

Final Track 2
Munitions Response
Remedial Investigation/Feasibility Study
Parker Flats Munitions Response Area,
Former Fort Ord, California

Prepared for

Department of the Army
Corps of Engineers
Sacramento District
1325 J Street
Sacramento, California 95814-2922

MACTEC Project No. 56286-070309

August 31, 2006



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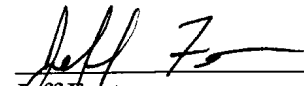
Volume 1 of 3

Remedial Investigation


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This document was prepared by MACTEC Engineering and Consulting, Inc. (MACTEC), at the direction of Parsons Infrastructure and Technology Group on behalf of the U.S. Army Corps of Engineers (USACE) – Sacramento District, for the sole use of the USACE, the only intended beneficiaries of this work. No other party should rely on the information contained herein without the prior written consent of the USACE. This report and the interpretations, conclusions, and recommendations contained within are based in part on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

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DISTRIBUTION

ACRONYM LIST

A

AAR	after action reports
ADL	Arthur D. Little, Inc.
AIC	AIC/Diagnostic Environmental/Inc.
AP	Antipersonnel
AR	Army Regulation
ARARs	Applicable or Relevant and Appropriate Requirements
Army	U.S. Army
ARTY	Artillery
ASP	Ammo Supply Point
ASR	Archive Search Report
AT	Antitank

B

BA	Bivouac Area
BAC	Bayonet Assault Course
BDE	Brigade
bgs	below ground surface
BIV/Biv	Bivouac
BLM	Bureau of Land Management
BRA	Fort Ord Basewide Range Assessment For Small Arms and Multi-Use Ranges
BRAC	Base Realignment and Closure
BTA	Bayonet Training Area

C

CAIS	Chemical Agent Identification Sets
Cal/EPA	California Environmental Protection Agency
CBR	Chemical, Biological and Radiological
CDFG	California Department of Fish and Game
CEHNC	U.S. Army Engineering and Support Center, Huntsville
CEHND	Army Corps of Engineers Huntsville Division
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CMS	CMS Environmental, Inc.
CN	w-Chloroacetophenone
CNCC	California Natural Coordinating Council
CONFID CSE	Confidence Course
CS	O-Chlorobenzylidenemalononitrile
CSM	Conceptual Site Model
CSUMB	California State University Monterey Bay
ctg	Cartridge

D

DA	Department of the Army
DDESB	Department of Defense Explosives Safety Board
D/Div	Division

Final

DMM	Discarded Military Munitions
DoD	Department of Defense
DOI	Department of Interior
DQO	Data Quality Objectives
DRMO	Defense Reutilization and Marketing Office
DRO	Del Rey Oaks
DTSC	California Department of Toxic Substances Control

E

E&D	Engineering and Demolitions
EC	Engineering Control
EE/CA	Engineering Evaluation/Cost Analysis
EFMB	Expert Field Medical Badge
ENGR/Engr	Engineer
EOD	Explosive Ordnance Disposal
EPW	Evaluation of Previous Work
ESA	Endangered Species Act
EVAC	Evacuation
EVOC	Emergency Vehicle Operation Center

F

F	Fahrenheit
FA	Field Artillery
FAAF	Fritzsche Army Airfield
FBTA	Field Battalion Training Area
FF	Field fortification
FFA	Federal facilities agreement
FM	Field Manual
FORA	Fort Ord Reuse Authority
FS	Feasibility Study
FTS	Field Test Site

G

GDA	Guard Duty Area, Gun Defended Area
GIS	Geographical Information System
GPS	Global Positioning System
GTC	Geotechnical Consultants, Inc.

H

Harding ESE	formerly known as Harding Lawson Associates (HLA)
HC	hexachlorethane
HCRS	Heritage Conservation and Recreation Service
HE	High Explosive
HEAT	High Explosive Antitank
HFA	Human Factors Applications, Inc.
HHCA	Hand-to-Hand Combat Area
HLA	Harding Lawson Associates
HMP	Habitat Management Plan
HTW	Hazardous and Toxic Waste

I

IC Institutional Control
 IT IT Corporation
 ITT Individual Tactical Training

K

KO Contracting Officer

L

LAW light antitank weapon
 lbs pounds
 LDSP Land Disposal Site Plan
 LE Low Explosive
 LUC Land Use Controls

M

MACTEC MACTEC Engineering and Consulting, Inc. (formerly Harding ESE)
 MC Munitions Constituents
 MCPD Monterey County Planning Department
 MCX Mandatory Center of Expertise
 MD Munitions Debris
 MEC Munitions and Explosives of Concern
 MILES Multiple Integrated Laser Engagement System
 mm Military Munitions
 MMRP Military Munitions Response Program
 MP Mortar Position
 MR Munitions Response
 MRA Munitions Response Area
 MRS Munitions Response Site
 MSL mean sea level
 MST Monterey Salinas Transit
 MTR/MORT Mortar

N

NAV Navigation
 NERL National Exposure Research Laboratory

O

ODDS Ordnance Detection and Discrimination Study
 OE Ordnance and Explosives
 OEW Ordnance and Explosive Waste

P

PA/SI Preliminary Assessment/Site Inspection
 Parsons Parsons Infrastructure & Technology Group Inc.
 Pd Percent of items detected
 PTA Physical Training Area

Q

QA/QC Quality Control/Quality Assurance

R

RA	Risk Assessment
RAC	Risk Assessment Code
RAO	Remedial Action Objectives
RDX	Cyclotrimethylene trinitramine
RGT	Rifle Grenade Training
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RRD	Range-Related Debris
RRTA	Recoilless Rifle Training Area
RSOP	Reconnaissance, Selection, and Occupation of Position
RWQCB	Regional Water Quality Control Board

S

SAA	Small Arms Ammunition
SAP	Sampling and Analysis Plan
SDA	Squad Defense Area
SGD	Staal, Gardner & Dunne, Inc.
SOP	Standard Operating Procedure
SOW	Scope of Work
SQD	Squad
SS/GS	SiteStats/GridStats
ST	Service Test, possibly
SUMP	Site Use Management Plan
SUXOS	Senior UXO Supervisor

T

TCRA	Time Critical Removal Action
TE-3D-Bde	Training, Third Brigade
TM	Technical Manual
TNG	Training
TNT	Trinitrotoluene
TOW	Tube-launched, optically-tracked, wire-guided
TP	target practice
TS	Training Site

U

USA	USA Environmental, Inc.
USACE	U.S. Army Corps of Engineers
USAEDH	U.S. Army Design Engineering and Support Center, Huntsville
USEPA	United States Environmental Protection Agency
USFWS	U.S. Department of the Interior, Fish and Wildlife Service
UXB	UXB International, Inc.
UXO	Unexploded Ordnance

W

WP	White phosphorous
WWI	World War I

WWII

World War II

GLOSSARY

Closed Range:	A military range that has been taken out of service and either has been put to new uses that are incompatible with range activities or is not considered by the military to be a potential range area. A closed range is still under the control of a Department of Defense (DoD) component. Source: (3).
Discarded Military Munitions (DMM):	Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2)) Source: (6) For the purposes of the basewide Munitions Response Program being conducted at the former Fort Ord, DMM does not include small arms ammunition .50 caliber and below
Engineering Control (EC):	A variety of engineered remedies to contain and/or reduce contamination, and/or physical barriers intended to limit access to property. Some examples of ECs include fences, signs, guards, landfill caps, soil covers, provision of potable water, slurry walls, sheet pile (vertical caps), pumping and treatment of groundwater, monitoring wells, and vapor extraction systems. Source: (1).
Expended:	The state of munitions debris in which the main charge has been expended leaving the inert carrier. Source: (2).
Explosive Soil:	<p>Explosive soil refers to mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive.</p> <p>(a) The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether the particular explosive is classified as “primary” or “secondary.” Guidance on whether an explosive is classified as “primary” or “secondary” can be obtained from the Ordnance and Explosives Mandatory Center of Expertise (OE MCX) or Chapters 7 and 8 of TM 9-1300-214, Military Explosives.</p> <p>(b) Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include Lead, Azide, Lead Styphnate, and Mercury Fulminate.</p> <p>(c) Secondary explosives are bursting and boosting explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives. They are less likely to detonate if struck or when exposed to friction or electrical sparks. Examples of secondary explosives include Trinitrotoluene (TNT), Composition B, and Ammonium Picrate (Explosive D).</p>

	<p>(d) Soil containing 10 percent or more by weight of any secondary explosive or mixture of secondary explosives is considered “explosive soil.” This determination was based on information provided by the USAEC as a result of studies conducted and reported in USAEC Report AMXTH-TE-CR 86096.</p> <p>(e) Soil containing propellants (as apposed to primary or secondary high explosives) may also present explosion hazards. (ER 1110-1-8153). Source (5).</p>
Feasibility Study (FS):	An evaluation of potential remedial technologies and treatment options that can be used to clean up a site. Source: (2).
Impact Area:	The impact area consists of approximately 8,000 acres in the southwestern portion of former Fort Ord, bordered by Eucalyptus Road to the north, Barloy Canyon Road to the east, South Boundary Road to the south, and North-South Road to the west. Source: (2).
Institutional Control (IC):	A legal or institutional mechanism that limits access to or use of property, or warns of a hazard. An IC can be imposed by the property owner, such as use restrictions contained in a deed, or by a government, such as a zoning restriction. Source: (1).
Land Use Controls (LUC):	LUC are physical, legal, or administrative mechanisms that restrict the use of, or limit access to, real property, to manage risks to human health and the environment. Physical mechanisms encompass a variety of engineering remedies to contain or reduce contamination and/or physical barriers to limit access to real property, such as fences or signs. Source: (6)
Magnetometer:	An instrument used to detect ferromagnetic (iron-containing) objects. Total field magnetometers measuring the strength of the earth’s natural magnetic field at the magnetic sensor location. Gradient magnetometers, sensitive to smaller near-surface metal objects, use two sensors to measure the difference in magnetic field strength between the two sensor locations. Vertical or horizontal gradients can be measured. Source: (2).
Military Munitions Response Program (MMRP):	DoD-established program to manage the environmental, health and safety issues presented by Munitions and Explosives of Concern (MEC). Source: (2)
Military Munitions:	<p>Military munitions means all ammunition products and components produced for or used by the armed forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the Department of Energy, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof.</p> <p>The term does not include wholly inert items, improvised explosive devices, and nuclear weapons, nuclear devices, and nuclear components, other than non nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required</p>

	sanitization operations under the Atomic Energy Act of 1954 (42 U.S.C. 2011 et seq.) have been completed. (10 U.S.C. 101(e)(4). Source: (7).
Munitions Constituents (MC)	Any materials originating from unexploded ordnance (UXO), discarded military munitions (DMM), or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (10 U.S.C. 2710 (e) (3)). Source: (6)
Munitions Debris:	Remnants of munitions (e.g., fragments, penetrators, projectiles, shell casings, links, fins) remaining after munitions use, demilitarizations, or disposal. Source: (7)
Munitions and Explosives of Concern (MEC):	Distinguishes specific categories of military munitions that may pose unique explosives safety risks, such as: UXO, as defined in 10 U.S.C. 101 (e) (5); discarded military munitions, as defined in 10 U.S.C. 2710 (e) (2); or munitions constituents (e.g., TNT, Cyclotrimethylene trinitramine [RDX]), as defined in 10 U.S.C. 2710 (e) (3), present in high enough concentrations to pose an explosive hazard. Source: (7). For the purposes of the basewide Munitions Response Program being conducted for the former Fort Ord, MEC does not include small arms ammunition .50 caliber and below.
Munitions Response Area (MRA):	Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples are former ranges and munitions burial areas. A MRA comprises of one or more munitions response sites. Source: (7)
Munitions Response Site (MRS):	A discrete location within MRA that is known to require a munitions response. Source: (7)
Mortar:	Mortars typically range from approximately 1 inch to 11 inches in diameter or larger, and can be filled with explosives, toxic chemicals, white phosphorus or illumination flares. Mortars generally have thinner metal casing than projectiles but use the same types of fuzing and stabilization. Source: (1).
MEC Sampling:	Performing MEC searches within a site to determine the presence of MEC. Source: (2).
Operating Grids:	Typically, 100-foot by 100-foot parcels of land as determined by survey and recorded by Global Positioning System (GPS), marked at each corner with wooden stakes. Sites are divided into operating grids prior to the commencement of work by brush removal or OE sweep teams. A single grid may be occupied by only one team at any time, and the grid system facilitates the maintenance of safe distances between teams. They are identified sequentially using an alpha-numeric system (e.g., E-5). Source: (2).
Projectile:	An object projected by an applied force and continuing in motion by its own inertia, as a bullet, bomb, shell, or grenade. Also applied to rockets and to guided missiles. Source: (4).

Range-Related Debris:	Debris, other than munitions debris, collected from operational ranges or from former ranges (e.g., target debris, military munitions packaging and crating material). Source: (6)
Remedial Investigation (RI):	Exploratory inspection conducted at a site to delineate the nature and extent of chemicals, and in this case OE, present at the site. Source: (2).
Removal Depth:	The depth below ground surface to which all ordnance and other detected items are removed. Source: (2).
SiteStats/GridStats:	Programs developed by QuantiTech for the Huntsville Corps of Engineers to predict the density of ordnance on sites with spatially random dispersal of ordnance. Source: (2).
Surface Removal:	Removal of OE from the ground surface by UXO teams using visual identification sometimes aided by magnetometers. Source: (2).
Track 2 Sites	Track 2 Sites are those where MEC was found and a removal action has been completed. Track 2 sites differ from Track 1 sites in that a removal action has been completed and that land use controls may be applicable based on future identified land uses and results of the removal actions. Source: (2).
Transferred Range:	A military range that is no longer under military control and has been leased, transferred, or returned to another entity, including Federal entities. This includes a military range that is no longer under military control but was used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the Federal land manager. Source: (3).
Transferring Range:	A military range that is proposed to be leased, transferred, or returned from the DoD to another entity, including Federal entities. This includes a military range that is used under the terms of a withdrawal, executive order, special-use permit or authorization, right-of-way, public land order, or other instrument issued by the Federal land manager. An active range will not be considered a “transferring range” until the transfer is imminent. Source: (3).
Unexploded Ordnance (UXO):	<p>Military munitions that</p> <p>(A) Have been primed, fuzed, armed, or otherwise prepared for action;</p> <p>(B) Have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations, personnel, or materials; and</p> <p>(C) Remain unexploded, whether by malfunction, design, or any other cause. (100 U.S.C. 101 (c)(5). Source: (7).</p> <p>For the purpose of the basewide Munitions Response Program being conducted for the former Fort Ord, UXO does not include small arms ammunition .50 caliber and below.</p>

Sources:

- (1) Compendium of Department of Defense Acronyms, Terms, and Definitions: The Interstate Technology and Regulatory Cooperation (ITRC) Work Group (Unexploded Ordnance Work Team), December 2000.
- (2) Non-standard definition developed to describe Fort Ord-specific items, conditions, procedures, principles, etc. as they apply to issues related to the MEC cleanup.

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- (3) Management Guidance for the Defense Environmental Restoration Program published by the office of the Under Secretary of Defense (Installations and Environment), September 2001.
- (4) "Unexploded Ordnance (UXO): An Overview", October 1996. DENIX.
- (5) Ordnance and Explosives Response Engineer Manual (EM) 1110-1-4009. U.S. Army Corps of Engineers, June 23, 2000.
- (6) Memorandum for the Assistant Chief of Staff for Installation Management, Subject: Munitions Response Terminology (April 21, 2005).
- (7) Federal Register/Volume 70. No. 192/Wednesday, October 5, 2005/Rules and Regulations, 32 CFR Part 179, Munitions Response Site Prioritization Protocol, Department of Defense, Final Rule. October, 2005.

1.0 INTRODUCTION

The former Fort Ord is located near Monterey Bay in northwestern Monterey County, California (Plate 1). Since 1917, portions of the former Fort Ord were used by Army units for maneuvers, target ranges, and other purposes. Military munitions were fired into, fired upon, or used on the facility in the form of artillery and mortar projectiles, rockets and guided missiles, rifle and hand grenades, practice land mines, pyrotechnics, bombs, and demolition materials. As a result, a wide variety of conventional munitions and explosives of concern (MEC), both unexploded ordnance (UXO) and discarded military munitions (DMM) items have been encountered at sites throughout the former Fort Ord.

MEC consists of either: (1) UXO as defined in 10 U.S.C. 101 (e) (5); (2) DMM as defined in 10 U.S.C. 2710 (e) (2); and (3) munitions constituents (e.g., trinitrotoluene [TNT], cyclotrimethylene trinitramine [RDX]) as defined in 10 U.S.C. 2710 (e) (3), present in high enough concentrations to pose an explosive hazard. Small arms ammunition that is .50 caliber and below is not being investigated or considered as UXO or MEC under the Track 2 Munitions Response Remedial Investigation/Feasibility Study (MR RI/FS) or Basewide MR RI/FS program. Site assessment, site characterization, remedial design, and remediation activities to address the presence of small arms ammunition .50 caliber and below and explosive munitions constituents at the former Fort Ord are being conducted under the Basewide Range Assessment Program (BRA; *IT, 2001*).

On behalf of the U.S. Army Corps of Engineers (USACE) – Sacramento District, MACTEC Engineering and Consulting, Inc (MACTEC), at the direction of Parsons Infrastructure & Technology Group (Parsons) has prepared this Draft Final Track 2 Remedial Investigation/Feasibility Study for the Parker Flats Munitions Response Area (MRA) (Track 2 MRA RI/FS). This final version of the report incorporates comments on the draft report dated February 2005 and on the draft final version dated December 30, 2005. Response to comments on the draft RI, FS, and risk assessment (RA) are provided in Appendix F of the RI. Responses to comments on the draft final RI,FS, and RA are provided in Appendix H. The Parker Flats MRA is composed of portions of all of several munitions response sites (MRSs; namely, MRS-3, MRS-4B, MRS-13B, MRS-27A, MRS-27B, MRS-27G, MRS-37, MRS-40, MRS-50, MRS-52, MRS-53, MRS-54EDC, and MRS-55) that were identified through a review of Fort Ord records completed for the Fort Ord Archive Search Report (ASR; *USAEDH, 1997*). The northern portion of the Parker Flats MRA is comprised entirely of MRS-13B (Practice Mortar Range), and is separated from the southern portion of the Parker Flats MRA by an area that has not been sampled for the presence of military munitions (Plate 2). The southern portion of the Parker Flats MRA includes the remaining MRSs. Track 2 sites are those sites where MEC was found and a removal action has been completed. Track 2 sites differ from Track 1 sites in that a removal action has been completed and that land use controls may be applicable based on future identified land uses and results of the removal actions. A UXO Safety Specialist with Parsons has provided technical review of this document. Qualifications of the UXO Safety Specialist are provided as Appendix E.

This Track 2 Parker Flats MR RI/FS is based on the evaluation of previous work conducted for the Parker Flats MRA according to the guidance provided in the *Final Plan for the Evaluation of Previous Work* (HLA, 2000b) and the Track 2 Data Quality Objectives Technical Memorandum (DQO Tech Memo) (MACTEC, 2003a). To be included in the Track 2 decision process, the results of the evaluation performed for a site must indicate a strong weight of evidence to support the conclusion that the data are useable for performing a RA and FS as determined by the project team (The Army, USACE, United States Environmental Protection Agency [USEPA], and the California Department of Toxic Substances Control [DTSC], a part of the California Environmental Protection Agency [Cal/EPA]). This report has been prepared in accordance with Parsons Contract No. DACA05-00-D-0003, BOA No. 739219-60000.

1.1 Description of the MR Program

The MR RI/FS program is described in detail in the Final OE RI/FS Work Plan (*Army, 2000a*). The MR RI/FS is being conducted pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). This MR RI/FS only addresses the physical risk from MEC. The potential chemical risks are being addressed under the BRA (*IT, 2001*). Elements of the MR program include a literature review, preparation of a Sampling and Analysis Plan (SAP) for additional MEC characterization activities, evaluation of previous MEC contractors work, performance of an Ordnance Detection and Discrimination Study (ODDS), identification of Applicable or Relevant and Appropriate Requirements (ARARs), evaluation of risks, development of long-term risk management measures, a community relations plan, and a health and safety plan.

The information gathered and evaluated during the literature review and the basewide MR RI/FS will be used to categorize all areas of the former Fort Ord according to actions that have been taken or that are identified as necessary to mitigate MEC hazards. The information that will be evaluated to form decisions will include, but not be limited to, the knowledge of the site, the quality of the available information, the work completed, and the intended future land uses. Areas will be addressed during the basewide MR RI/FS process within one of four proposed “tracks” (Tracks 0 through 3) as described in the OE RI/FS Work Plan (*Army, 2000a*). This report addresses the Track 2 sites which are described below.

1.2 Track 2 MR RI/FS

This section describes the elements and the purpose of the Track 2 MR RI/FS, and presents background information and the results of the evaluation of previous work for the Parker Flats MRA identified for inclusion in this report.

1.2.1 Elements of the Track 2 MR RI/FS

This report is divided into three main parts, the RI, the RA, and the FS. Each of these parts is described below.

The RI (Volume I) is divided into 2 parts. The first part presents background information including a description of the site, the site history and development, a description of the ordnance potentially present based on historical use of the area, the history of the MEC investigations, and a conceptual site model. The second part summarizes the evaluation of previous work. As part of the evaluation, archival and sampling and removal data were reviewed and checklists were prepared according to the Final Plan for Evaluation of Previous Work (*HLA, 2000b*). Information evaluated for the Parker Flats MRA include the adequacy of the removal actions conducted, the performance of the geophysical equipment used during the investigation, data quality, and the information used as the basis for the site boundaries.

The information used in preparation of the RI included historical training maps, aerial photographs, MR contractor after action reports (AARs), the archives search reports (ASRs), the ODDS report, field training manuals, technical manuals, and interviews. References for each of the sources used are provided in the RI section.

Information from historical training maps and aerial photographs was integrated into the project Geographical Information System (GIS). Data were integrated into the GIS according to procedures described in the Standard Operating Procedures (SOPs) prepared for the project (Appendix D).

The RA was performed by Malcolm Pirnie, Inc. on the Parker Flats MRA based on the data set used for the RI. Separate risk analyses, both baseline and “after action” scenarios, are presented for identified

reuse areas within the MRA. The after action risks represent the current state of the Parker Flats MRA. The baseline risk represents the risk assuming that all of the items discovered during the investigation remain on the site. Risks are also developed for each MEC risk item risk type. The after action risks represent the current risk following the removal action. Results of the risk assessment are provided in Volume II.

The FS (Volume III) describes the remedial action objectives (RAOs) for the site, background information, development of ARARs, and presents the screening and development of alternatives for reuse areas within the Parker Flats MRA. The FS also includes an evaluation and comparison of alternatives for remediation, and selection of the preferred alternatives for the Parker Flats MRA.

1.2.2 Purpose

The RI/FS process as outlined in the USEPA guidance (*EPA, 1988*) represents the methodology that the Superfund program has established for characterizing the nature and extent of risk posed by contaminated sites and for evaluating potential remedial options. The purpose of the Parker Flats MR RI/FS is to: 1) describe the site conditions and the results of the evaluation of previous work performed for the Parker Flats MRA; 2) to determine whether the existing Parker Flats data can be used to complete a risk assessment and feasibility study for the Parker Flats MRA; and 3) if the data are useable, complete the RA and FS.

The Parker Flats MR RI/FS will be used to support the Parker Flats MR Proposed Plan and Record of Decision (ROD) that will identify selected remedial alternative for the Parker Flats MRA.

1.3 Report Organization

The Track 2 MR RI/FS is organized as follows:

Volume I – Remedial Investigation

Section 1 – Introduction. This section provides background information on the Track 2 process. The purpose of this report is also included in this section.

Section 2 – Background. This section presents the Fort Ord military munitions-related history, describes the physical setting, and presents background information on the basewide MR RI/FS and Track 2 site investigation and removal.

Section 3 – Track 2 Parker Flats MRA Remedial Investigation. This section provides the RI for the Parker Flats MRA. This section presents the site background, conceptual site models and the results of the evaluation of previous work.

Section 4 – References. This section provides a list of references for pertinent documents cited in the report.

Volume 2 – Risk Assessment

This volume provides the results of the Parker Flats MRA risk assessment.

Volume 3 – Feasibility Study

Track 2 Parker Flats, MRA Feasibility Study. This volume provides the results of the Parker Flats feasibility study. It presents the remedial action objectives, identification of alternatives, screening of alternatives, and selection of alternatives.

The FS also describes the proposed plan and record of decision process.

2.0 BACKGROUND

This section provides a summary of the former Fort Ord military munitions-related history, a description of its physical setting, the background of the basewide MR RI/FS, and background on Track 2 site investigations and removals.

2.1 Historical Use

In 1917, the U.S. Army (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.

Military training at the former Fort Ord began in approximately 1917 and continued until base closure in 1994. From 1917 through the 1930s the property was used as a maneuver and training ground primarily for the 11th Cavalry and the 76th Field Artillery stationed at the Presidio of Monterey. During the spring and summer months, the 30th Infantry Regiment stationed at the Presidio of San Francisco also participated in maneuvers as did other National Guard and Army Reserve units (*HLA, 2000a*). Encampments established at the Camp Ord Military Reservation included Camps Clayton, Huffman, and Pacific.

In 1940, the 7th Infantry Division was activated and Fort Ord was named a permanent Army post. Other divisions that trained and embarked to the Pacific and European theaters from Fort Ord during World War II were the 3rd, 27th, 35th, and 43rd Divisions. Following World War II, infantry training became the focus at Fort Ord. Fort Ord was designated the 4th Replacement Training Center. The 4th Infantry Division was organized at Fort Ord in 1947 and the 7th Division was assigned to Korea. The 4th Infantry Division at Fort Ord assumed the role of training soldiers for future conflicts. In September 1950, the 4th Division was replaced by the 6th Division, which continued the mission of training troops in basic and advanced individual training. The 6th Division remained until the arrival of the 5th Division from Germany in January 1957. The 5th Division was inactivated in June 1957 and Fort Ord then became the United States Army Infantry Training Center from 1957 until 1974. In October 1974, the 7th Infantry Division was reactivated at Fort Ord. 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.

2.1.1 History of Military Munitions Use

Since 1917, portions of the Installation were used by cavalry and infantry units for maneuvers, target ranges, and other purposes. Military munitions that have been fired into, fired upon, or used on the facility include artillery and mortar projectiles, rockets and guided missiles, rifle and hand grenades,

Final

practice land mines, pyrotechnics, bombs, and demolition materials. A wide variety of conventional UXO and DMM items have been located at sites throughout the former Fort Ord, including pyrotechnics and explosives.

2.1.2 Summary of Existing MR Program

Prior to and concurrent with the preparation of the basewide MR RI/FS, the Army had been conducting a munitions response to MEC that consists of implementing and documenting munitions responses in areas with imminent hazards. These removal actions have not only reduced imminent hazards but have also provided information about the type of MEC and level of hazard at each of the sites that can be used in the basewide MR RI/FS.

Work performed for the existing MR program has been conducted in accordance with the following documents:

- Time-critical removal actions (TCRAs) have been implemented as described in the *Fort Ord Ordnance and Explosive Waste Time-Critical Removal Action Memorandum (Army, 1994)*.
- Non-time-critical removal actions are being addressed in the *Final Action Memorandum, Phase 2 Engineering Evaluation/Cost Analysis, Ordnance and Explosives Sites, Former Fort Ord, Monterey County, California (Army, 1999)*. The Action Memorandum, Phase 2 Engineering Evaluation/Cost Analysis (EE/CA) identifies and describes the rationale for continuing with MEC removal actions at MRSs while the basewide MR RI/FS is being conducted and addresses recommendations for future MEC removal actions.
- All removal actions have been implemented in accordance with the Land Disposal Site Plan (LDSP), LDSP amendments, and explosive safety submissions, which have been approved by the Department of Defense Explosives Safety Board (DDESB). These plans are required to describe the nature, extent, and types of known or suspected MEC contamination, the proposed future use of each area, and procedures for mitigating MEC hazards in a manner compatible with the proposed land reuse and in accordance with Department of Defense (DoD) safety standards.

Other elements of the MR program implemented prior to the basewide MR RI/FS include the following:

- **Archives Search Program** - MRSs were identified and listed in the 1997 Draft Revised Archive Search Report (ASR; *U.S. Army Engineer Division, Huntsville [USAEDH], 1997*), which is an update of previous ASRs (*USAEDH, 1993; 1994*). A preliminary site reconnaissance was conducted as part of the ASR to further identify/characterize potential MRSs; the results are contained in the 1997 ASR.
- **Phase 1 Engineering Evaluation/Cost Analysis (Phase I EE/CA; USAESCH, 1997) and the Phase 2 Engineering Evaluation/Cost Analysis (Phase 2 EE/CA; Army, 1998b)** – The Phase 1 and Phase 2 EE/CAs were developed to describe the munitions response to MEC and management activities for sites known or suspected to contain MEC. The Phase 1 EE/CA addressed 29 MRSs and subsites (*USAESCH, 1997*). The Phase 2 EE/CA addressed the remaining MRSs, including future sites (*Army, 1998b*).

2.2 Physical Setting

The following sections summarize the location and general physical setting of the base, including intended land uses.

2.2.1 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 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 Santa Fe Railroad and Highway 1 pass through the western part of the former Fort Ord, separating the beachfront portions from the rest of the base. Laguna Seca Recreation Area and Toro Park border the former Fort Ord to the South and Southeast, respectively, as well as several small communities such as Toro Park Estates and San Benancio.

2.2.2 General History

Beginning with its founding in 1917, Fort Ord served primarily as a training and staging facility for cavalry and infantry troops. From 1947 to 1974, Fort Ord was a basic training center. After 1974, the 7th Infantry Division occupied Fort Ord. Fort Ord was selected in 1991 for decommissioning, but troop reallocation was not completed until 1993. Although Army personnel still operate the base, no active Army division is stationed at the former Fort Ord.

2.2.3 Land Use

The former Fort Ord consists of developed and undeveloped land. The three principal developed areas are the East Garrison, the Marina Airfield, formerly Fritzsche Army Airfield (FAAF), and the Main Garrison; these areas collectively comprise approximately 8,000 acres. The remaining 20,000 acres are largely undeveloped areas. A description of the land uses when the former Fort Ord was active are provided below.

2.2.3.1 Developed Land

With up to 15,000 active duty military personnel and 5,100 civilians working onsite during its active history, the former Fort Ord's developed areas resembled a medium-sized city, with family housing, medical facilities, warehouses, office buildings, industrial complexes, and gas stations. Individual land-use categories were as follows:

- Residential areas included military housing, such as training and temporary personnel barracks, enlisted housing, and officer housing.
- Local services/commercial areas provided retail or other commercial services such as gas stations, mini-markets, and fast-food facilities.
- Military support/industrial areas included industrial operations such as motor pools, machine shops, a cannibalization yard (where serviceable parts are removed from damaged vehicles), and the FAAF.
- Mixed land-use areas combined residential, local services/commercial, and military support operations.
- Schools included the Thomas Hayes Elementary, Roger S. Fitch Middle, General George S. Patton Elementary, Marshall Elementary, and Gladys Stone schools. High school students attended Seaside High, outside the former Fort Ord's southwest boundary.
- Hospital facilities included the Silas B. Hayes Army Hospital, medical and dental facilities, and a helipad.

- Training areas included a central track and field, firing ranges, and obstacle courses.
- Recreational areas included a golf course and clubhouse, baseball diamonds, tennis courts, and playgrounds.

The three principal developed areas are described below:

- East Garrison: The East Garrison is on the northeast side of the base, adjacent to undeveloped training areas. Military/industrial support areas at the East Garrison included tactical vehicle storage facilities, defense recycling and disposal areas, a sewage treatment plant, and small arms ranges. The East Garrison also included recreational open space with primitive camping facilities, baseball diamonds, a skeet range, and tennis courts. Recreational open space occupied 25 of the approximately 350 acres of the East Garrison.
- Fritzsche Army Airfield (FAAF): The former FAAF is in the northern portion of the former Fort Ord, on the north side of Reservation Road and adjacent to the city limits of Marina. The primary land use was military/industrial support operations. Facilities included airstrips, a motor park, aircraft fuel facilities, a sewage treatment plant, aircraft maintenance facilities, an air control tower, a fire and rescue station, and aircraft hangars.
- Main Garrison: The Southern Pacific Railroad right-of-way and Highway 1 separate the coastal zone from the former Fort Ord's Main Garrison. The Main Garrison consisted of a complex combination of the various land-use categories. Facilities included schools, a hospital, housing, commercial facilities, (including a dry cleaner and a gasoline service station), and industrial operations (including motor pools and machine shops).

2.2.3.2 Undeveloped Land

The two principal undeveloped areas are described below:

Coastal Zone: A system of sand dunes lies between Highway 1 and the shoreline. The western edge of the dunes has an abrupt drop of 40 to 70 feet, and the dunes reach an elevation of 140 feet above mean sea level on the gentler, eastern slopes. The dunes provided a buffer zone that isolated the Beach Trainfire Ranges from the shoreline to the west. Numerous former target ranges, former ammunition storage facilities, and two inactive sewage treatment facilities lie east of the beach.

Because of the presence of rare and/or endangered species and because of its visual attributes, Monterey County has designated the former Fort Ord's coastal zone an environmentally sensitive area. The California Natural Coordinating Council (CNCC) and the Heritage Conservation and Recreation Service (HCRS) have identified the dunes at the former Fort Ord as among the best coastal dunes in California because of significant features including coastal strand vegetation and the habitat of the black legless lizard (*Monterey County Planning Department [MCPD], 1984*).

Inland Areas: Undeveloped land in the inland portions of the former Fort Ord includes the impact area and infantry training areas, portions of which were used for livestock grazing and recreational activities such as hunting, fishing, and camping. These undeveloped areas are primarily left in their natural state, with only minor development of facilities. One area of particular concern is the central maritime chaparral. Central maritime chaparral consists of open to dense shrub stands located in the eastern and southern portions of the former Fort Ord. Central maritime chaparral on the former Fort Ord has been divided into three classifications including mature chaparral, intermediate-age chaparral, and disturbed chaparral. Mature chaparral is composed of shrubs with closed canopies that have very little open ground

with little or no herbaceous species. Intermediate-age stands generally exhibit more open ground and herbaceous plant cover with a more diverse species composition. Disturbed chaparral habitat includes areas that were subject to regular disturbance. Disturbed chaparral often exhibits very open, sandy ground with limited herbaceous plant cover.

The Habitat Management Plan (HMP) identifies a number of species of concern on the former Fort Ord. HMP sensitive species are located in central maritime chaparral habitat including sandmat manzanita, Toro manzanita, Hooker's manzanita, Monterey ceanothus, Eastwood's goldenbush, Monterey spineflower, sand gilia, Seaside bird's-beak, and black legless lizards.

2.2.3.3 Future Land Use

The future land uses presented in this section are primarily based upon the Fort Ord Reuse Authority (FORA) March 1997 Fort Ord Base Reuse Plan (*FORA, 1997*) and the July 1995 USACE and Bureau of Land Management (BLM) Site Use Management Plan (SUMP) (*USACE, 1995b*). Other sources of future land use information include public benefit conveyance, negotiated sale requests, transfer documents, and the Installation-Wide Multispecies HMP (*USACE, 1997*). The Reuse Plan identified approximately 20 land-use categories at Fort Ord (*FORA, 1997*) including habitat management, open space/recreation, institutional/public facilities, commercial, industrial/business park, residential, tourism, mixed use, and others.

2.2.4 Site Features

The following section summarizes site features at the former Fort Ord.

2.2.4.1 Climate

The area's climate is characterized by warm, dry summers and cool, rainy winters. The Pacific Ocean is the principal influence on the climate at the former Fort Ord, and the source of fog and onshore winds that moderate temperature extremes. Daily ambient air temperatures typically range from 40 to 70 degrees Fahrenheit (F), but temperatures in the low 100s have occurred. Thick morning fog is common throughout the year. Winds are generally from the west.

The average annual rainfall of 14 inches occurs almost entirely between November and April. Because the predominant soil is permeable sand, runoff is limited and streamflow occurs only intermittently and within the very steep canyons in the eastern portion of the former Fort Ord.

2.2.4.2 Ecological Setting

The former Fort Ord is located on California's central coast, a biologically diverse and unique region. The range and combination of climatic, topographic, and soil conditions at the former Fort Ord support many biological communities. Field surveys were conducted from 1991 through 1994 to provide detailed site-specific, as well as basewide, information regarding plant communities, botanical resources, observed and expected wildlife, and biological resources of concern. Plant communities were mapped for the whole base as described in the *Draft Basewide Biological Inventory, Fort Ord, California (HLA, 1992)*.

Several of the former Fort Ord plant communities have been combined for simplification. The 11 plant communities described at former Fort Ord sites include coast live oak woodland (coastal and inland); central maritime chaparral; central coastal scrub; grassland; developed/landscaped/ruderal and disturbed dunes; dune scrub; iceplant mats; riparian forest; wetlands (including vernal pools and freshwater marsh); and coastal strand. Central maritime chaparral is the most extensive natural community at the former

Fort Ord, occupying approximately 12,500 acres in the south-central portion of the base. Oak woodlands are widespread at the former Fort Ord and occupy the next largest area, about 5,000 acres. Grasslands, located primarily in the southeastern and northern portions of the base, occupy approximately 4,500 acres. The other community types generally occupy less than 500 acres each. The remaining approximately 4,000 acres of the base are considered fully developed and not defined as ecological communities.

Among the more than 260 vertebrates known to occur or potentially occur at the former Fort Ord some are considered special-status species, as documented in the Fort Ord *Basewide Biological Inventory, Fort Ord, California*, dated December 8, 1992. These wildlife species, in addition to plant species and native biological communities, are collectively called special status natural resources. They receive various levels of protection under local, state, or federal laws, regulations, and codes. The closure and disposal of former Fort Ord is considered a major federal action that could affect several species of concern and other rare species listed by the California Department of Fish and Game and/or the California Native Plant Society or listed as threatened or endangered under the federal Endangered Species Act (ESA). The U.S. Department of the Interior, Fish and Wildlife Service (USFWS) final Biological Opinion for the Disposal and Reuse of Fort Ord (USFWS, 1993) required that a HMP be developed and implemented to reduce the incidental take of listed species and loss of habitat that supports these species.

Other subsequent biological opinions (USFWS, 2002; 2005) addressed reasonable and prudent measures specific to critical habitat for listed species such as the California tiger salamander (*Ambystoma californiense*), California goldfields (*Lasthenia conjugens*), and Monterey spineflower (*Chorizanthe robusta* var. *robusta*). The HMP for former Fort Ord complies with all of the USFWS Biological Opinions (USFWS, 1999; 2002; 2005) and establishes the guidelines for the conservation and management of wildlife and plant species and habitats that largely depend on former Fort Ord land for survival (USACE, 1997).

Two of the eleven plant communities at Fort Ord are considered rare or declining and of highest inventory priority by the California Department of Fish and Game (CDFG) (CDFG, 1997): central maritime chaparral and valley needlegrass grassland.

Special-status wildlife that occur or potentially occur at Fort Ord include one invertebrate, one reptile, two amphibians, 11 birds, and two mammals. The greatest diversity of wildlife species occurs in chaparral communities that potentially host special status wildlife species such as California black legless lizard (*Anniella pulchra nigra*), Monterey dusky footed woodrat (*Neotoma macrotis luciana*), coast horned lizard (*Phrynosoma coronatum*), golden eagle (*Aquila chrysaetos*) and loggerhead shrike (*Lanius ludovicianus*).

Special status wildlife species potentially occurring in the inland coast live oak woodland community include dusky-footed woodrat, American badger (*Taxidea taxus*), Cooper's hawk (*Accipiter cooperii*), and yellow warbler (*Dendroica petechia*).

In the grassland community, special status wildlife species are potentially represented by American badger, California horned lark (*Eremophila alpestris actia*), golden eagle, northern harrier (*Circus cyaneus*), loggerhead shrike, tricolored blackbird (*Agelaius tricolor*), prairie falcon (*Falco mexicanus*) and burrowing owl (*Athene cunicularia hypugaea*).

Special status wildlife species possibly occurring in the wetland community include Monterey ornate shrew (*Sorex ornatus salarius*), sharp-shinned hawk (*Accipiter striatus*), Cooper's hawk, Northern harrier, yellow warbler, tricolored blackbird, California tiger salamander (*Ambystoma californiense*), California red-legged frog (*Rana aurora draytoni*), Southwestern pond turtle (*Emmys marmorata pallida*), and California linderiella (*Linderiella occidentalis*).

From 1994 to the present, baseline and follow-up surveys have been conducted for habitats identified in the HMP that are potentially affected by OE removal activities. These data are presented in annual monitoring reports from 1994 through 2003 (*HLA 1994, 1995b, 1996, 1997, 1998, 1999b, 2000c, Harding ESE, 2001, 2002, MACTEC, 2004*).

2.2.4.3 Topography and Surface Waters

Elevations at the former Fort Ord range from approximately 900 feet above mean sea level (MSL) near Wildcat Ridge, on the east side of the base, to sea level at the beach. The predominant topography of the area reflects morphology typical of the dune sand deposits that underlie the western and northern portions of the base. In these areas, the ground surface slopes gently west and northwest, draining toward Monterey Bay. Runoff is minimal because of the high rate of surface-water infiltration into the permeable dune sand; consequently, well-developed natural drainages are absent throughout much of this area. Closed drainage depressions typical of dune topography are common.

The topography in the southeastern third of the base is notably different from the rest of the base. This area has relatively well-defined, eastward-flowing drainage channels within narrow, moderately to steeply sloping canyons draining into the Salinas Valley.

2.2.5 Geologic and Hydrogeologic Conditions

This section summarizes subsurface conditions at the former Fort Ord.

2.2.5.1 Geology

The former Fort Ord is within the Coast Ranges Geomorphic Province. The region consists of northwest-trending mountain ranges, broad basins, and elongated valleys generally paralleling the major geologic structures. In the Coast Ranges, older, consolidated rocks are characteristically exposed in the mountains but are buried beneath younger, unconsolidated alluvial fan and fluvial sediments in the valleys and lowlands. In the coastal lowlands, these younger sediments commonly interfinger with marine deposits.

The former Fort Ord is at the transition between the mountains of the Santa Lucia Range and the Sierra de la Salinas to the south and southeast, respectively, and the lowlands of the Salinas River Valley to the north. The geology of the former Fort Ord generally reflects this transitional condition; older, consolidated rock is exposed at the ground surface near the southern base boundary and becomes buried under a northward-thickening sequence of poorly consolidated deposits to the north. The former Fort Ord and the adjacent areas are underlain, from depth to ground surface, by one or more of the following older, consolidated units:

- Mesozoic granitic and metamorphic rocks
- Miocene marine sedimentary rocks of the Monterey Formation
- Upper Miocene to lower Pliocene marine sandstone of the Santa Margarita Formation (and possibly the Pancho Rico and/or Purisima Formations).

Locally, these units are overlain and obscured by geologically younger sediments, including:

- Plio-Pleistocene alluvial fan, lake, and fluvial deposits of the Paso Robles Formation
- Pleistocene eolian and fluvial sands of the Aromas Sand

- Pleistocene to Holocene valley fill deposits consisting of poorly consolidated gravel, sand, silt, and clay
- Pleistocene and Holocene dune sands
- Recent beach sand
- Recent alluvium.

The geology of the former Fort Ord is described in detail in *Volume II of the Basewide RI, Basewide Hydrogeologic Characterization (HLA, 1995a)*.

2.2.5.2 Hydrogeology

Recent studies of the former Fort Ord hydrogeology concluded that the base straddles two distinct groundwater basins, the Salinas and Seaside basins (Geotechnical Consultants, Inc. [GTC], 1984; Staal, Gardner & Dunne, Inc. [SGD], 1987). The former Fort Ord includes the southwestern edge of the Salinas basin and the eastern portion of the smaller Seaside basin. The Salinas basin underlies the northern and southeastern portions of the base, and the Seaside basin underlies the southern and southwestern areas. Basewide RI/FS sites with recognized groundwater contamination are limited to the Salinas groundwater basin at the former Fort Ord; therefore, only the Salinas basin is described herein.

The Salinas groundwater basin is relatively large and extends well beyond the boundaries of the former Fort Ord. At the former Fort Ord, the Salinas basin is composed of relatively flat-lying to gently dipping, poorly consolidated sediments. Although relatively simple structurally, the sediments are stratigraphically complex, reflecting a variety of depositional environments. Aquifers within the Salinas basin at the former Fort Ord, from top to bottom, include the unconfined A-aquifer, the confined Upper 180-foot aquifer, the confined and unconfined Lower 180-foot aquifer, and the confined 400-foot and 900-foot aquifers. These aquifer names reflect local historical water levels and are not directly correlated to present water levels at the former Fort Ord.

Groundwater extraction by the City of Marina, by the former Fort Ord, and by irrigation wells in the Salinas Valley has historically induced seawater intrusion into the Lower 180-foot and the 400-foot aquifers. Seawater intrusion continues to affect these aquifers. Intrusion into the Upper 180-foot aquifer appears to be limited to the vicinity of the beach at the former Fort Ord (HLA, 1999a).

2.3 MR RI/FS Background

Since the base was selected for BRAC in 1991 and was officially closed in September 1994, MEC removal actions have been performed and documented in preparation for transfer and reuse of the former Fort Ord property. The munitions response to MEC at identified MRSs continued after base closure because the expanded reuse of the former Fort Ord increased the possibility of the public being exposed to MEC hazards. The EPA listed Fort Ord on the National Priorities List (NPL) in 1990; therefore the Army performed its activities pursuant to the President's authority under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104, as delegated to the Army in accordance with Executive Order 12580 and in compliance with the process set out in CERCLA Section 120. The regulatory agencies (USEPA and the DTSC under the Cal/EPA) were provided copies of work plans and after action reports for review. The agencies had the opportunity to provide input during MEC removal and remedial activities; however, the removal actions were ultimately completed by the Army using its delegated removal authority under CERCLA.

In November 1998, the Army agreed to evaluate MEC at the former Fort Ord in an MR RI/FS consistent with CERCLA. The basewide MR RI/FS, which the Army is preparing to address MEC hazards on the former Fort Ord, will include input from the community and will require regulatory agency review and approval. The basewide MR RI/FS will evaluate past removal actions as well as recommend future remedial actions deemed necessary to protect human health and the environment under future uses.

In April 2000, an agreement was signed between the Army, EPA, and DTSC to evaluate MEC at the former Fort Ord subject to the provisions of a federal facilities agreement (FFA) and the agencies role was formalized. The FFA was originally signed in 1990 by the Army, EPA, and California Department of Health Services (now known as DTSC) and the Regional Water Quality Control Board (RWQCB). The FFA established schedules for performing remedial investigations and feasibility studies and requires that remedial actions be completed as expeditiously as possible.

The basewide MR RI/FS will contain a comprehensive evaluation of all MEC-related data for the entire former Fort Ord and will evaluate long-term response alternatives for cleanup and risk management of MEC.

2.4 Track 2 Sites Investigation

MEC-related field investigations, sampling, and removal activities were conducted at Track 2 sites by the Army's MR contractors according to contractual and/or work plan requirements in place at the time the work was conducted. Although Track 2 DQOs were not established at the time the MR contractors conducted field investigations and sampling activities at Track 2 sites, the purpose and objectives of the work conducted at the sites based on contractual and/or work plan requirements and approved methodologies are summarized below, and are evaluated against the Track 2 DQOs.

The investigation and removal work conducted at Track 2 sites was focused on addressing explosive safety. According to USACE Military Munitions Safety Specialist for the Sacramento District, when non military munitions related debris was found it was removed from the excavation and inspected for explosive hazards and for the presence of hazardous wastes. If MEC or hazardous wastes were identified they were removed and disposed of following the appropriate requirements. After the waste material was inspected, the non-hazardous debris was reburied or removed.

Four primary MR contractors performed munitions response to MEC at the Track 2 sites at the former Fort Ord: (1) Human Factors Applications, Inc. (HFA), (2) UXB International, Inc. (UXB) (3) CMS Environmental, Inc. (CMS), now known as USA Environmental, Inc. (USA) and (4) Parsons. UXB did not perform work within the Parker Flats MRA; however, information on their munitions response to MEC is included as a resource for later Track 2 evaluations. Parson's work was limited to a data validation effort performed in 2005.

Human Factors Applications, Inc. (HFA) -- January 1994 through June 1994

HFA was contracted by the U.S. Army Corps of Engineers Huntsville Division (CEHND) in late 1993 to provide munitions response to MEC services at Fort Ord. HFA's objective was to determine the presence or absence of MEC at sixteen sites distributed throughout Fort Ord. The sites were identified by the U.S. Army Corps of Engineers, St. Louis Division and reported in the 1993 Archives Search Report. If MEC was discovered it was reported to the CEHND Safety Specialist who was responsible for determining whether the site was to be declared contaminated with MEC. HFA performed sampling operations at Fort Ord from January 1994 through June 1994. HFA was also contracted to perform a removal action at a portion of MRS-31.

The sampling operation was conducted in two phases, a Grid and Boundary Location Survey, and MEC Surface/Subsurface Sweep and Characterization. Site boundaries were determined using information in the USACE Scope of Work, the Fort Ord Grid and Boundary Survey Plan and discussions with CEHND and Fort Ord representatives during site visits. The sites were investigated using one hundred percent sampling. This method requires that 100 percent of the anomalies detected in the sample grids be excavated. The Schonstedt GA-52/C or the Schonstedt GA-72/Cv magnetometers were used to identify anomalies. A maximum search lane width of 5 feet was used during the geophysical survey. According to the HFA work plan, survey grids were randomly located. Grids were generally 100 by 100 feet and separated by at least 200 feet. Each grid was given a 100 percent visual surface sweep and a 100 percent subsurface geophysical investigation using the Schonstedt GA-52/C or the Schonstedt GA-72/Cv. Surface contacts and anomalies were marked with yellow flags for excavation and identification. Subsurface contacts were uncovered using hand tools to a maximum depth of 3 feet.

During the removal action at MRS-31, HFA performed a 100 percent visual surface sweep and a 100 percent subsurface geophysical investigation using the Schonstedt GA-52/C or the Schonstedt GA-72/Cv. Subsurface checks were performed on each grid after all MEC operations were complete. HFA quality control (QC) specialists checked a minimum of 10 percent of each grid to insure MEC removal was done properly. After the QC check was performed, the CEHND Safety Specialist performed a quality assurance (QA) check of the site prior to accepting site work as complete according to contractual specifications.

UXB International, Inc. (UXB) – July 1994 through August 1995

UXB was contracted by the CEHND in July 1994 with the objective of performing MEC sampling and removal actions on selected sites at Fort Ord. The sites selected for sampling/removal action potentially contained MEC. As part of the sampling/removal action, UXB was to destroy all MEC encountered at each site. This action was performed according to CERCLA, Section 104 and the National Contingency Plan, Sections 300.120(c) and 300.400(e). Additionally, this action was completed under Chapter 12, DOD 6055.9-STD, DOD Ammunition and Explosives Safety Standards (*UXB, 1995*). UXB performed sampling operations at Fort Ord from July 1994 through August 1995.

Site locations were taken from the 1993 ASR and 1994 ASR Supplement with site perimeters and priorities provided by the Fort Ord BRAC office and CEHND project manager. Site perimeter surveys were done prior to any MEC sampling and removal work in the site area. The site investigation results were continuously monitored by the on-site CEHND Safety Specialist who determined whether a site was declared contaminated and if a clearance was required (*UXB, 1995*). Geophysical instruments (magnetometers) were provided by the CEHND. Instruments used included the Schonstedt GA-52/C, the Schonstedt GA-72/Cv, and the Schonstedt GA-52/Cx. Sample grids were 100 feet by 100 feet square and spaced so that no two grids were any closer than 200 feet, in order to provide maximum dispersion of the sample grids throughout the site. Sample grids were required to cover at least 10 percent of the total area of the site being sampled. Site perimeters and grid separation could be modified by the CEHND Safety Specialist if needed. Once the sample grid locations were established each grid was divided into 5-foot wide search lanes. Each lane was investigated visually while simultaneously searching for subsurface anomalies with the magnetometer. Each anomaly was marked (flagged) and excavated by hand by the UXO Safety Specialist. Grids with high concentrations of sub-surface ferrous metals required a second sweep normally made at an angle of 90 degrees to the first sweep.

Excavation to a depth of up to 4 feet below ground surface (bgs) (3 feet bgs prior to December 14, 1994) was required to identify or confirm the presence of MEC. If the anomaly could not be uncovered within 3 or 4 feet bgs, the onsite CEHND Safety Specialist determined if deeper excavation was required. Quality control (QC) checks were performed on each grid after all MEC operations were complete. UXB

QC specialists checked a minimum of 10 percent of each grid to insure that MEC removal was done properly. After the QC check was performed, the CEHND Safety Specialist performed a quality assurance (QA) check of the site prior to accepting site work as complete according to contractual specifications.

CMS Environmental, Inc. (CMS)/USA Environmental (August 1995-present)

CMS was awarded the contract in 1995 to perform munitions response to MEC, DMM, and MC at selected sites within the Former Fort Ord. This action was performed by CMS under contract issued by the U.S. Army Engineering and Support Center, Huntsville (CEHNC). The contract was revised on January 31, 1997 (CMS, 1997). In June of 1998, CMS was sold and the name of the company became USA Environmental, Inc. (USA). In July 1998, USA began to conduct work on Fort Ord as a subcontractor to CMS. In September 1998, the sale was complete and USA became the prime contractor. USA has worked as a munitions response contractor as a subcontractor to Parsons since 2000.

Part of this action constituted the destruction of all on-Site MEC encountered. This was implemented in accordance with CERCLA, Section 104 and the National Contingency Plan, Sections 300.120(c) and 300.400(e). In addition, this action was completed under Chapter 12, DoD 6055.9-STD, DoD Ammunition and Explosives Safety Standards.

The objective of CMS was to safely locate, identify and dispose of all MEC located on the project site down to a depth of four feet below ground surface, unless approval was given based on studies, site conditions or DDESB acceptance of a variance from the four foot depth (CMS, 1997). Sampling activities were performed according to guidelines from a sub-plan to the previously approved work plan under contract DACA87-94-D-0030 Task Order 16. The scope of work required the following with regards to planning, conducting, sampling, and removal actions, and the type of geophysical instrument that should be used to implement the actions. "The contractor shall propose a planned, systematic approach to search and clear the project site that will result in optimum search effectiveness. This methodology shall be outlined in the work plan. During the subsurface operations, the contractor shall utilize a magnetometer capable of detecting a 105mm projectile at a depth of four feet. The contractor shall excavate to a depth of four feet to determine the identity of the magnetic anomaly. If deeper excavation is required, the on-site Government Safety Specialist will make that decision if he decides necessary for future land use."

Sample grids were 100 by 100 feet square for 100 percent sampling grids and 100 by 200 feet for SiteStat/GridStat (SS/GS) sampling and spaced apart so that no two sample grids were any closer than 200 feet. SS/GS software was utilized on the sample grids to determine the amount and location of sampling, unless otherwise directed by the Contracting Officer (KO).

In 100 percent grid sampling and for removal actions, 100- by 100-foot grids were selected, surveyed and investigated with a magnetometer along maximum 5-foot wide search lanes. Whenever a subsurface anomaly or metallic surface object was encountered, it was investigated. Near surface anomalies were excavated with hand tools. While digging, a magnetometer was used to check and verify the location of the anomaly (CMS, 1995).

Parsons (2000 to 2005)

Parsons performed work at Fort Ord according to the Programmatic Work Plan (Parsons, 2004a). The Programmatic work plan was originally prepared in May 2001, with the second edition published in May 2004. The Programmatic work plan describes the procedures, methods, and resources the Parsons and its

Subcontractors (including USA), used while performing work under contract DACA05-00-D-003. The work plan contains the following elements:

- Technical Management Plan
- Explosive Management Plan
- Explosives Siting Plan
- Geophysical Investigation Plan
- Site Safety and Health Plan
- Location Surveys, Mapping and GIS Plan
- Work Data and Cost Management Plan
- Property Management Plan
- Sampling and Analysis Plan
- Quality Control Plan
- Environmental Protection Plan
- Investigative Derived Waste Plan.

Work performed by Parsons within the Track 2 Parker Flats area was limited to database management and a data validation effort performed in 2005.

Historical Reviews and Reconnaissance Activities

Archives Search Reports

Three ASRs were completed for the former Fort Ord. The first was completed in 1993 (*USAEDH, 1993*) by the St. Louis Corps of Engineers based on a Scope of Work provided by the Huntsville Corps of Engineers and example ASRs prepared by others. A Supplement to the 1993 ASR was prepared in November 1994 (*USAEDH, 1994*). This supplement was prepared based on a Scope of Work and guidance published in June 1994. The ASR was updated in 1997 (*USAEDH, 1997*) following USACE guidance *Procedures for Conducting Preliminary Assessments at Potential Ordnance Response Sites (USACE, 1995a)*.

The purpose of the ASRs conducted at the former Fort Ord was to gather and review historical information to determine the types of munitions used at the site, identify possible disposal areas, identify unknown training areas, and recommend follow-up actions. The 1995 guidance specified that the ASR include information on historical records, site visits, follow-up actions, prior documentation, and characterization and evaluation for potential MEC response sites.

Basewide Range Assessment Program (BRA)

The BRA is being conducted at the former Fort Ord to gather data that will be used to evaluate the potential for chemical contamination at suspected small arms and multi-use ranges and training areas at

Final

the former Fort Ord. As part of the BRA, the site assessment process includes conducting literature reviews, site reconnaissance and mapping, and site investigation sampling. The results of the assessment will be used to determine whether the areas may be recommended for the remedial phase that includes site characterization, risk evaluation, and remedial action.

Site reconnaissance and soil sampling was conducted within the Parker Flats MRA as part of the Basewide Range Assessment program. The Basewide Range Assessment for the Parker Flats MRA included a literature review for all of the MRS sites within the Parker Flats MRA and site reconnaissance within MRS-3, MRS-4B, MRS-13B, MRS-37, MRS-50, MRS-53, and MRS-55. Following reconnaissance, soil samples were collected from MRS-3, MRS-37, MRS-50, MRS-53, and MRS-55. Samples were analyzed for explosives and perchlorate. Selected samples were also analyzed for lead, copper, antimony, semivolatile organic compounds and total petroleum hydrocarbons as gasoline, diesel, and motor oil. The results of this sampling are provided in the Comprehensive Basewide Range Assessment Report (*MACTEC/Shaw, 2005*). No further action related to chemical contamination in soil was recommended for the MR sites within the Parker Flats MRA.

Although the Fort Ord BRA is not a part of the MR program, many of the DQOs identified for the Site Assessment Phase of the BRA investigation are the same DQOs established for the site reconnaissance phase of the current MR site investigation program being implemented at the former Fort Ord (*Parsons, 2001b*). Both programs include using the results of the site inspections to determine if additional work (i.e., sampling for MEC and chemicals associated with MEC) is necessary. The Fort Ord BRA was conducted in accordance to the Basewide Range Assessment Work Plan (*IT, 2001*). The Draft Comprehensive Basewide Range Assessment Report was issued in July 2004 (*MACTEC, 2004*).

2.5 Track 2 Sites

Track 2 sites are those where MEC was found and a MEC removal action was conducted. These sites will be evaluated under the Evaluation of Previous Work (EPW) using the DQOs established in 2003 (*MACTEC, 2003a*). A list of the Track 2 sites included in the Parker Flats MRA and other potential Track 2 sites is provided in Table 1. The contractors that worked on the sites are also presented in the table. The location of these sites is presented on Plate 2.

3.0 PARKER FLATS REMEDIAL INVESTIGATION (RI)

3.1 Parker Flats Munitions Response Area Description

The Parker Flats MRA is approximately 600 acres in size and is located in the central portion of former Fort Ord between the former Fort Ord Main Garrison and the former impact area (Plate 2). The Parker Flats MRA is composed of portions or all of several MRSs (MRS-3, MRS-4B, MRS-13B, MRS-27A, MRS-27B, MRS-27G, MRS-37, MRS-40, MRS-50, MRS-52, MRS-53, MRS-54EDC, and MRS-55) that were identified through a review of Fort Ord records completed for the Fort Ord Archive Search Report (ASR; *USAEDH, 1997*). The northern portion of the Parker Flats MRA is comprised entirely of MRS-13B (Practice Mortar Range) and is separated from the southern portion of the Parker Flats MRA by an area that has not been sampled for the presence of military munitions (Plate 2). The southern portion of the Parker Flats MRA includes the remaining MRSs, mentioned above.

3.2 Parker Flats Munitions Response Area History and Development

The following presents a summary of the Parker Flats MRA history and development that is based on archival research and review of historical training maps and aerial photographs. Plates have been prepared that present pertinent features digitized from historical training maps and scanned aerial photographs reviewed by MACTEC. It should be noted that minor discrepancies between source maps and natural degradation of older source maps and photographs have resulted in misalignment of some map features. In addition, camera angle and lens distortion introduced into older aerial photographs and changes in vegetation and site features over time may contribute to misalignment of some map and aerial photograph features.

Pre-1940s Era

With the exception of MRS-13B, the Parker Flats MRA lies within a tract of land purchased from private landowners by the government in 1917 (*Arthur D. Little, Inc. [ADL], 1994*). A small portion of MRS-13B (south of Gigling Road) was also included in this purchase. The remainder and majority of MRS-13B was privately held agricultural land until the 1940s. Documentation for use of this area by the U.S. Army (Army) for training prior to 1940 is limited to topographic and survey plat maps. Topographic maps of the area from 1918 (*Department of the Interior [DOI], 1918*) and 1933 (*Army, 1933-1934*) were reviewed. A review of a 1922 Survey Plat Map shows that the site is within an area identified on the survey plat map as the "U.S. Government Artillery Range" (*Cozzens, 1922*). On the 1933 map, the Parker Flats MRA (except MRS-13B) appears to be in what was the northwest corner of the Camp Ord Military Reservation. This map includes features such as "Artillery Hill" and "Parker Flats" that are coincident with the Parker Flats MRA. No other identifiable features or text were associated with this site. No specific features except Gigling Road are identified on the survey plat map. Eucalyptus Road is shown on the 1933 topographic map and is located close to its present location.

1940s Era

Review of 1940s era documentation including historical maps and aerial photographs indicates that the Parker Flats MRA, except the northern portion of MRS-13B, lies within an area identified on the 1945 and 1946 training facilities maps as "G-1" and "G-2." These area designations indicate that they were assigned at the Division Level to Personnel (G-1) and Intelligence (G-2). The majority of MRS-13B lies within an area identified on the 1945 and 1946 training facilities maps as "P." No specific features, with the exception of Gigling Road, are identified on the 1945 and 1946 training facilities maps.

A review of the 1941 and 1949 aerial photographs indicates that the entire Parker Flats MRA contains numerous well used roads and trails. No other manmade structures or features within the Parker Flats MRA were readily identifiable. Features indicating a possible impact area (e.g., craters) are visible in the vicinity of Artillery Hill.

1950s Era

Review of 1950s era documentation, which included training maps and aerial photographs, identified several training areas within the Parker Flats MRA. The following identifies the results of the review.

- Circa-1954, the southern portion of the Parker Flats MRA is divided roughly in half with the western half assigned to the 10th Infantry and the eastern half assigned to the 2nd Infantry (*Army, 1954*). The northern portion of the Parker Flats MRA (north side of Gigling Road) was assigned to the 11th Infantry. Training areas identified on the map include the Parker Flats Training Areas (1, 2, and 3), Bivouac Areas E and F, Squad Defense Area, and a Chemical, Biological, and Radiological (CBR) training area. A Squad Tactics training area is present just outside (south) of the Parker Flats site and a concurrent training area associated with the Squad Tactics training area is present within the southern boundary of the site (Plate 6). Training areas identified in the northern portion of the Parker Flats MRA include the “Sinkhole Training Area” and a “Guard Duty Area” located on the north side of Gigling Road (*Army, 1954*).
- Three additional training areas are partially within the Parker Flats MRA on a 1956 training map, including a Field Fortification Area located along the north side of Parker Flats, a Field Battalion Training Area located on the west side of Parker Flats Cutoff, and a Mortar Square (MT Square #1) located on the south side of Gigling Road (*Army, 1956*).
- No additional training areas within the Parker Flats MRA are noted on the 1957 Training Area and Facilities maps (*Army, 1957*). The training areas present within the Parker Flats MRA are in the same approximate location as noted on the Circa-1954 map. The concurrent training area associated with the Squad Tactics training area and Parker Flats Training Areas 1, 2, and 3, are no longer identified on the 1957 map. In 1957 the Sinkhole Training Area is identified as the “Sinkhole Practice Mortar Range” and remains in the same location as on the earlier maps. The Guard Duty Area is also present in the same location as it was on earlier maps. A new feature, “Mortar Square #2,” is identified just to the north of the Guard Duty Area. This area was previously assigned to the 11th Infantry, but in 1957 was within the area assigned to the 3rd Brigade (*Army, 1957*). Mortar Square #1 was still present on the south side of Gigling Road. The area to the south of Gigling Road was assigned to the 2nd Brigade. The 2nd Brigade provided advanced individual training to infantry soldiers (*Army, 1968*).
- In 1958, the entire Parker Flats MRA was assigned to the 1st Brigade (*Army, 1958*). The mission of the 1st Brigade was to conduct basic combat training (*Army, 1968*). Training areas identified on the Circa-1954 and 1957 maps and present on the 1958 map in the same approximate locations include the Guard Duty Area, Mortar Square #1 and #2, Sinkhole Practice Mortar Range, Bivouac Areas E and F, Squad Defense Area, CBR Training Area, Field Fortification Area, and the Field Battalion Training Area (*Army, 1958*). A feature identified as “ST 1” is shown on the map near the intersection of Parker Flats Road and Parker Flats Branch Road (Plate 6). The activities associated with the use of “ST 1” are not known. A map created in late 1958 by the USACE identifies a “Practice Mortar Range” on the eastern side of the Parker Flats MRA (*USACE, 1958*), but does not show a range fan. The boundary of the Sinkhole Practice Mortar Range depicted on the December 1958 training facilities map differs from the boundary shown on the January 1958 and earlier maps (*USACE, 1958*). The January 1958 and earlier training facilities maps show the boundary as a rectangle where as the December 1958 training facilities map depict the boundary as oval in shape. The January 1958 map

indicates that the portion of MRS-13B that is south of Gigling Road was reassigned to the 1st Brigade.

No range fans, targets or other permanent features (e.g., trenches, obstacles, or buildings) were visible from the review of the 1951 aerial photographs. The 1951 aerial photograph coverage includes only the western most corner and northern portion of the Parker Flats MRA. A machine gun square or possibly a mortar square is visible on the 1956 aerial photos in the southwest corner of MRS-13B. This is adjacent to the location of a machine gun square (MG SQ #5) identified on the Circa 1954, 1956, 1957, and 1958 training facilities maps. It is possible that Machine Gun Square #5 is miss-located on the 1950s training facilities maps. Only the very western portion of MRS-13B is visible on the 1956 aerial photographs.

1960s Era

Review of 1960s era documentation, which included training maps and aerial photographs, identified several training areas within the Parker Flats MRA. The following summarizes the results of the review.

- Features present on the 1961 Training Facilities map that were also present on the 1958 Training Areas and Facilities maps include a CBR Training Area, ST 1, and the Practice Mortar Range (*USACE, 1961*). Bivouac Areas E and F, present in the same location since approximately 1954, are also shown on the 1961 Training Facilities map, but have moved to the southern portion of the Parker Flats MRA (Plate 6). The Squad Defense Area, Field Fortification Area, and the Field Battalion Training Area are no longer shown on the 1961 map. A training area not previously identified on training facilities maps (Dead Reckoning) is present on the west side of Artillery Hill. Dead reckoning is a land navigational technique (*Army, 1993*). One new training area (a Bayonet Assault Course [BAC]) is identified on the 1961 training facilities map within the northern portion of the Parker Flats MRA. A second training area “RGT” (possibly rifle grenade training) is located just to the north of MRS-13B (*USACE, 1961*) (Plate 6).
- In 1964, the majority of the Parker Flats MRA was assigned to the 1st Brigade and identified as areas of “g” and “j” (*Army, 1964*). A small portion was assigned to the 3rd Brigade and identified as area “i”. The mission of the 1st and 3rd Brigades was to conduct basic combat training (*Army, 1968*). 1st Brigade training areas identified on the 1964 map within area “j” include an Individual Tactical Training (ITT) site, the “1000 MTR” site (practice mortar training) located near where the practice mortar range was located on previous maps, a location labeled “FF” (Field Fortification) located along the north side of Parker Flats Road and a site labeled E & D #44 (Engineering and Demolitions) south of “1000 MTR”. No range fan is shown associated with the “1000 MTR” as is shown at live-fire training areas. The “1000 MTR” is thought to be a training area used for direct fire training by gun crew or indirect fire using a forward observer to adjust fire (*HLA, 2000a*). 1st Brigade training areas identified on the 1964 map within area g include Bayonet Training Area 1 (“BTA-1”), Bayonet Assault Course (“BAC”), Hand-to-Hand Combat Area 1 (“HHCA 1”), a physical training area (“PCPTA-2”), and an area identified as “TE 3d Bde” (3rd Brigade). The specific type of activities conducted at TE 3d Bde are not known. These training areas lie within MRS-13B. A small portion of MRS-13B lies on the south side of Gigling Road. Gigling Road is the dividing line between Training Area G and Training Area I. Training Area I was assigned to the 3rd Brigade. Several Bivouac areas are located within Training Area I, but are outside of the Parker Flats MRA.
- Training areas identified on the 1967 and 1968 training facilities maps are the same as those identified on the 1964 training facilities map and continued to be used by the 1st and 3rd Brigades.

In addition to numerous well developed roads and trails, several of the training areas identified on the 1960s era training maps are also visible on the 1965 and 1966 aerial photographs. Several structures within the Parker Flats MRA can also be seen.

1970s Era

Review of 1970s era documentation, which included training maps and aerial photographs, indicates that the Parker Flats MRA was assigned to the 1st Brigade (identified as Field Training Areas G and J) and the 3rd Brigade (identified as Field Training Area I) in the early 1970s (*Army, 1972*). The footprints of Field Training Areas G, I, and J changed in the mid-1970s. In 1976 Field Training Area G includes the majority of the northern portion of the Parker Flats MRA, Field Training Area I includes the western portion of the Parker Flats MRA and Field Training Area J includes the eastern portion of the Parker Flats MRA (*Army, 1976*). The following identifies the results of historical maps and aerial photographs' review.

- Training facilities identified on 1971 and 1972 training facilities maps in the Parker Flats MRA included physical training, hand to hand combat training, and bayonet training in the northern portion, Field Fortification, Individual Tactical Training and CBR training areas in the central portion, and Bivouac areas, Range 49 Land Mine Warfare, and E & D #44 (Engineering and Demolitions) in the southern portion (*Army, 1972*). One additional training area, a land navigation area, was possibly located in the very northern portion of MRS-13B on the 1972 training facilities map (*Army, 1972*). However, because of the scale of the training facilities map, it cannot be determined if the land navigation area does fall within the boundary of the site.
- Training facilities identified on the 1976 and 1978 training facilities maps included a Helicopter Mockup Area, C-141 and C-5A Air Mobility Training Areas, and a CBR training area within Field Training Area I, and Range 49 and Bivouac Area E within Field Training Area J. Additionally, a TOW (Tube-Launched Optically-Tracked Wire-Guided) Tracking Area was possibly located in the southern portion of Field Training area J on the 1978 training facilities map (*Army, 1978*). However, the specific boundary of the TOW Tracking Area is not delineated on the training facilities map.
- Development, including grading, excavating, facilities construction, and paving occurred in the west central portion of MRS-13B beginning in 1977. Additional construction of facilities occurred in 1980 and 1985 adjacent to the facilities constructed in 1977. The total area of development covers 35.5 acres of MRS-13B. Construction within MRS-13B occurred in areas previously identified in the 1950s and 1960s as the Guard Duty Area, Mortar Square #2 and the physical training area (PCPTA-2).

1980s Era

Review of 1980s era documentation, which included training maps and aerial photographs, identified several training areas within the Parker Flats MRA. In 1981, the Parker Flats MRA continued to include portions or all of three Field Training Areas (Training Areas G, I and J; *Army, 1981*). Training Area G included the northern and central portion of the Parker Flats MRA (north side of Parker Flats Road). Training Area I included the northwest portion of the Parker Flats MRA. Training Area J included the area to the east of Training Area I which is north of Eucalyptus Road, east of Watkins Gate Road and south of Parker Flats Road. Training facilities identified on the 1980s training maps within the Parker Flats MRA included:

- Hand to hand combat training area, circuit interval running course (PCPTA-2), CBR training area and C-141 and C-5A Air Mobility Mock-Ups (Field Training Area G)

- A Litter Obstacle Course (qualification for the Expert Field Medical Badge [EFMB]) and an Aircraft Rappelling area (Field Training Area I)
- Anti-Armor training area and possibly a TOW Tracking Area (Field Training Area J). The TOW Tracking Area was located in the vicinity of the southern boundary of Field Training Area J.

Several of these training areas are also apparent on the 1985 and 1988 aerial photographs.

3.3 History of Munitions Response Program Investigations

The following describes the MR investigations that have been conducted at the Parker Flats MRA (MRS-3, MRS-4B, MRS-13B, MRS-27A, MRS-27B, MRS-27G, MRS-37, MRS-40, MRS-50, MRS-52, MRS-53, MRS-54EDC, and MRS-55). Appendix B contains a listing of the military munitions, both MEC and munitions debris found during the MR investigations described below. The database was updated between the draft and draft final documents as a result of ongoing QC efforts. Changes to the database include nomenclature modifications, and identification of risk codes for some items that did not previously have assigned risk codes.

1993 Archives Search Report (ASR)

The purpose of the Archives Search conducted at Fort Ord was to gather and review historical information to determine the types of munitions used at the site, identify possible disposal areas, identify unknown training areas, and recommend follow-up actions. Guidance for conducting archives searches did not exist prior to 1995. The 1993 ASR was completed based on the Scope of Work provided to the St. Louis Corps of Engineers by the Huntsville Corps of Engineers, and on archive search reports completed at other military installations. The Archives Search included a Preliminary Assessment/Site Investigation (PA/SI) consisting of interviews with individuals familiar with the sites, visits to previously established sites, reconnaissance of newly identified training areas, and reviewing data collected during sampling or removal actions. Requirements for preparation of an ASR are described in Section 2.0 of this report.

Of the MRSs within the Parker Flats MRA, only MRS-3, MRS-4B, and MRS-13B were identified in the 1993 ASR (*USAEDH, 1993*). According to the ASR, MRS-3 (Range 49, Old Demolition area) was identified based on review of historical maps and interviews and was used for landmine warfare, anti-armor, Molotov Cocktail, and demolition training. A site visit was conducted and two blackened areas that previously contained armored vehicles (Molotov Cocktail targets) were observed. Only the approximate location of the demolition area was identified. The recommendation in the ASR was that “a surface range sweep should be made to determine the presence of UXO.”

MRS-4B (CBR Training Area) was identified based on the review of 1957 and 1958 training maps and reported in the Enhanced Preliminary Assessment (*Weston, 1990*). This site was used to train troops in the proper use of gas masks. The ASR recommended that the site be checked for tear gas agent residue (*USAEDH, 1993*).

MRS-13B was identified during the review of historic maps conducted for the 1993 ASR. According to the ASR, MRS-13B (Practice Mortar Range) was used for mortar practice in the 1940s and 1950s. It was believed that only practice ammunition and sabot trainers were used (*USAEDH, 1993*). The ASR recommended that spot sweeps be conducted at the site.

1994 HFA Investigation

HFA conducted military munitions sampling investigation of MRS-3, MRS-4B, and MRS-13B in 1994. The HFA sampling methodology is discussed in Section 3.5.2.3. All three sites were 100 percent sampled to a depth of 3 feet (all anomalies detected were investigated to a depth of 3 feet and deeper anomalies were investigated as directed by the USACE UXO Safety Specialist). All sample grids were geophysically investigated using the Schonstedt Model GA-52/C or the GA-72/Cv magnetometers with a maximum search lane width of 5 feet (HFA, 1994). The grid locations are approximate and were digitized from hard copy maps in the HFA After Action Report. Because the locations are approximate, the locations are not provided in this report.

At MRS-3, twenty-three 100- by 100-foot grids were sampled. The sample grids were placed within and adjacent to the site. Two MEC items, a blasting cap and a M604 practice mine fuze, and 246 munitions debris items were found and removed from MRS-3 (Appendix B).

At MRS-4B, six 100- by-100-foot grids were sampled. The sample grids were placed within and adjacent to the site. One MEC item, a 40mm practice projectile, and 2 MD items were found and removed. Additionally, fifty-eight small arms cartridges were found. Based on the sampling results, a 4-foot removal was recommended in accordance with the Final Phase I EE/CA (USAESCH, 1997). MEC and MD removed is provided in Appendix B.

At MRS-13B, fifty-seven 100- by 100-foot grids were sampled. The sample grids were placed within the expanded site boundary. Five hundred and ninety-one MEC and 175 munitions debris items were found and removed from MRS-13B (Appendix B). Based on the sampling results, a 4-foot removal was recommended in accordance with the Final Phase I EE/CA (USAESCH, 1997).

Following the sampling conducted at MRS-13B, the northern portion of MRS-13B (approximately one third of the site) was incorporated into the boundary of the newly established MRS-31 (Site CSU). MRS-31 lies directly to the north of MRS-13B. Because there are no records documenting specifically which grid the military munitions items were found, it is not know whether those items found during the sampling of MRS-13B were located within MRS-13B or MRS-31.

The scope of work for HFA indicated that a detailed accounting of all military munitions encountered would be performed. However, grid records providing this information are no longer available. Existing information regarding items found is summarized in the text of the HFA *OEW Sampling and OEW Removal Action* (HFA, 1994). The report itemized munitions debris found and removed. Some range related debris was also removed and turned in at the end of the project. Contract requirements for the scope of work performed by HFA are described in more detail in Section 2.0 of this report.

1994 Archives Search Report (ASR) Supplement 1

The ASR Supplement 1 was performed for the purpose of evaluating additional historical maps and information obtained from on-going research (e.g., interviews, archive searches and site visits) and remediation activities pursuant to the basic ASR for Fort Ord. MRS sites identified after submittal of the 1993 ASR included MRS-27A, MRS-27B, and MRS-27G. These three sites were part of a group of 25 training sites noted on a 1984 training facilities map (USAEDH, 1994). One of the 25 training sites, Training Site 17 (OE-27Q), was chosen at random to survey for the presence of military munitions. Blank casings, grenade safety levers, and a grenade fuze (M201A1) were identified. Based on this review, further investigation was recommended for each of the 25 training sites (including MRS-27A [Training Site 1], MRS-27B [Training Site 2], and MRS-27G [Training Site 7]) identified during the archives search process (USAEDH, 1994).

1997 Revised Archives Search Report (ASR)

The Revised ASR combined information obtained through the previous archive searches with the results of a PA/SI conducted by the USACE. The PA/SI consisted of interviews with individuals familiar with the sites, visits to previously established sites, reconnaissance of newly identified training areas, and the review of data collected during sampling or removal actions. The Revised ASR was conducted in accordance with USACE guidance (*USACE, 1995a*). Requirements for preparation of an archives search are described in Section 2.0 of this report.

The revised ASR included a review of the sampling investigations conducted in 1994 by HFA and the TCRAs being conducted by USA. Based on the sampling results at MRS-3 and MRS-4B, 4-foot removals were recommended in accordance with the Final Phase I EE/CA (*USAESCH, 1997*). Because a TCRA was in progress at MRS-13B, no specific recommendations were made for this site in the Revised ASR (*USAEDH, 1997*).

Several new MRSs were identified in the Revised ASR and are located within the Parker Flats MRA including MRS-37, MRS-40, MRS-50, MRS-52, MRS-53, MRS-54EDC, and MRS-55. The site descriptions and Revised ASR recommendations are described below.

MRS-37 (Parker Flats Mortar Range) was identified on an undated map supplied by the Fort Ord Fire Department. MRS-37 lies immediately adjacent to MRS-3, MRS-54EDC, and MRS-55. MRS-37 was reportedly used for firing practice mortars or in nonfiring drills (dry-fire). Although MRS-37 had not undergone any type of MR investigation, a site walk conducted in 1996 by a USACE UXO Safety Specialist of adjacent MRS-55 identified an expended 75mm shrapnel projectile, a mine fuze (unknown model), and two 37mm practice fragments (munitions debris). On this basis the Revised ASR recommended that MRS-37 be investigated further as part of MRS-55.

MRS-40 (Parker Flats Gas House) lies partially within and immediately adjacent to MRS-50. MRS-40 was a CBR training area which was used to train troops in the use of gas masks. Based on the possible presence of tear gas agents, additional site investigation was recommended.

MRS-50 (Artillery Hill) was identified during interviews conducted during the PA/SI phase of the Fort Ord Archives Search (*USAEDH, 1997*). The area identified as "Artillery Hill" was reportedly used as a target area for rifle grenades (unknown type) and other shoulder-launched projectiles (unknown type) in the 1940s, 1950s, and 1960s. A site walk was conducted in 1996 by the USACE UXO Safety Specialist which included walking a portion of the site and sweeping the path walked using a Schonstedt Model GA-52/Cx magnetometer. During the site walk, munitions debris consisting of "fragmentation from 37mm and 75mm high explosive projectiles" (1920s-30s era) was found on the southwest slope of Artillery Hill. Expended signal flares were also reportedly found. On this basis of the site walk, an overall site investigation including sampling was recommended in the Revised ASR.

MRS-52 (Rifle Grenade and Projectile Target Area) was identified during interviews conducted during the PA/SI phase of the Fort Ord Archives Search (*USAEDH, 1997*). The location was reportedly used as a rifle grenade (unknown type) and shoulder-launched projectile target area (unknown type). A site walk was conducted in 1996 by the USACE UXO Safety Specialist which involved walking portions of the sites and sweeping the path walked using a Schonstedt Model GA-52/Cx magnetometer. During the walk in the central and northern portion of MRS-52, no evidence of MEC were observed, only expended blank small arms ammunition was found. During the walk of the southern portion of MRS-52, munitions debris consisting of fragmentation from 37mm projectile and three M10 practice antitank (AT) mines were found. On the basis of the site walk, further site investigation and sampling in the vicinity of the AT mine was recommended in the Revised ASR.

MRS-53 (Shoulder-Launched Projectile Area) was identified during interviews conducted during the PA/SI phase of the Fort Ord Archives Search (*USAEDH, 1997*). The site was reported to have been used in the 1940s, 1950s, and 1960s, for the firing of rifle grenades (unknown type) and ground/tube launched projectiles (unknown type). Site walks were conducted by the USACE UXO Safety Specialist. The reconnaissance involved walking portions of the sites and sweeping the path walked using a Schonstedt Model GA-52/Cx magnetometer. During the site walks, munitions debris consisting of portions of 3-inch Stokes mortars, an expended 75mm shrapnel projectile, and other projectile fragmentation was discovered. On the basis of the site walk, the Revised ASR recommended further site investigation and sampling at MRS-53.

MRS-54EDC is the portion of MRS-54 that lies within land that is slated for development. MRS-54 (Canyon Target Area) was identified during interviews conducted during the PA/SI phase of the Fort Ord Archives Search (*USAEDH, 1997*). The site was described as two canyons, southern canyon and northern canyon. Only the northern canyon lies within MRS-54EDC. The site as described in the interview also includes adjacent MRS-3 and MRS-54. The area as described was reportedly used for flame throwers and was also a firing point and range for hand grenades (unknown type), rifle grenades (unknown type), shoulder-launched projectiles (unknown type) and artillery (unknown type). A site walk was conducted in 1996 by the USACE UXO Safety Specialist. During the site walk munitions debris including a 2.36-inch practice rocket, two 75mm shrapnel projectiles, three 81mm practice mortars, two illumination signals, two tear gas grenades and unknown pyrotechnics were found. On this basis, the Revised ASR recommended further site investigation and sampling at MRS-54.

MRS-55 (Parker Flats) was identified during interviews conducted during the PA/SI phase of the Fort Ord Archives Search (*USAEDH, 1997*). The site was reported to have included a firing point and range for hand grenades, rifle grenades, shoulder-launched projectiles and artillery. It is unknown whether practice or high explosive munitions were authorized for use. This site includes portions of MRS-27A (TS-1) and MRS-27B (TS-2). During the site walk munitions debris consisting of shrapnel from a 75mm shrapnel projectile, two 37mm practice projectile fragments, and one mine fuze (condition and type not documented) were discovered. On this basis, the Revised ASR recommended further site investigation and sampling at MRS-55.

USA Environmental (USA/CMS)

Sampling and removal investigations conducted within the Parker Flats MRA were conducted by CMS and USA. In June 1998 CMS was purchased and USA became the company responsible for conducting the military munitions investigations at the former Fort Ord. For the purpose of clarity, USA will be referenced as having conducted the work at these sites. Contract requirements for the scope of work performed by USA are described in Section 2.0 of this report.

MRS-3

Based on the MRS-3 sampling results, a 4-foot removal was recommended in accordance with the Final Phase I EE/CA (*USAESCH, 1997*). In March of 1998, USA conducted a 4-foot removal (all anomalies detected were investigated using the Schonstedt Model GA-52/Cx magnetometer at MRS-3 (Plate 6). The removal action was performed over fifty-eight (58) 100- by 100-foot grids and partial grids. A total of one hundred sixty-seven (167) MEC items and three hundred twelve (312) MD items were found and removed (*USA, 2000b*). A list of all MEC and MD discovered at MRS-3 is provided in Appendix B. Items found at the site were consistent with the reported historical use of the site for practice mortar training, demolition training, landmine warfare, anti-armor training.

MRS-4B

In order to determine the necessity of conducting a removal action at MRS-4B, USA performed a subsurface sampling investigation (SiteStats/GridStats sampling; SS/GS). In December of 1997, five (5) 100- by 200-foot sample grids were established at MRS-4B. According to the work plan, the grids were surveyed using a Schonstedt GA-52/Cx magnetometer with a maximum search lane width of 5 feet. Following the survey, anomalies were selected for sampling following the SS/GS procedures. Three MEC items (smoke grenades) and several munitions debris items were found during GridStats sampling operations in MRS-4B. Based on the sampling results, a decision was made to conduct a 4-foot military munitions removal over all of MRS-4B. The site was subdivided into forty-eight (48) 100- by 100-foot removal grids. A 4-foot removal was conducted (all anomalies detected were investigated using the Schonstedt Model GA-52/Cx magnetometer; Plate 6). A total of two hundred and eleven (211) MEC items and two hundred and ninety-three (293) MD items were found and removed (*USA, 2000a*) (Appendix B). Most of the items found at the site were consistent with CBR training (grenades containing irritant smoke) and general training and maneuvers (simulators, illumination and smoke signals, blasting caps, and fuzes).

MRS-13B

Based on the MRS-13B sampling results, a 4-foot removal was recommended in accordance with the Final Phase I EE/CA (*USAESCH, 1997*). From August 1995 to April of 1998, USA conducted a 4-foot removal (all anomalies detected were investigated) using the Schonstedt Model GA-52/Cx magnetometer at MRS-13B (Plate 6). Portions of MRS-13B were either not geophysically investigated or only underwent a surface geophysical investigation. Thirty-five and one-half acres of MRS-13B, the Army Maintenance Center, could not be evaluated because of the presence of asphalt pavement and structures within the parcel. A small portion of the Army Maintenance Center (approximately 1 acre) underwent a surface clearance only due the proximity of metal fencing and underground utilities. Additionally, approximately 7 grids within the Park and Ride was also not geophysically investigated due the presence of asphalt pavement (Plate 6). The removal action was performed over six hundred fifty-four (654) 100- by 100-foot grids and partial grids. A total of two hundred sixty-seven (267) MEC items and one thousand three hundred ten (1,310) munitions debris items were found and removed (*USA, 2000c*). A significant number of the munitions debris items were expended 3.5-inch practice rockets found in burial pits. A list of all MEC and munitions debris discovered at MRS-13B is provided in Appendix B. MEC items found and removed included rockets, pyrotechnics (simulators, flares and signals), smoke grenades, fuzes, and projectiles of various sizes. Numerous burial pits were discovered during the removal conducted at MRS-13B. Items found in burial pits included fuzes (grenade and mine), firing devices, flares (signal, illumination and smoke), rockets, smoke grenades (rifle and hand), blasting caps, simulators, and rifle grenades. These items were found at depths ranging from a few inches bgs to 48 inches bgs and included both DMM and MD (Appendix B). On the basis of the results of the removal, no further action was recommended (*USA, 2000c*).

During the removal action at MRS-13B, two partial Chemical Agent Identification Sets (CAIS) were found. Two cardboard tubes containing 12 intact glass vials each were discovered adjacent to metal canisters buried at depths of 1 and 1.5 feet. The sets were removed by the Technical Escort Unit dispatched from Dugway Proving Ground, Utah. On the basis of the initial chemical analysis of the 24 vials, 12 vials were disposed through the Fort Ord Defense Reutilization and Marketing Office (DRMO) and the remaining 12 vials were transferred to Aberdeen Proving Grounds, Maryland for further analysis.

MRS-37

Based on the results of a site walk conducted by a USACE UXO Safety Specialist of adjacent MRS-55, additional characterization was conducted at MRS-37. SS/GS sampling was completed to determine the extent of military munitions contamination.

In March 1998, ten 100- by 200-foot sample grids were established at MRS-37. According to the contractor work plan, the grids were surveyed using a Schonstedt GA-52/Cx magnetometer with a maximum search lane width of 5 feet. Following the survey, anomalies were selected for sampling following the SS/GS procedures. GridStats sampling operations in MRS-37 involved the sampling and identification of eighteen hundred thirty-three (1,833) anomalies within the 10 grids. No MEC items were found during SS/GS sampling. Twenty-nine pounds of MD were also removed. In order to determine the necessity of conducting a 4-foot removal action at MRS-37, 100 percent grid sampling was performed around the GridStats grids with significant amounts of munitions debris.

In June of 1998, 100 percent grid sampling was performed (all anomalies detected were investigated) on eighteen (18) 100- by 100-foot sample grids using Schonstedt Model GA-52/Cx magnetometers (Plate 6). The 18 grids were established as two blocks of nine grids measuring 300- by 300 feet (Plate 6). Two MEC items, an illumination signal and 37mm projectile, and 84 pounds of MD were removed during 100 percent grid sampling. Based on the sampling results a decision was made to conduct a 4-foot removal over all of MRS-37. The site was subdivided into two hundred-forty (240) 100- by 100-foot removal grids. A 4-foot removal was conducted (all anomalies detected were investigated) using the Schonstedt Model GA-52/Cx magnetometer (Plate 6). A total of fifty MEC items and over 1,100 MD items were found and removed (*USA, 2001a*) (Appendix B).

MRS-40

In order to determine the necessity of conducting a removal action at MRS-40, USA completed a subsurface sampling investigation SS/GS. In October 1997, the boundary of MRS-40 was surveyed and two 100- by 200-foot sample grids were established. The total area of MRS-40 is approximately 1.7 acres and the two sample grids cover over half of the site. According to the contractor work plan, the grids were surveyed using a Schonstedt Model GA-52/Cx magnetometer with a maximum search lane width of 5 feet. A total of 151 samples were collected consistent with accepted SS/GS procedures. No MEC items were found and three munitions debris items (unknown fragments) were found and removed (*USA, 2001b*). Nothing was found during sampling to indicate that MRS-40 was used as a CBR training area. All of MRS-40 was later incorporated into the MRS-50 removal action. All grids within MRS-40 underwent a removal action.

MRS-50

In 1998, USA completed a subsurface sampling investigation of MRS-50. The contractor sampling methodology is discussed in Section 3.5.2.3. Twenty-two 100- by 100-foot grids were 100 percent sampled (all anomalies detected were investigated) using a Schonstedt Model GA-52/Cx magnetometer (Plate 6). Twenty-six MEC items and 149 pounds of MD were found and removed. Of the 26 MEC items found, two were penetrating projectiles; a MK I 75mm Shrapnel projectile found at a depth of 1 foot, and a 3-inch Stokes practice mortar found at a depth of 1.5 feet. Based on the results of sampling, a 4-foot military munitions removal operation was performed by USA at MRS-50 starting in September 1998 and continuing through December 2000. Removal operations were conducted on the remaining unsampled grids, consisting of one hundred and sixty-six (166) 100- by 100-foot grids and sixty-one (61) partial grids within MRS-50. As the removal grids within the boundary of MRS-50 were completed, a protocol was developed by the USACE and USA to be used to investigate military munitions detected at

the boundary of a site. The protocol specified conducting additional removal/sampling 200 feet beyond the location of any projected military munitions and 100 feet beyond the location of all thrown or placed military munitions (*USA, 2001c*). The protocol also considered significant discovery of munitions debris as reason for additional removals/sampling of the surrounding area. Following this protocol added approximately 85 acres to the investigation conducted at MRS-50 (MRS-50 expansion). The expansion of the investigation of MRS-50 extended west to Parker Flats Cut Off Road, east to the boundary of MRS-53, south to Eucalyptus Road (including MRS-40), and to the north to an arbitrary line established by the USACE (Plate 6). The MRS-50 expansion included the removal of MEC and munitions debris within a few grids on the west side of Parker Flats Cut Off Road (outside of the MRA, within and adjacent to MRS-44). However, a decision was made to not continue the investigation of MRS-50 beyond the MRA under the current removal contract. During the removal conducted within the MRS-50 expansion area, nine hundred thirty-six (936) MEC items were found and removed (*USA, 2001c*). The majority of these items were non-penetrating (e.g., pyrotechnics, grenades, and grenade and projectile fuzes). The penetrating MEC items found included projectiles, rifle grenades, and rockets. Numerous burial pits were discovered during the removal conducted at MRS-50. Items found in burial pits included grenade fuzes, illumination signals, ignition cartridges, simulators, and hand grenades (practice and smoke). The items were detected at depths ranging from a few inches bgs to 48 inches bgs and included both DMM and MD (Appendix B). The AAR indicated that while not probable, it is possible that DMM is buried beyond the detection capabilities of the Schonstedt Model GA-52/Cx, and may remain at MRS-50 and the MRS-50 expansion areas. The AAR also stated that there was a strong indication that penetrating MEC could be beneath the surface of Parker Flats Cut-Off and Eucalyptus Road.

MRS-53

In June 1998, USA performed a subsurface sampling investigation of MRS-53. This action was completed by USA. The contractor sampling methodology is discussed in Section 3.5.2.3. Fifty-two 100- by 100-foot grids were 100 percent sampled (all anomalies detected were investigated) using a Schonstedt Model GA-52/Cx magnetometer (Plate 6). Nineteen MEC items and 453 pounds of MD were found and removed. Ten of the MEC items were practice mortars and the remainder were non-penetrating pyrotechnics and explosives (*USA, 2001d*).

Based on the sampling results, a 4-foot removal was conducted by USA over all of MRS-53 beginning in September 1998 and continuing through December 2000. Removal operations were conducted on the remaining unsampled grids, consisting of one thousand three hundred and five (1,305) full and partial grids within MRS-53. As the removal grids within the boundary of MRS-53 were completed the expansion protocol procedures developed jointly by the USACE and USA was used to investigate military munitions detected at the boundary of a site (*USA, 2001d*). Following the expansion protocol added approximately 192 acres to the investigation conducted at MRS-53 (MRS-53 expansion). The expansion of the investigation of MRS-53 extended west to the MRS-50 removal boundary, east to the western boundaries of MRS-3, MRS-37 and MRS-55 (including MRS-52), southeast to the BLM property boundary, south to Eucalyptus Road (including MRS-27G), and to the north to an arbitrary line established by the USACE (Plate 6). During the removal conducted within MRS-53 and the MRS-53 expansion area, one thousand two hundred and ninety-one (1,291) MEC items were found and removed (*USA, 2001d*). The MEC found included non-penetrating items (e.g., pyrotechnics, grenades, and grenade and projectile fuzes) and projectiles the majority of which were 3-inch Stokes practice mortars. Numerous burial pits were discovered during the removal conducted at MRS-53. Items found in burial pits included fuzes (grenade, mine, time, and projectile), signals, practice mines (antitank and antipersonnel), projectile simulators, hand and rifle grenades (practice and smoke), and practice rockets (Appendix B). These items were detected at depths ranging from a few inches bgs to 48 inches bgs and included both DMM and MD (from database). The AAR indicated that while not probable, it is possible that DMM is buried beyond the detection capabilities of the Schonstedt Model GA-52/Cx and may

remain at MRS-53 and the MRS-53 expansion areas. The AAR also stated that there is a strong indication that penetrating MEC could be beneath the surface of Parker Flats Road and Eucalyptus Road.

MRS-54EDC

In March 1999, USA sampled MRS-54EDC. The CMS sampling methodology is discussed in Section 3.5.2.3. Seven 100- by 100-foot grids (70,000 square feet) were 100 percent sampled (all anomalies detected were investigated) using the Schonstedt Model GA-52/Cx magnetometers. Four non-penetrating MEC items and 16 munitions debris items were removed during sampling (Appendix B) (USA, 2001e). The non-penetrating MEC items were found at depths ranging from 6 inches to 3 feet bgs. On the basis of the results of site sampling, a 4-foot removal was conducted over all of MRS-54EDC in beginning in June 1999. MRS-54EDC was surveyed and the site was divided into eighty-three (83) 100- by 100-foot grids and partial grids. A 4-foot removal was conducted (all anomalies detected were investigated) using the Schonstedt Model GA-52/Cx magnetometer (Plate 6). Fourteen non-penetrating MEC items were removed (USA, 2001e). In addition, numerous MD items were also removed (Appendix B).

MRS-55

Based on the results of a site walk conducted by a USACE UXO Safety Specialist of MRS-55, additional characterization was conducted at the site. SS/GS sampling was completed to determine the extent of contamination. In March 1998, twenty-three 100- by 200-foot sample grids were established at MRS-55. An area equivalent to nineteen (19) 100- by 200-foot grids were surveyed using a Schonstedt Model GA-52/Cx magnetometer with a maximum search lane width of 5 feet. Following the survey, anomalies were selected for sampling following the SS/GS procedures. A total of six MEC items (four practice grenade fuzes, an illumination signal and a rifle fired smoke grenade) and eleven MD items were found and removed (Appendix B). Based on the results of the SS/GS sampling a decision was made to conduct a 4-foot removal at MRS-55. Starting in March 1999, USA began conducting a four-foot military munitions removal on two hundred eighty-two (282) 100- by 100-foot grids and partial grids. The removal effort stopped at the boundary of MRS-55. A total of one hundred forty-four (144) MEC items and 1,779 MD items were found and removed during the 4-foot sampling completed at MRS-55 (all anomalies detected were investigated) (Appendix B) (USA, 2001f). Of the 144 MEC items, only five were penetrating items (40mm and 37mm projectiles). The remainder of the MEC items were fuzes, signals (flares and illumination), simulators, hand grenades (smoke, riot, and practice), and pyrotechnic mixtures. Numerous burial pits were discovered during the removal conducted at MRS-55. Items found in burial pits included grenade fuzes, signals, projectile simulators, smoke pots, and rifle grenades (practice). These items were detected at depths ranging from a few inches bgs to 36 inches bgs and included both DMM and MD. The AAR indicated that while not probable, it is possible that discarded military munitions buried beyond the detection capabilities of the Schonstedt Model GA-52/Cx, may remain at MRS-55 (USA, 2001f).

FIELD LATRINES

In addition to the removal actions within the Parker Flats MRA, USA also performed investigation and removal of MEC within the Field Latrines at the former Fort Ord. The scope of work (SOW) for this task required the following: "Check latrine pit with hand-held magnetometer/visual inspection to locate OE and suspect items. Removal and disposal of any OE items encounters, (Removal and disposal of latrine structures and back filling the latrine pits will be performed by another contractor.)".

USA located un-surveyed latrines using GPS survey equipment, and conducted removal operations at 52 of the 132 identified field latrines. Review of the USA report indicates that 12 latrines were present within the Parker Flats MRA and that 10 of the latrines were investigated. No MEC or MD was

discovered in the 10 investigated latrines (USA, 2001i). The removal actions at the latrines was not completed due to issues with potential for hazardous materials associated with the latrine structures.

3.4 Conceptual Site Models

Conceptual site models (CSMs) are generally developed during the preliminary site characterization phase of work to provide a basis for the sampling design and identification of potential release (functioning of the MEC item; e.g., detonation) and exposure routes. CSMs usually incorporate information regarding the physical features and limits of the area of concern (the site), nature and source of the contamination (in this case MEC), and exposure routes (potential scenarios that may result in contact with MEC).

The CSMs for the Parker Flats MRA are based on currently available site-specific removal data and general information including literature reviews, aerial photographs, maps, training manuals (AR 385-63, *Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat*; available field and technical manuals [FMs and TMs]), field observations, and the information shown on Plates 3 through 15. The CSMs address training practices that occurred within the Parker Flats MRA from acquisition of the property by the Army through base closure. The practices are discussed by eras of use and include discussions of the following types of training: 1) 37mm projectile; 2) 75mm projectile; 3) practice Stokes mortar; 4) Livens projector; 5) 60mm and 81mm mortar; 6) rifle grenade; 7) practice hand grenade; 8) fragmentation hand grenade; 9) bivouac; 10) practice mortars; 11) CBR; 12) general training and maneuvers; 13) practice mines; 14) booby trap training; 15) 3.5-inch rocket training; 16) anti-armor demolition training; and 17) TOW tracking training. The CSM also addresses the potential sources and locations of MEC based on the distribution of MEC and MD discovered and removed from the site. They are provided to help evaluate the adequacy of the investigation completed to date and to identify potential release and exposure pathways.

Plate 16 presents a graphical view of the CSMs for the Parker Flats MRA. The plate shows the types of training that occurred historically, representations of the distribution of ordnance before and potentially still remaining after removal, and the planned reuses for the area.

3.4.1 Training Practices

Training practices are discussed below to provide information on the types of military munitions that may have been used at the site and the possible locations of MEC potentially remaining at the site.

Pre World War II Training

Little documentation of pre World War II (WWII) training activities at the former Fort Ord is available. Footage from a 1938 film entitled *A Year on a Calvary Post, 1938 – 11th Calvary, Presidio, Monterey, CA*, National Archives footage from 1940 and topographic maps from 1918, 1933, and 1938 were available for review (*DOI, 1918; Army, 1933 - 1934, 1938*). No training maps are available from this time period. A set of aerial photographs from 1941 are available and have been used in the review. Some of the information is based on information presented in *The American Arsenal (Hogg, 2001)*. The types of training likely to have occurred based on review of the literature and the removal action results are presented below. Because the northern portion of the Parker Flats MRS (north of Gigling Road) prior to 1940 was privately owned agricultural land, it is unlikely that this area was used for military training until after this time. This conclusion is supported by the fact that very few military munitions available for use during this era were found within the northern portion of the Parker Flats MRA (MRS-13B) during the removal investigation.

37mm Training

37mm projectiles as either fragments, MD or MEC that were found throughout the southern portion of the Parker Flats MRA include the low explosive Mk I and Mk II, the high explosive M54 and the M63A1 target practice (Plate 3). The distribution of the 37mm projectiles found is discussed further in Section 3.4.3. 37mm guns that may have been used in the southern portion of the Parker Flats MRA include the M3A1 light antitank weapon. The M3A1 was capable of firing High Explosive (HE), antipersonnel, and canister projectiles. The gun has a maximum range of 12,800 yards when firing the high explosive projectile (*Hogg, 2001*).

The M1916 gun, with an M5 Subcaliber mount for 37mm munitions was used for training in the firing of the 75mm Howitzer M1A1 and may also have been used at the site. The M1916 gun and its recoil mechanism were fastened to the 37mm Subcaliber Mount, M5, and used for training in the handling and firing of the 75mm Howitzer M1A1 (*Hogg, 2001*).

Only one 37mm M63 projectile (MEC) was found in the northern portion of the Parker Flats MRA (MRS-13B). No other evidence of the use of 37mm projectiles in this area was found.

75mm Training

Evidence of 75mm projectiles as fragments, MD, or MEC that were found throughout the southern portion of the Parker Flats MRA include the MK I shrapnel and high explosive, M41A1 high explosive, M48 high explosive, M309 high explosive and the M19 drill (Plate 4). The distribution of the 75mm projectiles found in the Parker Flats MRA is discussed further in Section 3.4.3. The models of guns available to U.S. Army forces prior to WWII and through the 1940s, that may have been fired within or into the southern portion of the Parker Flats MRA include the Model 1897, 1897A2, 1897A4 (French), M1916 (American), M1917 (British) and the 75mm Field Howitzer (*Hall, 2004*). The 75mm field howitzer is a light artillery piece used by horse artillery. Later models included modifications to the carriage to allow for towing at higher speed. Ammunition fired by the 75mm field howitzer included high explosive M41A1 and M48. Maximum range was 9,760 yards with the M41A1 projectile (*Hogg, 2001*). The French made M1897 was considered the most effective field gun used in World War I (WWI) and the standard for light field artillery. Maximum range of the M1897 was 9,200 yards. However, gun carriage modifications increased the maximum range to 13,870 yards (*Hogg, 2001*). Ammunition fired by these guns and found in the southern portion of the Parker Flats MRA include the MK I and M48 high explosive projectiles and the MK I shrapnel projectile. The M1916 and M1917 75mm guns are the American and British, respectively, manufactured versions of the M1897 75mm gun. Modifications to the guns enabled them to fire the same projectiles as the French guns. These models were taken out of service in 1940 and declared obsolete in 1945.

No 75mm projectiles were found in the northern portion of the Parker Flats MRA (MRS-13B).

Practice Stokes Mortar

Practice 3-inch Stokes mortars were found as MEC and MD primarily in the low-lying areas of the southern portion of the Parker Flats MRA (Plate 5). Additional information on the distribution of the practice Stokes mortars is provided in Section 3.4.3. The Stokes mortar was developed by the British during WWI for use in trench warfare. The mortar fires its projectile at a high angle so that it falls almost straight down on the enemy. The advantage offered by the mortar was that troops were able to fire it from battlefield trenches without exposing the mortar crew to direct enemy fire. The mortar is also lighter making it more mobile than artillery pieces. Early models of the weapon had a maximum range of approximately 800 to 1,100 yards (*Canfield, 2000*). The Stokes mortar projectiles were initially

unstabilized (i.e., no tail fins) and fell to the target with a tumbling motion (end-over-end). Despite this, the mortar was accurate at short range. Unstabilized mortars used an “all ways” fuze which were designed to detonate regardless of the velocity or angle that the tumbling projectile landed. The Mark III practice projectile was used for training purposes. The practice projectiles contain approximately 2 pounds of sand and a black powder charge which produces a puff of white smoke upon impact. The Mark III practice projectile simulates the weight and ballistic performance of the Mark I high explosive projectile (*Canfield, 2000*). Fin-stabilized projectiles were developed after WWI which increased mortar range.

No Stokes mortars were found in the northern portion of the Parker Flats MRA (MRS-13B).

Livens Training

The Livens projector, developed by the British near the end of WWI, was used to deliver liquid chemical agent into enemy lines. The projector was a cylinder with a central tube which contains a small explosive charge detonated by a contact fuze (*Smart, 1997*). The projector held approximately 30 pounds (lbs) of agent, typically phosgene or smoke compound. The projector (gun) consisted of a simple steel tube enclosed and rounded at one end, about 8.5 inches in diameter and approximately 3 feet in length. The bottom end of the projector was buried in the ground with the open end pointing toward the enemy at an angle of 45 degrees. The bottom of the projector sat atop a base plate consisting of a curved metal disc which improved stability and absorbed projector recoil. Projector range could be controlled by the length of the projector tube, quantity of the propellant charge, or the angle of projector burial and was typically 1,700 yards (*Smart, 1997*). One smoke producing Livens projector (MEC) and over 100 lbs of Livens projector fragments were found within the southern portion of the Parker Flats MRA. All of the projector fragments were found along the southern boundary of the southern portion of the Parker Flats MRA, on Grant Ewing Ridge. The Livens Projector was found on the southern slope of Artillery Hill (Plate 5). No Livens projectors with chemical agent were found at former Fort Ord. Film footage obtained from the National Archives shows Fort Ord troops firing Livens Projectors in what appears to be the Parker Flats area. It appears from the film that the projectors contained smoke compounds.

No Livens projectors were found in the northern portion of the Parker Flats MRA (MRS-13B).

60mm and 81mm Mortar Training

Mortars, including the 81 and 60mm mortars, provide infantry units with artillery-like fire support when artillery either was not available, or cannot be moved forward fast enough. The 81mm mortar M1 was developed in the 1930s and improved on the earlier Stokes mortar design. The 81mm mortar projectile included tail fins which provided stability to the projectile in flight and improved projectile ballistics and functioning (*Hogg, 2001*). Fins also assured that the mortar projectile would strike fuze-end first. Mortar projectiles fired from the M1 and later model mortars (M29 and M29A1) found within the southern portion of the Parker Flats MRA include the high explosive M43A1, illumination M301, target practice M44 and the training M68 (Plate 6). Munitions debris, MEC and fragments from the mortars were found in the southern portion of the Parker Flats MRA. The M43A1 is intended primarily for use against enemy personnel (*Hogg, 2001*). Maximum range of the M43A1 is approximately 3,290 yards. Projectile range could be varied by changing the number of propellant charges and/or adjusting the mortar elevation. Maximum range of the M301 illumination projectile is approximately 2,200 yards, and the illumination candle which it ejects burns for approximately 60 seconds (*tr66.com, 2004*). The target practice M44 projectile simulates the weight and ballistic performance of the M43A1 high explosive projectile. The M44 utilizes the point detonating fuze and contains a black powder spotting charge. Maximum range of the M44 is approximately 3,290 yards. The M68 projectile is an inert non-fuzed training device. The M68 contains a percussion primer and when dropped in the mortar is propelled in a fashion similar to the

M43A1 and the M44. However, the M68 does not include propellant charges or contain explosive filler. Maximum range of the M68 is 310 yards. The M68 drill projectile could be used over again by retrieving inert projectile and inserting a new percussion primer.

The 60mm mortar is an easily portable weapon ideally suited for firing distances that fall between the range of the 81mm mortar and the hand grenade (*tr66.com, 2004*). Models of 60mm mortars that were or may have been used in the Parker Flats MRA include the M2, M19 and possibly the M224. All three models were capable of being fired in the traditional method by dropping the projectile down the mortar barrel fin-end first. The Model M19 could either be fired in the traditional drop fire method or by lever fire where the cartridge is actuated manually by triggering the lever. Mortar projectiles found at the Parker Flats MRA include high explosive M49 Series and M720, illumination M83 and M721, practice M50 Series and training M69 (Plate 7). MEC MD and fragments were found within the Parker Flats MRA. Maximum range of the high explosive M49 Series is approximately 1,985 yards with an effective range of 1,000 yards (*Hogg, 2001*). Maximum range of the illumination projectiles is approximately 1,000 yards for the M83 Series and 3,830 yards for the M721 (*benning.army.mil, 2004*). The M50 Series practice projectile simulates the weight and ballistic performance of the M49 high explosive projectile. The M50 utilizes the point detonating fuze and contains a black powder spotting charge. The M69 contains a percussion primer and when dropped in the mortar is propelled in a fashion similar to the M49 Series. However, like the M68 the M69 does not include propellant charges or contain explosive filler. Maximum range of the M69 is 235 yards. The M69 drill projectile could be used over again by retrieving inert projectile and inserting a new percussion primer.

Practice versions of the 60mm and 81mm mortars, as well as ignition cartridges associated with these items, were also found in the northern portion of the Parker Flats MRA (MRS-13B). However, because practice mortar training was documented to have occurred in this area in the 1950s, this discussion is included in the discussion on the 1950s-era Training.

1940s Training

The 37mm, 60mm, 75mm, stokes mortar and livens training may have continued into the early 1940s. The earliest available training map for Fort Ord is a 1945 training facilities map (*Army, 1945*). This map shows training areas throughout the installation, but does not identify artillery training or any other specific training areas within the Parker Flats MRA boundary. Based on the MEC and MD identified during the removal actions at Parker Flats MRA, it appears that portions of the Parker Flats MRA were used for practice rifle grenade training including smoke rifle grenades, practice hand grenade training, and possibly for fragmentation hand grenade training during the 1940s. Although rifle grenade training in the vicinity of the northern portion of the Parker Flats MRA (MRS-13B) was not identified on training facilities maps until 1961, some of the rifle grenades found at MRS-13B were in use in the 1940s, so the potential for their presence at MRS-13B is discussed here. A description of training practices for these items is described below.

Rifle Grenade Training

This section describes information on the potential training practices for rifle grenades, both smoke and practice rifle grenades. Rifle grenades are designed for fire from U.S. rifles by a launcher that is attached to the gun muzzle. A special blank cartridge, issued with the grenade is required to complete the launching. The rifle grenade models most frequently found as other MD, MEC, or fragments within the southern portion of the Parker Flats MRA were the M22 and M23 series smoke grenades, and the M11 Series practice antitank rifle grenade (Plate 8). Less than ten M29 practice rifle grenades (all MD) and widely scattered individual fragments (only seven across all of the southern portion of the Parker Flats) from the M9 series rifle grenade, and four live M9 HE rifle grenades were also found, but the small

number of items and their distribution (two of the live M9 HE rifle grenades were along a road, and one was in a pit) does not indicate the presence of a live rifle grenade range in the area (Plate 8). It appears that the MEC items may have been discarded; however, information that might verify this was not documented during the removal. Based on the distribution of the MEC and MD found, it appears that the rifle smoke grenades and the M11 practice antitank rifle grenades were used for training within the Parker Flats MRA and these items are discussed below.

The rifle grenade models found within the northern portion of the Parker Flats MRA were the M22 series smoke grenades, the M9 antitank grenade, the M11 series practice antitank grenade and a M19A1 white phosphorous smoke grenade (Plate 8). Fifteen M9 antitank rifle grenades (MEC) were found buried in two pits at the site. No munitions debris from M9 antitank rifle grenades was found. On this basis it does not appear that the M9 antitank rifle grenades were fired in the northern portion of the Parker Flats MRA. Based on the distribution of the MEC and MD found, it appears that the rifle smoke grenades and the M11 practice antitank rifle grenades were used for training within the northern portion of the Parker Flats MRA and these items are discussed below.

Additionally, four M19A1 white phosphorous (WP) rifle grenades were found in the Parker Flats MRA. Three of the M19A1 WP rifle grenades were found in the southern portion of the Parker Flats MRA, two (MEC) were located in the northwest corner adjacent to Parker Flats Cut-Off and the third (MD) was located in the south central portion of the Parker Flats MRA (Plate 8). One M19A1 WP (MD) was found in the northern portion of the Parker Flats MRA. This item was found in the southern portion of MRS-13B in close proximity to Gigling Road. Because so few M19A1 WP rifle grenades were found during the removal it is believed that the use of these items was extremely limited within the Parker Flats MRA and the potential for other M19A1 rifle grenades to be present is unlikely.

Rifle Grenades, Smoke

General information on the use of pyrotechnic items, including smoke grenades, was obtained from Army field and technical manuals (*Army, 1977c and 1987b*). Pyrotechnics are generally used for signaling and ground smoke. The M23A1 is used only for signaling. The M22 and M22A2 can be used for both signaling and laying of smoke screens. The grenades are fired from a rifle equipped with a grenade launcher and function on impact. At impact a firing pin strikes a primer producing a flame, which ignites a starter mixture charge, which in turn ignites a smoke mixture charge. It is possible that the northern and southern portions of the Parker Flats MRA were used for practicing of signaling or laying of smoke screens.

Practice Rifle Grenade

The M11 series antitank practice grenade was available for use in the 1940s and 1950s. This item was an inert loaded dummy grenade similar in shape and weight to the M9 series high explosive antitank grenade. No explosive charge was associated with this practice item. The later M11 series differed from the M9 series in that the fins could be replaced in case they were damaged or wore out. Practice rifle grenades are inert; therefore, no MEC other than possible blanks used to fire the rifle grenade would be expected. Based on the distribution of the M11 practice rifle grenades MD (Plate 8) and details provided in Section 3.4.3, it appears that practice rifle grenade training took place in two areas within the southern portion of the Parker Flats MRA. Because only two M11 practice rifle grenades (MD) were found at MRS-13B, it is not believed that training with these items occurred in the northern portion of the Parker Flats MRA. It is not expected that the high explosive M9 series would have been fired in these areas.

Range Configuration

Range configuration information for practice rifle grenade training was obtained from *Policies and Procedures for Firing Ammunition for Training, Target Practice and Combat* (Army, 1983). Technical information for recent rifle grenade training was obtained from TM 43-0001-29 (Army, 1987a). Information on WWII Grenade launchers was obtained from the American Arsenal (Hogg, 2001). According to the 1983 policies and procedures manual, live rifle grenades were fired behind a protective barrier equivalent to a screen of sandbags 0.5 meter thick or reinforced concrete walls 0.16 meter thick. It is suspected that sandbags could have been used in a practice training area. The maximum range of the practice rifle grenade M29 (model described in TM 43-0001-29) is 150 meters. Because range information for the M11 series rifle grenade is not available, the 150 meter maximum range is assumed for the M11 series. According to information in *The American Arsenal*, the depth to which the launcher is inserted into the rifle stabilizer tube determines the range attained by the fired grenade. Therefore, it is expected that targets would be placed at various distances to practice firing at different ranges. The only targets found during the MEC removal are on the side of Artillery Hill and could be related to practice rifle grenade training.

Hand Grenade Training

Although no specific hand grenade training areas are identified on the 1945 and 1946 training facilities maps, review of the removal action data indicate that hand grenades available for use in the 1940s and 1950s, including MK II fragmentation, MK II practice and MK I illumination, were found in the Parker Flats MRA.

MK II Fragmentation Grenade Training Area

The possible presence of a live grenade training area in the 1940s within the southern portion of the Parker Flats MRA is based on the discovery of MEC and MD in the area as part of the removal action. No MK II fragmentation grenades were found in the northern portion of the Parker Flats MRA. Review of the 1941 aerial photograph does not show a cleared area or other features that might indicate a range in the area where the MEC and MD were discovered. Although no features are present on the 1941 aerial photograph, it is possible that a grenade training area was established after 1941, and would therefore, not be evident on the 1941 aerial photograph. Review of a 1945 training map also does not show areas for live grenade training are shown in this area. It should be noted that the 1945 training map does show three areas as designated live grenade training areas outside the Parker Flats MRA.

Live hand grenade training areas usually consist of throwing bays or trenches, observation bays, and targets. According to the 1983 guidance, targets are a minimum of 25 meters from the throwing bays. Throwing bays should be separated by 20 meters unless they are separated by another physical barrier such as an earthen berm or concrete. It is anticipated that similar guidance would have been used prior to 1983. The maximum danger area for hand grenades is 450 feet.

MK II Practice Grenade Training

Although no specific practice hand grenade training areas are identified on the available 1940s training maps, review of the removal action data indicate use of MK II Practice grenades in several areas in the northern and southern portions of the Parker Flats MRA (Plate 9).

The MK II practice hand grenade used the M205 series or the M10 series fuze on earlier models, and was designed to train personnel to arm and throw hand grenades (Army, 1977c). It was identical to the MK II fragmentation hand grenade, except for a filling hole in the base and a cork stopper to close the hole after

the black powder strips had been inserted. The black powder strips provided noise and smoke without fragments upon functioning. It was functioned when a soldier removed the safety pin from the safety lever and threw the grenade allowing the safety lever to fly free, releasing the spring-loaded striker to strike the primer (FM 3-23.30; *Army, 2000b*). It should be noted that no M10 series fuzes used in the early models of the MK II practice hand grenades were found in the northern portion of the Parker Flats MRA.

The largest concentration of MK II practice hand grenade (MEC) and related MD is in the southern portion of the Parker Flats MRA along Grant Ewing Ridge. Based on review of the 1941 aerial photograph it does not appear that a cleared area was used in the Grant Ewing Ridge area. This might indicate that the area was used as a practice hand grenade confidence course. The qualification course would allow soldiers to engage targets under natural terrain, possibly with simulated battle conditions.

Based on current information provided in FM 3-23.30, the qualification course would consist of several stations that could include fighting positions, bunkers, logs, silhouettes, and other obstacles. It is suspected that this type of training could have occurred within the Parker Flats MRA.

MK I Illumination Grenade

MK I illumination grenades, mostly MD, were found mainly on the east side of Artillery Hill in the southern portion of the Parker Flats MRA, but were also found scattered through other parts of both the northern and southern portions of the Parker Flats MRA. It appears that the MK I illumination grenades may have been associated with a variety of types of training along the eastern side of Artillery Hill.

The MK I illumination grenade was used for ground signaling. Information obtained from FM 3-23.30 indicated that it could also be used as an incendiary agent. The grenade contained 3.5 ounces of illuminating pyrotechnic composition and a special igniter fuze. The filler would burn for 25 seconds and could illuminate an area 200 meters in diameter (*Army, 2000b*).

1950s Training

In the 1950s the Parker Flats MRA was used as an infantry training area and included basic combat and advanced individual training (*Army, 1957*). Training activities identified within the Parker Flats MRA included bivouac areas, practice mortar training, CBR training, Field Battalion Training, Squad Tactics, Squad Defense Area, Field Fortification Area training, and guard duty training. Operations related to the Field Battalion Training, Squad Tactics, Squad Defense Area and Field Fortification are described in the Training and Maneuvers section below. Because it is not believed that military munitions were used during guard duty training, no further discussion of this activity will be provided. Information on training practices for 3.5-inch rockets is also provided because expended practice 3.5-inch rockets (MD) were found within the Parker Flats MRA and were readily available beginning in the 1950s.

Bivouac Area Training

Bivouac areas at Fort Ord were used for overnight training and field exercise. Two bivouac areas (E and F) had been established within the southern portion of the Parker Flats MRA by the mid 1950s. Later use of bivouac areas at Fort Ord are documented in Fort Ord Range Regulation 350-5 (*Army, 1980*). The storage of ammunition was not allowed within 100 feet of a bivouac area. Normally, blank cartridges, simulators, pyrotechnics, and smoke items were the only items allowed for storage near bivouac areas. However, field storage of sensitive items, demolition materials, and small arms ammunition (other than blank) was permitted if clearance was obtained from the division ammunition officer (*Army, 1980*). The burial of trash or garbage was prohibited. To discourage the burial or discarding of unspent ammunition,

ammunition was inventoried when checked out from the Ammo Supply Point (ASP), daily while stored in the field, and again upon turn in of the unused ammunition at the ASP. Fort Ord range regulations required that a Range Control representative inspect the bivouac areas after each use (*Army, 1980*). Although the above mentioned reference applies to circa 1980, it is anticipated that similar regulations were also in effect in the 1950s.

Numerous M18, and M48 smoke hand grenades, smoke pots, various signals and simulators were located throughout the Parker Flats MRA (MEC, MD). It is possible that these items were used for training and maneuvers related to the overnight bivouac areas (Plates 9, 10, and 11).

Practice Mortar Training

Based on the review of training facilities maps practice mortar training occurred within the Parker Flats MRA in the 1950s and continued into the 1960s. During this time period 60mm and 81mm mortar ranges used for the purposes of live fire training were present within the impact area to the south (*Army 1956, 1957, 1958, and 1964*). Fort Ord training facilities maps indicate that practice mortar training areas were established in the northern and southern portions of the Parker Flats MRA with training occurring over a relatively short period of time in the northern portion and continuing into the 1960s in the southern portion. A relatively small number of mortar-related military munitions items were found in the northern portion of the Parker Flats MRA which is consistent with short-term use as a practice mortar range or as a mortar demonstration area. Fort Ord training facilities maps indicate that bleachers were present at the practice mortar range. The military munitions items found in the northern portion of the Parker Flats MRA included practice and training mortars, an illumination mortar and mortar components (i.e., ignition cartridges). Mortars, including the 81mm and 60mm mortars, provide infantry units with artillery-like fire support when artillery either was not available, or cannot be moved forward fast enough. The 81mm MI mortar was developed in the 1930s and improved on the earlier mortar design (Stokes mortar). The 81mm mortar projectile included tail fins which provided stability to the projectile in flight and improved projectile ballistics and functioning (*Hogg, 2001*). Fins also assured that the mortar projectile would strike fuze-end first. Mortar projectiles fired from the M1 and later model mortars (M29 series) found within the northern portion of the Parker Flats MRA include the illumination M301 and target practice M43 series (Plate 6). The M43 practice projectile simulates the weight and ballistic performance of the M43 series high explosive projectiles. The M43 practice projectile utilizes a point detonating fuze and contains a black powder spotting charge. Depending on the number of propellant charges used the range of the M43 practice projectiles varied from 565 to 4,050 yards (*Army, 1977a*).

The 60mm mortar is an easily portable weapon ideally suited for firing distances that fall between the range of the 81mm mortar and the hand grenade (*tr66.com, 2004*). Models of 60mm mortars that were or may have been used at the practice mortar training areas in the Parker Flats MRA in the 1950s include the M2 and the M19. Both models were capable of being fired in the traditional method by dropping the projectile down the mortar barrel fin-end first. The Model M19 could either be fired in the traditional drop fire method or by lever fire where the cartridge is actuated manually by triggering the lever. 60mm mortar projectiles found in the northern portion of the Parker Flats MRA include the practice M50 series (Plate 7). The M50 series practice projectile simulates the weight and ballistic performance of the 60mm M49 high explosive projectile. The M50 utilizes the point detonating fuze and contains a black powder spotting charge. Using the maximum number of propellant charges the maximum range of the M50 series mortar is 1,963 yards (*Army, 1977a*). Additional 60mm mortar-related items found in the northern portion of the Parker Flats MRA included M4 ignition cartridges and a 60mm mortar tail boom assembly.

Other mortar-related training devices found in the northern portion of the Parker Flats MRA included 22mm and 25mm sub-caliber training projectiles. The 22mm sub-caliber is a training device for 81mm or 60mm mortars. The 25mm training projectile can be fired from 4.2-inch, 60mm or 81mm mortars fitted

with the M32A1 pneumatic mortar trainer. Both sub-caliber projectiles are fitted with a blank cartridge that functions on impact, setting off a report and a puff of smoke for spotting purposes.

In the southern portion of the Parker Flats MRA training maps indicate that a practice mortar training area was present in the 1950s. 1960s era training maps identify a "1000 Mtr" in the same location as the mortar training area identified in the 1950s. These training areas were located within the current MRS-37 boundaries just north of MRS-3 (Plate 6). The removal action at MRS-3 resulted in the discovery of numerous M68 81mm mortars (all MD). This data corresponds with the information on the training maps that the area was used for practice mortar training. An area of M69 60mm mortars (all MD) was also identified within MRS-37 (Plate 7). This data also corresponds to use of the area as 1000 mortar and practice mortar training areas. A description of practice mortars is provided below.

Information obtained from the St. Louis District Corps of Engineers indicates that training cartridges, Models M68 and M69, could have been used at a practice mortar range (*Kocher, 2001*). These practice mortars had a range of 235 and 310 yards, respectively. These mortars consist of an iron pear-shaped body, which was of a size and weight that simulated the HE version of the 60mm or 81mm mortar. The practice mortars were assembled by attaching a fin assembly that contained an ignition cartridge. The ignition cartridge, similar to a shotgun cartridge was used to propel the inert portion of the mortar. If the ignition cartridge failed to function, the mortar would not be fired; therefore, it would not be possible for a live practice mortar to be found downrange as a result of firing. Both the M68 and M69 were reusable rounds and could be collected and reused by inserting a new ignition cartridge.

CBR Training

It is possible that the tear gas agents O-Chlorobenzylidenemalonitrile (CS), and w-Chloroacetophenone (CN) might have been part of the training performed in the CBR areas. Documentation confirming the use of CS and CN in this area is not available, but is assumed to have occurred based on the information provided below. Based on an army training manual, training using CS typically involved using a small 4-inch tall, 2.75-inch wide tin can filled with gelatin capsules, and a candle flame would be used to heat the open tin can (*Army, 1982*). This was usually performed in a test chamber. Building 3984 identified as a gas chamber on facilities maps is located within MRS-4B (Plate 9). Once the test chamber was filled with the CS agent, masked troops were then brought into the chamber to gain confidence with their masks and fit test their masks. Troops were then required to unmask to become familiar with the effects of the agent. The training could also be performed using hand grenades containing CS or CN. CS and CN hand grenades (MEC and MD) were found in the vicinity of the CBR training area (MRS-4B) and in other locations within the Parker Flats MRA.

CS and particularly CN are dangerous, particularly at concentrations higher than would be expected in the training materials; CN can be damaging to mucous membranes, upper respiratory tract, eyes and skin. However, it would be expected that the CS and CN concentrations used by Army training personnel would be similar to that used to control mobs or riots. CS and CN temporarily incapacitates the victim (typically less than 30 minutes) through intense irritation of the eyes; irritation of the mucous membranes of the nose, trachea, or lungs; and irritation of the skin.

According to the EE/CA (*USAESCH, 1997*), powdered tear gas agent might have been dumped in the area. Concentrations of any CS and CN agent that might have been dumped in pits would be expected to have dissipated through time because these agents have half-lives measured in days and minutes. In addition, exposure to moisture in the soil should increase the chemical degradation of these compounds by hydrolysis.

Hand Grenade Training

Although no specific practice hand grenade training areas are identified on the available 1950s training maps, review of the removal action data indicate use of practice M30, M62, and M69 grenades in the Parker Flats MRA. Only one M67 fragmentation grenade (MD) was found. Over 100 live and expended grenade fuzes (MEC and MD) were also found. Grenade fuze models found included M204 and M205 series, M218 and M228.

As described previously, live hand grenade training areas usually consist of throwing bays or trenches, observation bays, and targets. According to the 1983 guidance, targets are a minimum of 25 meters from the throwing bays. Throwing bays should be separated by 20 meters unless they are separated by another physical barrier such as an earthen berm or concrete. It is anticipated that similar guidance would have been used prior to 1983. The maximum danger area for fragmentation hand grenades is 450 feet. Because none of the described features are present within the Parker Flats MRA it is not believed that training with fragmentation or HE grenades was conducted within the Parker Flats MRA.

Although no specific practice hand grenade training areas are identified on the available 1950s training maps, review of the removal action data indicate use of M30 Practice grenades on the east side of Artillery Hill. Both MEC and MD were identified. Based on review of the available historical aerial photographs, it does appear that a cleared area was present on Artillery Hill. This might indicate that the area was used as a practice hand grenade confidence or qualification course. The confidence course would allow soldiers to engage targets under natural terrain, possibly with simulated battle conditions.

The M30 practice hand grenade used the M205A1 or M205A2 fuze and was designed to train personnel to arm and throw hand grenades. It was used to simulate the M26 series of fragmentation hand grenades. The M30 emitted a small puff of white smoke and made a loud popping sound when functioned. Based on current information provided in FM 3-23.30 (*Army, 2000b*), a qualification course would consist of several stations that could include fighting positions, bunkers, logs, silhouettes, and other obstacles. It is suspected that this type of training could have occurred within the southern portion of the Parker Flats MRA on the eastern side of Artillery Hill.

Training and Maneuver Areas

Because the Parker Flats MRA was used to conduct basic combat training, it is possible that this area was used as a training and maneuver area. Use of the Parker Flats MRA for these activities would probably have continued into the 1960s in the northern portion and into the 1980s in the southern portion of the Parker Flats MRA. A training and maneuver area may have included using the site for squad patrols. Infantry platoons and squads conduct three types of patrols: reconnaissance, combat, and tracking (*Army, 1992*). Each patrol includes specific objectives using infantry troops, sometimes with engineer support, to gather information and conduct simulated combat operations. Combat patrols would include the use of blank small arms ammunition, and possibly pyrotechnics and smoke producing items (e.g., signals, flares and smoke grenades). Specific areas identified within the Parker Flats MRA include Parker Flats Training Areas 1, 2, and 3, a portion of a field battalion training area, a field fort training area, and individual tactical training areas. Numerous pyrotechnic items including simulators and illumination and smoke producing signals, and flares (MEC and MD) were found throughout the Parker Flats MRA suggesting that this area was used for various training activities (Plates 9, 10, and 11).

Mine Training

Review of the Parker Flats MRA data indicates that practice mines may have been used for training in several localized areas within Parker Flats MRA (Plate 12). In the southern portion of the Parker Flats

MRA practice mines and mine fuzes (MEC and MD) were located in the southern portion of MRS-3, the western part of MRS-55, and in expansion grids within MRS-50. In the northern portion of the Parker Flats MRA, a few practice mine fuzes (MEC and MD) were found scattered in the central and eastern portions of MRS-13B. Two expended practice mines and a mine activator were found in the southern portion of MRS-13B adjacent to Gigling Road (Plate 12). Specific mine training areas are not identified on 1950s training maps within the Parker Flats MRA, but the information on training practices is presented below because of the discovery of practice mines and mine fuzes during the removal action.

Mines are explosive devices that are emplaced to kill, destroy, or incapacitate enemy personnel and/or equipment. They can be employed in quantity within a specified area to form a minefield, or they can be used individually to reinforce non explosive obstacles. A minefield is an area of ground that contains mines or an area of ground that is perceived to contain mines (a phony minefield). Minefields may contain any type, mix, or number of AT and/or antipersonnel (AP) mines. A tank force is the greatest threat to an infantry defense. Protective minefields in this case consist predominantly of antitank mines that reduce the enemy's ability to close quickly onto the infantry's position

There is no available information confirming landmine training in the Parker Flats MRA, and, if so, how it was performed in the 1950s. According to current field manuals, practice and inert mines or explosive booby trap simulators were used in training personnel in the precautions and proper methods to be observed in the care and handling, arming, booby trapping, and disarming of mines (*Army, 1997*). High explosive mines are not normally used in training, except for demonstration purposes. The 1997 training manuals indicate that live mines are used as part of current training practices, but that live mine training and simulator training will not take place concurrently at the same location in order to preclude a live mine being mistaken for an inert mine (*Army, 1997*).

Information concerning emplacement of minefields in Army training manuals serves as a guide as to how the site vicinity may have been used for mine training (*Army, 2000c; Army, 1997a*). Based on practices described in field manuals, it is likely that during training, the trainees would learn to mark practice mine locations as well as perform practice mine removal operations. It is also likely that the trainees would practice clearing a path or lane through the minefield by probing, marking, and possibly destroying the practice mines with explosives or grappling hooks.

Booby Trap Training

Review of available training maps for the Parker Flats MRA do not indicate specific booby trap training areas; however, booby trap simulators and firing devices that could have been used in setting booby traps were found during the removal actions conducted at the Parker Flats MRA (MEC and MD) (Plate 11). Based the review of a 1959 Fort Ord Yearbook, booby trapping of mines appears to have been taught at Fort Ord. Firing devices that may have been used as part of booby trap training at Fort Ord include the M5 Pressure Release Firing Device, M1A1 Pressure Firing Device, the M1 Pull Firing Device, the M3 Pull/Release Firing Device, and the M1 Pressure Release (See FM 5-31 Boobytraps; September 31, 1965). These firing devices contain no energetic materials (e.g., pyrotechnic charges), unless the coupling base is attached. Information presented below is provided for descriptive purposes and is based on current training manuals (*Army, 1997*).

Booby traps are placed in a variety of locations, some of which can include:

- In and around buildings, installations, and field defenses
- In and around road craters or any obstacle that must be cleared

- In natural, covered, resting places along routes
- In likely assembly areas
- In the vicinity of stocks of fuels, supplies, or materials
- At focal points and bottlenecks in road or rail systems.

When setting booby traps, the commander establishes a control point that serves as a headquarters and material holding area. Each setting party works in a clearly defined area. Entry to these areas is strictly controlled. The locations of booby traps are recorded. The traps are inspected for safety and camouflage before they are armed.

Based on these general field practices, it would be expected that as well as setting the traps, personnel would also practice neutralizing and removing the traps.

If the training was in setting or disarming the traps, it is likely that actual booby trap firing devices were used with a standard coupling base (sometimes referred to as a base coupling) which provided an energetic report to indicate that the trap had been successful. Only rarely would any reason exist to connect these firing devices to explosives, blasting caps, or detonating cord, and this would have to be done in a demolition area properly sited for the explosives quantities used (*Hall, 2003*). Training may also have included booby trapping practice mines.

3.5-Inch Rocket Training

3.5-inch practice rockets (M29A2), mostly found buried in large groups, were removed from the Parker Flats MRA (Plate 13). Review of available training maps does not indicate a range for 3.5-inch rocket training within either the northern or southern portions of the Parker Flats MRA, but use of 3.5-inch rockets in ranges within the Impact area south of the Parker Flats MRA is known to have occurred. Based on the limited number of 3.5-inch practice rockets found outside of burial pits within the Parker Flats MRA and the absence of a defined range on training maps, it does not appear that a rocket range was present in this area; however, because some evidence of 3.5-inch practice rockets was identified within the Parker Flats MRA, a short discussion of a 3.5-inch rocket range is included below. No evidence of the use of high explosive 3.5-inch rockets was found in the Parker Flats MRA.

A 3.5-inch rocket range includes an impact area, ricochet areas to the side and behind the impact area, secondary danger zones located outside of the ricochet areas. Minimum distance to targets is 250 meters and range length from firing point to the end of the impact area is 950 meters (*Army, 1983*). The 3.5-inch rocket launcher (M20) is a two-piece, smooth bore, open-tube weapon that is fired electrically. The weapon can be fired while sitting, kneeling, standing, or from a prone position. A magneto-type firing device in the trigger provides the current for igniting the rockets. Ordnance fired from the M20 included the M28A2 high explosive antitank (HEAT), M29A2 practice rocket, and the M30 WP smoke rocket. Only practice M29 Series rockets were found at MRS-13B (*USA, 2000c*).

1960s Training

The majority of the northern portion of the Parker Flats MRA (north of Gigling Road) was assigned to the 1st Brigade (*Army, 1964*). The area to the south of Gigling Road was assigned to the 1st and 3rd Brigades. The mission of the 1st and 3rd Brigades was to conduct basic combat training (*Army, 1968*). Features identified on the 1960s training maps on the north side of Gigling Road include a BTA, BAC, HHCA, a PCPTA, and a location labeled as “TE 3d Bde.” The training activities conducted at this location are not

known, however, it is assumed that this location was assigned to the 3rd Brigade. An area labeled RGT (possibly rifle grenade training) is present on the training facilities map from 1961 only. A discussion of the MEC and MD associated with rifle grenade training was included in the 1940s training. No training areas are identified on the 1960s training facilities maps within the northern portion of Parker Flats MRA that is on the south side of Gigling Road.

Several overnight bivouac areas are present on the 1960s training facilities maps in the southern portion of the Parker Flats MRA. Use of the area for overnight bivouac and general training and maneuvers continued through the 1980s. Specific training areas included squad defense, field battalion, and field fortification, and individual tactical training areas. These areas are discussed as part of the general training and maneuvers. The CBR training area in the northern part of the site is also still shown on training maps. Practice mortar training was still occurring in the area. Training practices associated with these activities are expected to have been essentially the same as the training in the 1950s described above.

1970s, 1980s, and Early 1990s Training

Use of the Parker Flats MRA for overnight bivouac, general training and maneuvers, and CBR training continued into the 1970s through base closure. The training practices associated with these activities have been discussed above. Due to the development and construction of maintenance facilities adjacent to and within the northern portion of the Parker Flats MRA, training in this area was limited to physical training and drill exercises during this time period. Range 49, used for Land Mine Warfare training is identified on the southeastern part of the site. A TOW tracking area was possibly located in the southern portion of the Parker Flats MRA. Training practices potentially associated with Range 49 and the TOW tracking area is described below.

Range 49 Training

Range 49 was identified as an anti-armor course and demolition range. The range consisted of 10 demolition pits, one APC, one tank, an established tank route and numerous tank obstacles (*Army, 1980*). One-quarter pound charges of TNT and C4 were authorized for fire in each demolition pit. TNT was issued as ¼ pound blocks while C4 was issued in either MSN block demolition charge (2.5 pounds) or the MIIZ block demolition charge (1.25 pounds). The C4 blocks could be cut into smaller ¼ pound charges. Molotov cocktail or eagle fireball cocktails were also authorized, but were not to exceed 1 quart in size. The vehicles that were used while the range was active were removed and an area excavated as part of a hydrocarbon remediation. This range was located partly within MRS-3 along the southeastern side of the Parker Flats MRA. MEC that might be expected as part of this training include ¼ pound charges of TNT and C4. Because the C4 was issued in 2.5 and 1.25 pound blocks these charges might also be expected as part of training.

An anti-armor confidence course was present south of the Parker Flats MRA that contained an area for mines and demolitions training. Although not expected, practice mines associated with this training could be present within the southeastern part of the Parker Flats MRA due to the proximity of this anti-armor confidence course to the southern portion of the Parker Flats MRA.

TOW Tracking Training

TOW weapon systems were designed to engage and destroy armor vehicles and to also destroy other point targets such as non-armored vehicles, weapons, and launchers. The maximum effective range of the system is 2.33 miles (*USMC, 2004*). It is not expected that high explosive models of missiles were used in this area because of the range of the weapon and because a TOW missile range is not documented on

any training maps from 1970 or later. A TOW tracking training area was identified within or adjacent to the southern portion of the Parker Flats MRA (Plate 11), and M22 antitank guided missile and rocket simulators were also found within the Parker Flats MRA during removal activities suggesting that the training conducted in this area was simulated training. The M22 simulator is part of the Multiple Integrated Laser Engagement System (MILES) and is employed with the MILES, TOW, DRAGON, and VIPER firing devices (Army, 1977b). It provides a simulation of the weapon signature including report, flash, and smoke.

3.4.2 Site Features

The prominent features of the Parker Flats MRA include several hills, ridges, and valleys, along with several low areas or depressions. Some of these features have been named over time and include Artillery Hill, Grant Ewing Ridge, Parker Flats, and the Sinkhole Training Area. Based on the distribution of MEC and MD located within the Parker Flats MRA, it appears that these features played a role in the types of training that occurred. The area also contains oak woodland, chaparral, and grasslands that may also have played a roll in the selection of training activities that occurred over time. Some erosion of non-maintained trails is evident within the site. The vegetation types result in areas that could be used for concealment, while open areas could be used for other types of training. With the exception of approximately 35 acres of the northern portion of the Parker Flats MRA, this area is undeveloped. The area does include several roads and trails, some of which were present prior to the 1940s.

3.4.3 Potential Sources and Location of MEC Discovered and Removed

Based on the review of historical data, MEC that may still be present at the Parker Flats MRA, although unlikely, after completion of the removal action includes the items discussed above. Some items were located throughout the Parker Flats MRA while others were more localized in their occurrence and may not be expected throughout the MRA. A breakdown of locations where MEC was removed is presented below following the era of use format above.

Pre 1940s MEC

The potential distribution of remaining pre 1940s MEC within the Parker Flats MRA is based on the training practices presented above and the distribution of the MEC and MD removed from the site. The pre-1940s items are broken out by general munitions type.

37mm Items

The distribution of 37mm fragments and 37mm MEC indicates that the items may have been fired at targets, either on the hillsides, or at the base of the hillsides within the southern portion of the Parker Flats MRA (Plate 3). The 37mm projectile results from direct fire, therefore it is anticipated that the targets would be visible from the firing points. Aerial photographs from 1941 were reviewed in an effort to determine locations of firing points and/or targets within the area, but none were identified. Training maps from the 1920s, 1930s, and early 1940s are not available for Fort Ord; the earliest available training map is dated 1945. It was, therefore, not possible to determine the firing points for these items, the range safety fans, or the exact target areas for these items. The 37mm MEC that were found were located in both the flats and on the ridges making it difficult to identify areas not used for 37mm training or areas that would have been within the 37mm training range fans. For this reason, to be conservative, it appears that the potential area where 37mm MEC could still be found covers the entire southern portion of the Parker Flats MRA. It should be noted that although 37mm fragments were found, no 37mm MEC items were found within the County Development Reserve parcel.

A penetration study performed by the Corps of Engineers, Huntsville calculated a maximum penetration depth in sandy soil for the M63 HE 37mm projectile (the deepest penetrating model of 37mm projectile found at Fort Ord) of 3.9 feet (*USAESCH, 1998*). This study calculated the theoretical maximum penetration depth and may not reflect penetration depths expected during training activities. MEC related to 37mm projectiles located within the Parker Flats MRA were all located within the top 18 inches. Most were located within the top 1 foot. Although the results of the sampling suggests that most of the 37mm projectiles would be located in the top foot of soil, it is possible that 37mm projectiles could be found at depths greater than 18 inches based on the maximum calculated depth of penetration. Field surveys conducted at test sites at the former Fort Ord show that a 37mm projectile, while readily detected 6 inches bgs, is difficult to detect and may be undetectable at 18 inches bgs or deeper.

75mm items

The distribution of MEC and MD related to 75mm projectiles indicates that they may have been fired at targets, either on the hillsides, or at targets at the base of the hillsides within the southern portion of the Parker Flats MRA. The 75mm projectile could have been fired through either direct or indirect fire; therefore it is possible that the firing points would not be within a line of sight of the targets. The heaviest accumulations of fragments, and expended items and MEC were on Grant Ewing Ridge and the east side of Artillery Hill. Several MEC items were also found within the Parker Flats low areas and on the west side of Artillery Hill (Plate 4). No evidence of 75mm projectiles were found in the northern portion of the Parker Flats MRA. The earliest available aerial photograph (1941) did not show evidence of any firing points or targets within the Parker Flats MRA. Based on the distribution of 75mm projectiles and MD including fragments, and the lack of information or physical evidence on firing points and range fans, it is not possible to eliminate areas within the southern portion of the Parker Flats MRA as potential 75mm projectile impact areas. To be conservative, it appears that 75mm projectiles (if any) remaining after the removal action could be located anywhere in the southern portion of the Parker Flats MRA. It should be noted that no 75mm MEC items were found within the County Development Reserve parcel.

A penetration study performed by the Corps of Engineers, Huntsville, calculated a maximum penetration depth in sandy soil for the M48 HE 75mm projectile of 4.9 feet and a maximum penetration depth in sandy soil for the MK I 75mm shrapnel projectile of 6.7 feet in sandy soil. Review of the 75mm projectile depth information from the Parker Flats MRA, and a case study of MRS-50 and -53 presented at the UXO Forum in September 2002 (*Ralston, 2002*) indicated that the majority of the 75mm projectiles detected within the Parker Flats MRA were located within the top foot of soil. One 75mm projectile was located at 4 feet bgs. Although the results of sampling suggests that most of the 75mm projectiles would be located in the top foot of soil, it is possible 75mm projectiles could be found at greater depths based on the maximum calculated depth of penetration.

3-inch Stokes Mortars

The distribution of the 3-inch practice Stokes mortars, both MEC and MD (expended) indicates that the practice mortars may have been fired at targets located in the southern portion of the Parker Flats MRA within the area designated as Parker Flats (Plate 5). No evidence of the use of high explosive Stokes mortars was found in the southern portion of the Parker Flats MRA. No Stokes mortars of any type were found in the northern portion of the Parker Flats MRA. In contrast to the 37mm and 75mm projectiles, it appears that the Stokes mortars were fired towards topographic depressions in the southern portion of the Parker Flats MRA. No practice Stokes mortars were found on the west side of Artillery Hill or in the eastern part of the Parker Flats MRA. Although no firing points, or range fans can be determined from review of available historical documents or physical evidence, it is possible that the firing points were located on the hillsides and the mortars were fired into the flats. Based on review of the removal data, it

appears that Stokes mortars that potentially remain after the removal action would be primarily within the Parker Flats depressions. No chemical filled Stokes mortars have been found at Fort Ord and none are expected based on the results of the removals completed to date.

A penetration study performed by the Corps of Engineers, Huntsville, calculated a maximum penetration depth in sandy soil for the 3-inch Stokes mortar, HE at 3.3 feet (*Smith, 2000*). The 3-inch Stokes mortars were found at up to 4 feet bgs. Most of the mortars were found in the top 2 feet. Although the sampling results indicate that the Stokes mortars were located within the top 2 feet of soil, the Stokes mortars were found up to 4 feet bgs in the southern portion of the Parker Flats MRA.

Livens Projectors

One screening smoke FM Livens projector and over 100 pounds of projector fragments were found in the southern portion of the Parker Flats MRA on Grant Ewing Ridge (Plate 5). Based on review of available film footage of training activities available from the national archives (*NARA, 1941*) it appears that Livens Projectors were positioned within Parker Flats and were fired from Parker Flats towards Grant Ewing Ridge (Plate 5). No chemical-filled Livens projectors have been found at Fort Ord and none are expected based on the results of the removals completed to date. If Livens projectors were to remain after the removal action, they would most likely be found on Grant Ewing Ridge.

A penetration study performed by the Corps of Engineers, Huntsville, calculated a maximum penetration depth for the 8-inch HE MK II Livens projectile of 5.0 feet in sandy soil. The results of the study were communicated by A.R. Smith of the USACE Sacramento District (*Smith, 2000*). The screening smoke Livens projectors were not modeled. The Livens projectiles were found at depths ranging from the surface to 12 inches on Grant Ewing Ridge. Although the results of the sampling suggests that most of the Livens projectors would be found in the top foot of soil, it is possible that the Livens projectors could be found at depths as great as 5 feet bgs based on the maximum calculated depth of penetration.

60mm Mortars

One M49 series HE 60mm mortar (MEC) was found in the southern portion of the Parker Flats MRA on Grant Ewing Ridge during the removal action at the Parker Flats MRA. In addition to the high explosive mortar, 60mm mortar fragments, M49 series, and unknown model fragments, were found on the northwestern side of Artillery Hill and on Grant Ewing Ridge (Plate 7). The presence of the fragments and MEC item indicate potential impact areas for 60mm mortars on the northwest side of Artillery Hill and on Grant Ewing Ridge. It does not appear that additional impact areas for 60mm HE mortars are present within the Parker Flats MRA. As noted above, no firing points or targets were identified on the 1941 aerial photograph or the earliest available training maps (1945). The effective range for the M49 60mm mortar was 1,000 yards so it is assumed that the firing point would have been within a 1,000 yard radius of the impact area. It appears that the most likely locations for 60mm mortars to remain following the removal action would be on Artillery Hill or Grant Ewing Ridge.

A penetration study performed by the Corps of Engineers, Huntsville, calculated a maximum penetration depth for the 60mm HE M49A2 mortar in sandy soil of 1.1 feet. The 60mm MEC item was found at a depth of 20 inches bgs. Based on the penetration study and the depth that the item was discovered, it is anticipated that the 60mm mortars would be found within the top 14 inches of the soil.

Two expended M50 series practice 60mm mortars (MD) were found within the southern portion of the Parker Flats MRA. Based on finding only 2 expended mortars, it does not appear that the area was used for practice with the 60mm version.

Scattered expended M83 series 60mm illumination mortars (MD) were also identified within the southern portion of the Parker Flats MRA. The items were found mostly in the eastern portion of the MRA. Because these items were used for illumination and they are incorporated into maneuvers and training activities, it is possible that they were also used in other areas and landed within the southern portion of the Parker Flats MRA.

81mm Mortars

Fragments from high explosive 81mm mortars (unknown model) were found within the southern portion of the Parker Flats MRA on the northwestern side of Artillery Hill and on Grant Ewing Ridge. The presence of the fragments indicates potential impact areas for 81mm mortars (Plate 6). It does not appear that additional impact areas for 81mm mortars are present within either the southern or northern portion of the Parker Flats MRA. As noted above, no firing points or targets were identified on the 1941 aerial photograph or the earliest available training map (1945). The effective range for the M43 81mm mortar was over 3,000 yards so it is assumed that the firing point would have been within a 3,000 yard radius of the impact area. It appears that the most likely areas for 81mm mortars to remain after the removal action would be on the northwestern side of Artillery Hill and on Grant Ewing Ridge.

The maximum calculated penetration depth for the 81mm mortar in sandy soil was calculated at 2.7 feet. Because only fragments were identified within the southern portion of the Parker Flats MRA, data is not available on the depth of actual penetration of items at the site. Based on the penetration study the maximum depth that the 81mm mortar would be expected is 2.7 feet.

Expended practice M43 series 81mm mortars (MD) were also found on Grant Ewing Ridge. This may indicate that the ridge was also used for practice mortar training with the 81mm practice version, although only a couple of expended items were found.

One expended M301 series illumination mortar (MD) was found in the southern portion of the Parker Flats MRA. Because these items were used for illumination and they are incorporated in maneuvers and training activities, it is possible that the items were also used in other areas and landed within the Parker Flats MRA.

1940s MEC

The potential distribution of remaining military munitions used in the 1940s within the Parker Flats MRA is based on the training practices described above and the distribution of the MEC and MD removed from the site. The 1940s items are broken out by general munitions type.

Rifle Grenades

Most of the rifle grenades found in the northern portion of the Parker Flats MRA (MRS-13B) were the M22 series of smoke grenades. The M9 series rifle grenades found in this area were un-fired discarded munitions buried in two pits at depths of up to 36 inches bgs. Other rifle-fired grenades found in the northern portion of the Parker Flats MRA included two expended M11 practice antitank rifle grenades and one expended M19A1 white phosphorous smoke grenade (MD) (Plate 8).

The most common rifle grenade models found (MEC or MD) within the southern portion of the Parker Flats MRA were the M22 and M23 series smoke grenades and the M11 practice antitank rifle grenade. Less than ten M29 practice rifle grenades and widely scattered fragments from the M9 series rifle grenades, four live M9 rifle grenade were also found. Two of the M9 series rifle grenades were found along a road and one was found in a pit. This distribution indicates that the M9 rifle grenades found

within the Parker Flats MRA were possibly discarded, but the distribution does not indicate the presence of a defined M9 rifle grenade range in the area (Plate 8).

M22 and M23 Rifle Grenades, Smoke

M22 series rifle grenades (MEC and MD) were found scattered throughout MRS-13B (Plate 8). M22 and M23 series rifle grenades (MEC and MD) were also found scattered throughout the southern portion of the Parker Flats MRA. The M22 series can be used for both signaling and laying of smoke screens. The M23A1 is used only for signaling. Therefore, it is possible that these areas were used for practice of signaling or laying of smoke screens in support of basic combat training. Based on the wide distribution of the rifle grenade-related MEC and MD, it is possible that undiscovered M22 and M23 series rifle grenades not found during the removal action, if any, could be located anywhere in the Parker Flats MRA.

In the northern portion of the Parker Flats MRA (MRS-13B), one M22 series rifle-fired smoke grenade (MEC) was found on the ground surface. The remaining M22 series MEC items (8) were discarded in two burial pits. Expended rifle-fired smoke grenades (MD) were found on the ground surface and in burial pits up to 2 feet in depth.

In the southern portion of the Parker Flats MRA, the rifle grenade smoke MEC items were found at depths ranging from just below the surface to 2 feet bgs. MD rifle grenade smoke items were found to 42 inches including the items found in pits. These items have a modeled maximum penetration depth of 0.1 feet in sandy soils (USAESCH, 1998). Based on the depth information collected during the removal action, it appears that most of the rifle smoke grenades were located in the top foot; however, it is possible that items could be found deeper than one foot, and are known to have been buried in pits.

M11 Practice Rifle Grenades

Because only two M11 practice rifle grenades were found in the northern portion of the Parker Flats MRA it appears that use of these items at MRS-13B was limited.

In the southern portion of the Parker Flats MRA, two areas that may have been used as practice rifle grenade ranges are evident based on review of the removal data. One area is located on the western side of Artillery Hill and the second area is in the northeastern part of the site within MRS-55 (Plate 8). The M11 practice rifle grenades do not pose a hazard because they have no explosive component after firing, but do indicate evidence of training that is not shown on any of the available training maps.

M9 HE Rifle Grenade

In the northern portion of the Parker Flats MRA 15 M9 series rifle grenades (DMM) were found buried in two pits. One of the burial pits was within the central portion of MRS-13B, and the other burial pit was located in the southwestern corner of MRS-13B (Plate 8). No expended M9 rifle grenades or fragments were found in this area. Because the M9 rifle grenades found in the northern portion of the Parker Flats MRA were unfired and discarded in burial pits and based on the lack of expended M9 series rifle grenades on the ground surface it is not believed that the northern portion of the Parker Flats MRA was used for training with M9 series rifle grenades.

Four M9 HE rifle grenades (MEC) were found during removal actions within the southern portion of the Parker Flats MRA. Three of the items were found in the MRS-50 expansion area west of Artillery Hill and one item was found on the ridge south of Parker Flats (Plate 8). Several fragments from M9 rifle grenades were also found in the eastern part of site within MRS-37. The fragments were widely scattered in several locations throughout the entire southern portion of the Parker Flats MRA and do not appear to indicate a designated impact area. The small number and random distribution of the M9 rifle grenades,

(one in a pit, and two along the road) along with the lack of large amounts of fragments in the area suggests that an impact area is not within the southern portion of the Parker Flats MRA. It is possible, although not expected based on the removal data, that M9 HE rifle grenades could still be present in the northern and southern portions of the Parker Flats MRA.

The modeled maximum penetration depth for the M9 HE rifle grenade is 0.1 feet. The M9 rifle grenades found west of Artillery Hill were found at 2 to 4 inches bgs. The rifle grenade found on the ridge south of Parker Flats was found at 36 inches. The fifteen M9 series rifle grenades found in the northern portion of the Parker Flats MRA were found in burial pits up to 36 inches bgs. Based on this information, it is expected that the rifle grenades would be located primarily in the top few inches, but could be found deeper. It is suspected that rifle grenades found at 36 inches may have been buried, either in a pit, through disturbance of soil, or through erosion and deposition.

Mark II Fragmentation Grenades

Fragments from MK II HE fragmentation grenades were found in the southern portion of the Parker Flats MRA on the north side of Artillery Hill, suggesting a possible training area for MK II fragmentation grenades (Plate 9). No MK II fragmentation MEC was found in this area. Fragments and MK II fragmentation grenade MEC were found on Grant Ewing Ridge, suggesting that this area was also used for MK II fragmentation grenade training. One MEC MK II fragmentation grenade was also located in the northwestern side of the southern portion of the Parker Flats MRA near the road. Numerous grenade fuzes and practice hand grenades were also found adjacent to the road and could be related to items accidentally dropped during travel to or from training areas (Plate 9). It appears that the MK II fragmentation grenade training was limited to the two identified areas, and that if MK II fragmentation grenades still remained after the removal action, they would most likely be found in these two areas.

MK II fragmentation grenades are considered non-penetrating items and would be expected to be found at or near the surface. However, the MK II fragmentation hand grenades (MEC) were found up to 12 inches bgs. It is suspected that the MK II fragmentation grenades found at 12 inches may have been buried, either in a pit, through disturbance of the soil, or through erosion and deposition.

MK II Practice Hand Grenade Training

Numerous MK II practice hand grenades, MEC and MD, were found in the southwest corner of the northern portion of the Parker Flats MRA (MRS-13B) (Plate 9). The MK II practice hand grenade is the practice version of the MK II fragmentation grenade. The MK II practice grenade was equipped with either the M10A3 or M205 series igniting fuze. Several of the MK II practice grenades found in MRS-13B contained live fuzes (MEC). M10 series and M205 series fuzes (MEC and MD) were also found in the vicinity. Most live M205 series fuzes were found along Gigling Road. It is possible that MK II practice hand grenades potentially remaining after the removal action could be found in the southwest corner of MRS-13B.

The MK II practice hand grenade is considered a non-penetrating item and would be expected to be found at or near the surface. Most of the MK II practice grenades in MRS-13B were found within the top 6 inches of soil, however, some were found as deep as 13 inches bgs. Some of the MK II practice grenades found at depths greater than 6 inches were found in burial pits. It is suspected that the other MK II practice grenades found at depths greater than 6 inches were either buried through disturbance of soil, or through erosion and deposition.

It appears that a MK II practice hand grenade training area was also established on Grant Ewing Ridge based on the number of MK II practice hand grenades and M10 series fuzes (MEC and MD) found along

the ridge (Plate 9). It appears that a MK II practice hand grenade training area may also have been located in the southwestern part of MRS-37 based on accumulation of MK II practice grenades located in the area. Some scatter of MK II practice grenades is also seen across the southern portion of the Parker Flats MRA. Based on review of the data, it does appear that most of the training was conducted on Grant Ewing Ridge and in the southwest corner of MRS-37; however, because MK II practice hand grenades are also scattered throughout the area, it is possible that potentially remaining practice grenades could be found outside of the suspected training areas (Grant Ewing Ridge and MRS-37).

The MK II practice grenades (MEC and MD) were found between the surface and 24 inches bgs. It is suspected that the items found at depths greater than 6 inches may have been buried as previously described.

MK I Illumination Hand Grenades

MK I illumination hand grenades and related debris are scattered throughout the southern portion of the Parker Flats MRA (Plate 9). There are several clusters of MD, one on the southeast side of Artillery Hill. Because these items were used for ground signaling, it is expected that they would be used throughout an area where general training and maneuvers were ongoing. It is possible that MK I illumination grenades remaining after the removal action could be found through most of the southern portion of the Parker Flats MRA.

In the southern portion of the Parker Flats MRA, the MK I illumination hand grenades were found to a depth of 36 inches, although most were found in the top 6 inches. It is suspected that the items found at depths greater than a few inches may have been buried at some time, either in a pit, through disturbance of soil, or through erosion and deposition.

Several MK I illumination hand grenades (MEC and MD) were found in the northern portion of the Parker Flats MRA primarily in the southwest corner of MRS-13B and adjacent to Gigling Road (Plate 9). Because these items were used for ground signaling, it is expected that they would be used in areas where basic combat training was ongoing. It is possible that MK I illumination grenades remaining after the removal action could be found in the southwest corner of MRS-13B and in the vicinity of Gigling Road.

The MK I illumination grenade is considered a non-penetrating item, and would be expected to be found at the surface or the near surface. All MK I illumination grenades found in the northern portion of the Parker Flats MRA were located on the ground surface.

1950s, 1960s, 1970s, and 1980s MEC

The potential distribution of remaining MEC from training that occurred in the 1950s through 1980s is based on the training practices discussed above and the distribution of MEC and MD found within the Parker Flats MRA. The distribution of MEC found and the possible distribution of remaining MEC is discussed below.

Bivouac Area and General Maneuvers Training

The types of military munitions that may have been used around bivouac areas include smoke-producing items, pyrotechnics, and simulators. The distribution of these items is discussed below. Not all of the items discussed below are related to bivouac area training, but may be related to general maneuvers training that occurred within the Parker Flats MRA. It is not expected that 37mm, 75mm, Stokes mortar, Livens projector, 81mm HE mortar, 60mm HE mortar, and fragmentation grenade training continued into the 1950s.

Smoke Hand Grenades

M18 series and AN-M8 smoke grenades (MEC and MD) were found in the northern portion of the Parker Flats MRA primarily in the southwest corner and adjacent to Gigling Road (Plate 9). These smoke grenades are used as ground- to-ground or ground- to-air signaling devices, target or landing zone marking devices or screening devices for unit movements (*Army, 1977c and 2000b*).

M18 smoke hand grenades (MEC and MD) were found scattered throughout the southern portion of the Parker Flats MRA with a higher concentration along the ridge south of Parker Flats (Plate 9). The distribution of smoke grenades found in the Parker Flats MRA suggests that training using the items occurred through much of the area. Smoke grenades possibly remaining after the removal action, if any, could be located through much of the Parker Flats MRA.

The M48 smoke grenade was also used, but in lesser quantities, in the Parker Flats MRA. The distribution of these items is shown on Plate 9. No M48 smoke hand grenades were found in the northern portion of the Parker Flats MRA.

Smoke hand grenade MD and MEC were generally found in the top 6 inches of soil; however, MD was found up to 48 inches bgs and M18 smoke hand grenade MEC was found up to 36 inches bgs. Smoke hand grenades are considered non-penetrating and would be expected in the top few inches of soil. It is suspected that the items found at depth greater than a few inches may have been buried, either in pits, or through disturbance of soil, or through erosion and deposition.

Signals and Flares

The flares and signals found in the Parker Flats MRA (MEC and MD) could have been used in the 1950s and during later decades for training. The distribution of all models of flares and signals found in the Parker Flats MRA are discussed in this section.

Flares found at the Parker Flats MRA include the M48 parachute trip flare and the M49 series surface trip flare. The M49 series trip flares give warning of infiltrating troops by illuminating the field of the advancing enemy (*Army, 1977b*).

Signals were found throughout at the Parker Flats MRA (Plate 10), and include the M125, M126, M131 series, and M20A1 and M21A1 ground illumination signals, the M17 and M19 ground rifle parachute series illumination signals, the AN-M37, AN-M43 series and AN-M53A2 aircraft illumination signals; the M166 series ground smoke signal; and the M62 and M128A1 ground smoke parachute signals. The signals were used for various purposes including daytime or night time signaling, distress signaling, air-to-surface and air-to-air, surface-to-air, and surface-to-surface signaling (*Army, 1977b*).

Signals were found throughout the southern portion of the Parker Flats MRA (Plate 10). The density of signals in the northern portion of the Parker Flats MRA was far less than in the southern portion. Most of the signals in the northern portion were found in close proximity to Gigling Road. In the southern portion of the Parker Flats MRA, several areas of greater concentrations of signals were found along the ridge south of Parker Flats, the eastside of Artillery Hill, and on the ridge within MRS-55. Although there are areas where greater concentrations of signals were found, it appears, based on the data, that signals could have been used or landed throughout the Parker Flats MRA.

The signals identified within the Parker Flats MRA are also considered non-penetrating items. The signals found within the Parker Flats MRA were also found primarily in the top few inches, but were found as deep as 48 inches bgs. The deeper items were sometimes found in pits and it anticipated that

items found at depths greater than 6 inches, but not identified as being from a pit were buried at some point, either by disturbance of soil, or erosion and deposition.

Flares were found throughout the southern portions of the Parker Flats MRA with higher concentrations of M48 series parachute trip flares in the eastern part of MRS-37 and higher concentrations of M49 series trip flares in along the ridge south of Parker Flats (Plate 10). In the northern portion of the Parker Flats MRA, the majority of the flares were M49 series and found mainly in the central and eastern portion of MRS-13B.

Because M48 series flares deploy parachutes, it is considered a non-penetrating item and would be expected to be found on or near the surface. The M49 series trip flare functions by burning in the location where it is emplaced, with no movement of the flare when ignited and is also considered a non-penetrating item. The M48 and M49 series flares were found mostly in the top six inches of soil, but were found as deep as 48 inches bgs. The deeper items were sometimes found in pits and it is anticipated that items found at depths greater than 6 inches, but not identified as being from a pit, were buried at some point, either through disturbance of soil or erosion.

Based on review of the removal data, it is possible that signals and flares remaining after the removal action could be located throughout the Parker Flats MRA and could be buried up to 48 inches bgs.

Simulators

Several simulators were found within the northern portion of the Parker Flats MRA. Simulators found included the M80 explosive detonation simulator, the M110 flash artillery simulator, M22 antitank guided missile and rocket simulator, M74 airburst projectile simulator, M115A2 ground burst projectile simulator, M117 explosive boobytrap simulator (flash), and the M119 explosive boobytrap simulator (whistling) (Plate 11). No more than 3 of any simulator model was found. The number of simulators found suggests significant use of these items within the northern portion of the Parker Flats MRA did not occur. If simulators were used in the northern portion of the Parker Flats MRA, they were probably used for demonstration purposes or in conjunction with other training activities (e.g., booby trap training). It is possible that if any of these items remain after the removal action, they could be found anywhere within the northern portion of the Parker Flats MRA.

Simulators (MEC or MD) found within the southern portion of the Parker Flats MRA include the M80 explosive detonation simulator, the M110 flash artillery simulator, M21 flash artillery simulator, M22 antitank guided missile and rocket simulator, M74 airburst projectile simulator, M27A1B1 airburst simulator, M115A2 ground burst projectile simulator, hand grenade simulator, M117 explosive boobytrap simulator (flash), the M118 explosive boobytrap simulator (illumination) and the M119 explosive boobytrap simulator (whistling) (Plate 11). Not all of the simulators found within the southern portion of the Parker Flats MRA were related to the bivouac training area, for example, the M22 antitank guided missile and rocket simulators were related to TOW training that occurred within or just south of the southern portion of the Parker Flats MRA in the 1970s and 1980s. The most common simulators found were the M74 airburst simulator and the M22 antitank guided missile and rocket simulator. Most of the M22 antitank guided missile and rocket simulators were found in two pits, one with 70 expended (MD) items and one with 80 MEC items.

The M74 airburst projectile simulators were found primarily in the northeastern part of the southern portion of the Parker Flats MRA, but were also found in other areas of the site. The distribution of the other simulators found in the southern portion of the Parker Flats MRA does not suggest significant use of these items within a designated area, but there could have been some random use of these items throughout the Parker Flats MRA. This indicates that if any of these items remain after the removal

action, they could be found throughout the MRA, with potentially greater concentrations in the northeast part of the southern portion of the Parker Flats MRA.

Simulators are non-penetrating items and would be expected to be found at or near the surface. Most of the simulators found within the northern portion of the Parker Flats MRA were buried in pits at depths down to 30-inches. The buried items included both MEC and munitions debris. The remaining simulators found in the northern portion of the Parker Flats MRA were located on the ground surface and also included MEC and munitions debris. The simulators found within the southern portion of the Parker Flats MRA were mostly within the top 6 inches. The deepest items were found at 48 inches bgs. Some of these MD and MEC were identified as being from burial pits; however, not all items found below the top few inches were identified as being from burial pits. The items located below the top few inches, but not from burial pits, were most likely buried through soil disturbance, or through erosion and deposition.

Smoke Pots

Two MK III HC screening smoke pots (MEC) were found in the northern portion of the Parker Flats MRA in a burial pit. M1 HC screening smoke pots (MEC or MD), both 2.5-and 10-pound models were found widely scattered around the southern portion of the Parker Flats MRA (Plate 15). These items are used to produce screening smoke for training exercises and demonstrations (*Army, 1982*). Because the smoke pots were found in burial pits or widely scattered throughout the Parker Flats MRA, it is not possible to limit the area where remaining smoke pots could potentially be found.

The smoke pots in the northern portion of the Parker Flats MRA were buried in a pit. No depth information was recorded. The smoke pots in the southern portion of the Parker Flats MRA were found at depths ranging from 1 to 36 inches. Sixteen smoke pots were found at 12 inches within a burial pit and 2 other smoke pots were found at 18 inches. None of the other smoke pots, including those found at 18 inches were found in burial pits. It is suspected that the smoke pots found below the first few inches of soil were buried at either through disturbance of soil, or through erosion and deposition.

Booby Traps

Firing devices and simulators (MEC and MD) found during the Parker Flats MRA removal action indicate booby trap training occurred within the Parker Flats MRA boundaries. The distribution of booby trap simulators found within the Parker Flats MRA is discussed in the above section on simulators. Firing devices (MEC and MD) found within the northern portion of the Parker Flats MRA include the M1A1 pressure, M1 pull, M1 release, M5 release, M3 tension and release, and a base coupling firing device (Plate 11). During the initial sampling investigation conducted in the northern portion of the Parker Flats MRA (MRS-13B) hundreds of firing devices (MD) were removed. The information on the locations and depths at which the firing devices were found was not available. During the removal action conducted at MRS-13B, firing devices (MEC and MD) were found primarily in burial pits scattered around the northern portion of the Parker Flats MRA. Two of the burial pits were located adjacent to Gigling Road (Plate 11). On the basis of the number of firing devices found at MRS-13B and the presence of booby trap simulators, booby trap training alone or in conjunction with practice mine training may have occurred in the northern portion of the Parker Flats MRA. However, because location information was not available for most of the firing devices found, a specific training area within the northern portion of the Parker Flats MRA is not identifiable. It is possible that if any of these items remain they could be found anywhere within the northern portion of the Parker Flats MRA.

Firing devices were found up to 48 inches bgs in the northern portion of the Parker Flats MRA; however, no depth information is available for most of the items. Firing devices are considered non-penetrating items and would be expected to be found at or near the surface.

Firing devices (MEC and MD) found within the southern portion of the Parker Flats MRA include the MK-1 combination, M1A1 pressure, M2 pull friction, M1 pull, M5 release, M3 tension and release, and a base coupling firing device (Plate 11). Firing devices were found primarily within MRS-3 and MRS-54 and to the north and west of MRS-3. Most of the items were found in groups indicating that specific areas were used for training using these items. It appears based on the distribution of these items that any remaining items would most likely be found in the same areas.

Firing devices were found up to 24 inches bgs in the southern portion of the Parker Flats MRA; however, most were found within the top 6 inches of soil. A few of the items were identified as being in burial pits, but not all items found at 1-foot or deeper were identified as being in pits. It is expected that firing devices found at or below 1-foot bgs were buried either through soil disturbance or through erosion and deposition.

Practice Mortars

In the northern portion of the Parker Flats MRA practice mortar training is identified on training maps from the mid 1950s, but is not identified on later maps (1960s, 1970s or 1980s). Practice mortars found included the M50 and M43 models and their components. One expended illumination mortar was also found. Sub-caliber training devices associated with mortar training were also found including 22mm and 25mm sub-caliber projectiles (*USA, 2000c*). In the southern portion of the Parker Flats MRA practice mortar training is identified on training maps from the mid 1950s through the 1960s. The training areas were located within MRS-55 and MRS-37. Practice mortars found included M68 and M69 training mortars.

60mm Mortars

The only 60mm mortars found during the removal action conducted in the northern portion of the Parker Flats MRA were five M50 practice mortars. A sixth 60mm mortar was found, but the model number was unknown (Plate 7). Other 60mm mortar components found included M4 ignition cartridges and a tail boom from a 60mm mortar. As noted above, no firing points or targets were identified on the 1956 aerial photograph or the 1950s era training maps. Depending on the angle of the mortar and the number of propellant charges used, the range of the M50 60mm practice mortar was from 280 to 1,963 yards. Because the grid records are not available, the exact location of where the practice mortars were found is not available. The M4 ignition cartridges were found in the vicinity of Gigling Road and were probably disposed of at this location. If 60mm practice mortars remain in the northern portion of the Parker Flats MRA, the most likely location for them to be found would be in the vicinity of the Sinkhole Practice Mortar Range.

A penetration study performed by the Corps of Engineers, Huntsville, calculated a maximum penetration depth for the high explosive equivalent of the M50 practice mortar of 1.1 feet in sandy soil. Based on the penetration study it is anticipated that the 60mm mortars would be found within the top 14 inches of the soil. Five expended 60mm practice mortars found in the northern portion of the Parker Flats MRA. Because the grid records are not available the depth at which the practice mortars were found is not available.

M69 practice 60mm training mortars were found within MRS-37. The M69 practice 60mm training mortars are grouped together with only three found outside of the main accumulation area. The distribution of these mortars appears to correspond with the practice mortar training areas identified on the training maps.

The modeled maximum penetration depth for the M69 practice 60mm mortar is 0.2 feet. The M69 practice mortars were found between 4 and 24 inches bgs. The depths that the items were found are much deeper than the modeled penetration depths. It is possible that the items were buried at sometime either through soil disturbance or through erosion and deposition.

81mm Mortars

Three expended M43 practice mortars and one expended M301A2 illumination mortar (MD) were found during the removal action conducted in the northern portion of the Parker Flats MRA (Plate 6). No firing points or targets were identified on the 1956 aerial photographs or the available 1950s era training maps. The distance the mortar will travel varies depending on the propellant charge added and ranged from 565 to 4,050 yards for the M43 (*Army, 1977a*). Because the grid records are not available, the exact location of where the three practice mortars were found is not available. It appears that the most likely areas for 81mm mortars to remain after the removal action would be in the vicinity of the Sinkhole Practice Mortar Range.

No penetration data is available for the M43 practice mortar. The maximum calculated penetration depth for the M43A1 high explosive 81mm mortar in sandy soil is 2.7 feet (*USAESCH, 1998*). Depth information for the M43 practice mortars found in the northern portion of the Parker Flats MRA is not available. The maximum calculated depth of penetration for the M301A2 illumination mortar in sandy soil is 2.0 feet. The M301A2 illumination mortar was found at a depth of 6 inches. Based on the penetration study the maximum depth that the 81mm mortar would be expected is 2.7 feet.

M68 practice 81mm training mortars were found in MRS-3. This appears to be the target area for the practice mortar training areas identified on the 1950s and 1960s training maps. Three M68 practice 81mm training mortars were also found on the southern edge of the site just north of Grant Ewing Ridge. These items would not be expected to present a danger, because once fired down range they contain no explosive components. No unfired M68 practice 81mm training mortars were found within the Parker Flats MRA (Plate 6).

The modeled maximum penetration depth for the M68 practice 81mm mortar is 0.3 feet. Most of the M68 practice 81mm mortars were found between 12 and 48 inches bgs. The depths that the items were found are much deeper than the modeled penetration depths. It is possible that the items were buried at sometime either through soil disturbance or through erosion and deposition.

Based on the review of the data, MEC associated with the practice mortar training would not be expected, but if an unfired practice M43, M50, M68, or M69 was still present, it would likely be in the area shown on Plate 7 as the practice mortar area. It is expected that, unless the items were buried, that they would be located in the top few inches of soil.

Hand Grenades

Based on the number and variety of models of practice grenades and grenade fuzes found, it appears that training in the use of practice hand grenades occurred in the Parker Flats MRA (Plate 9). It appears that practice hand grenade training continued into the 1960s and possibly later. Practice hand grenade training in the northern portion of the Parker Flats MRA included the use of M30, M62, and M69 practice grenades. Hand grenades found in the southern portion included the M30, M62, and M69 practice hand grenades; M15 and M34 white phosphorous hand grenades; and M7A3 and ABC-M25A2 CS riot grenades. A description of some of the practice hand grenades found during the removal and the areas where they appear to have been used is provided below.

M30 Practice Hand Grenade

In the northern portion of the Parker Flats MRA M30 practice hand grenades, primarily munitions debris, were found primarily in the southwest corner in the same location as the MK II practice hand grenades (Plate 9). M205 series hand grenades fuzes were also found in this area and along Gigling Road. It appears that this area was used as a practice hand grenade training area based on the finding of MK II practice hand grenades, M30 practice hand grenades, and M205 series hand grenade fuzes. It is expected that any remaining M30 practice grenades would be found in the same area.

In the southern portion of the Parker Flats MRA M30 practice hand grenades, primarily MD, were found mostly on the east side of Artillery Hill, with some found on the southwest side of Artillery Hill (Plate 9). M205 series hand grenades fuzes were also found in this area. It appears that this area may have been used as a practice hand grenade training area based on the finding of M30 practice hand grenades and M205 series hand grenade fuzes. It is expected that any remaining M30 practice grenades would be found in the same area.

The M30 practice hand grenade is considered a non-penetrating item and would be expected to be found at or near the surface. Most of the M30 practice grenades (MD) were found within the top 6 inches of soil; however, some were found as deep as 24 inches. Some of the M30 practice grenades found at depths greater than 6 inches were found in burial pits. It is suspected that the other M30 practice grenades found at depths greater than 6 inches were either buried through disturbance of soil, or through erosion and deposition.

M62 Practice Hand Grenade

Only a few M62 practice hand grenades (MD) were found in the northern portion of the Parker Flats MRA. The M62 practice grenades were found in the southwest corner of MRS-13B in the same general area as the other models of practice hand grenades. Based on the number of M62 practice hand grenades found, training with these items appears to have been limited in this area.

The M62 practice hand grenades found in the northern portion of the Parker Flats MRA were found at or near the surface. The M62 practice hand grenade is considered a non-penetrating item and was found where expected. Items found at a greater depth would probably have been buried either through disturbance of soil, or through erosion and deposition.

M62 practice hand grenades, both MEC and MD, were found within the southern portion of the Parker Flats MRA, but at concentrations, much lower than the MK II, the M30, and the M69 practice hand grenades. The M62 practice grenades were all found in the central section of the southern portion of the Parker Flats MRA, but there does not appear to be a pattern to the distribution of these items within the area that they were found, suggesting that they may not have been used in a defined training area. The M62 practice grenades were found from the surface to 10 inches bgs. It is expected that the deeper items were buried either through disturbance of soil, or through erosion and deposition.

M69 Practice Hand Grenades

Three M69 practice hand grenades (MEC and MD) were found in the northern portion of the Parker Flats MRA. The M69 practice hand grenade is the practice version of the M67 fragmentation grenade and used the M228 practice hand grenade fuze. A limited number of M228 fuzes, both MEC and MD, were also found (Plate 9). The M69 practice hand grenades were found outside of the areas where other practice grenades were concentrated. Use of the M69 practice grenades in this area appears to have been very limited. The M228 practice hand grenade fuzes were scattered mostly across the southern portion of MRS-13B. It appears, based on review of the data, that if M228 fuzes and M69 practice hand grenades

remain following the removal action that they could be found in the general area where other models of practice hand grenades were found, or primarily in the southern portion of MRS-13B.

The M69 practice grenades were found on the surface or in the upper 6 inches of soil. All of the single item M228 hand grenade fuze finds were within the first 6 inches bgs, but three were found in a burial pit at 18 inches bgs.

Both M69 practice hand grenades (MEC and MD) and M228 fuzes (MEC and MD) were found throughout the southern portion of the Parker Flats MRA (Plate 9). Many fuzes are grouped along the roads and trails, indicating that some of the items may have been discarded. Several other groups were found, including one along the east side of Artillery Hill, and one in the northern part of MRS-37 and MRS-55. Although grouping is evident, but both the M228 fuze and the M69 practice hand grenades were found outside of the groupings. It appears based on review of the data, that if M228 fuzes and M69 practice hand grenades remain following the removal action that they could be found through most of the southern portion of the Parker Flats MRA.

In the southern portion of the Parker Flats MRA, the M69 practice grenades were found up to 40 inches bgs, although most were found in the upper 6 inches of soil. Most of the single item M228 hand grenade fuze finds were within the first 6 inches bgs, but some were found up to 48 inches bgs. Many of the deeper finds were in burial pits; however, not all of the deeper finds were identified as being in burial pits. It is suspected that the deeper items, not found in pits, were buried through disturbance of soil, or through erosion and deposition.

M34 and M15 White Phosphorous Hand Grenades

Fragments from M34 and M15 white phosphorous hand grenades and expended M34 white phosphorous hand grenades are present on the southwest side of Artillery Hill north of Bivouac Areas E and F (Plate 9). M34 and M15 white phosphorous hand grenades were found at other locations within the southern portion of the Parker Flats MRA, but no other areas of accumulation were found. The M206 grenade fuze is used with both the M34 and M15 white phosphorous hand grenade. Expended M206 fuzes are concentrated on the northeast side of Artillery Hill. The area southwest of Artillery Hill is not identified as a hand grenade training areas on available training maps; however, the presence of the expended grenades and fragments indicates that these items were used in this area. One MEC M15 white phosphorous hand grenade was found within the southern portion of the Parker Flats MRA, within the Field Fort Training Area. If M34 and M15 white phosphorous grenades were to remain after the removal action it is suspected that they would be in the same area as they were found.

The M34 and M15 white phosphorous hand grenades are considered non-penetrating items and would be expected to be found at or near the surface. The MEC M15 white phosphorous hand grenade was found at 2 inches bgs. The fragments and MD were generally found in the top 6 inches of soil. It would be expected based on this information, that any remaining M34 and M15 white phosphorous hand grenades would be found in the top 6 inches of soil.

CS and CN Grenades

A limited number of hand grenades (approximately 50) containing CS and CN (MEC and MD) were found almost exclusively within the southern portion of the Parker Flats MRA. One CN hand grenade (MD) was found in the northern portion of the Parker Flats MRA. The grenade models found included CS M7A3, CS-1 ABC-M25A2, and CN M7 series. Several of the grenades were found within and adjacent to MRS-4B, the CBR training area, others were found primarily on the ridges south of Parker Flats and in MRS-3 (Plate 9). In addition to the CS and CN hand grenades that were found, four M561 CS 40mm projectiles (MEC and MD) were found in MRS-3 (Plate 14). The CS and CN hand grenades

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were found at depths up to 14 inches bgs. The four projectiles were found at the same location at depths up to 12 inches bgs. CS and CN hand grenades are considered non-penetrating items and would be expected in the top few inches of soil. The M561 40mm projectile has a maximum calculated penetration depth of less than 4 inches. It is suspected that the items found at depth greater than a few inches may have been buried, either in pits, or through disturbance of soil, or through erosion and deposition. It appears that these items were not used extensively within the area. Based on the distribution of the CS and CN grenades found and removed, it is not expected that these grenades would remain at the site, but if they do remain it is expected that they would be in the same general area as where they were found.

Rockets

No evidence of training with rockets, either high explosive or practice, is identified within the Parker Flats MRA on historical training maps. However, MEC and MD items were found during the removal action, and appear to be related primarily to burial pits or possibly discarded items. The distribution of the MEC and MD found and removed is described below.

2.36-inch Practice Rockets

Three M7 2.36-inch practice rockets were found in the northern portion of the Parker Flats MRA. The 2.36-inch rockets were located in the south central and eastern portion of MRS-13B (Plate 13). One of the M7 2.36-inch practice rockets was found buried at a depth of 30 inches bgs. The two remaining M7 2.36-inch practice rockets were found on the ground surface. Because of the limited number of items, it does not appear that the northern portion of the Parker Flats MRA was used to fire M7 2.36-inch practice rockets.

Two areas with pits containing M7 2.36-inch practice rockets were found within the southern portion of the Parker Flats MRA, one on the ridge south of Parker Flats, and the second pit area in MRS-3 (Plate 13). Expended M7 2.36-inch practice rockets were also found widely scattered across the southern portion of the Parker Flats MRA. One MEC was found near Parker Flats Training Area 2. Because most of the items were found within burial pits, and the other items were widely scattered, it does not appear that a 2.36-inch practice rocket range was present within the southern portion of the Parker Flats MRA.

One M10 2.36-inch smoke, WP rocket was found in the southern portion of the Parker Flats MRA within MRS-3 at a depth of 48 inches. Although the item was not specified as being from a burial pit, it does appear that this item was buried at sometime based on finding the item at 48 inches. Because only one item was found and it was found at 48-inches, it does not appear that the item was used for training within the Parker Flats MRA. Although not likely, it is possible that if 2.36-inch rockets remain at the site they could be widely scattered.

3.5-inch Practice Rockets

Several areas of 3.5-inch rocket accumulations, (MD both fragments and expended) were found within the northern and southern portions of the Parker Flats MRA (Plate 13). In the northern portion of the Parker Flats MRA several hundred expended M29 series 3.5-inch practice rockets were found in burial pits in the southwest corner of MRS-13B. Other M29 series 3.5-inch practice rockets (MD) were found at depths ranging from 3 to 12 inches bgs in the same location. Because most of these items were found in pits and because of the lack of a range noted on training facilities maps, it appears that these items were disposed of within MRS-13B and were not related to training in the area.

In the southern portion of the Parker Flats MRA several hundred pounds of M29 series 3.5-inch practice rockets fragments and expended M29 series 3.5-inch practice rocket fragments were found on the ridge east of Parker Flat within burial pits. Burial pits with expended M29 series 3.5-inch practice rockets were

also found north of Parker Flats, west of the CBR training area. Because these items were found in pits and were not found at or near the surface, it appears that these items were placed within the Parker Flats MRA and were not related to training in the area.

Based on review of the removal data, it is not expected that 3.5-inch MEC would be present within the Parker Flats MRA unless they are present in undiscovered burial pits.

Antitank Rockets (66mm and 35mm)

Two areas with fragments from 66mm rockets, one from an M72 series high explosive antitank rocket, and one from an M74 incendiary 66mm rocket, and one expended M72 series high explosive antitank rocket were found within the southern portion of the Parker Flats MRA (Plate 12). No other evidence of 66mm antitank rocket use was found during the removal actions in the northern or southern portions of the Parker Flats MRA, and it appears that these items may be related to the light antitank weapon (LAW) rocket range located south of the site within the Impact Area (Plate 12). Two 35mm subcaliber MEC items were found on the southern boundary of the Parker Flats MRA along the roads; one off a road, and one expended item was found adjacent to a trail and may be discarded items related to training within the impact area. All of the items were found in the top 3 inches of soil. No other evidence of 35mm practice training was identified in the Parker Flats MRA. Because very few 66mm rockets and 35mm subcaliber rockets were found during the removal actions conducted within the Parker Flats MRA, it appears that the extent of training with these items in these areas was limited. Based on review of the removal data, it is not expected that other 35mm or 66mm MEC items would remain in the Parker Flats MRA.

Practice Mines

Practice mine training within the Parker Flats MRA is not documented on any available training maps; however, expended practice mines, antitank mine activators (practice) and several mine fuzes were found during the removal actions conducted with the Parker Flats MRA. Practice mine training south of MRS-3 (south of the Parker Flats MRA) was documented on the 1970s through 1980s training maps and in Range Control SOP (*Army, 1980*).

During the initial sampling investigation conducted in the northern portion of the Parker Flats MRA (MRS-13B) 71 antipersonnel and 27 antitank mines (MD) and one mine fuze were removed. The information on the models, locations and depths at which the mines and fuze were found was not available. During the removal action conducted at MRS-13B, mines found included four practice M8 series antipersonnel and two practice M68 series antipersonnel mines found in burial pits (Plate 12). Other associated mine training items found consisted of one non-metallic antipersonnel training mine (MD), four M604 practice antitank mine fuzes (MEC and MD), and 20 expended M1 antitank mine activators. One of the M604 practice fuzes and the 20 M1 mine activators were found in burial pits. Other items found in these burial pits that may have been used for training in conjunction with the practice mines included M1 and M3 firing devices and a firing device base coupling (MEC). On the basis of the number of practice mines found at MRS-13B practice mine training occurred in the northern portion of the Parker Flats MRA. However, because location information was not available for most of the practice mines found, a specific training area within the northern portion of the Parker Flats MRA is not identifiable.

The practice mines found in the northern portion of the Parker Flats MRA for which depth and location information are available, were located at 3 to 24 inches bgs. Because location information for most of the mines is not available it is not possible to determine where practice mines may be found in the future and it is assumed that any potentially remaining practice mines could be found anywhere within the northern portion of the Parker Flats MRA.

Practice mines found within the southern portion of the Parker Flats MRA include the M8 series antipersonnel mines, and M1, M10, M12 series, M20, and the M7 practice antitank mines. Mine fuzes found within the southern portion of the Parker Flats MRA include the M604 antitank practice, the M10 series combination, the M605 combination and the M6A1 combination fuzes. The practice mines appear to be scattered within the southern portion of the Parker Flats MRA and within several small groups (Plate 12).

One group is in the northwest side of the site consisting of expended M20 antitank mines, and M8 antipersonnel mines.

A second group is on the far eastern side of the site and a third group is within MRS-3. MEC and MD found at and around MRS-3 include M12 series, M7 practice antitank mines. A Teller 35 antitank training aid mine was also found in the area. The Teller 35 was a German WW II mine. Several other mines, some possibly training aids, were also found at MRS-3, during sampling performed by HFA, including the USSR AT training mine (model not recorded), AP training mine, and AT training mine. It is suspected that these items were related to the practice mine training that occurred south of MRS-3 as part of the anti-amour training course.

Practice mines were found from the surface to 48 inches bgs. Most of the practice mines were found at the surface or within 4 inches of the surface which is consistent with standard placement depths. The practice mines found at 48 inches were found in groups and were identified as being in burial pits.

Based on the limited number of practice mines found it is not expected that practice mines would be encountered in most areas of Parker Flats in the future. If practice mines were still present, it is most likely that they would be found within or near MRS-3 or within burial pits.

Miscellaneous Items

Some items found within the Parker Flats MRA did not appear to correspond to the training discussed in the above sections. These items are discussed briefly below.

Projectiles

Miscellaneous projectiles (MEC) found in the northern portion of the Parker Flats MRA (MRS-13B) include one 20mm HE incendiary projectile M56A3, one 37mm HE projectile M63, one 40 mm HE projectile M384, and one 40mm practice projectile M382. Miscellaneous projectile related MD found included one 40mm parachute projectile M662, three illumination projectiles M583, and one 105mm cartridge (model unknown). The distribution of these items is shown on Plate 14. With the exception of the three illumination projectiles that were found in a burial pit, each of these miscellaneous items were single finds which suggests that the items were most likely discarded or only used infrequently possibly for demonstration purposes. Because these items do not appear to have been used for training within the MRS-13B, it is not possible to identify areas within the site where they would be more likely to remain after the removal action.

Items found in the southern portion of the Parker Flats MRA include two expended 155mm shrapnel projectiles MK1, one expended 155mm HE projectile M107, and various 40mm projectiles and cartridge cases. The distribution of these items is shown on Plate 14. Most of these items were single finds which suggests that the items could have been discarded or only used a few times. Because these items do not appear to have been used for training within the southern portion of the Parker Flats MRA, it is not possible to identify areas within the site where they would be more likely to remain after the removal action.

Other Items

Other MEC and MD found within the Parker Flats MRA include blasting caps, various Ordnance and Explosive Waste (OEW) -related material (e.g., nitrostarch, TNT, and black powder charges, igniters, and pyrotechnic mixtures), various cartridges, and cartridge cases, M2 ignition cartridges, and two electric squibs (Plate 15). Most of the other items found in the northern portion of the Parker Flats MRA consisted of M2 series ignition cartridges that were discarded along Gigling Road. A group of M2 ignition cartridges was also found in the southern portion of the Parker Flats MRA southeast of Bivouac Areas E and F. The M2 ignition cartridge is used with flamethrowers and in some projectiles including the 4.2-inch mortar. No evidence was found to indicate that flamethrowers were used in these areas. Blasting caps were found at random locations scattered throughout the Parker Flats MRA. Most of the blasting caps were found in groups within burial pits. Nitrostarch, TNT, and black powder charges and pyrotechnic mixtures were also found at random locations throughout the Parker Flats MRA. These charges may be related to general training in the area. Based on the distribution of these items and because some of the items were found in pits, it is not possible to identify areas within the southern portion where they would be more likely to remain after the removal action. Due to the concentration of ignition cartridges along Gigling Road, it is possible that additional ignition cartridges are present in this area.

In addition to the other MEC and MD in the Parker Flats MRA two M1 K951 Chemical Agent Identification Sets (CAIS) were found in the northern portion of the Parker Flats MRA (MRS-13B). The CAIS were found buried in two pits near one another at depths of 12 and 18 inches bgs. The M1 K951 CAISs contain dilute solutions of chemical agents in small (1-ounce), hermetically sealed ampoules (glass containers). The CAIS kits were used to train soldiers to recognize and protect themselves from chemical agents (*Army, 1942*). Training in recognition of chemical agents is not believed to have occurred at MRS-13B and no other CIASs were found during intrusive investigations in the Parker Flats MRA or at the former Fort Ord. It is possible that these sets were used in one of the nearby CBR training areas or in a classroom setting at another location and later buried at MRS-13B.

3.4.4 Potential Exposure Routes

The area within the Parker Flats MRA includes portions of ten reuse parcels. Plate 16 presents a conceptual model showing previous use and proposed reuse. Preliminary plans have been developed for these parcels, however, planning continues and future uses may be modified. Proposed parcel reuse in the southern portion of the Parker Flats MRA includes the establishment of a veterans' cemetery, an emergency vehicle operations center for Monterey Peninsula College, and habitat reserve areas. A small area within the Parker Flats MRA is designated for possible residential development. This includes 37 acres in the southern portion of the Parker Flats MRA, and less than 1 acre in the northern portion of the Parker Flats MRA. Proposed parcel reuse in the rest of the northern portion of Parker Flats MRA includes a maintenance center for Monterey Salinas Transit (MST), an Army maintenance center, a park and ride, public facilities for Monterey County, and a small part of the California State University Monterey Bay (CSUMB) Expansion Area. Portions of the entire Parker Flats MRA also include plans for a horse park. All of the proposed reuse scenarios could result in ground disturbing activities occurring (e.g., construction/excavation, visits the by the public and possible trespassers).

Potential exposure to MEC, although unlikely, could result from persons encountering MEC that was not removed during the removal action (e.g., during construction activities, trespassing, or visits by the public). No MEC was found within three of the reuse parcels, or portions of parcels, that lie within the boundary of MRS-13B (the Monterey County Public Facilities, CSUMB Expansion Area and the Habitat Reserve area). Although no MEC was found within these areas the possibility exists that MEC could still be present. It is expected that any MEC that could remain would be of a type that is similar to the MEC

items that were found in areas adjacent to these parcels or portions of parcels. MEC items found in the adjacent parcels include items used in training and maneuver areas such as flares, signals, firing devices, practice hand grenades and fuzes, and practice mines. It is not expected that burial pits would still be present in these parcels because removals have been completed. The risk assessment, which evaluates the potential explosives hazard risk to various receptors due to the potential presence of MEC at the Parker Flats MRA, is presented in Volume 2.

3.5 Site Evaluation

The available data (e.g., archival and removal data) regarding the Parker Flats MRA were reviewed and evaluated according to procedures described in the *Final Plan for Evaluation of Previous Work (HLA, 2000b)*. The evaluation process is documented through the completion of a series of checklists. Checklists were prepared for the southern part of the Parker Flats MRA and for the northern part of the Parker Flats MRA (MRS-13B). Copies of the checklists are provided as Appendix A. This section presents a summary of the results of the checklist evaluation. It is divided into two sections; an assessment of the literature review and an assessment of the removals performed at the site. A detailed evaluation of reconnaissance and sampling performed at the Parker Flats MRA is not provided because a removal action was completed.

3.5.1 Literature Review

As part of the Archives Search, an interview was conducted with Mr. Fred Stephani. Mr. Stephani served as a Fort Ord fire fighter from 1942 to 1944 at which time he left the Fort Ord fire department and joined the Army. Mr. Stephani returned to the Fort Ord fire department in 1947 where he worked until he retired, as Fire Chief, in 1978. Mr. Stephani identified several locations within the southern part of the Parker Flats MRA (MRS-50, MRS-52, MRS-53, MRS-54EDC and MRS-55) that were used in the 1940s, 1950s and 1960s as target areas and firing points (*USAEDH, 1997*). According to Mr. Stephani, military munitions that were fired or used within the Parker Flats MRA include rifle grenades, shoulder-launched projectiles, hand grenades, and artillery projectiles. Reconnaissance (site walks) was performed as part of the ASR by a USACE UXO Safety Specialist.

The northern Parker Flats MRA (MRS-13B) was not purchased by the Army until the 1940s, and no evidence of use of this area as an artillery range was identified. Maps do indicate possible rifle grenade training in the early 1960s in the northern part of the Parker Flats MRA.

Several training locations and field maneuver activities were identified on Fort Ord historic facility maps within the southern and northern parts of Parker Flats MRA, including 2 practice mortar ranges (one in the southern part and one in the northern part), bivouac areas, CBR training, squad defense area, squad tactics, field fortification, individual tactical training, land navigation, land mine warfare, engineering and demolitions, air mobility training, helicopter mockup training area, bayonet training area, hand to hand combat training, physical training areas, and TOW tracking area. The expected types of military munitions associated with these activities include practice mortars, practice mines, pyrotechnics, simulators, signals, firing devices, and fuzes. Details regarding these types of training and munitions are presented in Section 3.4.

Subsequent Use of the Area

A small area of MRS-13B was developed beginning in 1977. The development included grading, excavation, facilities construction, and paving. Additional construction of facilities occurred adjacent to the facilities constructed in 1977, 1980, and 1985. The total development area covers 35.5 acres of MRS-13B.

From base closure to the present, the southern part and all but the previously developed 35.5 acres in the northern part of the Parker Flats MRA remains undeveloped. Future development plans include the establishment of a veterans' cemetery, Monterey Peninsula College Emergency Vehicle Operation Center, and a horse Park. A habitat reserve area will be established on a portion of the Parker Flats MRA. Areas established as habitat reserve will remain undeveloped. A small part of the Parker Flats MRA is also designated for development reserve (possibly for residential development).

Proposed parcel reuse in the northern portion of Parker Flats MRA includes a maintenance center for MST, an Army maintenance center, a park and ride, and public facilities for Monterey County. Portions of the northern part of Parker Flats MRA are also identified as a horse park and habitat reserve.

Because only a small area of the Parker Flats MRA was developed after documented use as a general training area, it is not possible to determine whether military munitions were used at the site in the undeveloped portion of the site after development occurred. It should be noted that the area of MRS-13B that was developed was identified in the 1950s and 1960s as the Guard Duty Area, Mortar Square #2, and the Physical Training Area (PCPTA-2). Use of military munitions would not have been expected in these areas; however, data documenting whether UXO clearance was complete during the construction activities is not available. The lack of data documenting UXO clearance is a concern because of the high number of burial pits identified in the area. Use of the site for training in the 1950s through 1980s would not have indicated knowledge of the pre-1940s impact area. Use of the Parker Flats MRA as an impact area was not known (*Stickler, 2003*).

Establishment of Site Boundaries

The establishment of the Parker Flats MRA boundary is not based on a single defined area of use. The Parker Flats MRA encompasses several MRSs, the boundaries of which were established as part of the archives search process. No clear areas of training are present on aerial photographs for the southern part of the Parker Flats MRA. The locations of some of the training areas within the northern part of the Parker Flats MRA are evident on historical aerial photographs. (Appendix A). As removal occurred within the individual MRSs the site boundaries were expanded to accommodate the removal of munitions and explosives of concern encountered near and beyond site boundaries. Expansion of the removal areas continued until the removal contractor encountered investigation limits as defined in the scope of work. Based on the results of the removal conducted to date at the Parker Flats MRA, it appears that additional investigation in some locations surrounding the Parker Flats MRA footprint may be necessary as a part of future military munitions response actions.

Summary of Literature Review Analysis

Based on a review of site literature, there was sufficient historical evidence to warrant sampling for military munitions within the Parker Flats MRA. The historical information reviewed indicates that a wide variety of training activities have been conducted within the Parker Flats MRA including activities involving the use of munitions and explosives of concern.

3.5.2 Removal Action Review

This section describes the Parker Flats MRA boundary based on the results of the military munitions investigations. The historical information related to the removal results as summarized in checklist questions 1 through 14 are not discussed in detail in this section. This information is presented in Section 3.4 and on Plates 2 through 15. There is also a discussion regarding sampling equipment, methods, and quality control measures used during prior sampling and removal efforts.

3.5.2.1 Investigation Design

This section summarizes the information contained in removal checklist questions 15 through 17 (Appendix A). The boundary of the Parker Flats MRA is based on the limits of investigation as defined in the removal contractor's scope of work and not on defined areas of military munitions use. The Parker Flats MRA contains several MRSs investigated as part of the former Fort Ord military munitions response program. Initial sampling was conducted at each site within the Parker Flats MRA to determine if further action (removal) was necessary. Based on sampling results, a 4-foot removal action was conducted at each MRS. The objective of the removal action was to remove all munitions and explosives of concern from each site to a depth of four feet. Based on protocol developed jointly by the USACE and USA, removals were conducted beyond the established MRS boundary at some sites. Through a combination of the 4-foot removal conducted at each MRS and expansion at some MRSs, the entire Parker Flats MRA footprint was subjected to a 4-foot removal action. According to the November 30, 2001 Grid Sampling and OE Removal Inland Range Contract Closure After Action Report – Former Fort Ord (USA, 2001h), USA actively pursued the investigation of all anomalies encountered during 4 foot removal operations. If an anomaly was detected below 4 feet, permission from the USACE OE Safety Specialist was obtained prior to continuing the investigation. Based on the statements in the USA report all anomalies detected within the Parker Flats MRA were investigated and all military munitions removed. Although all military munitions detected within the Parker flats MRA have been removed, the investigation of military munitions beyond the Parker Flats MRA may be necessary in some areas.

3.5.2.2 Equipment Review

This section describes results of a review of the geophysical instruments used during the removal action performed within the Parker Flats MRA. Information used in this review included the penetration study presented in the Phase 2 EE/CA (Army, 1997), the ODDS (Parsons, 2001a), results of the Del Rey Oaks removal (USA, 2001g), and the Draft MRS-MOCO.2 After-action Report (Parsons, 2004b). An evaluation of the equipment used during the sampling is not presented because the sampled areas were completely resurveyed by the Schonstedt Model GA-52/Cx magnetometer during the removal action.

Schonstedt Model GA-52/Cx Magnetometer

The investigation for MEC and MD within Parker Flats was performed by USA Environmental, Inc. using a Schonstedt Model GA-52/Cx magnetometer. This instrument is a passive dual flux-gate magnetometer – a highly sensitive magnetic locator that detects ferrous (iron) metal objects; however, it cannot detect non-ferrous metal objects (e.g., lead, brass, copper, aluminum). In general, magnetometers make passive measurements of the earth's natural magnetic field; ferrous metal objects (and rocks) are detected because they produce localized distortions (anomalies) in the magnetic field. The Schonstedt magnetometer actually detects slight differences in the magnetic field (the "gradient") by means of two sensors mounted a fixed distance apart within the instruments' staff. Because the magnetic response falls off (changes) greatly even over a short distance, a gradient magnetometer like the Schonstedt is especially sensitive to smaller, near-surface ferro-metal objects (Breiner, 1973).

The Schonstedt GA-52/Cx magnetometer is a hand-held device that, when properly adjusted, will emit a distinctive tone when placed near a ferrous metal object; the volume and pitch of this tone can provide an experienced operator with qualitative information about the nature of the detected object (e.g., size, location, burial depth). It should be noted, however, that Schonstedt magnetometers will also respond to soil and rock ("hot rocks") containing ferrous minerals. It should also be noted that asphalt pavement may contain enough ferrous mineralization to produce a Schonstedt response, which can mask the response from potential MEC items. Accordingly, it is recognized that the interpretation of the Schonstedt instrument response can be subjective; for deeper targets, especially, the operator often must

analyze a subtle change in the audio output and decide whether the instrument is responding to a potential MEC item or to pavement or soil mineralization. Additionally, it can be difficult to determine the exact location of a more deeply buried object because the Schonstedt's audio response may be dispersed over an area that is several feet wide.

The Schonstedt magnetometer is a so-called analog device that does not itself record (save) any data; typically, the location of a detected object (a "hit") is marked in the field or promptly excavated to uncover the detected object. For that reason, Schonstedt surveys are sometimes called "mag and flag" or "mag and dig" surveys.

Parker Flats Survey Procedures

The Parker Flats MRA comprises a number of designated munitions response sites that were surveyed as part of separate removal actions by USA in 1998 and 1999. The largest sites are MRS -37, MRS-50, MRS-52, and MRS-53. The terrain at Parker Flats includes open grassland and moderate to steep slopes vegetated with oak trees, manzanita, and poison oak. Parker Flats was cleared of brush to facilitate the MEC surveys, although large oak trees were not removed. The cleared areas were divided into 100- by 100-foot grids and surveyed along a series of adjacent 5-foot wide search lanes.

Schonstedt survey procedures, as documented in the USA work plan, were performed as follows: the hand-held Schonstedt instrument, which resembles a "walking stick" in appearance, was swung from side to side as the operator walked down the centerline of 5-foot wide search lanes delineated by lengths of rope laid on the ground. Schonstedt responses indicative of potential MEC items ("hits") were marked in the field with pin flags and the hit location was excavated until a metal object was encountered or the instrument no longer showed a response. Found objects were then mapped and cataloged. Over 15,000 MEC or munitions debris items were discovered (Appendix B). In general, 37mm, 60mm, and 75mm projectiles, 3-inch Stokes mortars, various types of grenades, grenade fuzes, signal flares, and unidentified fragments comprised the bulk of the items found.

Functional checks of the Schonstedt instruments were performed daily. Additionally, QC and QA surveys were performed. QC procedures entailed a resurvey of at least 10 percent of each grid by a USA QC Officer. QA procedures generally entailed a second 10 percent resurvey by USACE personnel.

Evaluation of Schonstedt Model GA-52/Cx Detection Efficiency at the Parker Flats MRA

The detection efficiency of the Schonstedt GA-52/Cx used with 5-foot lane widths was tested during the ODDS seeded test and during the Del Rey Oaks (DRO) removal action. These two data sources are described below.

As part of the ODDS, seeded tests were performed to evaluate the ability of the Schonstedt GA-52/Cx to detect MEC items buried at various depths. The seeded test was conducted with multiple lane widths, including the 5-foot width used at the Parker Flats MRA. The ODDS seeded test evaluated instrument performance based on two different search radii, 1.6-foot and 3.3-foot. If the distance between the location identified by the instrument and the actual location of an item was equal to or less than the search radius the item was considered detected by that instrument.

During the DRO removal action, 55 lots of items were seeded in the DRO Group sites prior to the removal action. Twenty-one of these items were seeded in areas where the Schonstedt GA-52/Cx was subsequently used to perform the removal. Fifteen of these items were similar to items found within the

Parker Flats area and have been included in this evaluation. Locations which contained multiple seeded items were not included in this analysis.

The ODDS report included the percent of items detected (Pd) in the seeded test for each instrument. However, this Pd should not be directly translated to the Pd at an actual site. For any detection equipment, the Pd depends on the depth distribution of items. If all the items are shallow, the Pd will be high, but if all the items are deep, the Pd will be low. The depth distribution of seeded items in the ODDS was designed to test and compare the detection capabilities of different detection instruments, not to represent a typical site. According to the ODDS Work Plan, items were seeded at three different depths, at the limit of detection, 6-12 inches shallower than the limit of detection, and 6-12 inches deeper than the limit of detection. The limit of detection was based on the ODDS static, free air tests conducted prior to the seeded tests.

The following table lists the ODDS and DRO seeded items which are of the same type as items that were found at Parker Flats. The final column indicates whether these items were detected with the Schonstedt GA-52/Cx during the ODDS seeded test using 5-foot lane widths and a 1.6-foot search radius, or recovered during the Schonstedt GA-52/Cx DRO removal action.

Item ID	Depth (in)	Item Description	Detected
OEI113	3	Rocket, 2.36mm, Practice, M7 Series	Y
DRO138G	12	Rocket, 2.36mm	Y
OEI031	12	Rocket, 2.36mm, Practice, M7 Series	Y
OEI111	19	Rocket, 2.36mm, Practice, M7 Series	Y
OEI110	23	Rocket, 2.36mm, Practice, M7 Series	N
OEI112	23	Rocket, 2.36mm, Practice, M7 Series	N
OEI035	24	Rocket, 2.36mm, Practice, M7 Series	Y
DRO143FA	24	Rocket, 2.36mm	Y
OEI033	36	Rocket, 2.36mm, Practice, M7 Series	N
DRO143FB	36	Rocket, 2.36mm	N
OEI101	2	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI104	5	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI011	6	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI007	6	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI004	6	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI105	8	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI102	8	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI103	10	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI008	12	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI002	12	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI006	18	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI009	18	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI106	18	Rocket, 35mm, Practice, Sub-caliber, M73	Y
OEI003	18	Rocket, 35mm, Practice, Sub-caliber, M73	N
OEI027	36	Rocket, 35mm, Practice, Sub-caliber, M73	N
OEI147	3	Projectile, 37mm, AP-T, M-51	Y
DRO1 46G	6	Projectile, 37mm	Y
DRO1 33I	6	Projectile, 37mm	Y
OEI149	10	Projectile, 37mm, AP-T, M-51	N

Item ID	Depth (in)	Item Description	Detected
DRO1-30P1	12	Projectile, 37mm	Y
OEI148	13	Projectile, 37mm, AP-T, M-51	N
OE43 23I	18	Projectile, 37mm	N
DRO1-46G	18	Projectile, 37mm	Y
DRO1-38G	18	Projectile, 37mm	N
OEI063	18	Projectile, 37mm, AP-T, M-51	N
OEI150	21	Projectile, 37mm, AP-T, M-51	N
OEI146	25	Projectile, 37mm, AP-T, M-51	N
OEI064	30	Projectile, 37mm, AP-T, M-51	N
OEI049	18	Projectile, 60mm, Mortar, Target Practice, M50	N
OEI050	24	Projectile, 60mm, Mortar, Target Practice, M50	N
OEI043	24	Projectile, 60mm, Mortar, Target Practice, M50	N
OEI051	36	Projectile, 60mm, Mortar, Target Practice, M50	N
OEI154	8	Projectile, 75mm, Shrapnel, MK I, Cases Only	Y
OEI155	8	Projectile, 75mm, Shrapnel, MK I, Cases Only	Y
OEI151	9	Projectile, 75mm, Shrapnel, MK I, Cases Only	Y
OEI152	16	Projectile, 75mm, Shrapnel, MK I, Cases Only	Y
OEI067	30	Projectile, 75mm, Shrapnel, MK I, Cases Only	N
OEI156	32	Projectile, 75mm, Shrapnel, MK I, Cases Only	N
OEI153	34	Projectile, 75mm, Shrapnel, MK I, Cases Only	N
OEI065	40	Projectile, 75mm, Shrapnel, MK I, Cases Only	N
OEI121	2	Grenade Hand, MK-2, Practice	Y
OEI015	6	Grenade Hand, MK-2, Practice	Y
OEI017	6	Grenade Hand, MK-2, Practice	Y
DRO-26O1	6	Grenade Hand, M68	Y
OEI120	7	Grenade Hand, MK-2, Practice	Y
DRO-26O2	9	Grenade Hand, M68	Y
OEI118	10	Grenade Hand, MK-2, Practice	N
OEI119	11	Grenade Hand, MK-2, Practice	N
DRO1-30P2	12	Grenade Hand, MK-2, Practice	Y
DRO1-26U	12	Grenade Hand, MK-2, Practice	Y
OEI016	12	Grenade Hand, MK-2, Practice	N
OEI018	12	Grenade Hand, MK-2, Practice	N
OEI107	12	Grenade, Rifle, AT, Practice, M9	Y
OEI028	12	Grenade, Rifle, AT, Practice, M9	Y
OEI108	15	Grenade, Rifle, AT, Practice, M9	Y
OEI109	24	Grenade, Rifle, AT, Practice, M9	N
OEI029	24	Grenade, Rifle, AT, Practice, M9	N
OEI030	36	Grenade, Rifle, AT, Practice, M9	N
OEI122	1	Signals, Illumination, M125, M126, M127	Y
OEI123	1	Signals, Illumination, M125, M126, M127	Y
OEI124	3	Signals, Illumination, M125, M126, M127	Y
OEI126	3	Signals, Illumination, M125, M126, M127	Y
OEI132	5	Signals, Illumination, M125, M126, M127	Y
OEI022	6	Signals, Illumination, M125, M126, M127	Y
OEI019	6	Signals, Illumination, M125, M126, M127	Y

Item ID	Depth (in)	Item Description	Detected
DRO126U	6	Signals, Illumination, M125, M126, M127	N
OEI131	7	Signals, Illumination, M125, M126, M127	N
OEI125	9	Signals, Illumination, M125, M126, M127	Y
OEI129	10	Signals, Illumination, M125, M126, M127	N
OEI130	11	Signals, Illumination, M125, M126, M127	Y
OEI134	11	Signals, Illumination, M125, M126, M127	N
OEI133	11	Signals, Illumination, M125, M126, M127	Y
OEI128	11	Signals, Illumination, M125, M126, M127	Y
OEI023	12	Signals, Illumination, M125, M126, M127	Y
OEI020	12	Signals, Illumination, M125, M126, M127	Y
OEI127	12	Signals, Illumination, M125, M126, M127	N
OEI024	18	Signals, Illumination, M125, M126, M127	N
OEI021	18	Signals, Illumination, M125, M126, M127	Y
OEI160	5	Projectile, 3 inch, Stokes Mortar	Y
DRO1-32K	12	Projectile, 3 inch, Stokes Mortar	Y
OEI157	13	Projectile, 3 inch, Stokes Mortar	Y
OEI161	15	Projectile, 3 inch, Stokes Mortar	Y
DRO1-33I	22	Projectile, 3 inch, Stokes Mortar	Y
OEI164	27	Projectile, 3 inch, Stokes Mortar	Y
OEI162	33	Projectile, 3 inch, Stokes Mortar	Y
OEI163	34	Projectile, 3 inch, Stokes Mortar	Y
OEI159	37	Projectile, 3 inch, Stokes Mortar	N
OEI068	40	Projectile, 3 inch, Stokes Mortar	N
OEI069	48	Projectile, 3 inch, Stokes Mortar	N
OEI072	48	Projectile, 3 inch, Stokes Mortar	N
OEI070	55	Projectile, 3 inch, Stokes Mortar	N
OEI158	56	Projectile, 3 inch, Stokes Mortar	N
OEI071	60	Projectile, 3 inch, Stokes Mortar	N
OEI073	60	Projectile, 3 inch, Stokes Mortar	N
OEI074	61	Projectile, 3 inch, Stokes Mortar	N

In order to accommodate the different depth distributions at DRO and the ODDS seeded test site and at the Parker Flats MRA, this evaluation considers types of MEC items (i. e. 75mm Projectile) separately to determine each MEC type's Pd. Based on the data listed above, the Pd for six depth intervals (0-6, 7-12, 13-24, 25-36, 37-48, >48 inches) were calculated. These Pds are shown on the table below with the number of seeded items in parentheses.

MEC Type	Max Pen. Depth ⁴ (in)	Pd for Depth Interval bgs (in) ¹					
		0-6	7-12	13-24	25-36	37-48	>48
Rocket, 2.36-inch	4.8	100% (1)	100% (2)	60% (5)	0% (2)	NE	NE
Rocket, 35mm Subcaliber	6	100% (5)	100% (5)	75% (4)	0% (1)	NE	NE
Projectile, 37mm	46.8	100% (3)	50% (3)	17% (6)	0% (2)	NE	NE
Projectile, 60mm Mortar ³	13.2	100% ³	50% ²	0% (3)	0% (1)	NE	NE
Projectile, 75mm	58.8	100% ²	100% (3)	100% (1)	0% (3)	0% (1)	NE
Hand Grenade	NP	100% (4)	50% (8)	NE	NE	NE	NE
Rifle Grenade	1.2	100% ²	100% (2)	33% (3)	0% (1)	NE	NE

MEC Type	Max Pen. Depth ⁴ (in)	Pd for Depth Interval bgs (in) ¹					
		0-6	7-12	13-24	25-36	37-48	>48
Signal Illumination Flare	NP	88% (8)	60% (10)	50% (2)	NE	NE	NE
Projectile, 3-inch Stokes Mortar	Unknown	100% (1)	100% (1)	100% (3)	100% (3)	0% (4)	0% (5)

NE = Not Evaluated

NP = Non-Penetrating – Items expected on the surface only.

¹The number of items seeded in the depth interval is included in parentheses.

²100% Pd is assumed in depth intervals with no seed items when the next deeper depth interval has a 100% Pd.

³The values for the 60mm Mortar above 12 inches are based on the results of Hand Grenade seeds at the ODDS because the shallowest seeded 60mm Mortar was 18 inches bgs. The 60mm Mortar is approximately the same weight and diameter as the MK II seeded Hand Grenades and both are made from ferrous material.

⁴Maximum penetration depths are from the penetration study conducted as part of the Phase II EE/CA.

The Pd values in the table above are based on small numbers of each seeded MEC type in each depth interval. This small sample size increases the uncertainty of these Pd values. However, the Pd vs. depth relationship makes sense, consistently starting at 100% near surface and continuously dropping to 0% at deeper depths. This reasonable relationship provides confidence that these Pd values are generally valid.

Limitations of the Schonstedt GA-52/Cx at Parker Flats

The limitations of the Schonstedt GA-52/Cx magnetometer survey at Parker Flats include:

1. The Schonstedt is unable to detect non-ferrous metal MEC items and has limited effectiveness at detecting predominantly non-ferrous items such as the grenade fuzes found in abundance at Parker Flats. Some of these fuzes may have been “detected” visually (i.e., present on the ground surface) or, if buried, were encountered by chance while excavating detected ferro-metal items.
2. The Schonstedt is subject to interference from asphalt pavement. Considering that the Parker Flats area includes paved roads, there is a possibility that MEC may be present beneath pavement.
3. The effectiveness of a Schonstedt survey depends on the skill of the instrument operator, particularly the thoroughness of their coverage when swinging the instrument within the survey lane. Unlike surveys with digital instruments, where positioning data are also obtained, there is no way to check or document the actual coverage of a Schonstedt survey; therefore, it must be assumed that the Schonstedt operator achieved complete survey coverage within the survey lane. In addition, instrument gain (sensitivity) and volume settings will also affect the ability of the operator to recognize a response from a buried metal object. No documentation of instrument setting is provided; therefore, it must be assumed that the instrument settings used were appropriate for the site conditions.
4. The detection capability of the Schonstedt magnetometer is greater for larger, shallowly buried items and decreases as items are more deeply buried and smaller in size.

Despite these limitations, the evaluation above should be considered conservative for the following reasons:

1. The ODDS results used a 1.6 foot search radius instead of the larger 3.3 foot search radius.

2. A total of over 163,000 locations were excavated over the approximately 600 acre Parker Flats MRA. After removing the source of each of these anomalies, the UXO technicians rechecked the location and were often able to extend the Schonstedt GA-52/Cx below ground surface. This increased access increased the likelihood that deeper items could be detected in these locations.
3. A more recent removal at MRS-MOCO.2 used the Schonstedt GA-52/Cx and included QC and QA seeding (*Parsons, 2004*). These data were not included in this evaluation because the lane width used at MRS-MOCO.2 was three-feet as opposed to the five-foot lane width of the work at the Parker Flats MRA. However, the seeding recovery results indicate that the instrument itself is capable of detecting small items such as 37mm Projectiles and hand grenades using a 3-foot lane spacing deeper than the ODDS and DRO data show. 100 percent of the fourteen 37mm projectiles seeded between 7-12 inches bgs and 100 percent of the two 37mm projectiles seeded between 13-24 inches bgs were recovered during the Schonstedt GA-52/Cx operations. 86 percent of the 7 hand grenades seeded between 7-12 inches were recovered during the Schonstedt GA-52/Cx operations. No hand grenades were seeded deeper than 12 inches bgs and no 37mm projectiles were seeded deeper than 18 inches bgs.
4. Typical depth distributions of UXO items are significantly shallower than the depth distribution of the ODDS seeded test and the DRO seeds. For example, during the field trial site phase of the ODDS, six sites were surveyed with multiple instruments including the Schonstedt GA-52/Cx using 5-foot wide lanes. At the four sites analyzed in the ODDS report, 83 percent of UXO and expended ordnance items were located between 0-12 inches bgs. Between 97 percent and 99 percent of these items (including all depths) were within the 1.6-foot search radius of anomalies detected by the Schonstedt GA-52/Cx.
5. Documented QC and QA procedures involved equipment functional checks and independent resurveying of portions of a site, providing assurance that the Parker Flats MEC survey was performed in a thorough and appropriate manner.

3.5.2.3 Sampling and Removal Methods, and Data Management

This section summarizes the sampling and removal methods used by the MEC contractors and the data management procedures. This information is documented in the contractor after action reports and is used to support the “Yes” response to Removal Evaluation Checklist question 24 (Appendix A).

HFA Sampling

100 percent Grid Sampling

HFA conducted sampling at three sites within the Parker Flats MRA (MRS-3, MRS-4B, and MRS-13B; Section 3.3). Sample grids were established within and adjacent to the sites. According to the HFA work plan, grids were generally to be 100- by 100-feet and separated by at least 200 feet (*HFA, 1993*). A maximum search lane width of 5 feet was used during sampling. These grids were 100 percent sampled which required that 100 percent of the anomalies detected in the sampling grids be excavated. The number of anomalies found was not documented and no field-generated grid records were available for review. According to the HFA work plan, each grid was given a 100 percent visual surface survey while performing a 100 percent subsurface survey, using either the Schonstedt Model GA-52/C or GA-72/Cv magnetometers. If surface items were found, their locations were plotted on a map and the items removed. Subsurface contacts and anomalies were flagged for excavation and identification and were later excavated using hand tools (*HFA, 1993*). The general approach to the investigation of anomalies was to dig down to the anomaly, remove it, and check the excavation with the Schonstedt. If the anomaly

was no longer detected, no further digging was performed. If the Schonstedt continued to detect an anomaly, the area was excavated to 4 feet bgs. Because field records for the HFA sampling are not available, the number of anomalies detected and excavated, the depths of excavations, and the types of range-related debris located are not available.

USA Sampling and Removals

SiteStats/GridStats (SS/GS) Sampling Methodology

SS/GS sampling methodologies were used at MRS-4B, MRS-37, MRS-40, and MRS-55. SS/GS is a computer program used to statistically estimate the ordnance density of a site or grid during field investigations. It estimates the number of ordnance items at a given site or grid and can be used to assess whether a site has been characterized adequately. This program was designed so there were equal chances of finding military munitions and range-related debris. Excavation of anomalies identified with a magnetometer is performed in accordance with direction of the program; generally 32 to 40 percent of the flagged anomalies are investigated using this technique (*CMS, 1995*). The SS/GS methodology was reviewed by the EPA's Federal Facilities Restoration and Reuse Office. The Technical Support Center, EPA National Exposure Research Laboratory (NERL) in Las Vegas, Nevada also provided statistical assistance in reviewing the SS/GS methodology (*NERL, 2000*). Several problems were identified as a result of the review. The primary conclusions were: 1) the statistical procedures were vague and not well documented, 2) conclusions about homogeneity are not consistent, 3) the stopping rules are faulty and 4) the program was not able to identify munitions and explosives of concern and discarded military munitions clusters at a site. Although these problems were identified, the information obtained during sampling is useful in identifying the presence and type of MEC, munitions debris and range-related debris present at the site.

100 Percent Grid Sampling

One hundred percent grid sampling was performed at MRS-37, MRS-50, MRS-53, and MRS-54EDC. In 100 percent grid sampling, the number and size of the grids were selected such that 10 percent of the OE site was covered by grids. Each grid is divided into search lanes of 5-foot widths. The selected areas (grids) were investigated with the Schonstedt Model GA-52/Cx magnetometer with the operator swinging the Schonstedt from side to side while walking the length of the search lane. Prior to conducting the intrusive investigation a surface sweep of each search lane is performed. The surface sweep is used to locate surface munitions debris. The munitions debris is flagged and its location is recorded. After the munitions debris is consolidated an intrusive geophysical investigation is conducted. The search lanes are again investigated with the Schonstedt magnetometer using the same technique as used in the surface sweep. All subsurface anomalies encountered were investigated (excavated). Near surface anomalies were excavated with hand tools while some deeper anomalies were excavated by backhoe. While digging, the Schonstedt was used to check and verify the location of the anomaly (*CMS, 1995*).

USA 100 Percent Removal Operations

Removal actions were performed by USA Environmental over all but about 46 acres of the Parker Flats MRA. Two areas within MRS-13B did not undergo removal actions. Both areas were not cleared because of the presence of asphalt. In addition, the roads within the Parker Flats MRA were not cleared because of the asphalt cover. A surface only removal was conducted in an approximately 1 acre area of MRS-13B. The areas that were not cleared are shown on Plate 6. With the exception of the investigation of MRS-50, these removals were conducted as individual investigations at each of the MRSs located within the footprint of the MRA. Areas within the Parker Flats MRA that were not included in a MRS or in MRS-50, were investigated as part of the expansion of the removal operations that occurred at some of

the adjacent sites (Section 3.3). The removals at the Parker Flats MRA were conducted in a similar fashion as the 100 percent grid sampling. Each MRS was completely divided into 100- by 100-foot grids or portions of grids. As during sampling, each grid is divided into search lanes of 5-foot widths. Each grid (or portion of grid) was investigated with the Schonstedt Model GA-52/Cx magnetometer with the operator swinging the Schonstedt from side to side while walking the length of the search lane. Prior to conducting the intrusive investigation a surface sweep of each search lane is performed. The surface sweep is used to locate surface munitions debris. The munitions debris is flagged and its location is recorded. After the munitions debris is consolidated an intrusive geophysical investigation is conducted. The search lanes are again investigated with the Schonstedt magnetometer using the same technique as used in the surface sweep. All subsurface anomalies encountered were investigated (excavated) to a depth of 4 feet. Near surface anomalies were excavated with hand tools while some deeper anomalies were excavated by backhoe. While digging, the Schonstedt was used to check and verify the location of the anomaly (CMS, 1995). The depth at which MEC and MD were encountered was recorded for all sites within the Parker Flats MRA except for about two-thirds of MRS-13B.

3.5.2.4 Quality Assurance/Quality Control

The QA/QC procedures used by USA during the field operations are described below.

Field Operations QA/QC

Throughout operations, USA performed daily operational checks and QC inspections. QA/QC performed throughout the removal action is documented in the After Action Reports for the MRS sites within the Parker Flats MRA (USA, 2000a, 2000b, 2000c, 2001a, 2001b, 2001c, 2001d, 2001e, 2001f). In accordance with the USA work plan (CMS, 1995), all instruments requiring maintenance and/or calibration were checked prior to the start of each workday. Batteries were replaced as needed and the instruments were checked against a known source. The USA Environmental Quality Control (QC) specialist was responsible for ensuring that personnel perform operational checks and made appropriate log entries. The QC specialist performed random unscheduled checks of the various sites to ensure the personnel performed the work as specified in the work plan.

The QC procedures also entailed a resurvey of at least 10 percent of each 100 percent sampling grid or 100 percent removal grid by a USA Environmental Quality Control specialist. After Action Reports prepared by USA indicate that there were only 15 grid QC failures out of 5,164 grids surveyed. If a grid failed QC, the entire grid was reswept. Following the sweep, the grid went back through the QC process. Ten MEC or MD items were located during the QC process. QA procedures included a second 10 percent resurvey by USACE personnel. No QA failures were documented.

Additional Site Validation

In response to DTSC comments on the Draft version of this report, an additional QA/QC validation effort was performed by Parsons under the direction of the USACE with representatives from the EPA and DTSC. This site validation was performed on portions of four 100-by 100-foot grids and included a site walk in the remainder of the southern portion of Parker Flats. The work was completed in the first week of November, 2005. A memorandum describing the results of the survey is included as Appendix G.

The grid search covered approximately 25 percent of each of four previously cleared grids. A Schonstedt GA52Cx was used to search the site for anomalies. The areas in which the grids were located were selected by the DTSC. One pound of munitions debris was found in grids CZC8J1 and CZE9B8. One pound of cultural debris (nails, wire) was found in grids CZE9B8 and CZE6J9. No MEC was found in any of the grids.

The site walk meandered throughout the southern part of Parker Flats and covered approximately 6.2 miles. A Schonstedt GA52Cx was used during the site walk to identify subsurface anomalies present along the path. A total of 83 anomalies were identified and excavated along the path. Twenty six anomalies resulted in discovery of munitions debris, of these ten were small arms items, one was two empty ammo cans, nine were fragments, two were expended pyrotechnic debris, three were pieces of M125 series illumination signals, and one was an expended MK II practice hand grenade. The remaining anomalies consisted of range related debris and cultural debris. No MEC was identified during the grid search or site walk.

The DTSC completed an additional geophysical investigation in December 2005 on the same four 2,500 sq. ft. grids surveyed in November. The investigation used an EM61-MK2 high sensitivity metal detector to complete the survey. No MEC was identified during the survey. 5.56 and 7.62 mm casings, shotgun base wad, a .45 cartridge and cultural debris were identified. The results of the survey are included in Appendix G.

Data Management QA/QC

Parsons, the current MR contractor, performed a 100 percent QC review of the data associated with the site. This review followed the guidelines presented in the SOP provided in Appendix D (*Parsons, 2001a*). This evaluation included a review of the field grid records and the former Fort Ord Munitions Response database. It also included a review of the HFA data provided in the After Action Report (*HFA, 1994*). The USACE implemented QA review of ten percent of the data reviewed by Parsons. The QA review included a comparison of the data set with the data set reported in the AAR. The requirements of the USACE QA review are described in the SOP provided as Appendix D. The purpose of the QC data review was to complete a 100 percent check of all available grid records to identify discrepancies between the after action reports and the grid records, if any. Discrepancies were then researched and corrections made, if appropriate, prior to loading the data into the project database.

A comparison of the Fort Ord MMRP database to the USA After Action Reports was performed by MACTEC to identify discrepancies, if any, between the After Action Report and the current database. MACTEC's review indicated that there were differences between the After Action Report and the final database. It appears that some changes were made to model descriptions of items found and that some items were changed from MEC to MD. However, because only a few items were changed from MEC to MD at each MRS site, and documentation was generally provided for the change, the data are considered useable for performance of the risk assessment and feasibility study.

Review of the data collected from MRS-13B indicates that the depth at which items were encountered was not required, or recorded, for grids completed prior to May 13, 1997. Data collected on, or after, May 13, 1997, does contain information on the depth at which the items were encountered.

Data collected during sampling performed by HFA is also included in the database; however, location and depth data was not collected for MEC and MD removed during sampling, and the items found cannot be plotted on maps. It should be noted that although data collected by HFA is less complete than the data collected by USA, work performed by USA covered the same areas as the HFA sampling. These areas were therefore subjected to 2 removal actions.

The following summarizes the usability of the data collected at the Parker Flats MRA.

- Removals conducted by CMS/USA were conducted according to the work plan and field QA/QC resulted in only 15 QC grid failures and no QA failures out of 5,164 grids. Review of available

documentation indicates that all anomalies detected were investigated and all military munitions identified, both MEC and MD, were removed as required by the contractor work plan.

- Overall, the Schonstedt surveys at the Parker Flats MRA are believed to have been effective in detecting the ferro-metal items in the top foot of soil. This is based on comparison with the ODDS, where most MEC items were found in the top two feet of soil.
- Limitations affecting the Schonstedt surveys at Parker Flats are its limited ability to detect primarily non-ferrous metal MEC items such as aluminum fuzes that contain only a small amount of ferrous material and its poor detection capabilities for smaller MEC items deeper than 2 feet bgs (in particular for the 37mm projectiles).
- Limitations to the data collected at MRS-13B were identified related to the depth at which items were found. This does limit the quality of the MRS-13B data, because it is not possible to verify the depth distribution of MEC removed from the site.
- Approximately 35.5 acres of MRS-13B has not undergone a removal. This area is covered with structures or paved. Review of the history of the area indicates that the portion of MRS-13B where no action occurred was primarily used as a physical training area, guard duty area, and as a practice mortar square. These uses would not typically involve the use of military munitions; however, it is possible that burial pits may remain in this area.
- A comparison of the database used for this report to the after action reports did indicate some changes had occurred between the AAR and the database; however, because only a few items discrepancies were noted, the data are considered useable for a risk assessment and a feasibility study. Verification of the appropriateness of the changes that were made between the after action reports and the final database is continuing.

3.6 Conclusions and Recommendations

The following section presents conclusions and recommendations for the Parker Flats MRA based on the review and analysis of the data associated with historical information and sampling and removal data (Appendix A).

3.6.1 Conclusions

Site Use and Development

- Based on the results of the literature review, sampling results, and removal action (munitions response), the site appears to have been used for the following types of training:
 - Artillery (37mm and 75mm), Stokes mortar, 60mm and 81mm mortar and Livens projector prior to WWII
 - Practice rifle grenade and hand grenade in the 1940s
 - Practice mortar, bivouac, CBR, hand grenade, practice mine, booby trap, and general maneuvers in the 1950s and 1960s
 - General maneuvers, TOW tracking, CBR, hand grenade, and mine and booby trap training in the 1970s through 1980s.

- Other MEC and MD not related to the training listed above were also found within the Parker Flats MRA, but appear to be primarily the result of items being discarded in the area.
- Most of the area remains undeveloped with multiple reuses planned for the area.
- A small portion (35 acres) of MRS-13B was developed in the late 1970s and 1980s. The developed area of MRS-13B has not undergone a removal action.

Removal Adequacy and Data Quality

- Removal actions were performed in all of the grids within the Parker Flats MRA except for a portion of MRS-13B and under paved roads. All anomalies detected were excavated and ordnance removed.
- The Schonstedt Model GA-52/Cx was used for all geophysical surveys completed as part of the MEC removal action. The instrument was evaluated as part of the ODDS study and also as part of the DRO removal actions. The results of the evaluation indicate that the Schonstedt Model GA-52/Cx is effective in detecting shallow ferro-metal items in the areas surveyed.
- The instrument is less effective for detecting the smaller (less than 2 lbs) or more deeply buried (greater than 2 feet) objects. For example, surveys at the DRO test site show that a 37mm projectile (1.75 lbs), while readily detected 6 inches below ground surface (bgs), is difficult to detect and may be undetectable at 18 inches bgs or deeper. In addition, the Schonstedt GA-52/Cx is not effective for detecting some fuzes (which occur in abundance at Parker Flats) because they contain little or no ferrous metal. It should be noted that fuzes located in burial pits and as single items were detected during the removal at depths greater than 3 feet bgs.
- The site boundaries represent the limits of the removal action as specified in the removal contract, and may not reflect the limits of MEC in the area. Additional investigation and possible removal actions may be necessary outside the Parker Flats MRA and within the uninvestigated area of MRS-13B.
- The database is useable for preparation of the RI, RA, and FS.
- The Parker Flats MRA removal data are usable for preparation of a risk assessment and feasibility study per the review that was conducted following guidance provided in the *Plan for Evaluation of Previous Work (HLA, 2000b)* and the *Final Technical Memorandum, Data Quality Objectives, Track 2 Sites (MACTEC, 2003a)*.

3.6.2 Recommendations

The following recommendations are made for the Parker Flats MRA:

- Review of the available literature, removal results, and equipment performance results indicate that it is possible for low concentrations of MEC to remain in the Parker Flats MRA; therefore, a risk assessment and feasibility study should be performed.
- This site qualifies as a Track 2 site because a removal action has been performed and the data are useable for preparation of a risk assessment and feasibility study.

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