all MEC-related chemicals.

With regard to the second objective, the data from this investigation need to be considered along with visual observations and photographic records from the burn to assess the adequacy of the burn prescription. This evaluation is complicated by the unplanned size and duration of the burn as it extended beyond the original perimeter. The data from this investigation show that PM_{10} concentrations (the best overall measure of smoke impacts) on the active ignition day were significantly above the 24-hour CAAQS 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. Aldehyde and

acrolein concentrations, other measures of smoke impact, were also elevated above screening levels on both the active ignition and smolder days at several sites.

It is worth noting that acrolein concentrations were recorded above the regulatory screening level at five sites even on the baseline sampling day. Further investigation of possible ubiquitous sources of acrolein or the appropriateness of the screening level may be warranted.

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Ranges 43–48 Prescribed Burn
Air Monitoring Report
Former Fort Ord, California

March 19, 2004

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TABLES

Table 1. Target Analytes for Investigation of
Air Pollutant Emissions from Prescribed Burns
Ranges 43–48 Prescribed Burn
Air Monitoring Program
Former Fort Ord, California

Analyte Class	Analyte	Rationale
Vegetation-Related Combustion Compounds		
Gaseous Species	Carbon Dioxide (CO_2)	CO_2 is the combustion species produced in the greatest amounts from vegetation burning. CO_2 data will indicate the presence or absence of smoke impacts at the sampling locations.
Particulate Matter	Particulate Matter less than 10 microns (PM_{10})	PM_{10} may also be produced in large amounts from vegetation burning. PM_{10} data will provide a relative indication of smoke impact at the sampling locations.
Aldehydes	Formaldehyde, Acetaldehyde, Acrolein, and Total Aldehydes	Aldehydes are commonly associated with acute eye and respiratory system irritation in smoke-impacted areas.
MEC-Related Combustion Species		
Energetic Analytes	HMX Nitrobenzene RDX PETN 1,3 Dinitrobenzene 1,3,5 Trinitrobenzene 2,4 Dinitrotoluene 2,4,6 Trinitrotoluene 2,6 Dinitrotoluene	Energetic materials and their likely breakdown products are not produced by vegetation burning. Consequently, if present in the smoke plume, their concentrations can be directly attributed to MEC emissions.
Particulate Metals	Aluminum Antimony Barium Beryllium Cadmium Chromium (total) Cobalt Copper Lead Manganese Mercury Molybdenum Nickel Zinc	Particulate metals may be produced both from MEC detonation and from vegetation burning, so their presence in smoke is not necessarily a positive signature of emissions from MEC. Measurement of particulate metals is included here nonetheless because of the uncertainty in the metal emission factors for MEC. The presence of any metal above its regulatory screening level will require further investigation to assess the possible contribution from MEC.
Dioxins and Furans	Total Dioxin and Furan Toxicity Equivalent (TEQ)	Dioxins and furans may be produced both from MEC detonation and from vegetation burning, so their presence in smoke is not necessarily a positive signature of emissions from MEC. Measurement of dioxins and furans is included here nonetheless because of the uncertainty in the emission factors for MEC. The presence of dioxins and furans above a regulatory screening level will require further investigation to assess the possible contribution from MEC.

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Table 2. Regulatory Screening Levels
Prescribed Burn Air Monitoring Report
Former Fort Ord, California

Analyte Class	Analyte	Air Screening Level (µg/m³)		Screening Level Reference
Vegetation-Related Combustion Compounds				
Gaseous Species	Carbon Dioxide (CO_2)	N/A		N/A
Particulate Matter	Particulate Matter less than 10 microns (PM_{10})	50	(24-hour)	California AAQS [1]
Aldehydes	Formaldehyde	94	(1-hour)	OEHHA Acute REL [2]
	Acetaldehyde	9	(long term)	OEHHA Chronic REL [3]
	Acrolein	0.19	(1-hour)	OEHHA Acute REL
OE-Related Combustion Species				
Energetic Analytes	HMX	180	(long term)	EPA Region 9 PRG [4]
	Nitrobenzene	2.10	(1-hour)	EPA Region 9 PRG
	RDX	3.57	(1-hour)	MBUAPCD Rule 1000 [5]
	PETN	1.19	(1-hour) [6]	MBUAPCD Rule 1000
	1,3 Dinitrobenzene	0.37	(1-hour)	EPA Region 9 PRG
	1,3,5 Trinitrobenzene	110	(long term)	EPA Region 9 PRG
	2,4 Dinitrotoluene	7.30	(1-hour)	EPA Region 9 PRG
	2,4,6 Trinitrotoluene	1.19	(1-hour)	MBUAPCD Rule 1000
	2,6 Dinitrotoluene	3.70	(1-hour)	EPA Region PRG
Particulate Metals	Aluminum	23.8	(1-hour)	MBUAPCD Rule 1000
	Antimony	1.19	(1-hour)	MBUAPCD Rule 1000
	Barium	1.19	(1-hour)	MBUAPCD Rule 1000
	Beryllium	0.0047	(1-hour)	MBUAPCD Rule 1000
	Cadmium	0.0119	(1-hour)	MBUAPCD Rule 1000
	Chromium (total)	1.19	(1-hour)	MBUAPCD Rule 1000
	Cobalt	0.047	(1-hour)	MBUAPCD Rule 1000
	Copper	100	(1-hour)	OEHHA Acute REL
	Lead	1.5	(3-month)	California AAQS
	Manganese	0.47	(1-hour)	MBUAPCD Rule 1000
	Mercury	1.8	(1-hour)	OEHHA Acute REL
	Molybdenum	23.8	(1-hour)	MBUAPCD Rule 1000
	Nickel	6	(1-hour)	OEHHA Acute REL
	Zinc	11.9	(1-hour)	MBUAPCD Rule 1000
Dioxins and Furans	Total Dioxin and Furan Toxicity Equivalent (TEQ)	4.0E-05	(long term)	OEHHA Chronic REL

[1] California Ambient Air Quality Standard

[2] Office of Environmental Health Hazard Assessment Acute Reference Exposure Levels (http://www.oehha.ca.gov/air/acute_rels/allAcRELs.html)

[3] Office of Environmental Health Hazard Assessment Chronic Reference Exposure Levels (http://www.oehha.ca.gov/air/chronis_rels/allChRELs.html)

[4] U.S. Environmental Protection Agency, Region 9, Preliminary Remediation Goals

[5] Monterey Bay Unified Air Pollution Control District Rule 1000 (screening values shown are 1/420th of the OSHA Permissible Exposure Limit)

[6] A chemical-specific screening level does not exist for PETN, so the most restrictive acute screening level from the other energetic compounds (TNT) was used.

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Table 4. Summary of Sampling Locations, Equipment, and Objectives
Ranges 43–48 Prescribed Burn
Air Monitoring Program
Former Fort Ord, California

Pollutant	Sampling Equipment	BA 1	BA 2	OB 1	OB 2	OB 3	PS 1	PS 2	PS 3	PS 4	PS 5	PS 6	PS 7	PS 8	PS 9	MS 1
Energetic Compounds	High Volume PUF Sampler equipped with quartz fiber particulate filter and XAD-2 resin packed cartridge (GMW PS 1 Sampler)	✓ (1)	✓	✓	✓	✓										✓
Particulate Metals	High Volume TSP Sampler equipped with quartz fiber filter (GMW 2000H Sampler)	✓ (1)	✓													
	Low Volume PM_{10} Sampler with Size-Selective Inlet equipped with Teflon filter (Airmetrics MiniVol)			✓	✓	✓	✓	✓ (2)	✓	✓ (2)	✓ (2)	✓ (2)	✓ (2)	✓ (2)	✓	✓
	High Volume Sampler with Size-Selective Inlet equipped with quartz fiber filter (Anderson GUV-16H Sampler)	✓	✓													
Particulate Matter < 10 microns (PM_{10})	High Volume Sampler with Size-Selective Inlet equipped with quartz fiber filter (Anderson GUV-16H Sampler)	✓	✓ (1)													
	Low Volume Sampler with Size-Selective Inlet equipped with Teflon filter (Airmetrics MiniVol)			✓	✓	✓ (1)	✓	✓ (2)	✓	✓ (2)	✓ (2)	✓ (2)	✓ (2)	✓ (2)	✓	✓
	Real-Time Aerosol Monitor with Size-Selective Inlet (MIE DataRAM 1000)	✓	✓	✓	✓	✓	✓		✓							✓
Carbon Dioxide (CO_2)	Real-Time Monitor (Solomat Surveyor Pro)			✓	✓	✓										✓
Aldehydes	Low Volume Sample Pump with DNPH-impregnated Sorbent Tube (Sensidyne Gilian AirCon 2)	✓	✓	✓ (1)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓

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Table 4. Summary of Sampling Locations, Equipment, and Objectives
Ranges 43-48 Prescribed Burn
Air Monitoring Program
Former Fort Ord, California

Pollutant	Sampling Equipment	BA 1	BA 2	OB 1	OB 2	OB 3	PS 1	PS 2	PS 3	PS 4	PS 5	PS 6	PS 7	PS 8	PS 9	MS 1
Acrolein	SUMMA Canisters with 10-hour mass flow controller	✓	✓	✓ (1)	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Dioxins/Furans	High Volume PUF Sampler equipped with quartz fiber particulate filter and PUF packed cartridge (GMW PS 1 Sampler)	✓	✓ (1)													✓

Sampling Objectives

The Burn Area (BA) stations will be co-located with the existing meteorological monitoring stations operated by Fire Stop at Ranges 43 and 46. The objective is to collect samples in an area that receives substantial smoke impact as close to the burn polygon as possible.

The On-Base (OB) stations will be located in areas near the burn polygon where smoke impacts may be observed. The objective is to collect samples from the smoke as it begins to disperse downwind.

The Public Stations (PS) will be located in the communities surrounding former Fort Ord. The objective is to characterize selected constituents of smoke in areas where public exposure may occur.

The Mobile Station (MS) will be deployed on the day of the prescribed burn after the smoke dispersion pattern is observed. The objective is to locate the MS in an area of observed smoke impact, either on-base or in a public area, that may not be adequately characterized by the fixed stations described above.

Notes:

(1) Collocated samplers at this site.
(2) Equipment operated by MBUAPCD.

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Table 3. Summary of Sampling and Analytical Methods
Ranges 43–48 Prescribed Burn
Air Monitoring Program
Former Fort Ord, California

Pollutant	Sampling Equipment	Sampling Method	Analytical Method	Quality Assurance / Quality Control		
				Field Duplicates	Field Blanks	Lab QA/QC
Energetic Compounds	High Volume PUF Sampler equipped with quartz fiber particulate filter and XAD-2 resin packed cartridge (GMW PS 1 Sampler)	USEPA Compendium Method TO-13A	USACHPPM Laboratory SOP CAD 26-2 and SOP CAD 26.3	One per day of sampling	10%	See Note 1.
Particulate Metals	High Volume TSP Sampler equipped with quartz fiber filter (GMW 2000H Sampler)	USEPA Compendium Method IO-2.1, modified for less than 24 hour sampling	40 CFR, Part 60, Appendix A, Method 12	One per day of sampling	10%	See Note 1.
	Low Volume PM_{10} Sampler with Size-Selective Inlet equipped with Teflon filter (Airmetrics MiniVol)	USEPA Compendium Method IO-2.1, modified for low volume and less than 24 hour sampling	NIOSH 7300 and NIOSH 6009	One per day of sampling	10%	See Note 1.
	High Volume Sampler with Size-Selective Inlet equipped PM_{10} with quartz fiber filter (Anderson GUV-16H Sampler)	USEPA Compendium Method IO-2.1, modified for less than 24 hour sampling	USEPA Compendium Method IO-3.4 (ICP)	One per day of sampling	10%	See Note 1.
Particulate Matter < 10 microns (PM_{10})	High Volume Sampler with Size-Selective Inlet equipped with quartz fiber filter (Anderson GUV-16H Sampler)	USEPA Compendium Method IO-2.1, modified for less than 24 hour sampling	USEPA Compendium Method IO-3.1	One per day of sampling	10%	See Note 1.
	Low Volume Sampler with Size-Selective Inlet equipped with Teflon filter (Airmetrics MiniVol)	USEPA Compendium Method IO-2.1, modified for low volume and less than 24 hour sampling	USEPA Compendium Method IO-3.1	One per day of sampling	10%	See Note 1.
	Real-Time Aerosol Monitor with Size-Selective Inlet (MIE DataRAM 1000)	Harding ESE, Inc. Standard Operating Procedure HESE SOP-101	N/A	N/A	N/A	N/A
Carbon Dioxide (CO_2)	Real-Time Monitor (TSI Q-Trak 8552)	TSI Operations Manual	N/A	N/A	N/A	N/A

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Table 3. Summary of Sampling and Analytical Methods
Ranges 43-48 Prescribed Burn
Air Monitoring Program
Former Fort Ord, California

Pollutant	Sampling Equipment	Sampling Method	Analytical Method	Quality Assurance / Quality Control		
				Field Duplicates	Field Blanks	Lab QA/QC
Aldehydes	Low Volume Sample Pump with DNPH-impregnated Sorbent Tube (SKC PCXR4 Pump)	USEPA Compendium Method TO-11A	USEPA Compendium Method TO-11A	One per day of sampling	10%	See Note 1.
Acrolein	SUMMA Canisters with 10-hour mass flow controller	USEPA Compendium Method TO-14	USEPA Compendium Method TO-14 with GC/MS Full Scan	One per day of sampling	10%	See Note 1.
Dioxins/Furans	High Volume PUF Sampler equipped with quartz fiber particulate filter and PUF packed cartridge (GMW PS 1 Sampler)	USEPA Compendium Method TO-9A	USEPA Compendium Method TO-9A	One per day of sampling	10%	See Note 1.

N/A Not applicable

Note 1: Laboratory Quality Assurance/Quality Control (QA/QC) samples, at a minimum, will be performed at the frequency specified in the analytical method. Analytical parameters such as initial calibrations and instrument conditions will be in compliance with the acceptance criteria as specified in the analytical method.

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PLATES

APPENDIX A

DATA CONVERSION SHEETS

APPENDIX B

FIELD SAMPLING FORMS

APPENDIX B

FIELD SAMPLING FORMS

Active Ignition Phase
and
Smolder Phase

APPENDIX B

FIELD SAMPLING FORMS

Baseline

APPENDIX C

FIELD SAMPLING NOTES

APPENDIX C

FIELD SAMPLING NOTES

Active Ignition Phase
and
Smolder Phase

APPENDIX C

FIELD SAMPLING NOTES

Baseline

APPENDIX D

DATA VALIDATION REPORT

(MACTEC DATA)

APPENDIX E

USACHPPM REPORTS

APPENDIX F

MBUAPCD REPORT