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# **Screening Level Ecological Risk Assessments of Some Military Munitions and Obscurant-related Compounds for Selected Threatened and Endangered Species**

Katherine Von Stackleberg, Craig Amos, C. Butler,  
Thomas Smith, J. Famely, M. McArdle, B. Southworth,  
and Jeffrey Steevens

October 2006

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## **Final Report**

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**ABSTRACT:** Preparation for anticipated, unknown, and invariably adverse battlefield conditions requires military training activities involving military smokes and obscurants (S&Os) and related chemical compounds, and can result in the release of other chemical agents and military unique compounds (MUCs) associated with munitions. This study evaluates the potential long-term impacts on selected threatened and endangered species resulting from dispersion and deposition of vapors and particles found in the fog oils, hexachloroethane smoke, colored smokes, white phosphorus, and obscurants such as brass flakes and graphite flakes used during training. Residue from these constituents can deposit directly on plants and prey species favored by higher vertebrates and other species or can be taken up by plants and prey species from the soil. From the literature and installation use reports, the authors develop estimates of toxicity and exposure to calculate installation-specific screening-level risk for selected threatened and endangered species.

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## Conversion Factors

Non-SI\* units of measurement used in this report can be converted to SI units as follows:

| Multiply              | By                                            | To Obtain       |
|-----------------------|-----------------------------------------------|-----------------|
| Acres                 | 4,046.873                                     | square meters   |
| cubic inches          | 0.00001638706                                 | cubic meters    |
| degrees Fahrenheit    | $(5/9) \times (^\circ\text{F} - 32)$          | degrees Celsius |
| degrees Fahrenheit    | $(5/9) \times (^\circ\text{F} - 32) + 273.15$ | kelvins         |
| feet                  | 0.3048                                        | meters          |
| gallons (U.S. liquid) | 3.785                                         | liters          |
| inches                | 02.54                                         | centimeters     |
| miles (U.S. statute)  | 1.609347                                      | kilometers      |
| pounds (mass)         | 0.4535924                                     | kilograms       |
| square feet           | 0.09290304                                    | square meters   |
| square miles          | 2,589,998                                     | square meters   |

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\* *Système International d'Unités* ("International System of Measurement"), commonly known as the "metric system."

## Preface

This report is a deliverable product under military direct-allotted Department of the Army project A896, “Base Facility Environmental Quality”; Work Unit number 3B6GFD, and is part of a Science and Technology Objective. The technical monitor at the start of the project was William Woodson; the current Technical Monitor is Scott Belfit, DAIM-ED-N.

This report was prepared by employees of Menzie-Cura & Associates, Inc. and by Thomas Smith of the Engineer Research and Development Center (ERDC), Construction Engineering Research Laboratory (CERL), Installations Division (CN), Land and Heritage Conservation Branch (CN-N) and Jeffrey Steevens of the ERDC Environmental Laboratory (EL). The CERL Principal Investigator was Thomas Smith.

This report was initiated under the general supervision of Steve Hodapp Chief, CEERD-CN-N; the current Chief of CN-N is Alan Anderson. Dr. John T. Bandy is Chief, CEERD-CN. The associated Technical Director is Dr. William D. Severinghaus, CEERD-CV-T. The Director of CERL is Dr. Ilker Adiguzel. Technical supervision was provided by Steve Hodapp, Threatened and Endangered Species Manager; the current TES Program Manager is Timothy J. Hayden.

COL Richard B. Jenkins was Commander and Executive Director of ERDC. Dr. James R. Houston was Director.

# 1 Introduction

## Background

Preparation for anticipated, unknown, and invariably adverse battlefield conditions requires military training activities involving military smokes and obscurants (S&Os) and related chemical compounds, and can result in the release of other chemical agents and military unique compounds (MUCs) associated with munitions.

There is little doubt that the S&Os typically used during training and maneuver exercises may cause short-term irritation and effects via inhalation to some receptors. A purpose of this analysis is to evaluate the potential long-term impacts resulting from dispersion and deposition of vapors and particles found in the fog oils, hexachloroethane smoke, colored smokes, white phosphorus, and obscurants such as brass flakes and graphite flakes. Residue from these constituents can deposit directly on plants and prey species favored by higher vertebrates and other species or can be taken up by plants and prey species from the soil.

Similarly, long-term use of munitions can lead to measurable concentrations of MUCs such as TNT, RDX, and related compounds in soil, which can be taken up by plants and other prey items through terrestrial food webs to which wildlife are exposed. Concentrations in the environment accumulate primarily through unexploded ordnance (UXO) or from low-fired ordnance resulting in an incomplete fire of a munition.

Many threatened and endangered species are associated with military training areas where S&Os and MUCs are released. Specific endangered species associated with Army installations have been identified. The installations reviewed in this report vary in location, geography, ecology, and mission.

The installations and their mission category are:

| State      | Installation        | Category | State          | Installation      | Category |
|------------|---------------------|----------|----------------|-------------------|----------|
| Alabama    | Fort Rucker         | TI       | Missouri       | Fort Leonard Wood | TI       |
| Arizona    | Yuma Proving Ground | PG       | North Carolina | Fort Bragg        | MI       |
| California | Fort Irwin          | TARC     | Oklahoma       | Fort Sill         | TI       |
| Georgia    | Fort Benning        | TI       | South Carolina | Fort Jackson      | TI       |
| Georgia    | Fort Gordon         | TI       | Kentucky       | Fort Knox         | TI       |

| State       | Installation  | Category | State | Installation     | Category |
|-------------|---------------|----------|-------|------------------|----------|
| Georgia     | Fort Stewart  | MI       | Texas | Camp Bullis      | TARC     |
| Kentucky    | Fort Campbell | TI       | Texas | Fort Hood        | MI       |
| Louisiana   | Fort Polk     | TARC     | Texas | Fort Sam Houston | TI       |
| Mississippi | Camp Shelby   | TARC     |       |                  |          |

The mission categories are:

- **MI — Maneuver Installations:** Major Army power projection platforms that provide facilities and resources to house, sustain, maintain, train, and deploy major combat forces. These installations also provide the capability to conduct developmental and operational testing and experimentation to test concepts for future forces.
- **TI — Training Installations:** U.S. Army installations that house schools for each Army branch where doctrine is written. These installations provide entry, functional, and specialized training. They also provide the capability to conduct developmental and operational testing and experimentation to test concepts for future forces.
- **TARC — Training Areas and Reserve Component training sites:** These installations provide facilities to conduct large-scale unit training for active and Reserve components but vary in terms of characteristics, capabilities, and organization.
- **PG — Proving Ground:** These facilities support developmental tests to evaluate battlefield application of new technologies over a wide range of terrain and climactic conditions. Testing includes all types of equipment and munitions.

For this screening-level ecological risk assessment, S&Os are:

|                                            |                                 |
|--------------------------------------------|---------------------------------|
| fog oil smoke                              | (o-Chlorbenzol)malonitrile (CS) |
| hexachloroethane (HC) smoke                | Dibenz(b,f)-1, 4-oxazepine (CR) |
| white phosphorous (WP) smoke               | titanium dioxide                |
| colored smoke (red, green, yellow, purple) | polyethylene glycol (PEG)       |
| brass flakes                               | graphite flakes                 |
| terephelatic acid                          |                                 |

For this screening level ecological risk assessment MUCs are:

|                                        |                                                                              |
|----------------------------------------|------------------------------------------------------------------------------|
| 1,3,5-Trinitrobenzene (1,3,5-TNB)      | 1,3-Dinitrobenzene (1,3-DNB)                                                 |
| 2,4 – Dinitrophenol (2,4-DNP)          | Dinitrotoluene isomers<br>(e.g., 2,4 – Dinitrotoluene; 2,6 – Dinitrotoluene) |
| High Melting Point Explosive (HMX)     | Nitrobenzene (NB)                                                            |
| Nitroglycerin (NG)                     | Nitrophenol isomers<br>(e.g., 2 – Nitrophenol; 4 – Nitrophenol)              |
| Pentaerythritol Tetranitrate (PETN)    | Cyclotrimethylenetrinitramine (RDX)                                          |
| Trinitrophenylmethylnitramine (Tetryl) | 2,4,6-Trinitrotoluene (TNT)                                                  |

In this document, S&Os and MUCs are also referred to as contaminants/chemicals of concern (COCs) or contaminants of potential concern (COPCs).

For purposes of this ecological risk assessment, threatened and endangered species (identified in accordance with the Endangered Species Act [ESA]) of particular Army interest and selected Army installations they are associated with are as follows:

|                                                         |                                               |
|---------------------------------------------------------|-----------------------------------------------|
| Indiana Bat ( <i>Myotis sodalis</i> )                   | Gray Bat ( <i>Myotis grisescens</i> )         |
| Fort Campbell, KY                                       | Fort Campbell, KY                             |
| Fort Knox, KY                                           | Fort Knox, KY                                 |
| Fort Leonard Wood, MO                                   | Fort Leonard Wood, MO                         |
| Gopher Tortoise ( <i>Gopherus polyphemus</i> )          | Desert Tortoise ( <i>Gopherus agassizii</i> ) |
| Fort Stewart, GA                                        | Fort Irwin, CA                                |
| Fort Rucker, AL                                         | Yuma Proving Ground, AZ                       |
| Camp Shelby, MS                                         |                                               |
| Fort Benning, GA                                        |                                               |
| Fort Gordon, GA                                         |                                               |
| Golden-cheeked Warbler ( <i>Dendroica chrysoparia</i> ) |                                               |
| Fort Hood, TX                                           |                                               |
| Fort Sam Houston, TX                                    |                                               |
| Camp Bullis, TX                                         |                                               |
| Black-capped Vireo ( <i>Vireo atricapillus</i> )        |                                               |
| Fort Hood, TX                                           |                                               |
| Fort Sam Houston, TX                                    |                                               |
| Camp Bullis, TX                                         |                                               |
| Fort Sill, OK                                           |                                               |
| Red-cockaded Woodpecker ( <i>Picoides borealis</i> )    |                                               |
| Fort Polk, LA                                           |                                               |
| Fort Bragg, NC                                          |                                               |
| Fort Benning, GA                                        |                                               |
| Fort Gordon, GA                                         |                                               |
| Camp Shelby, MS                                         |                                               |
| Fort Jackson, SC                                        |                                               |
| Fort Stewart, GA                                        |                                               |

This report builds on two literature reviews of the physical, chemical, and toxicological properties of chemical constituents in S&Os and munitions (Von Stackelberg

et al. 2004, 2005). From the literature and installation use reports, the authors develop estimates of toxicity and exposure to calculate installation-specific screening-level risk for selected threatened and endangered species.

## Objective

The objectives of this research are to:

- Provide a screening-level evaluation of the potential long-term effects of smokes and obscurants and selected military compounds on threatened and endangered species during typical training maneuvers using an ecological risk-based framework;
- Identify data gaps;
- Identify assumptions and uncertainties in the assessment; and,
- Provide recommendations for additional analyses that would further refine the estimates presented in this report.

## Approach

To accomplish these objectives, the analysis was conducted by:

- Obtaining usage statistics for S&Os and MUCs for each installation for 2002;
- Developing exposure estimates in soil, plants, and prey items for the threatened and endangered species of concern for each installation;
- Developing toxicity reference values (TRVs) for the S&Os and MUCs; and,
- Combining the exposure and effects estimates to calculate toxicity quotients (TQ) for each species, chemical, and installation to determine the potential for ecological risk.

This report follows generally established ecological risk assessment procedures and practices (USEPA 1992, 1998) and previously developed ecological risk assessment approaches (Suter et al. 2001).

This report attempts to provide a uniform level of review and discussion of each installation, relevant species, and chemical/contaminant of concern and to provide equal treatment of each. However, due in part to the differing amounts and levels of installation-specific, biological, and S&Os and munitions use information available, this has not always been possible. Therefore, in some instances the level of treatment differs for those reasons and because of subjective judgments made by the authors. In all instances, the judgments made were intended to be conservative and follow established ecological risk assessment protocols (USEPA 1998, Suter et al. 2001). In all instances the researchers have attempted to address all relative information. In this review, relevant literature and reports are identified and summarized.

## Mode of Technology Transfer

This information can be used in developing Biological Assessments under the Endangered Species Act, environmental assessments under the National Environmental Policy Act, and in other planning and management relative to threatened and endangered species and related wildlife resources.

This report will be made accessible through the World Wide Web (WWW) at URL:  
<http://www.cecer.army.mil>

## 2 Description of Installations

U.S. Army installations with one or more priority threatened and/or endangered species were chosen for evaluation in this assessment. The following sections describe the site location and history, munition and smoke and obscurant use, and biological information available for each installation. Installations are organized alphabetically by state.

### Fort Rucker, Alabama

Fort Rucker covers about 64,500 acres of southeast Alabama countryside in an area known as the Wiregrass, named for a wild grass indigenous to the region. Much of the main post is in Dale County, with the remaining government-owned and leased acreage in Coffee, Geneva, and Houston counties (<http://www.rucker.army.mil/activities/ruckercommunity.html>). Figure 1 <sup>\*</sup> shows a map of the training areas, impact areas, and ranges at Fort Rucker.

All Army Aviation flight training is conducted at Fort Rucker. Table 1 summarizes the use of smokes and obscurants at this installation.<sup>†</sup> Table 2 summarizes the quantity of each type of ammunition used at Fort Rucker during 2002.

The gopher tortoise is found on Fort Rucker. Fort Rucker is located east of the Tombigby and Mobile Rivers, which is the eastern demarcation of western population of the gopher tortoise. The tortoises found on Fort Rucker are considered part of the eastern population of gopher tortoises, and while the western population is considered threatened, the eastern population is not. However, taking of tortoises on Fort Rucker is prohibited under state regulations. Detailed information about gopher habitat and forage areas for Fort Rucker is not available. However, as a screening evaluation, this report assumes that gopher tortoise is potentially exposed to military-related compounds used at Fort Rucker.

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<sup>\*</sup> Figures and Tables are grouped at the end of the chapter, beginning on page 22.

<sup>†</sup> Table 1 contains the summary of S&O use at all the installations discussed in this report.

## Yuma Proving Ground, Arizona

Yuma Proving Ground (YPG) is located near the Arizona-California border, adjacent to the Colorado River, approximately 24 miles north of the city of Yuma, Arizona. Situated in the southwest portion of the state, the proving ground is in the heart of the great Sonoran desert and is 1,300 square miles (or 832,000 acres) in size (<http://www.yuma.army.mil/location.html>).

Yuma Proving Ground is the Army's desert environmental test center where testing of different types of ammunition and weapons is performed. Smoke and obscurant testing involving fog oil smoke, brass flakes, and graphite flakes has been conducted at YPG. Ammunition testing at YPG has also resulted in the potential for white phosphorous and terephthalic acid residues to be present in impact areas. A query for smokes and obscurants in YPG's Document Inventory Data Control (DIDC) indicates that tests involving smokes and obscurants are not conducted on a regular basis (e.g., every year). Three tests involving COCs were conducted in 2003, one test and one training event involving smokes were conducted in 2002, and one test was conducted in 2000. The records of studies involving smokes and obscurants on the DIDC list go back to 1967 and are documented in the Research, Development Test and Evaluation Activity Reports. Table 1 summarizes the use of smokes and obscurants at this installation.

The Arizona desert tortoise populations in and around YPG are not listed as threatened or endangered. However, under provisions of the ESA they are specifically identified as "Threatened by Similarity of Appearance," which means these tortoises aren't at risk to warrant listing, but it's not feasible for anyone to be able to distinguish between these and those from listed populations. The desert tortoise populations at Yuma live in inaccessible, north-facing slopes of higher terrain that is not used for mission use (personal communication, Valerie Morrill, Yuma Proving Ground, 20 February 2004). Therefore the exposure pathway for desert tortoise exposed to military-related compounds is likely to be incomplete.

## Fort Irwin, California

Fort Irwin is the location of the National Training Center, the U.S. Army's heavy maneuver Combat Training Center (CTC). Fort Irwin is located approximately 37 miles northeast of Barstow, California in the High Mojave Desert midway between Las Vegas, Nevada and Los Angeles, California. The entire Fort encompasses approximately 636,000 acres of training area with the northern boundary less than 3 km from Death Valley National Monument. Desert hills and mountains surround the installation. The San Bernardino and San Gabriel mountains extend in an east-

west path 135 km southwest of Bicycle Lake. The Sierra Nevada Mountains, oriented north-to-south, are to the west. Elevations in excess of 10,000 feet (3,050 meters) are common in these ranges. Natural vegetation is sparse and consists of mesquite, creosote, yucca, and other low growing plants. Figure 2 presents the training areas and topography of the National Training Center at Fort Irwin.

Table 1 summarizes the use of smokes and obscurants at this installation. Table 3 summarizes the quantity of each type of ammunition used at Fort Irwin in 2002.

In this screening level assessment, the desert tortoise is the species of concern that will be evaluated for Fort Irwin. Figure 2 shows the location of desert tortoise critical habitat in relation to the training areas.

## **Fort Benning, Georgia**

Fort Benning is located in the lower Piedmont Region of central Georgia and Alabama, 6 miles southeast of Columbus, Georgia. The Fort consists of approximately 182,000 acres. About 170,000 acres are in Muscogee and Chattahoochee Counties, Georgia, and another 12,000 acres are in Russell County, Alabama. The Chattahoochee River separates the Georgia and Alabama portions of the installation. Fort Benning is located at the intersection of two ecologically different regions: the Piedmont and East Gulf Coastal Plain. The result is a mosaic of Piedmont- and Coastal Plain-influenced habitats (U.S. Army 2001a). Figure 3 shows the geographic location and major features of Fort Benning.

Fort Benning is the home of the U.S. Army Infantry School and Center. In peacetime Fort Benning provides ranges and maneuver training areas to conduct initial entry training for infantry soldiers and officers; basic and advanced level noncommissioned officer and officer training courses; the U.S. Army's Airborne and Ranger schools; study, testing, and development of infantry doctrine, weapons systems, tactics, techniques and procedures (U.S. Army 2001a). Table 1 summarizes the use of S&Os at this installation. Table 4 summarizes the quantity of each type of ammunition used at Fort Benning in 2002.

An Integrated Natural Resources Management Plan (INRMP) for 2001-2005 has been completed for Fort Benning. The Fort is home to five Federally listed species and numerous species of conservation concern listed by either the Federal government or by the States of Georgia and Alabama. There are 96 species of conservation concern found on Fort Benning (4 amphibians, 8 birds, 7 fishes, 4 mammals, 4 mussels, 9 reptiles, and 60 plants). A species is listed as of conservation concern if it is listed by the U.S. Fish and Wildlife Service or by the states of Alabama or Georgia

as threatened (T) or endangered (E) or is otherwise identified as a candidate (C) species, species of special concern, state protected species, rare species, unusual species, or a watch-list species. The five Federally listed threatened and endangered species that occur at Fort Benning include the red-cockaded woodpecker (*Picoides borealis*) (E), wood stork (*Mycteria americana*) (E), Bald Eagle (*Haliaeetus leucocephalus*) (T), American alligator (*Alligator mississippiensis*) (T [S/A], in which S/A = due to similar appearance), and relict trillium (*Trillium reliquum*) (E). Endangered Species Management Plans (ESMPs) have been prepared for all of these species and are included as appendices to the INRMP (U.S. Army 2001a).

Potential exposure of red-cockaded woodpeckers to military-unique constituents at Fort Benning will be evaluated in this report. Fort Benning has one of the largest red-cockaded woodpecker populations in the southeastern United States with 186 active manageable clusters and 28 known, active unmanageable clusters (these clusters occur within impact areas) as of 1999. As shown in Figure 4, the population is well dispersed over the entire installation, except that no active clusters are located on the Alabama portion of the installation (U.S. Army 2001a). There are several Unique Ecological Areas identified in the INRMP (U.S. Army 2001a) that provide favorable roosting, nesting, and foraging habitat for red-cockaded woodpeckers due to the presence of longleaf pine forest. Specifically these are identified as:

- Lakeland Sandhills – longleaf savanna habitat in the central portion of the installation (portions of training compartments D14 and J7 as shown on Figure 4);
- Hastings Relict Sandhills – longleaf pine dominates the overstory in the northeastern portion of the installation (portions of compartments K11, K12 [minus Hastings Range], K13, K14, and K17);
- Malone Cane Brakes – large acreage of longleaf pine/mature mixed pine forests in the western portion of the installation (central portion of compartment M6);
- Slopes of Northern Affinities – longleaf pine sandhill communities in the upland areas at the east-central boundary of the installation (southern portion of compartment K20);
- Longleaf Pine Loamhills – southwest portion of the installation (portions of compartments A13, A14, A15, A16 [minus Griswold Range], and A17); and,
- Longleaf Pine Sandhills – northeast portion of the installation (portions of compartments K8 and K13).

## Fort Gordon, Georgia

Fort Gordon is located just a few miles southwest of the city of Augusta, Georgia, and covers 56,000 acres. The post is located in Richmond County. The local area is referred to as the Central Savannah River Area, a group of 13 Georgia and South Carolina counties along the Savannah River which forms the state border. Figure 5 shows the training and impact areas at Fort Gordon.

The U.S. Army Signal Center is located at Fort Gordon. Fort Gordon's mission includes training, doctrine, force integration requirements, and mobilization. The Reserve Components Support Division at Fort Gordon provides year-round training for more than 60,000 reservists, as well as Army and Navy Reserve Officer Training Corps students. Fort Gordon is home to Dwight D. Eisenhower Army Medical Center, 93rd Signal Brigade, 513th MI Brigade, Gordon Regional Security Operations Center, and Navy, Marine, and Air Force Detachments (<http://www.gordon.army.mil/cmdgrp/default.htm>). Colored smokes (smoke grenades) and CS gas (grenades) are used at Fort Gordon in the training areas. A fog oil machine may have been used one time in one training area (TA 37a). There are 49 training areas at Fort Gordon. In the past 2 years of training at Fort Gordon, smoke has been used in all but seven training areas. Units typically use smokes in training exercises between 1 and 4 times per year (personal communication, Robert Drumm, Fort Gordon, 2004), although the installation was unable to quantify the amounts typically used. Table 1 summarizes the use of S&Os at this installation. Table 5 summarizes the quantity of each type of ammunition used at Fort Gordon during fiscal year (FY) 2002.

There are 31 target species at Fort Gordon (6 birds, 5 fish, 3 herps, 2 mammals, and 15 plants), as shown in Table 6. The target species rank information is based on information collected by the Georgia Natural Heritage Program. Four species are listed as endangered [bald eagle, wood stork, red-cockaded woodpecker, and sweet pitcherplant (*Sarracenia rubra* var. *rubra*) (State E)], and four more are listed as threatened [gopher tortoise (State T); rosemary (*Ceratiola ericoides*) (State T); Indian-olive (*Nestronia umbellula*) (State T); and Pickering's morning glory (*Stylisma pickeringii* var. *pickeringii*) (State T)]. The target species that will be evaluated in this assessment are the red-cockaded woodpecker and gopher tortoise. As shown in Figure 5, red-cockaded woodpecker nest cavities and gopher tortoise burrows are located throughout the installation. According to installation training records for 2002, training occurred in most of the areas where red-cockaded woodpeckers and gopher tortoise are found.

## Fort Stewart, Georgia

Fort Stewart is located in the Atlantic Coastal Plain of southeastern Georgia, 41 miles southwest of Savannah. It comprises portions of Long, Liberty, Tattnall, Bryan, and Evans counties. It is nearly rectangular, averaging 35 miles long by 18 miles wide, and contains 279,270 acres (MARCOA 1995). Fort Stewart rises from near sea level in the eastern portion of the installation to 183 feet along its western border. Most of the land is less than 33 feet above sea level with slopes less than 3 percent (The Nature Conservancy 1995). Figure 6 shows the training areas at Fort Stewart.

Fort Stewart and Hunter Army Airfield are the home of the 3rd Infantry Division (Mechanized). Several National Guard mechanized infantry units and U.S. Reserve units also train at Fort Stewart. Infantry, tanks, field artillery, helicopter gunnery, and small arms ranges can operate simultaneously at Fort Stewart throughout the year (Jones Technologies, Inc. and Gene Stout and Associates 2001a). Table 1 summarizes the use of smokes and obscurants at this installation. Table 7 summarizes the quantity of each type of ammunition used at Fort Stewart during 2002.

A multi-species Endangered Species Management Plan (ESMP) and INRMP have been prepared for Fort Stewart (Jones Technologies, Inc. and Gene Stout and Associates 2001a). There are four general types of ecosystems on Fort Stewart: sandhills, pine flatwoods, upland forests, and wetlands (Elfner 1996). Most soils on the two installations are classified as sandy and infertile. Fort Stewart is home to six species that are Federally listed as threatened or endangered: bald eagle, wood stork, red-cockaded woodpecker, eastern indigo snake (*Drymarchon corais couperi*), flatwoods salamander (*Ambystoma cingulatum*), and shortnose sturgeon (*Acipenser brevirostrum*). In addition, there are numerous species of concern listed by either the Federal government or by the state of Georgia (1 insect, 5 birds, 3 reptiles, 2 amphibians, and 9 plants). The gopher tortoise is on the Federal list of species of concern and is classified as threatened by the State of Georgia (Jones Technologies, Inc. and Gene Stout and Associates 2001a). Although not Federally listed in Georgia, this screening level assessment assumes that the gopher tortoise is potentially exposed to military-related compounds used at Fort Stewart. Gopher tortoises can be found in the dwarf oak forest (i.e., longleaf pine turkey oak) habitat in the sandhills areas at Fort Stewart. Characterized by deep sandy soils, the dwarf oak forest is an extremely dry forest of small deciduous oaks with a longleaf pine overstory. The sandhills occur along major streams and are remnants of Pleistocene barrier islands. The habitat is a fire maintained climax type, and in the absence of fire it will succeed to an oak woodland (Jones Technologies, Inc. and Gene Stout and Associates 2001a). Figure 6 depicts gopher tortoise populations in relation to training areas at Fort Stewart.

## Fort Campbell, Kentucky

Fort Campbell lies on the Kentucky-Tennessee border between the towns of Hopkinville, KY, and Clarksville, TN, about 60 miles northwest of Nashville, TN. The post encompasses 164 square miles (105,068 acres) in four counties: Montgomery and Stewart in Tennessee and Christian and Trigg in Kentucky. Approximately 12,000 acres of the installation have been developed into the cantonment or developed area while the remaining 93,000+ acres of the installation are dedicated to training and firing ranges (<http://www.campbell.army.mil/overview.htm>).

Fort Campbell is home to the 101st Airborne Division (Air Assault). The designation indicates that the helicopter is the primary means of transportation for the division (<http://www.campbell.army.mil/overview.htm>). Approximately 26,156 acres are designated small arms and artillery impact areas and 67,142 acres are available for military training activities. Table 1 summarizes the use of smokes and obscurants at this installation. Table 8 summarizes the quantity of each type of ammunition used at Fort Campbell in 2002.

Work by Fort Campbell has identified that at least 336 vertebrate species have been on the installation (Zirkle 1999). Forty species are listed by Federal or State agencies (Zirkle 1999). In this ecological risk assessment, potential exposure to two species listed as endangered, the Indiana bat and gray bat, will be assessed. Both bat species prefer to roost 4 km or less from water bodies in order to forage for aquatic insects. Numerous intermittent and permanent streams, two small impoundments (Lake Kyle in Stewart County and Lake Taal in Montgomery County), each containing more than 1 hectare in surface area, and numerous small ponds, marshy lowlands, and beaver swamps are present on the installation (Zirkle 1999). The biological assessment makes reference to areas with “high quality foraging habitat” for Indiana and gray bats.

## Fort Knox, Kentucky

Fort Knox is located 30 miles southwest of Louisville in north-central Kentucky. The installation comprises 109,054 acres, or approximately 170 square miles, in Bullitt, Hardin, and Meade counties (<http://www.knox.army.mil/garrison/dbos/fw/index.htm>). Fort Knox is located in the Pennyroyal Plain area of the Mississippian Plateau Region and the Knobs area of the Outer Bluegrass Region. Small rounded uplands with moderately steep slopes characterize the Knobs area of the Outer Bluegrass region. Streams are numerous in this area and commonly run through steep valleys and gullies (BHE 2002).

Fort Knox is home of the U.S. Army Armor Center and the U.S. Army Recruiting Command. Fort Knox's mission is to provide high quality, realistic training for the Army, Air Force, Navy, Marine Corps, National Guard, Coast Guard, and Reserve Forces. Current land use on Fort Knox includes an approximately 7,000-acre cantonment area, approximately 101,000 acres of live-fire ranges, associated impact areas, and training/maneuver areas, and approximately 1,000 acres of recreation areas and managed lakes (Harland Bartholomew and Associates 1995). Table 1 summarizes the use of S&Os at this installation. Table 9 summarizes the quantity of each type of ammunition used at Fort Knox in 2002.

Several reports have been prepared for Fort Knox relevant to this ecological risk assessment (BHE 2001a, 2001b, 2002, Carter and Merritt 1995, Harland Bartholomew and Associates 1995). Approximately 60 percent (65,400 acres) of the installation is a diversified forest containing upland oak-hickory, poplar-beech-maple, oak-maple terrace, silver maple-cottonwood riparian forest, and pine plantations. These forested areas provide roosting habitat for bats. Ten caves are located in the western third of the installation (Carter and Merritt 1995). Surveys indicate at least three of the caves provide suitable habitat for summering or wintering bats. Species identified during cave surveys include Indiana bat, gray bat, little brown bat (*Myotis lucifugus*), the eastern pipistrelle (*Pipistrellus subflavus*), northern long-eared bat (*Myotis septentrionalis*), hoary bat (*Lasiurus cinereus*), and big brown bat (*Eptesicus fuscus*) (BHE 2001a, 2001b). Potential exposure of the Indiana bat and gray bat to obscurants and military-unique compounds is assessed in this report. Gray bats can be found roosting and foraging along waterways at Fort Knox. Indiana bats are expected to be found all over the installation where there are loose bark sycamore trees. There is a 1,400-acre Indiana bat management area in the northeast portion of the installation (personal communication, Gail Pollock, Fort Knox, 2004).

## Fort Polk, Louisiana

Fort Polk covers 198,963 acres in Vernon County in west-central Louisiana. Almost half of the lands on post (98,125 acres) belong to the United States Forest Service as part of the Kisatchie National Forest (<http://www.fs.fed.us/r8/kisatchie/calcasieu-rd/vernon/index.htm>).

Fort Polk is currently the home of the Joint Readiness Training Center (JRTC), the 2nd Armored Cavalry Regiment, the FORSCOM Redistribution Center (operated by Martin-Lockheed), and the garrison's Warrior Brigade (<http://www.jrtc-polk.army.mil/>). Table 1 summarizes the use of smokes and obscurants at this installation. Table 10 summarizes the quantity of each type of

ammunition used at Fort Polk in 2002. Some evaluation of U.S. Army potential training impacts at Fort Polk has been conducted (Wagner 1999).

## Camp Shelby, Mississippi

National Guard and Reserve units from all over the country train at Camp Shelby, which is a state-owned and -operated facility. The Camp Shelby Joint Forces Training Center, encompassing over 129,675 acres (525 square kilometers), is located in portions of Perry and Forrest counties, in south Mississippi. The training site consists of a mix of State, DoD, and approximately 110,000 acres of U.S. Forest Service land in the DeSoto National Forest

(<http://www.epa.gov/fedrgstr/EPA-IMPACT/2003/September/Day-04/i22475.htm>).

Figure 7 shows the military training compartments at Camp Shelby.

There are two major areas with dedicated impact areas at Camp Shelby: 202 East and 201 West. The area called 202 East is an aircraft firing/bombing range and 201 West is a helicopter gunnery range. Several small arms firing ranges are located around the 14,000-acre West impact area. Table 1 summarizes the use of smokes and obscurants at this installation. Table 11 summarizes the quantity of each type of ammunition used at Camp Shelby in 2002.

Camp Shelby is located in the Lower Coastal Plain ecoregion. The terrain consists of gently rolling hills, longleaf pine forest, mixed hardwood pine ridges, and deciduous hardwood in wetland areas. A number of streams drain the impact area at Camp Shelby, and riparian wetlands are common along these streams (<http://www.globalsecurity.org/military/facility/camp-shelby.htm>). Two Federally listed species are present at Camp Shelby: the gopher tortoise and Louisiana quillwort (*Isoetes louisianensis*). Training Area 44 has been designated as a gopher tortoise refuge. Off-road maneuvers are prohibited, but there are some firing points within that training area. Training Area 44 is a preferred habitat for gopher tortoise. However, as shown in Figure 7, there is gopher tortoise habitat in other training areas on post. According to personnel at Camp Shelby, gopher tortoises apparently prefer the ridges, especially in areas that are burned regularly, where the vegetation is low to the ground. The Louisiana quillwort is a Federally listed (E) wetland plant species present at Camp Shelby. The Camp also manages red-cockaded woodpecker habitat (i.e., mature longleaf pines), but red-cockaded woodpecker colonies have not been noted there. There are several gopher tortoise burrows within the small arms impact area and 202 East that could potentially be exposed to military-related COCs. This screening level assessment evaluates potential exposure of the gopher tortoise to military-related COCs used or present at Camp Shelby.

## Fort Leonard Wood, Missouri

Fort Leonard Wood is located in Pulaski County, Missouri. The installation covers approximately 62,208 acres in the Ozarks, approximately 1150 feet above mean sea level (<http://www.globalsecurity.org/military/facility/fort-leonard-wood.htm>). The terrain is mostly flat with some gently rolling hills. MANSCEN (Maneuver Support Center), the U.S. Chemical, Engineer, and Military Police Schools, the Center of Excellence for Homeland Defense, and other units are located at Fort Leonard Wood. Types of training conducted at this installation include: engineer basic and advanced individual training, basic combat training, chemical training, military police training, non-commissioned officer training, and training in 14 different military occupational specialties including Motor Transport Operator Course, construction equipment operators, plumbing, technical drafting, material quality specialists, construction surveyors, and demolition (<http://www.wood.army.mil>). As part of the chemical training program, soldiers learn how to use a fog oil generator. Table 1 summarizes the use of S&Os at this installation. The table includes the amount of fog oil, generator type, and frequency information for items used in fog oil generator equipment training. Four training areas are currently approved for fog oil use under the air permit, but only TA401 is used (except for a couple of times in September 2002). Table 12 summarizes the quantity of each type of ammunition used at Fort Leonard Wood in 2002. Data was available for September through December of 2002 only. Range Control staff said that the estimates for September through December represent about 1/3 of the training done throughout the year. The annual estimate was obtained by multiplying the September through December estimates by three.

This screening level assessment evaluates potential exposure of the Indiana bat and gray bat to military-related compounds used at Fort Leonard Wood.

## Fort Bragg, North Carolina

Fort Bragg is located 10 miles northwest of Fayetteville, North Carolina, in the Sandhills Region. It covers 153,562 acres and has range and training areas primarily within 4 counties: Hoke, Cumberland, Harnett, and Moore. Camp Mackall, within Scotland, Moore, and Richmond counties, is 40 miles west of the Fort Bragg cantonment and contains 7,935 acres (Jones Technologies, Inc. and Gene Stout and Associates 2001b).

The mission at Fort Bragg is to maintain the XVIII Airborne Corps as a strategic crisis response force, manned and trained to deploy rapidly by air, sea, and land anywhere in the world. The Advanced Airborne School is also located at Fort Bragg

(<http://www.bragg.army.mil/18abn/>). Armor, artillery, and mechanized infantry reserve units also use Fort Bragg for inactive duty training and annual training (Jones Technologies, Inc. and Gene Stout and Associates 2001b). The Range and Training Area is geographically divided into five areas. From east to west these five areas are the Northeast Area (separated from other training by the Cantonment), the Greenbelt, the Northern Training Area (including Overhills), the primary maneuver training area (extending west from the Greenbelt and Cantonment) and Camp Mackall. Ranges and impact areas are located in the center of Fort Bragg and consist of some 33,040 acres and are described as follows:

- Manchester Impact Area (2,780 acres) is located adjacent to the northeastern part of the primary maneuver area and 25 ranges are located along the periphery of this impact area.
- The MacRidge Impact Area (10,436 acres) is located in the east-central part of the primary training area and contains the largest number of ranges. Rifle marksmanship training and qualification ranges, small arms ranges, and mortar, artillery, and tank firing positions ring the periphery of MacRidge, along with two explosive demolition areas.
- Coleman Impact Area (13,143 acres) is the largest impact area on the reservation and is located near the center of the primary maneuver area. Weapons used range from small arms and hand grenades to the 203-mm howitzer, as well as Air Force aircraft bombing and strafing and several types of missiles.
- McPherson Impact Area (6,671 acres) is located in the western end of the reservation in an irregular configuration. Weapons are limited due to the area's shape, but activities are similar to those listed for the Coleman Impact Area, with the exclusion of direct fire artillery, tank firing, and Stinger missile. Compared to other impact areas, there are few ranges around the periphery of McPherson (Jones Technologies, Inc. and Gene Stout and Associates 2001b).

Table 1 summarizes the use of smokes and obscurants at this installation. Table 13 summarizes the quantity of each type of ammunition used at Fort Bragg in 2002.

An INRMP for 2001-2005 has been completed for Fort Bragg (Jones Technologies, Inc. and Gene Stout and Associates 2001b). Almost half the installation, 72,000 acres, is forested by longleaf pines (*Pinus palustris*) making it the dominant canopy tree species on post. Much of the forest on Fort Bragg contains wiregrass (*Aristida stricta*) as the primary ground cover. When found together, these two species make up the major components of the longleaf pine/wiregrass ecosystem, which is characterized by widely spaced mature pines in the canopy and a scattered mix of successional stages, a clear mid- and understory, and a ground cover composed mainly of wiregrass with numerous other species intermingled. The five Federally listed en-

dangered species found on Fort Bragg/Camp Mackall are: American chaffseed (*Schwalbea americana*), Michaux's sumac (*Rhus michauxii*), red-cockaded woodpecker (*Picoides borealis*), rough-leaved loosetrife (*Lysimachia asperulaefolia*), and the butterfly called St. Francis Satyr (*Neonympha mitchellii francisci*). Additionally, Fort Bragg is home to many species of Federal concern and/or state-listed (endangered, threatened, species of concern) biota. This list includes: Bachman's sparrow (*Aimphila aestivalis*), loggerhead shrike (*Lanius ludovicianus*), star-nosed mole (*Condylura cristata*), tiger salamander (*Ambystoma tigrinum*) and dwarf salamanders (*Eurycea quadridigitata*), southern hognosed snake (*Heterodon simus*), Atlantic pigtoe (*Fusconaia masoni*), Venus flytrap (*Dionaea muscipula*), sandhills milkvetch (*Astragalus michauxii*), sandhills pyxie-moss (*Pyxidanthera barbulata* var. *brevifolia*), Pickering's dawnflower (*Stylisma pickeringii* var. *pickeringii*), and dwarf bladderwort (*Utricularia olivacea*) ([http://www.bragg.army.mil/esb/longleaf\\_ecosystem.htm](http://www.bragg.army.mil/esb/longleaf_ecosystem.htm)).

This screening level assessment evaluates potential exposure of the red-cockaded woodpecker to military-related COCs used at Fort Bragg. The red-cockaded woodpecker is considered to occur throughout Fort Bragg due to the presence of pine forest throughout most of the installation (Map 3.4.2.2.2 in the INRMP). There is essentially one red-cockaded woodpecker cluster for each square kilometer of maneuver land on Fort Bragg and Camp Mackall. Fort Bragg and Camp Mackall sub-populations occur within the North Carolina Sandhills physiographic province. The INRMP indicates that the Greenbelt is considered an area of special concern for the red-cockaded woodpecker. The Greenbelt includes 6,329 acres, is approximately 6.6 miles in length, and ranges from 0.26 to 2.2 miles wide. Training areas in the Greenbelt include a landing zone, compass courses, CS chamber, and defensive driving course (Jones Technologies, Inc. and Gene Stout and Associates 2001b). The exact location of red-cockaded woodpecker clusters in areas where ammunition and S&Os are likely to be used is unclear.

## Fort Sill, Oklahoma

Fort Sill's 94,000 acres of land is located in southwest Oklahoma, the heart of "Oklahoma's Great Plains" country. It is 90 miles southwest of Oklahoma City, the state capitol, and 50 miles north of Wichita Falls, Texas on Interstate 44. The post is adjacent to and just north of the city of Lawton (<http://www.globalsecurity.org/military/facility/fort-sill.htm>).

The U.S. Army's Field Artillery School is located at Fort Sill. Fog oil obscurant smoke is not used at Fort Sill, however Table 1 summarizes the use of other S&Os

at this installation. Table 14 lists the quantity of each type of ammunition used at Fort Sill in 2002.

Black-capped Vireo nests have been located in the following Training Areas: 8, 11, 12, 13, 14, 17, 24, 25, and 43. Of these areas Fort Sill provided the following information about training activities in those areas:

- TA 8 is rarely used (people might drive through there occasionally);
- TA 11, 12, 13, 14, and 43 are mountainous/rocky areas used for navigation training (map and compass);
- TA 17 is rarely used because it is remote;
- TA 24 is sometimes used, but mostly blanks are fired. There are no ranges in this Training Area;
- There are no ranges in TA 25. Units fire over TA 25, but there isn't much activity in the training area itself.

Therefore, the exposure pathway for black-capped vireo exposed to military-related COCs Fort Sill is likely to be incomplete.

## **Fort Jackson, South Carolina**

The U.S. Army Training Center at Fort Jackson is in central South Carolina in Richland County adjacent to and part of the city of Columbia. Fort Jackson encompasses 52,301 acres of land including over 50 ranges and field training sites. Fort Jackson is on the northwestern edge of the Atlantic Coastal Plain Province, a region of low to moderate relief and gently rolling plains, known as the Sand Hills. Gently to moderately rolling, moderately dissected high plains occupy most of Fort Jackson. These high plains are interrupted by the nearly flat alluvial plains of Gills, Cedar, and Colonels creeks and their tributaries, and an irregularly distributed, gently sloping, low relief area in the central portion of the installation near the headwaters of Cedar Creek (Parsons Harland Bartholomew and Associates, Inc. 2000). Figure 8 shows the training and impact areas at Fort Jackson.

The U.S. Army Basic Combat Training Center of Excellence is located at Fort Jackson. The installation trains about 45,000 soldiers in Basic Combat Training and Advanced Individual Training each year. In addition, Fort Jackson supports over 60,000 Reserve, South Carolina Army National Guard (SCARNG), and Reserve Officers Training Course personnel annually on its weapons ranges and training lands. The SCARNG is licensed to use 14,832 acres for maneuver and field training requirements in the southeastern corner of Fort Jackson (McCrady Training Center). Fort Jackson has 143 alphanumeric training areas, which encompass about 37,735 acres. Twelve of these areas (training area 6A-6I and 7A-7C, totaling 4,857

acres) are part of the West Impact Area and are not available for maneuver or field training exercise (FTX). The East Impact Area (Artillery Impact Area) includes about 5,250 acres near the center of the installation. The East Impact Area is the established impact area for mortar and artillery weaponry training; an Engineer Demolition Site is also located within the East Impact Area. Maneuver, FTX, or any other land-based training is prohibited within the East Impact Area (except at established ranges), and unauthorized access into the East Impact Area is prohibited due to the presence of unexploded ordnance that presents a safety hazard. The SCARNG is licensed to use training areas TA 21 and TA 23 through TA 35. SCARNG training activities are similar, so impact to natural resources are the same as for other field training exercises at Fort Jackson (U.S. Army 2001b). Table 1 summarizes the use of smokes and obscurants at this installation. Table 15 lists the quantity of each type of ammunition used at Fort Jackson in 2002.

In this screening level assessment potential exposure of the red-cockaded woodpecker to military-related COCs used at Fort Jackson is evaluated. Fort Jackson has completed a Biological Assessment on the effects of military training activities on listed species (U.S. Army 2001b). As with all other Army installations, an INRMP has also been developed.

Forest cover constitutes the primary cover type with wetland communities occurring adjacent to streams and drainages. In general, Fort Jackson can be classified into five primary terrestrial vegetative types: pine, pine/upland hardwood, upland hardwood, bottomland hardwood, and open field. Field investigations and surveys have identified over 750 species of flora on the installation. Two Federally listed endangered plant species, rough-leaved loosestrife and smooth coneflower (*Echinacea laevigata*) occur on Fort Jackson. Various inventories have confirmed the occurrence of 30 mammals, 109 birds, 24 fish, 68 reptile and amphibian species, and 45 invertebrate species on the installation. One Federally listed endangered animal, the red-cockaded woodpecker, is a resident of Fort Jackson. The Bald Eagle (listed as threatened), is a transient visitor to the installation. Fort Jackson provides habitat for four rare animal species that are not currently listed as threatened or endangered: the southeastern myotis (*Myotis austroriparius*), Rafinesque's big eared bat (*Plecotus rafinesquii*), loggerhead shrike, and Bachman's sparrow (Parsons Harland Bartholomew and Associates, Inc. 2000). Longleaf pine forest areas on the installation provide habitat for red-cockaded woodpeckers. There are 25 or 26 active clusters located primarily within the southeastern quadrant of the installation and eight active clusters in the East Impact Area. Figure 8 shows the location of red-cockaded woodpecker cavities in relation to training and impact areas at Fort Jackson.

## Camp Bullis, Texas (and Fort Sam Houston, Texas)

Camp Bullis is located 17 miles northwest of San Antonio in Bexar County. All training for soldiers stationed at Fort Sam Houston takes place at Camp Bullis. Camp Bullis has almost 28,000 acres of maneuver areas and firing ranges (DoD 2005). Figure 9 shows the maneuver areas at Camp Bullis.

The U.S. Army Medical Department (AMEDD) Center and School is located at Fort Sam Houston. Camp Bullis is used for annual training of soldiers at the AMEDD Center and School and the Joint Medical Readiness Training Center (JMRTC) at Fort Sam Houston as well as thousands of Army Reserve and National Guard soldiers. Training areas at Camp Bullis include: Military Operations in Urban Terrain (MOUT) Site; Combat Medic Training Park; Tactical Vehicle/Driver Training Course; Nuclear, Biological, Chemical Confidence Chamber; Parachute Drop Zone (DZ Hall); Litter Obstacle Course; Black Jack Village; Bivouac Area and Training Site; Combat Assault Landing Strip (CALS); and numerous small arms firing ranges. Table 1 summarizes the use of S&Os at this installation. The fog oil amount, generator type, and frequency information are used when training medical students in triage where there is limited visibility. Table 16 summarizes the quantity of each type of ammunition used at Camp Bullis in 2002.

Two Federally listed endangered bird species, the Golden-cheeked Warbler and the Black-capped Vireo, and two endangered cave invertebrate species (*Rhadine exilis* and *R. infernalis*) are present at this installation. Figure 9 shows the location of black-capped vireo and golden-cheeked warbler habitat in relation to maneuver areas at Camp Bullis.

## Fort Hood, Texas

Fort Hood is a 217,337-acre armor training installation located in central Texas, approximately 60 miles north of Austin and 160 miles south of Dallas/Fort Worth (<http://www.globalsecurity.org/military/facility/fort-hood.htm>). Fort Hood is located in Bell and Coryell counties, adjacent to the city of Killeen. Located at the northern extent of the Edward's Plateau, the topography consists of numerous steep sloped hills and ridgelines above flat to gently rolling plains (Hayden et al. 2001). Figure 10 shows the military training compartments at Fort Hood.

Fort Hood stations two armored divisions and supports training for an armored division of the National Guard. There are 138,948 acres of maneuver areas and 50 live-fire training ranges at Fort Hood. Table 1 summarizes the use of S&Os at this

installation. Table 17 summarizes the quantity of each type of ammunition used at Fort Hood in 2002.

An ESMP for fiscal years 2001-2005 has been prepared for Fort Hood (Hayden et al. 2001). Data obtained from the Army's Land Condition Trend Analysis (LCTA) Program at Fort Hood show that the installation is divided mainly into perennial grassland and woodland community types. Most of the grasslands exhibit a dense or closed vegetative cover and are dominated by Texas wintergrass (*Stipa leucotricha*) and prairie dropseed (*Sporobolus heterolepis*). Broadleaf woodlands comprise about 39 percent of LCTA woodland sites and typically are dominated by oaks. Coniferous and mixed woodlands comprise 61 percent and are dominated by Ashe juniper (*Juniperus ashei*) or a mixture of juniper and various oaks (Hayden et al. 2001).

Two Federally listed endangered bird species are present at Fort Hood: the black-capped vireo and the golden-cheeked warbler. Additional listed and formerly listed species, such as the bald eagle, whooping crane (*Grus americana*) and peregrine falcon (*Falco peregrinus*), occur as transient species on Fort Hood. Alabama croton (*Croton alabamensis*) is a plant species of concern at Fort Hood, but known populations are in locations where virtually no military training is conducted and/or where training is restricted under the Fort Hood Endangered Species Training Guidelines. Monitoring of cave-adapted species is also included in the ESMP for Fort Hood (Hayden et al. 2001). Potential exposure of the black-capped vireo and the golden-cheeked warbler to obscurants and military-unique compounds will be assessed in this report. Warblers on Fort Hood occupy habitats consisting of Ashe juniper and a variety of oak species. Black-capped vireo habitat at Fort Hood consists of low hardwood scrub patches resulting from accidental fires or mechanical clearing related to military training. Nest parasitism of black-capped vireo by brown-headed cowbirds (*Molothrus ater*) is of concern at this installation (Hayden et al. 2001). Warbler and vireo habitats at Fort Hood are shown in Figure 11.

## Wind Rose Information

Smoke and obscurants are released into the atmosphere and move in accordance with local atmospheric and other conditions. Figure 12 provides wind rose data for each of the installations. The wind rose provides information about the distribution of wind speed and the frequency of varying wind directions. The wide arc shows how long the wind has been blowing from that direction expressed as a percentage, while the narrower, filled arc shows the wind strength from that direction. If the green, filled arc is longer than the wide arc, the wind speed was above average, and if it's shorter, the wind speed was below the average. For example, for Fort Rucker, Alabama, the wind blew from the north approximately 20 percent of the time at a

higher-than-average wind speed (in this case approximately 4.5 kph). This figure can be used to determine, on average over the course of a year, what direction the wind blow from and at what speed. This is useful in terms of gauging the direction in which the plumes and clouds formed from the smokes and obscurants are likely to go, and at what speeds.

It was beyond the scope of this report to determine site-specific meteorology for each of the installations; however, this information is available (in many cases specific to the installation rather than from an airport or other nearby location) and could be used to conduct installation-specific modeling of fog oil, other obscurant and signal smoke, and other chemical compounds (e.g., CS) dispersion in the environment.

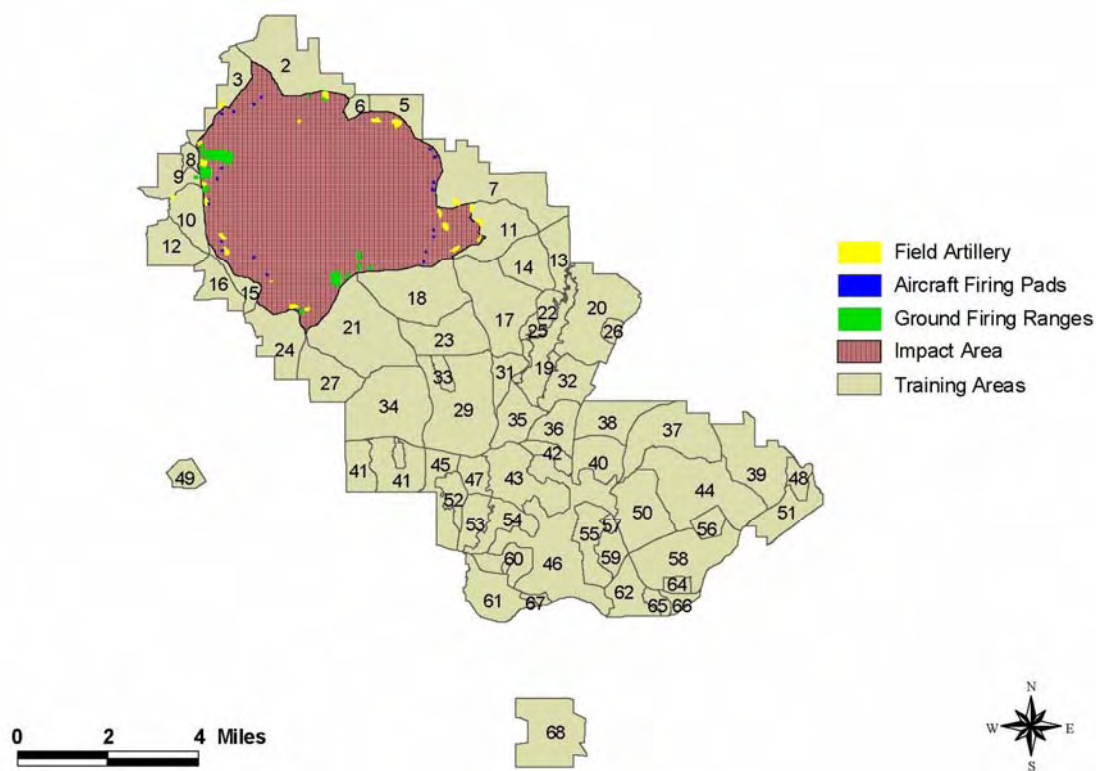


Figure 1. Military training compartments at Fort Rucker, Alabama.

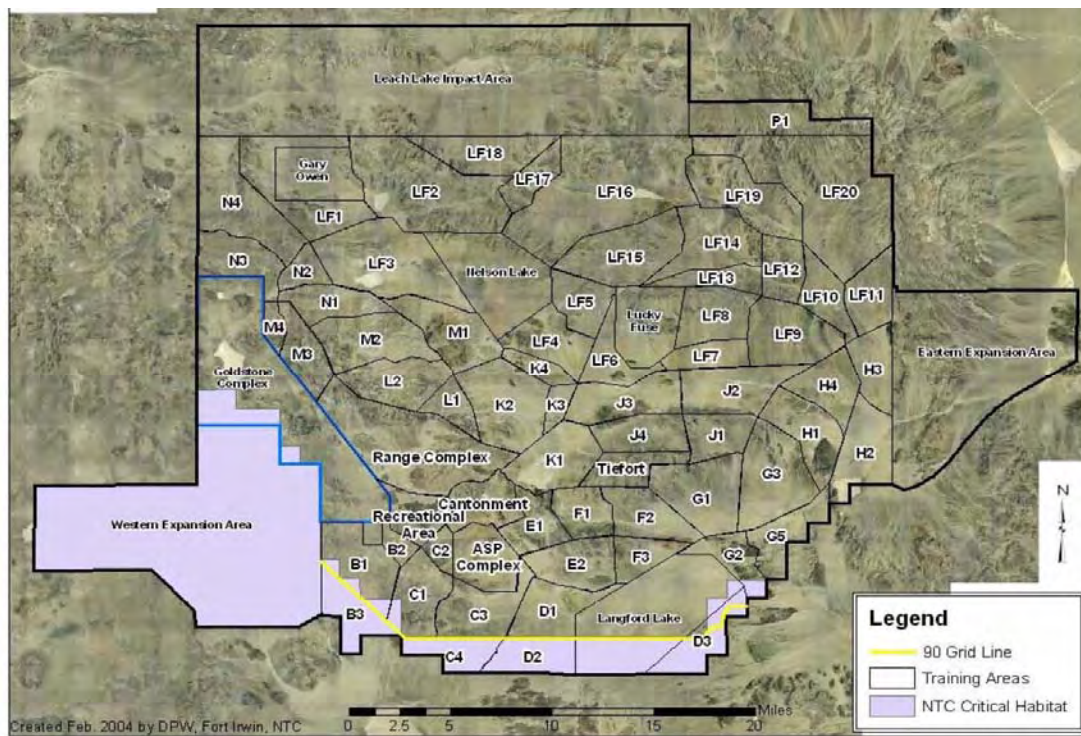


Figure 2. Training areas and desert tortoise critical habitat at Fort Irwin, National Training Center, California.

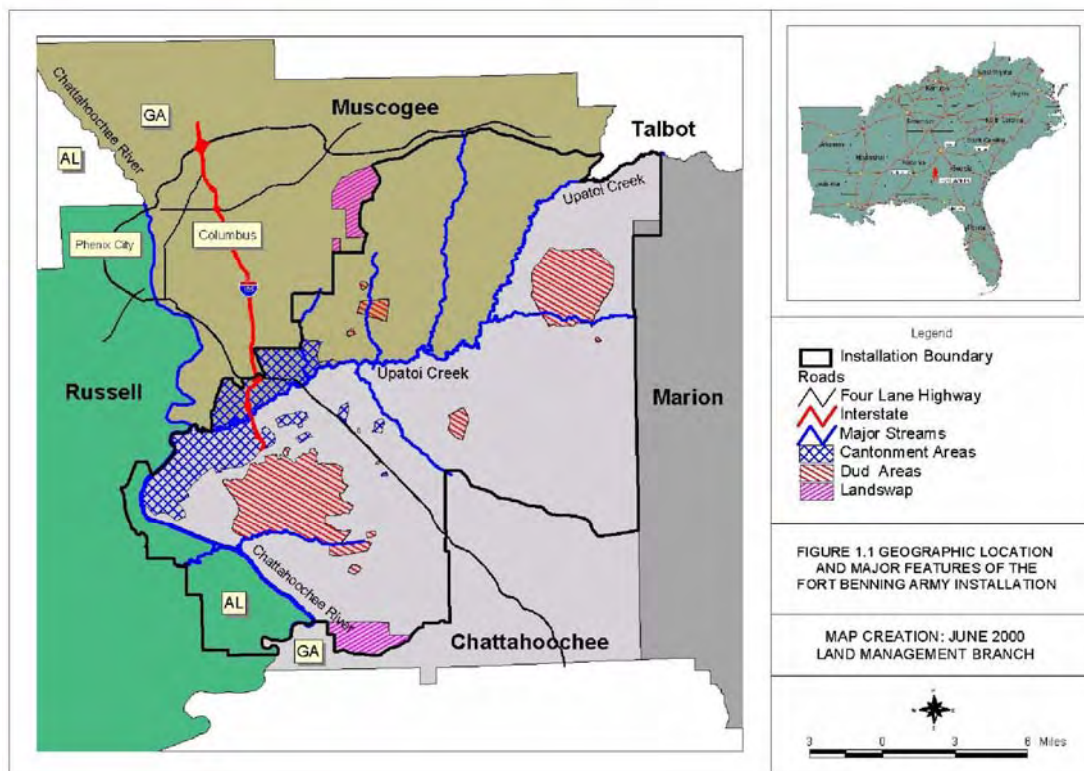


Figure 3. Geographic location and major features at Fort Benning, Georgia.

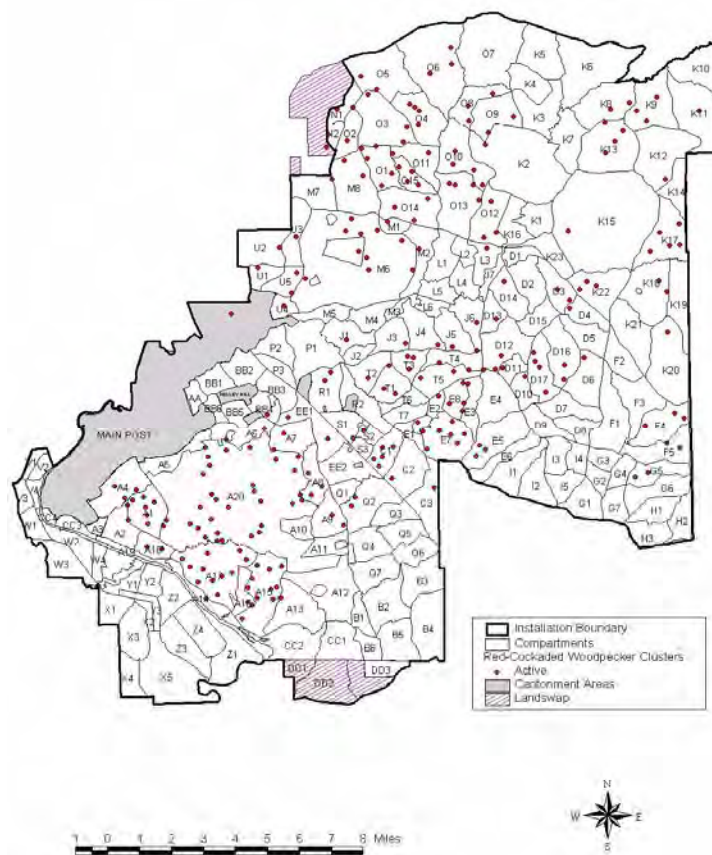


Figure 4. Active red-cockaded woodpecker clusters at Fort Benning, Georgia.

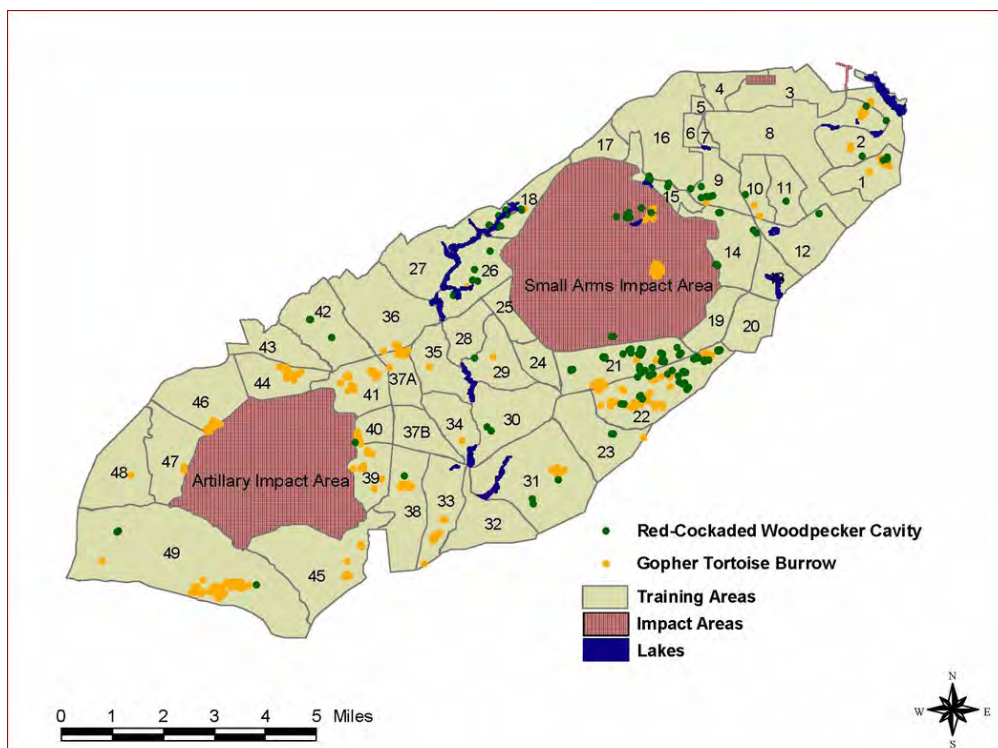


Figure 5. Training areas and locations of threatened and endangered species at Fort Gordon, Georgia.

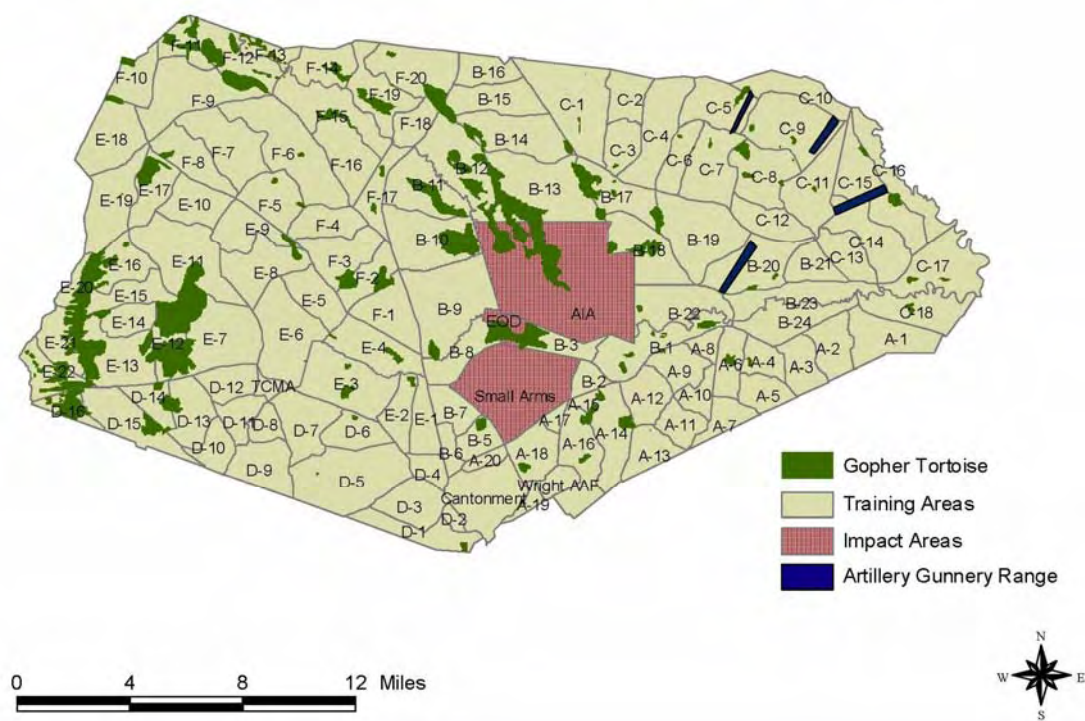


Figure 6. Training areas and gopher tortoise populations at Fort Stewart, Georgia.

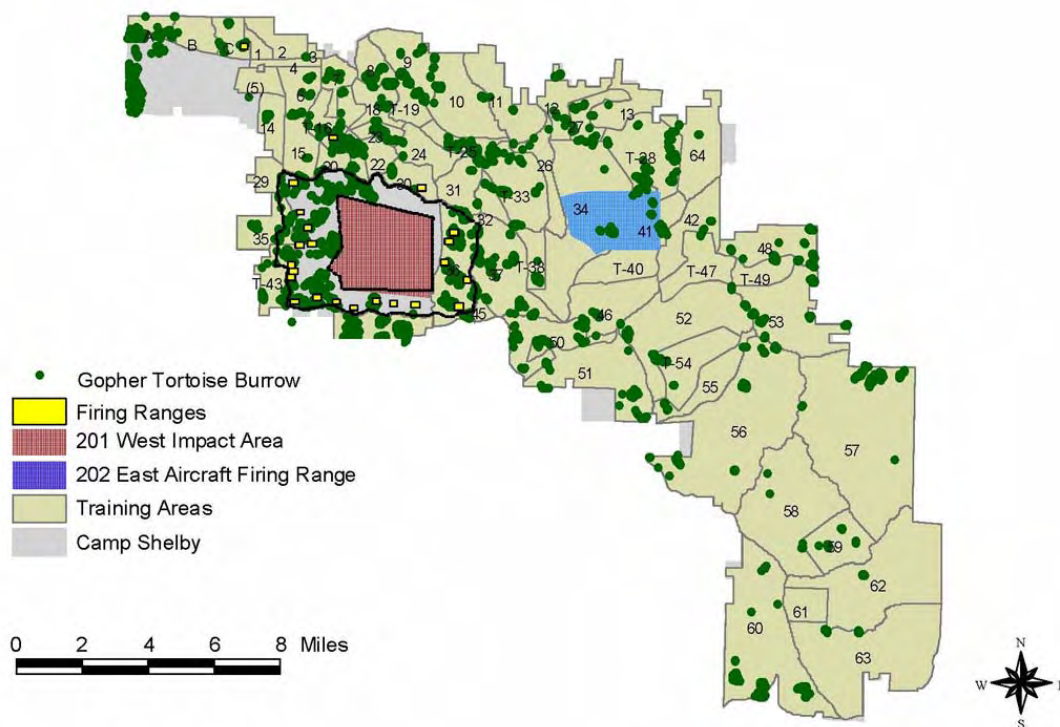


Figure 7. Military training compartments and gopher tortoise burrow locations at Camp Shelby, Mississippi.

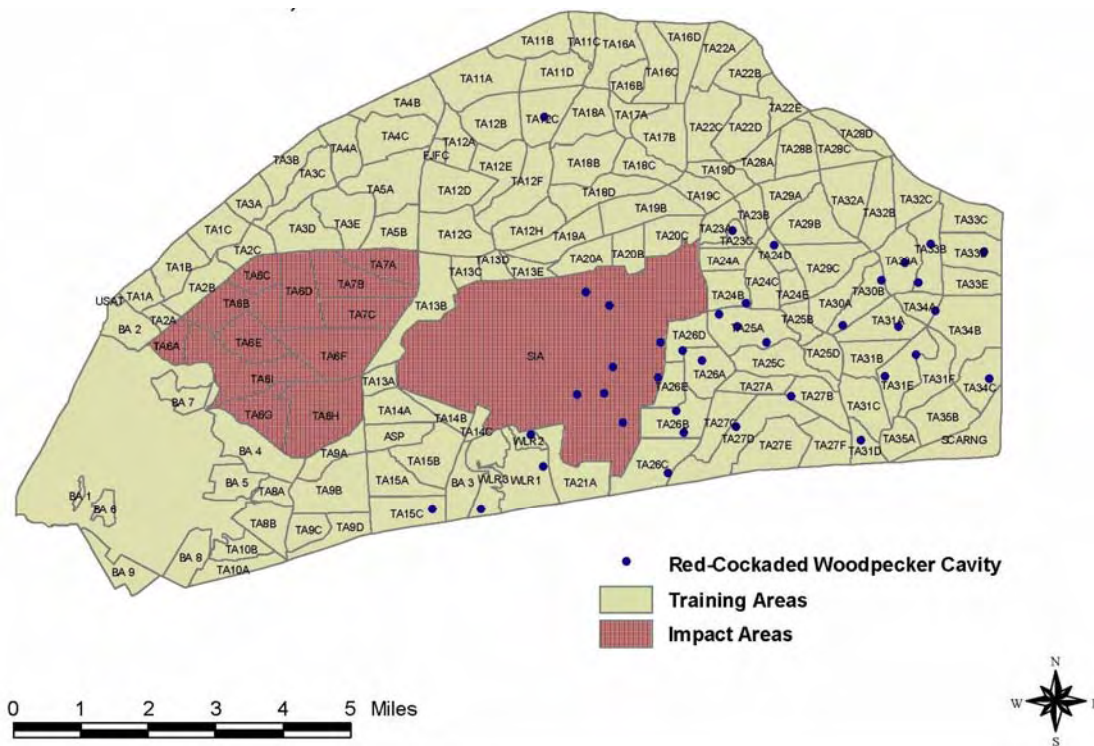


Figure 8. Training areas and red-cockaded woodpecker cavities at Fort Jackson, South Carolina.

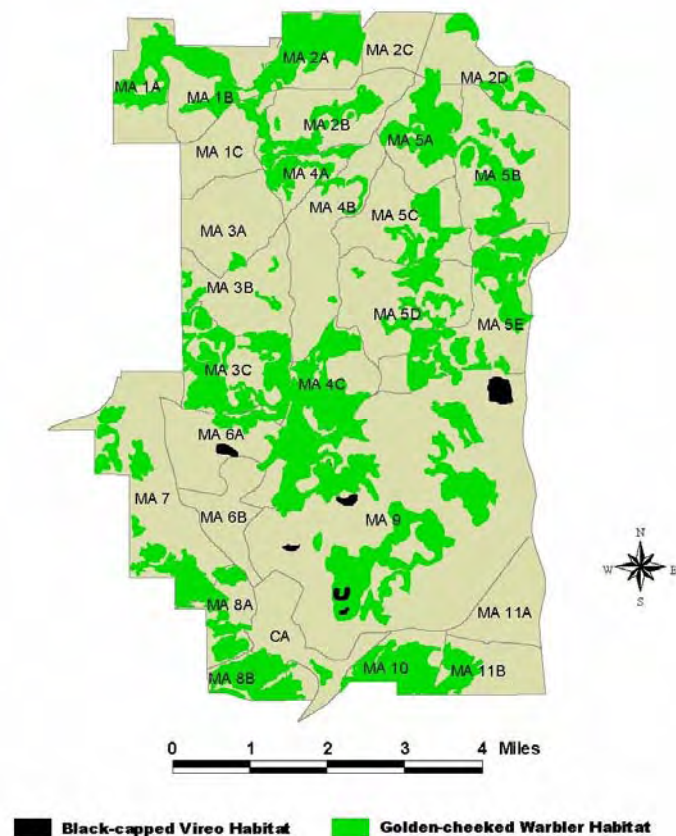
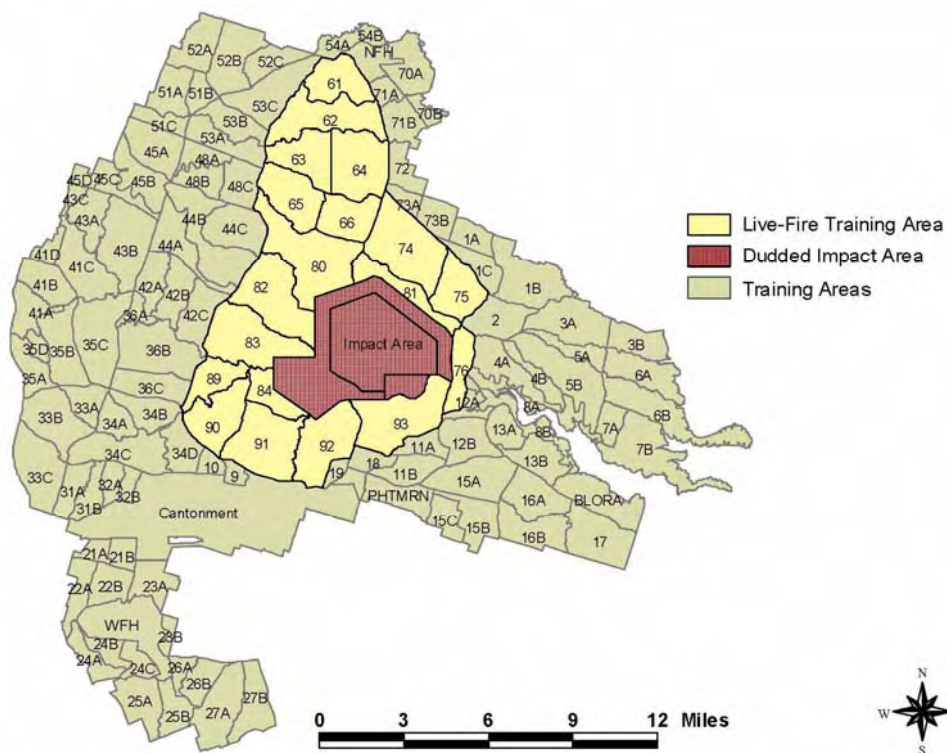
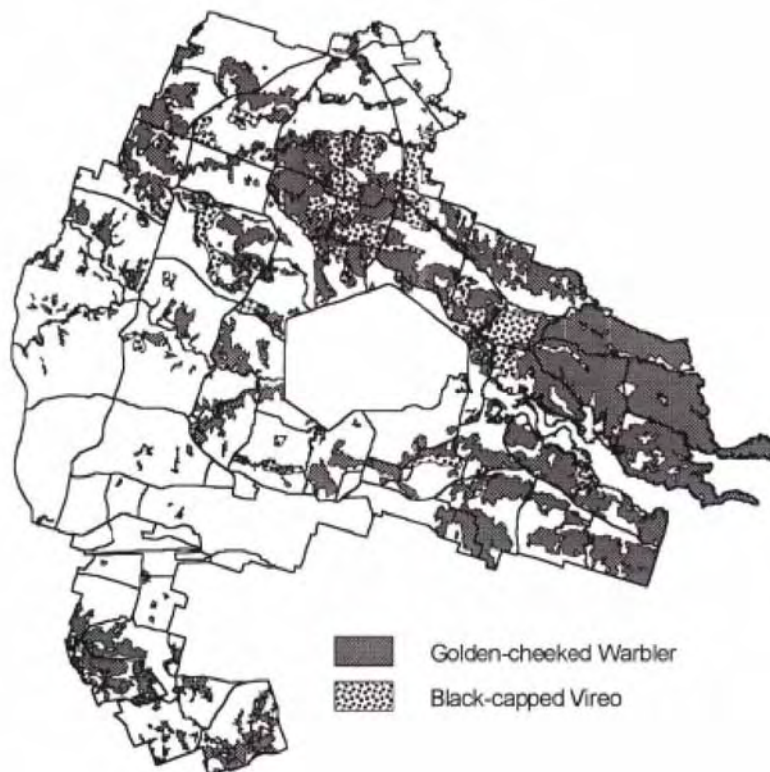


Figure 9. Maneuver areas and endangered avian species habitats at Camp Bullis, Texas.



**Figure 10. Military training compartments at Fort Hood, Texas.**



**Figure 11. Distribution of golden-cheeked warbler and black-capped vireo habitat at Fort Hood, Texas.**

**Source: Hayden et al, 2001, Endangered Species Management Plan for Fort Hood, Texas.**

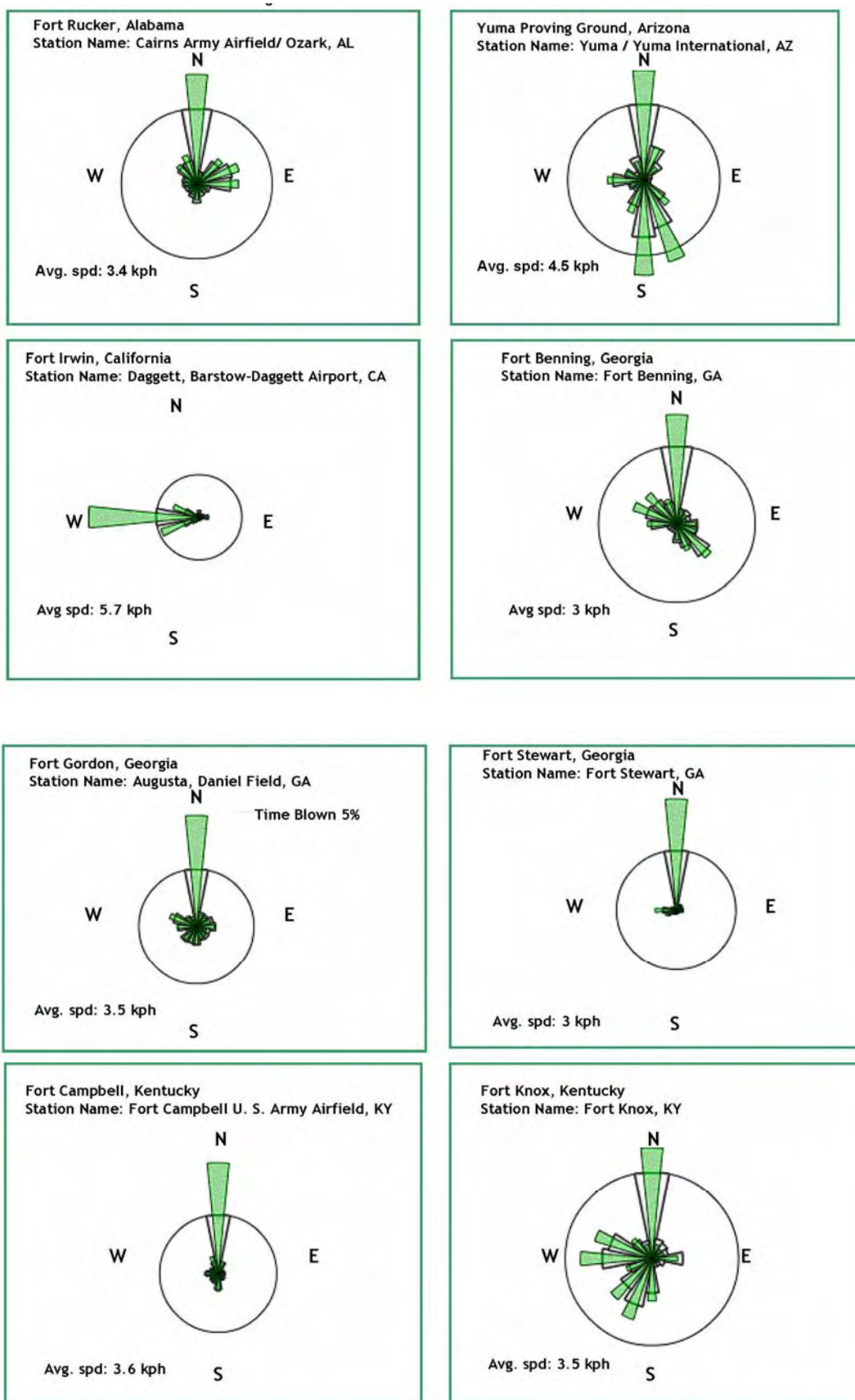


Figure 12. Wind rose data for the installations.

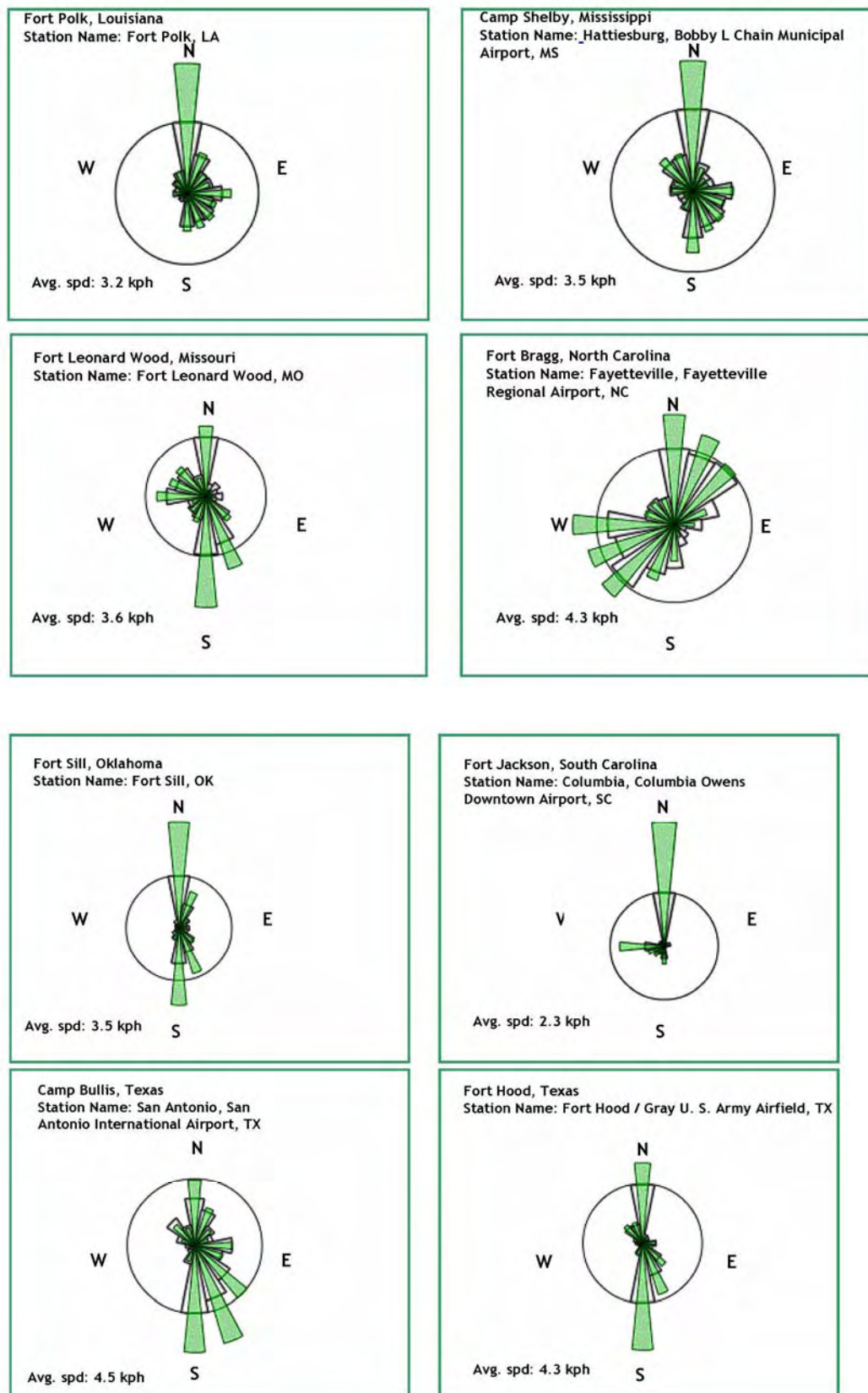


Figure 12. Continued.

**Table 1. Summary of smoke and obscurant use at select Army installations.**

| Installation Name             | Use fog oil? <sup>3</sup> | Use graphite flakes? <sup>3</sup> | Use brass flakes? <sup>3</sup> | Use colored smoke? <sup>4</sup> | Use HC smoke? <sup>4</sup> | Use WP smoke? <sup>4</sup> | Amount of fog oil used per year | Type of fog oil generator used                      | Day/year fog oil used | Hours/day fog oil used                             | Frequency of graphite use with fog oil |
|-------------------------------|---------------------------|-----------------------------------|--------------------------------|---------------------------------|----------------------------|----------------------------|---------------------------------|-----------------------------------------------------|-----------------------|----------------------------------------------------|----------------------------------------|
| Ft. Rucker                    | No                        | No                                | No                             | Yes                             | No                         | No                         | NA                              | NA                                                  | NA                    | NA                                                 | NA                                     |
| Yuma Proving Ground           | Yes, test                 | Yes, test                         | Yes, test                      | Yes                             | NI                         | Yes, test                  | NA                              | M3A3, M1059, M56, M58 (tested)                      | NA                    | NA                                                 | NA                                     |
| Ft. Irwin                     | Yes                       | No                                | No                             | Yes                             | Yes                        | Yes                        | 55 gallon (April '02 - Jan '03) | M56, M58                                            | 92                    | 4 hour total time avg. (1 hour avg. per generator) | NA                                     |
| Ft. Stewart                   | NI                        | NI                                | NI                             | Yes                             | Yes                        | Yes                        | NI                              | NI                                                  | NI                    | NI                                                 | NI                                     |
| Ft. Benning                   | Yes (>2 years ago)        | No                                | No                             | Yes                             | Yes                        | Yes                        | NI                              | NI                                                  | NI                    | NI                                                 | NA                                     |
| Ft. Gordon                    | Yes                       | NI                                | NI                             | Yes                             | Yes                        | No                         | NI                              | NI                                                  | NI                    | NI                                                 | NI                                     |
| Ft. Campbell                  | Yes                       | Yes                               | No                             | Yes                             | Yes                        | Yes                        | NI                              | M56                                                 | 4                     | 1                                                  | 100%                                   |
| Ft. Knox                      | Yes                       | No                                | No                             | Yes                             | No                         | Yes                        | 55 gallons (used in 2001)       | M56 used in 2001, M157/A2 has also been used before | 1                     | 2                                                  | NA                                     |
| Ft. Polk                      | Yes                       | No                                | No                             | Yes                             | Yes                        | Yes                        | NI                              | NI                                                  | NI                    | NI                                                 | NA                                     |
| Ft. Leonard Wood <sup>1</sup> | Yes                       | No                                | No                             | Yes                             | Yes                        | No                         | 36,522 gallons                  | M157, M56/58                                        | 237                   | 2.6 (M157), 1.3 (M56/58)                           | NA                                     |
| Camp Shelby                   | Yes                       | No                                | No                             | Yes                             | No                         | Yes                        | 800 gallons                     | M1059                                               | 11                    | NI                                                 | NA                                     |

| Installation Name        | Use fog oil? <sup>3</sup>             | Use graphite flakes? <sup>3</sup> | Use brass flakes? <sup>3</sup> | Use colored smoke? <sup>4</sup> | Use HC smoke? <sup>4</sup> | Use WP smoke? <sup>4</sup> | Amount of fog oil used per year   | Type of fog oil generator used                                                             | Day/year fog oil used | Hours/day fog oil used | Frequency of graphite use with fog oil |
|--------------------------|---------------------------------------|-----------------------------------|--------------------------------|---------------------------------|----------------------------|----------------------------|-----------------------------------|--------------------------------------------------------------------------------------------|-----------------------|------------------------|----------------------------------------|
| Ft. Bragg                | Yes                                   | Yes                               | No                             | Yes                             | Yes                        | Yes                        | NI                                | M3A3 mechanical smoke generator, M52 helicopter smoke system, and the M157 vehicle mounted | < 25                  | 1-2                    | less than half the time                |
| Ft. Sill                 | No                                    | No                                | No                             | Yes                             | Yes                        | Yes                        | NA                                | NA                                                                                         | NA                    | NA                     | NA                                     |
| Ft. Jackson              | Yes                                   | No                                | No                             | Yes                             | No                         | Yes                        | 330 gallons                       | M56                                                                                        | NI                    | up to 1.5              | NA                                     |
| Camp Bullis <sup>2</sup> | Yes                                   | Yes                               | No                             | No                              | No                         | No                         | 1/2 cup                           | Rosco 1500                                                                                 | 6                     | 2                      | 0%                                     |
| Ft. Hood                 | Yes                                   | NI                                | No                             | Yes                             | Yes                        | Yes                        | 1760 gallons purchased in CY 2003 | M56 & M58                                                                                  | NI                    | NI                     | NI                                     |
| Ft. Sam Houston          | All training conducted at Camp Bullis |                                   | NA                             | NA                              | NA                         | NA                         | NA                                | NA                                                                                         | NA                    | NA                     | NA                                     |

NA = Not applicable.

NI = No information available (colored smoke info comes out of munitions database).

HC = Hexachloroethane.

WP = White phosphorous.

1 Note, the fog oil amount, generator type and frequency information are what is used in equipment training (i.e. train soldiers how to use a fog oil generator).

2 Note, the fog oil amount, generator type and frequency information are what is used to train medical students in triage where there is limited visibility.

The fog oil is generated within a tent, hence the small amount of fog oil used.

3 "Yes" or "No" refers to whether these constituents have ever been used at the installation.

4 "Yes" indicates that these constituents were used in training exercises in calendar year 2002.

Table 2. Munitions used in 2002 at Fort Rucker, Alabama.

| DoD Identification Code | Description of Ammunition   | Quantity Fired |
|-------------------------|-----------------------------|----------------|
| A011                    | 12 GUAGE                    | 1,870          |
| A059                    | 5.56MM BALL                 | 268,964        |
| A062                    | 5.56MM LINK BALL            | 57,904         |
| A063                    | 5.56MM TRACER               | 16,615         |
| A064                    | 5.56MM BALL LINKED TRACER   | 61,937         |
| A066                    | 5.56MM BALL                 | 125,509        |
| A068                    | 5.56MM TRACER               | 20             |
| A071                    | 5.56MM BALL                 | 58,544         |
| A075                    | 5.56MM BLANK                | 9,100          |
| A080                    | 5.56MM BLANK                | 88,598         |
| A088                    | 5.56MM TRACER               | 7,500          |
| A111                    | 7.62MM BLANK                | 19,893         |
| A131                    | 7.62MM BALL LINKED 4/1      | 60,552         |
| A136                    | 7.62MM BALL                 | 2,000          |
| A143                    | 7.62MM BALL LINK 4/1        | 66,460         |
| A146                    | CTG,7.62MM 4:1 LINKED       | 1,600          |
| A164                    | 7.62MM BALL M80 LINKED F/MG | 5,772          |
| A363                    | 9MM BALL                    | 132,368        |
| A540                    | .50 CAL AP LNK 4/1          | 135,150        |
| A555                    | .50 CAL BALL LNK 4/1        | 16,218         |
| A940                    | CTG,25MM TPDS-T M910        | 1,331          |
| A976                    | CTG,25MM TP-T M793 LNKD     | 573            |
| AA11                    | 7.62MM BALL                 | 220            |
| AA12                    | PAINT BALL                  | 180            |
| AA33                    | 5.56MM BALL                 | 62,240         |
| AA49                    | 9MM BALL                    | 13,074         |
| AX11                    | 9MM TRACER                  | 30             |
| B118                    | 30MM TP                     | 206,769        |
| B519                    | 40MM GND PRAC               | 1,091          |
| B579                    | 40MM PRAC                   | 56             |
| B584                    | 40MM TP LINK                | 406            |
| B642                    | 60MM HE                     | 16             |
| B643                    | 60MM HE                     | 644            |
| B647                    | 60MM ILLUM                  | 103            |
| C256                    | 81MM HE                     | 99             |
| C868                    | 81MM HE M821                | 348            |
| C871                    | 81MM ILLUM                  | 40             |
| D513                    | PROJ 155MM PRCT             | 160            |
| D540                    | CHG PROP M3 GB              | 160            |
| G878                    | HND GREN FUSE               | 800            |
| G940                    | GRND, GRN SMK               | 518            |
| G945                    | GRND, YLW SMK               | 212            |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| G950                           | GRND, RED SMK                    | 313                   |
| G955                           | GRND, VIO SMK                    | 495                   |
| G982                           | Grenade, Smoke White, M83        | 8                     |
| HA13                           | 2.75 IN ROCKET TP                | 45,366                |
| HX05                           | 83MM HE ROCKET                   | 1                     |
| HX07                           | 83MM TP ROCKET                   | 10                    |
| K143                           | MINE AP M18A1                    | 21                    |
| K765                           | CHEMICAL AGENT (CS)              | 215                   |
| L116                           | SIG KIT PER DIST RED             | 91                    |
| L119                           | SIG PER KIT DISTRESS             | 36                    |
| L275                           | SIG SMK ILLUM MK 13              | 191                   |
| L305                           | Sig Illum Grnd Grn Star M195     | 17                    |
| L306                           | SIM ILLUM GRND                   | 119                   |
| L307                           | SIG ILLUM W/STAR                 | 1                     |
| L594                           | SIM PROJ GB                      | 1,090                 |
| L598                           | SIM EXP TRAP FLASH M117          | 121                   |
| L599                           | SIM BOOBY ILL M118               | 13                    |
| L600                           | BOOBY TRAP WHIST M119            | 282                   |
| L601                           | SIM HAND GRDE M116               | 809                   |
| M023                           | CHRG DEMO BL C4 M112             | 25                    |
| M030                           | CHG DEMO 1LB C4                  | 20                    |
| M130                           | CAP BLAST ELEC                   | 50                    |
| M131                           | CAP BLAST NON-ELEC               | 30                    |
| M327                           | BASE COUPLING FIRING DEVICE      | 15                    |
| M456                           | DET CORD                         | 100                   |
| M546                           | 40MM HEDP M433                   | 6                     |
| M766                           | IGN TIMED                        | 25                    |
| N286                           | M582 FUSE                        | 80                    |
| N335                           | FUZE PD M557                     | 80                    |
| N523                           | PRIMER M82                       | 164                   |
| PE64                           | Tow Practice, EXT,BTM-71A        | 5                     |
| PM80                           | DRAGON GUIDED MISSILE            | 25                    |
| TOTAL ROUNDS:                  |                                  | 1,475,468             |

**Table 3. Munitions used in 2002 at Fort Irwin, California.**

| <b>DODIC</b> | <b>Description of Ammunition</b>     | <b>Quantity Fired</b> |
|--------------|--------------------------------------|-----------------------|
| A010         | CTG 10 GAGE BLANK/SUBCAL SALUTE M220 | 342                   |
| A011         | CTG 12 GAGE #00 BUCKSHOT M19M/M162   | 700                   |
| A059         | CTG 5.56 BALL F/M16A2                | 170,681               |
| A062         | CTG. 5.56MM BALL LINKED              | 73,200                |
| A063         | 5.56MM TRACER F/M16A2                | 47,666                |
| A064         | 5.56MM BALL AND TRACER LINKED        | 102,421               |
| A066         | CTG 5.56MM                           | 43,684                |
| A071         | CTG., 5.56 BALL M193                 | 11,760                |
| A075         | CTG 5.56MM BLANK, M200 LINKED        | 882,031               |
| A080         | CTG, 5.56MM BLANK M200               | 993,805               |
| A106         | CTG, CAL .22 BALL                    | 20,000                |
| A111         | CTG 7.62MM BLANK M82 LNKD            | 1,951,280             |
| A111         | CTG 7.62MM BLANK M82 LNKD 800 BX     | 504,819               |
| A131         | CTG 7.62MM 4 & 1                     | 515,682               |
| A143         | CTG. 7.62MM BALL LINKED              | 41,400                |
| A146         | CTG, 7.62MM, TRACER LINKED           | 200                   |
| A171         | CTG,7.62MM,M852,MATCH                | 1,000                 |
| A358         | CTG, 9MM TP-T                        | 3,951                 |
| A363         | CTG 9MM BALL NATO                    | 70,637                |
| A525         | CARTRIDGE, .50 CAL AP                | 5                     |
| A552         | CTG, CAL.50 BALL M2                  | 60                    |
| A555         | CTG CAL 50 BALL                      | 9,600                 |
| A557         | CARTRIDGE, .50 CAL BALL & TRACER     | 250,484               |
| A598         | CTG, CAL .50 BLANK                   | 345,966               |
| A940         | CARTRIDGE, 25MM, TPDS-T              | 4,800                 |
| A940         | CARTRIDGE, 25MM, TPDS-T              | 32,488                |
| A976         | CTG 25MM TP-T M793 LNK               | 10,154                |
| A976         | CTG 25MM TP-T M793 LNK               | 21,663                |
| AA33         | CTG, 5.56MM BALL COMMERCIAL PACK     | 445,444               |
| AA49         | CARTRIDGE, 9MM                       | 48,565                |
| B118         | CTG 30MM TP                          | 30,065                |
| B568         | CTG, .40MM HE M406                   | 318                   |
| B584         | CTG, 40MM TP-T M918                  | 7,247                 |
| B610         | LAUNCHER AND CARTRIDGE CS            | 83                    |
| B627         | CTG 60MM ILLUM M83A3                 | 129                   |
| B643         | CARTRIDGE, 60MM, HE                  | 962                   |
| B645         | CTG 60MM TP                          | 100                   |
| B646         | CTG 60MM SMOKE WP                    | 91                    |
| C045         | KIT, REFURBISH F/CTG 81MM            | 86                    |
| C226         | CARTRIDGE, 81MM ILLUMINATING         | 345                   |
| C256         | CTG, 81MM HE M374                    | 1,461                 |
| C276         | CTG 81MM SMOKE WP M375A2 W/FZ        | 358                   |
| C379         | CTG 120MM HE                         | 363                   |

| DODIC | Description of Ammunition            | Quantity Fired |
|-------|--------------------------------------|----------------|
| C445  | CTG 105MM M1 2 P/B                   | 1,013          |
| C445  | CTG, 105MM HE, M1                    | 1,535          |
| C479  | CTG 105MM SMOKE (HC) M84A1           | 197            |
| C623  | 120 MM HE M933 W/FUZE PD             | 2,471          |
| C624  | CTG, 120MM SMOKE WP                  | 635            |
| C784  | CTG 120MM TPW/T                      | 4,259          |
| C785  | CTG 120MM TPCSDS-T M865              | 6,833          |
| C876  | CTG, 81MM                            | 245            |
| C995  | LAUNCHER & CTG 84MM AT4              | 15             |
| CX01  | EXPENDED AT-4 LAUNCH TUBE ASSEMBLIES | 22             |
| D505  | PROJECTILE, 155MM ILLUM M485A        | 387            |
| D510  | PROJ 155MM HEAT M712                 | 21             |
| D528  | PROJECTILE, 155MM SMOKE WP M825      | 580            |
| D528  | PROJECTILE, 155MM SMOKE WP M825      | 1,266          |
| D533  | CHG PROPELLING 155MM M119            | 3,437          |
| D540  | CHG PROP 155MM GB M3A1               | 3,427          |
| D541  | CHARGE PROPELLING, 155M M4           | 14,722         |
| D544  | PROJECTILE 155MM HE M107 COMP B      | 308            |
| D544  | PROJECTILE 155MM HE M107 COMP B      | 1,950          |
| D544  | PROJECTILE, 155MM HE M107B2          | 5,846          |
| D544  | PROJECTILE, 155MM, HE, M107          | 8,660          |
| D544  | PROJECTILE, 155MM, HE, M107          | 811            |
| D550  | PROJECTILE, 155MM, SMOKE WP          | 16             |
| D550  | PROJECTILE, 155 MM SMOKE WP          | 45             |
| D579  | PROJECTILE 155MM M549                | 509            |
| D579  | PROJECTILE, 155MM HERA M549A1        | 183            |
| G841  | CARTRIDGE, GRENADE 5.56MM            | 75             |
| G878  | FUZE HAND GREN M228                  | 2,001          |
| G881  | GRENADE HAND M67                     | 674            |
| G900  | GREN HAND INCD AN M14                | 12             |
| G940  | GRENADE HAND SMOKE GREEN M18         | 2,165          |
| G945  | GRENADE HAND SMOKE YELLOW M18        | 498            |
| G950  | GREN HAND SMOKE RED M18              | 1,073          |
| G955  | GRENADE HAND SMOKE VIOLET M18        | 1,643          |
| G963  | GRENADE, HAND                        | 2,664          |
| G982  | GRENADE, HAND PRAC SMOKE TA          | 6,732          |
| GM2B  | STINGER TUBE ASSEMBLY LAUNCH         | 12             |
| GM2C  | DRAGON EXPENDED TUBE                 | 5              |
| H185  | ROCKET POD PRACTICE (MLRS) M28A1     | 2              |
| H463  | ROCKET 2.75 W/WARHEAD, PRAC          | 34             |
| H974  | RKT, 2.75" WITH SMOKE PROJECTILE     | 168            |
| H974  | RKT, 2.75" WITH SMOKE PROJECTILE     | 24             |
| H975  | ROCKET PRACTICE 2.75IN               | 316            |
| H975  | ROCKET PRACTICE 2.75IN W/WARHEAD     | 572            |

| <b>DODIC</b> | <b>Description of Ammunition</b>     | <b>Quantity Fired</b> |
|--------------|--------------------------------------|-----------------------|
| HA17         | ROCKET, 2.75" W/WARHEAD, PRACTICE    | 157                   |
| J143         | ROCKET MOTOR 5 IN MK22 MOD 4         | 59                    |
| K008         | FIRING DEVICE ELEC M57               | 82                    |
| K145         | MINE, APERS M18A1 WO A               | 178                   |
| K180         | MINE AT M15 1/BX                     | 159                   |
| K181         | MINE, AT HEAVY M21                   | 7                     |
| K231         | MINE AT M20 3/BOX                    | 1,008                 |
| K250         | MINE AT M19 HEAT 2/BX                | 6                     |
| K765         | CHEMICAL AGENT CS (CAPSULE)          | 231                   |
| K866         | SMOKE POT ABC-M5 GRD                 | 1,008                 |
| L116         | SIGNAL KIT PERS DISTRESS M185        | 148                   |
| L305         | SIGNAL ILLUM GRN M195                | 40                    |
| L306         | SIG ILLUM GRND RED STURNIN CLUS M158 | 837                   |
| L307         | SIGNAL ILL GRD M159                  | 128                   |
| L307         | SIGNAL, W S CLUSTER, ILLUM           | 1,266                 |
| L311         | SIGNAL ILLUM GRD, M126 SERIES        | 5                     |
| L312         | SIGNAL GRND ILLUM SIG WHITE STURNIN  | 1                     |
| L312         | SIGNAL ILLUM GRD, M127 SERIES        | 4,436                 |
| L314         | SIGNAL ILL M125A1 36B                | 3,533                 |
| L366         | SIMULATOR PROJ AIRBURST M74A1        | 25,421                |
| L367         | SIMULATOR, CARTRIDGE, ATWESS, M22    | 44,459                |
| L495         | FLARE SURF TRIP PARA                 | 36                    |
| L594         | SIMULATOR, PROJ GRD BURST            | 29,474                |
| L598         | SIMULATOR,EXPLOSIVE                  | 66                    |
| L599         | SIMULATOR, EXPLOSIVE                 | 51                    |
| L600         | SIMULATOR M119 150/B                 | 62                    |
| L601         | SIMULATOR HAND GRENADE               | 9,612                 |
| L602         | SIMULATOR, ARTILLERY FLASH, 50MM M21 | 59,827                |
| L603         | SIM. FLASH ARTY. XM24E1              | 15,112                |
| L709         | SIM TURNINGET HIT                    | 5,756                 |
| L715         | SIMULATOR, MISSILE SAGGER, XM27      | 468                   |
| LA06         | SIMULATOR, TANK MAIN GUN             | 30                    |
| LA07         | SIMULATOR, M31A1                     | 30                    |
| M023         | CHG DEMO BLOCK M112 COMP             | 8,617                 |
| M028         | DEMOLITION KIT BANG TORP M1A2        | 13                    |
| M030         | CHARGE DEMO BLOCK TNT 1/4 LB         | 281                   |
| M032         | CHARGE DEMOLITION BLOCK TNT 1 LB     | 230                   |
| M039         | CHG DEMO CRATERING 40 LB             | 66                    |
| M044         | CHARGE DEMOLITION MK26               | 629                   |
| M130         | CAP BLAST M6 500/BX                  | 584                   |
| M130         | CAP BLAST M6 500/BX                  | 79                    |
| M131         | CAP BLASTING, NON-ELECTRIC           | 612                   |
| M174         | CTG IMPULSE .50 CAL                  | 134                   |
| M327         | COUPLING BASE,FIRING DEVISE W/PRIME  | 335                   |

| <b>DODIC</b>  | <b>Description of Ammunition</b>   | <b>Quantity Fired</b> |
|---------------|------------------------------------|-----------------------|
| M420          | CHARGE, DEMOLITION SHAPED          | 22                    |
| M421          | CHARGE DEMO M3 1 P/B               | 72                    |
| M456          | CORD DET 4000FT P/BOX              | 83,283                |
| M591          | DYNAMITE, MILITURNINY M1 38.5LB BX | 420                   |
| M670          | FUZE BLASTING TIME M700            | 5,500                 |
| M757          | CHG ASSY DEMO M183                 | 6                     |
| M766          | IGNITER M60 300 P/B                | 403                   |
| M913          | CHARGE DEMOLITION LINEAR M58A4     | 35                    |
| ML03          | FIRING DEVICE, DEMO M142           | 186                   |
| ML04          | CUTTER HIGH EXPLOSIVE              | 48                    |
| ML05          | CUTTER HE MK24                     | 27                    |
| ML15          | CHARGE DEMO                        | 205                   |
| ML15          | CHARGE DEMO FLEX LINEAR SHAPED     | 282                   |
| ML45          | M9 HOLDERS BLASTING, VARIOUS DWGS  | 3,938                 |
| ML47          | CAP, BLASTING NON-ELECTRIC         | 1,970                 |
| MM50          | SHAPED CHARGE, DEMO                | 59                    |
| MN02          | CAP, BLASTING NON-ELECTRIC         | 201                   |
| MN03          | CAP, BLASTING NON-ELECTRIC         | 322                   |
| MN06          | CAP, BLASTING NON-ELECTRIC, DELAY  | 1,113                 |
| MN07          | CAP, BLAST NON-ELECT DELAY         | 2,149                 |
| MN32          | DYNAMITE, 60% AMMONIUM NITRATE     | 6                     |
| MN60          | ELECTRIC MATCH ASSY                | 713                   |
| MN68          | BOOSTER, DEMOLITION CHARGE, M151   | 50                    |
| MN69          | BOOSTER, DEMOLITION CHARGE, M152   | 55                    |
| MU34          | REFIRE KIT CABLE & CUTTER ASSEMBLY | 2                     |
| N278          | FUZE MTSQ M564 W/BOOSTER WRBN BX   | 16                    |
| N285          | FUZE MTSQ M577 W/O BOOSTER         | 2,139                 |
| N286          | FUZE MTSQ M582, WRBND BX           | 37                    |
| N286          | FUZE MTSQ M582, WRBND BX           | 2,053                 |
| N340          | FUZE PD M739 WRBND BX              | 17,078                |
| N340          | FUZE, POINT DETONATING M739        | 1,914                 |
| N464          | FUZE, PROXIMITY M732               | 827                   |
| N523          | PRIMER PERCUSSN M82                | 23,048                |
| PA79          | GM SURFACE ATTACK HELLFIRE         | 1                     |
| PB99          | GM. PRAC BTM-71A-3 <TOW>           | 6                     |
| PE64          | GUIDED MISSILE, SURFACE            | 1                     |
| PL23          | GM, SURFACE ATTACK DRAGON          | 5                     |
| PL94          | GM INTERCEPT AERIAL STINGER ROUND  | 1                     |
| PL95          | STINGER MISSILE                    | 6                     |
| PL96          | GM INTERCEPT AERIAL (STINGER RND)  | 5                     |
| YW33          | SAGGER SAM, SMOKEY SAM             | 252                   |
| TOTAL ROUNDS: |                                    | 7,087,888             |

Table 4. Munitions used in 2002 at Fort Benning, Georgia.

| DoD Identification Code | Description of Ammunition                                | Quantity Fired |
|-------------------------|----------------------------------------------------------|----------------|
| A001                    | CTG, 12 GAGE SKEET #9 SHOT                               | 10,560         |
| A011                    | CTG, 12 GAGE #00 BUCKSHOT M19/M162                       | 6,136          |
| A014                    | CTG, 12 GAGE #7 1/2 SHOT                                 | 1,278          |
| A052                    | CTG, .410 SHOOTGUN SKEET #9 SHOT                         | 759            |
| A058                    | CTG, 5.56MM BALL M855 SNGL RD                            | 840            |
| A059                    | CTG, 5.56MM BALL M855 10/CLIP                            | 4,888,754      |
| A062                    | CTG, 5.56MM BALL M855 LNKD                               | 393,131        |
| A063                    | CTG, 5.56MM TR M856 SNGL RD                              | 184,817        |
| A064                    | CTG, 5.56MM 4 BALL M855/1 TR M856 LNKD                   | 2,104,091      |
| A065                    | CTG, 5.56MM SR M862 SNGL RD (Short Range Training ROUND) | 3,100          |
| A066                    | CTG, 5.56MM BALL M193 SNGL RND                           | 135,773        |
| A070                    | CTG, 5.56MM HPT M197 SNGL RD                             | 14,420         |
| A071                    | CTG, 5.56MM BALL M193 10/CLIP                            | 2,550,187      |
| A075                    | CTG, 5.56MM BLANK M200 LNKD                              | 17,555         |
| A079                    | CTG, 5.56MM BLANK M755 F/64MM KE PROJ (GREN LNCHR)       | 20,160         |
| A080                    | CTG, 5.56MM BLANK M200 SNGL RD                           | 82,960         |
| A085                    | CTG, CAL .22 SHORT BLANK                                 | 1,633          |
| A091                    | CTG, CAL .22 BALL LR MATCH (RIFLE)                       | 4,750          |
| A095                    | CTG, CAL .22 SHORT BALL MATCH (PISTOL)                   | 363            |
| A111                    | CTG, 7.62MM, BLANK, M82, LNK                             | 1,600          |
| A127                    | CTG, 7.62MM 4 BALL M59/M80/1 TR M62 LNKD                 | 133,014        |
| A131                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD                     | 1,373,361      |
| A136                    | CTG, 7.62MM BALL M118 MATCH SNGL RD                      | 116,080        |
| A143                    | CTG, 7.62MM BALL M80 LNKD                                | 136,520        |
| A146                    | CTG, 7.62MM TR M62 LNKD                                  | 900            |
| A151                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD                     | 380,780        |
| A166                    | CTG, 7.62MM BALL M80 SNGL RD                             | 150            |
| A170                    | CTG, 7.62MM HLLW PNT RT-TL MATCH SNGL RD (SRTR)          | 2,113          |
| A171                    | CTG, 7.62MM MATCH M852 SNGL RD                           | 23,906         |
| A172                    | CTG, 7.62MM PRAC XM869 SNGL RD                           | 350            |
| A234                    | CTG, CAL .30 TR M1/M25 8/CLIP                            | 75             |
| A255                    | CTG, 7.62 4-BALL M80, 1-DIM TR M1276                     | 42             |
| A358                    | CTG, 9MM TP-T M939 F/AT-4 TRNR                           | 95,008         |
| A360                    | CTG, 9MM BALL M1 PARABELLUM                              | 4,666          |
| A363                    | CTG, 9MM BALL M882                                       | 206,194        |
| A365                    | CTG, 14.5MM TRAINER M181 3 SEC DELAY                     | 434            |
| A483                    | CTG, CAL .45 BALL M1911 MATCH                            | 200            |
| A531                    | CTG, CAL .50 API M8 AC SNGL RD                           | 3,043          |
| A540                    | CTG, CAL .50 4 API M8/1 TR M1/M17 LNKD                   | 745            |
| A552                    | CTG, CAL .50 BALL M2 CTN PACK                            | 552            |
| A555                    | CTG, CAL .50 BALL M2/M33 LNKD                            | 36,546         |
| A557                    | CTG, CAL .50 4 BALL M33/M2/1 TR M17/M10 LNKD             | 88,216         |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b>                             | <b>Quantity Fired</b> |
|--------------------------------|--------------------------------------------------------------|-----------------------|
| A576                           | CTG, CAL .50 4 API M8/1 API-T M20 LNKD                       | 885                   |
| A606                           | CTG, CAL .50 API MK211 SNGL RD                               | 2,200                 |
| A701                           | CTG, 20MM HEI M56A3 SERIES LNKD                              | 3,200                 |
| A940                           | CTG, 25MM TPDS-T M910 & M910, IN, PA 125, CNTR               | 54,030                |
| A953                           | CTG, 20MM HEI M56 SERIES LNKD                                | 5                     |
| A974                           | CTG, 25MM APDS-T M791 LNKD                                   | 60                    |
| A976                           | CTG, 25MM TP-T M793 LNKD                                     | 22,905                |
| AA01                           | CTG, 5.65 AP M995 LNKD                                       | 20,668                |
| AA11                           | 7.62mm LR (7.62) Ball                                        | 65,811                |
| AA12                           | 9mm, Red Non-lethal Marking cartridges (Simunitions)         | 32,800                |
| AA21                           | 9mm, FX MKG Blue Non-lethal Marking cartridges (Simunitions) | 30,542                |
| AA31                           | CTG, 12 GAGE FIN STABILIZED NON-LETHAL                       | 4,500                 |
| AA33                           | Cartridge, Small Arms, 5.56 Ball                             | 7,408,213             |
| AA48                           | CTG, 5.56mm, Ball (Lead Free)                                | 28,800                |
| AA49                           | 9mm Ball                                                     | 38,464                |
| AAAD                           | Rubber Fin Stabilized Round (23FS) (12 Gauge)                | 12,000                |
| B511                           | CTG, 40MM TP M813 4/CLIP                                     | 110                   |
| B517                           | CTG, 40MM HEI-PD M811 4/CLIP                                 | 912                   |
| B518                           | CTG, 40MM HE-PFPX M822 4/CLIP                                | 700                   |
| B519                           | CTG, 40MM TP M781                                            | 207,983               |
| B534                           | CTG, 40MM MP M576                                            | 1,100                 |
| B535                           | CTG, 40MM ILLUM WHT STAR PARA M583                           | 47                    |
| B542                           | CTG, 40MM HEDP M430 LNKD                                     | 612                   |
| B545                           | CTG, 40MM BLANK SALUTING                                     | 394                   |
| B546                           | CTG, 40MM HEDP M433 (PA120 MTL CNTR)                         | 3,227                 |
| B549                           | CTG, 40MM HEI-P M162                                         | 1,400                 |
| B558                           | CTG, 40MM HEI-T-NSD 4/CLIP                                   | 10                    |
| B568                           | CTG, 40MM HE M406                                            | 564                   |
| B569                           | CTG, 40MM HE M397                                            | 15                    |
| B584                           | CTG, 40MM TP M918 LNKD                                       | 32,470                |
| B585                           | CTG, 57MM CANISTER T25E5                                     | 20                    |
| B630                           | CTG, 60MM SMK WP M302 SERIES                                 | 40                    |
| B642                           | CTG, 60MM HE XM720                                           | 360                   |
| B643                           | CTG, 60MM HE M888                                            | 3,921                 |
| B645                           | CTG, 60MM TP SHORT M840 (SRTR)                               | 698                   |
| C004                           | SABOT, 81MM, PRAC.                                           | 355                   |
| C009                           | CTG, IGN M285 F/81MM MORTAR                                  | 144                   |
| C045                           | REPAIR KIT AMMO 81MM 7/B                                     | 3,033                 |
| C074                           | CTG, 81MM, M374A3                                            | 116                   |
| C205                           | CTG, 3 IN 50 CAL VT MK31                                     | 64                    |
| C226                           | CTG, 81MM ILLUM M301 SERIES                                  | 1,877                 |
| C256                           | CTG, 81MM HE M374 SERIES W/PD FUZE                           | 2,834                 |
| C276                           | CTG, 81MM SMK WP M375/M375A2/M375A3 W/PD FUZE                | 100                   |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b>                             | <b>Quantity Fired</b> |
|--------------------------------|--------------------------------------------------------------|-----------------------|
| C356                           | CTG, 3 IN 50 CAL VT MK31 FLASHLESS                           | 1,068                 |
| C379                           | CTG, 120MM HE M934 W/FUZE MO M734                            | 313                   |
| C382                           | CTG, 84MM HE, FFV 441B FOR RAAWS                             | 111                   |
| C383                           | CTG, 84MM, HE, FFV 551 FOR RAAWS                             | 25                    |
| C384                           | CTG, 84MM, ILLUM, FFV545B FOR RAAWS                          | 48                    |
| C385                           | CTG, 84MM, SMOKE, FFV469B FOR RAAWS                          | 38                    |
| C386                           | CTG, 84MM, TP, FFV552 FOA RAAWS                              | 40                    |
| C387                           | CTG, 84MM HEDP FFV502                                        | 6                     |
| C623                           | CTG, 120MM HE XM933                                          | 316                   |
| C624                           | CTG, 120MM SMK                                               | 256                   |
| C784                           | CTG, 120MM TP-T M831 WDN CNTR) & M831 (METAL CNTR)           | 315                   |
| C785                           | CTG, 120MM TPCSDS-T M865 (METAL CNTR) & (WDN CNTR)           | 619                   |
| C786                           | CTG, 120MM, APFSDS-T, M829 & M829 (PA-116 CNTR)              | 41                    |
| C868                           | CTG 81MM HE M821 W/MO FZ M734 2/B, M984 3/CNT, M821 MULTI-OP | 1,788                 |
| C870                           | CTG, 81MM SMK RP M819 W/MTSQ FUZE M772                       | 20                    |
| C871                           | CTG, 81MM ILLUM M853A1 W/FUZE MTSQ M772, W/ FUZE             | 553                   |
| C876                           | CTG, 81MM, M880                                              | 140                   |
| C878                           | CTG, 81MM HE, M984 W/FUZE MULTI-OPTION                       | 308                   |
| C995                           | CTG & LAUNCHER, 84MM M136 AT-4                               | 134                   |
| CA03                           | CTG, 120MM WP M929 W/MO FZ (SEE C624)                        | 36                    |
| CA05                           | CTG, 120MM HE-OR-T XMM908/M908                               | 110                   |
| CA09                           | Cartridge, 120MM:Full Range Practice, M931 W/ FUZE, PD, M931 | 1,606                 |
| D505                           | PROJ, 155MM ILLUM M485 SERIES                                | 159                   |
| D544                           | PROJ, 155MM HE M107                                          | 1,311                 |
| D545                           | PROJ, 155MM ILLUM M118                                       | 6                     |
| D550                           | PROJ, 155MM SMK WP M105/M110 SERIES                          | 28                    |
| DWBS                           | Flash Bang Distraction Device, XM-84                         | 21                    |
| E745                           | BOMB, CLUSTER INC TH-3 750 LB M36E3                          | 32                    |
| G042                           | INITIATOR, BOMB FUZE                                         | 360                   |
| G382                           | TARGET DETECTING DEVICE, FUZE                                | 6                     |
| G878                           | FUZE, HAND GREN PRAC M228                                    | 13,133                |
| G881                           | GRENADE, HAND FRAG M67                                       | 21,730                |
| G887                           | GRENADE, HAND FRAG M59                                       | 163                   |
| G888                           | GRENADE, HAND FRAG M33                                       | 220                   |
| G890                           | GRENADE, HAND FRAG MK2/M26 SERIES                            | 1                     |
| G900                           | GRENADE, HAND INCD TH-3 AN-M14                               | 290                   |
| G930                           | GRENADE, HAND SMK HC AN-M8                                   | 12                    |
| G940                           | GRENADE, HAND SMK GRN M18                                    | 5                     |
| G945                           | GRENADE, HAND SMK YLW M18                                    | 20                    |
| G950                           | GRENADE, HAND SMK RED M18                                    | 70                    |
| G955                           | GRENADE, HAND SMK VIO M18                                    | 10                    |
| G982                           | GRENADE, HAND, PRACTICE                                      | 40                    |

| DoD Identification Code | Description of Ammunition                           | Quantity Fired |
|-------------------------|-----------------------------------------------------|----------------|
| G995                    | GRENADE, RIFLE SMK GRN M22                          | 1              |
| H975                    | ROCKET, 2.75" PRAC M274 MK66 MOD 3                  | 52             |
| HA16                    | RCKT, 84MM HEATFFV551 W/IM WHD                      | 10             |
| K001                    | ACTIVATOR, M1 F/AT MINE M15                         | 42             |
| K143                    | MINE, APERS M18A1 W/M57 FIRING DEVICE               | 357            |
| K145                    | MINE, APERS M18A1 W/O FIRING DEVICE                 | 199            |
| K180                    | MINE, AT HEAVY M15                                  | 11             |
| K181                    | MINE, AT HEAVY M21                                  | 17             |
| K250                    | MINE, AT HEAVY M19 NON-METALLIC                     | 15             |
| K765                    | RIOT CONTROL AGENT, CS                              | 4              |
| K867                    | SMOKE POT, FLOATING HC M4A2                         | 10             |
| L212                    | MARKER, LOCATION YLW MK22 MOD 0                     | 12             |
| L306                    | SIGNAL, ILLUM GRND RED STAR CLUSTER M158            | 28             |
| L311                    | SIGNAL, ILLUM GRND RED STAR PARA M126               | 48             |
| L312                    | SIGNAL, ILLUM GRND WHT STAR PARA M127A1             | 1,389          |
| L314                    | SIGNAL, ILLUM GRND GRN STAR CLUSTER M125A1          | 5              |
| L495                    | FLARE, SURF TRIP PARA YLW M49 SERIES                | 32             |
| L497                    | FLARE, SURFACE, PRACTICE                            | 75             |
| L601                    | SIMULATOR, HAND GREN M116A1                         | 20             |
| L602                    | SIM FLASH ARTY M21 9/CT IN BG 162/B                 | 10             |
| M008                    | CTG, IMPULSE M270                                   | 549            |
| M009                    | CTG, IMPULSE                                        | 84             |
| M011                    | CTG, IMPULSE MK17 MOD 1                             | 108            |
| M012                    | CTG, IMPULSE MK19 MOD 0                             | 56             |
| M015                    | CTG, IMPULSE MK24 MOD 0                             | 12             |
| M020                    | CHG, DEMO SHAPED MK45                               | 14             |
| M022                    | CHG, DEMO SHAPED PETN                               | 29             |
| M023                    | CHG, DEMO BLOCK M112 1 1/4 LB COMP C-4              | 1,941          |
| M024                    | CHG, DEMO BLOCK M118 2 LB PETN                      | 98             |
| M028                    | DEMO KIT, BANGALORE TORP M1A2                       | 30             |
| M029                    | CHG, DEMO SHAPED FLEX LINEAR                        | 20             |
| M030                    | CHG, DEMO BLOCK TNT 1/4 LB                          | 2,267          |
| M031                    | CHG, DEMO BLOCK TNT 1/2 LB                          | 22             |
| M032                    | CHG, DEMO BLOCK TNT 1 LB                            | 274            |
| M034                    | CHG, DEMO BLOCK TNT 8 LB                            | 5              |
| M039                    | CHG, DEMO BLOCK 40 LB CRATERING                     | 48             |
| M073                    | CTG, IMPULSE CCU 11/B BDU-38B                       | 15,000         |
| M097                    | CAP, BLASTING, NON-ELECTRIC, INERT                  | 20             |
| M098                    | CAP, BLASTING, ELECTRIC, INERT                      | 20             |
| M115                    | CAP, BLASTING ELEC NO 6                             | 248            |
| M130                    | CAP, BLASTING ELEC M6 & M6 ELEC, IMPROVED PACKAGING | 1,384          |
| M131                    | CAP, BLASTING NON-ELEC M7                           | 211            |
| M153                    | CAP, BLASTING ELEC SPEC STRENGTH E108               | 12             |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b>                      | <b>Quantity Fired</b> |
|--------------------------------|-------------------------------------------------------|-----------------------|
| M193                           | CTG, ACFT FIRE EXTINGUISHER                           | 1,100                 |
| M223                           | CTG, IMPULSE M37                                      | 8                     |
| M420                           | CHG, DEMO SHAPED M2 SERIES 15 LB                      | 71                    |
| M443                           | DEMO KIT, PROJ CHG M173                               | 400                   |
| M456                           | CORD, DET, PETN, TYPE 1 CL E (NEW=1000 FT)            | 38,616                |
| M458                           | CORD, DET, 1000 FT SPOOL 1000 FT/B                    | 218                   |
| M591                           | DYNAMITE, MILITARY M1                                 | 18                    |
| M670                           | FUZE, BLASTING TIME M700                              | 100                   |
| M701                           | INITIATOR, CTG ACTUATED MK11 MOD 0                    | 100                   |
| M766                           | IGNITER, M2/M60 F/TIME BLASTING FUSE                  | 60                    |
| M783                           | CTG, IMPULSE                                          | 444                   |
| M816                           | INITIATOR, CTG ACTUATED                               | 6                     |
| M855                           | CAP, BLASTING ELEC                                    | 9,100                 |
| ML23                           | CAP, BLASTING ELEC EXPLODING BRIDGE WIRE              | 55                    |
| ML45                           | HOLDER, BLASTING CAP                                  | 15                    |
| ML47                           | CAP, BLASTING                                         | 1,241                 |
| MM30                           | Booster PETN 20 gram                                  | 298                   |
| MM31                           | CHG, DEMO, LINEAR SHAPED 6 FT                         | 20                    |
| MN02                           | CAP, BLASTING NON-ELEC 500FT SHK TUBE XM12/M12        | 268                   |
| MN03                           | CAP, BLASTING NON-ELEC 1000FT SHK TUBE XM12/M12       | 125                   |
| MN06                           | CAP, BLASTING NON-ELECT DELAY XM14/M14                | 1,103                 |
| MN08                           | IGNITER, TIME BLASTING FUSE XM147/M147                | 1,589                 |
| MN11                           | FIRING DEVICE, DEMO TIME DELAY XM147/M147             | 7                     |
| N335                           | FUZE, PD M557                                         | 32                    |
| NONE                           | Non-Military Munitions                                | 763,678               |
| PE64                           | GUIDED MISSILE, PRAC BTM-71A-3A EXT RANGE (TOW)       | 25                    |
| PL23                           | GUIDED MISSILE W/LNCHR SURF ATTACK M222 (DRAGON) (04) | 4                     |
| X104                           | Hatton Shotgun Round, 12 gauge                        | 1,073                 |
| X455                           | DETA Prime Booster                                    | 25                    |
| X554                           | Nonel 1000                                            | 4                     |
| X577                           | Shock Tube Igniter                                    | 13                    |
| X585                           | Nonel 100                                             | 30                    |
| TOTAL ROUNDS:                  |                                                       | 21,904,094            |

Table 5. Munitions used in 2002 at Fort Gordon, Georgia.

| DOD Identification Code | Description of Ammunition    | Quantity Fired |
|-------------------------|------------------------------|----------------|
| A011                    | 12GA SHOTGUN 00 BUCKSHOT     | 1,580          |
| A014                    |                              | 200            |
| A017                    |                              | 740            |
| A059                    | 5.56MM BALL F/M16A2          | 55,726         |
| A062                    | 5.56MM BALL LKD F/SAW        | 15,180         |
| A063                    | 5.56MM TR F/M16A2            | 200            |
| A064                    | 5.56MM BALL TR 4/1 F/SAW     | 12,955         |
| A071                    | 5.56MM BALL (M16) 10/CLIP    | 108,651        |
| A075                    | 5.56MM BLANK LKD F/SAW       | 16,863         |
| A080                    | 5.56MM BLK F M16A1/A2        | 152,482        |
| A111                    | 7.62MM BLNK LNKD (MILES)     | 4,945          |
| A131                    |                              | 7,600          |
| A136                    |                              | 1,227          |
| A143                    |                              | 1,918          |
| A363                    | 9MM BALL PISTOL              | 74,609         |
| AA33                    | 5.56MM BALL COMMER PACK, CTG | 94,053         |
| AA49                    | CARTRIDGE, 9MM BALL M882     | 5,550          |
| B519                    | 40MM PRAC M781               | 1,998          |
| G924                    |                              | 50             |
| G940                    | GREN SMK GRN (MILES)         | 125            |
| G945                    | GREN HAND SMK YEL            | 141            |
| G950                    | GREN HAND SMK RED            | 13             |
| G955                    | GREN HAND SMK VIOL           | 75             |
| G963                    | GREN HAND RIOT CS            | 11             |
| G982                    | HAND GRENADE SMOKE TNG M83   | 32             |
| K139                    | DDI, MINE APERS M68 PRAC     | 6              |
| K765                    | RIOT CNTRL AGENT CS CAPSULE  | 363            |
| K866                    |                              | 4              |
| L307                    | SIG ILLUM WS CLUSTER M159    | 4              |
| L311                    | SIG ILLUM RS PARA M126A1     | 15             |
| L312                    | SIG ILLUM WS PARA M127A1     | 22             |
| L594                    | LIM PROJ GRND BRST M115A2    | 16             |
| L601                    | SIM HAND GREN M116 SERIES    | 2              |
| TOTAL ROUNDS:           |                              | 557,356        |

Table 6. Target species on Fort Gordon.

| Scientific name                                                                                  | Common name                   | State status   | Federal status | Global rank | State rank |
|--------------------------------------------------------------------------------------------------|-------------------------------|----------------|----------------|-------------|------------|
| <b>BIRDS</b>                                                                                     |                               |                |                |             |            |
| <i>Aimophila aestivalis</i>                                                                      | Bachman's sparrow             | R              | SC             | G3          | S3         |
| <i>Falco sparverius paulus</i>                                                                   | Southeastern American kestrel | tracked        | SC             | G5T3T4      | S3         |
| <i>Haliaeetus leucocephalus</i> *                                                                | bald eagle                    | E              | T              | G4          | S2         |
| <i>Lanius ludovicianus migrans</i> **                                                            | loggerhead shrike (migrant)   | tracked        | SC             | G5T3Q       | S?         |
| <i>Mycteria americana</i> *                                                                      | wood stork                    | E              | E              | G4          | S2         |
| <i>Picoides borealis</i>                                                                         | red-cockaded woodpecker       | E              | E              | G3          | S2         |
| <b>FISHES</b>                                                                                    |                               |                |                |             |            |
| <i>Acantharchus pomotis</i>                                                                      | mud sunfish                   | tracked        | -              | G5          | S3         |
| <i>Elassoma okatie</i>                                                                           | bluebarred pygmy sunfish      | 1st find in GA | -              | G2G3        | -          |
| <i>Etheostoma fricksium</i>                                                                      | Savannah darter               | tracked        | -              | G3          | S2         |
| <i>Etheostoma serriferum</i>                                                                     | sawcheek darter               | tracked        | -              | G5          | S3         |
| <i>Pteronotropis hypselopterus</i>                                                               | sailfin shiner                | tracked        | -              | G5          | S3         |
| <b>HERPS</b>                                                                                     |                               |                |                |             |            |
| <i>Gopherus polyphemus</i>                                                                       | gopher tortoise               | T              | SC             | G3          | S3         |
| <i>Heterodon simus</i>                                                                           | Southern hognose snake        | tracked        | SC             | G4          | S3         |
| <i>Pituophis melanoleucus mugitus</i>                                                            | Florida pine snake            | tracked        | SC             | G5T3?       | S3         |
| <b>MAMMALS</b>                                                                                   |                               |                |                |             |            |
| <i>Corynorhinus rafinesquii</i>                                                                  | Rafinesque's big-eared bat    | R              | SC             | G3G4        | S3?        |
| <i>Myotis austroriparius</i>                                                                     | Southeastern bat              | tracked        | SC             | G3G4        | S3         |
| <b>PLANTS</b>                                                                                    |                               |                |                |             |            |
| <i>Agrimonia incisa</i>                                                                          | cut-leaf harvest lice         | tracked        | -              | G3          | S3         |
| <i>Carphephorus bellidifolius</i>                                                                | sandy-woods chaffhead         | tracked        | -              | G4          | S1?        |
| <i>Ceratiola ericoides</i>                                                                       | rosemary                      | T              | -              | G4          | S2         |
| <i>Chamaecyparis thyoides</i>                                                                    | Atlantic white-cedar          | R              | -              | G4          | S2         |
| <i>Chrysoma paucifluculosa</i>                                                                   | woody goldenrod               | tracked        | -              | G4G5        | S3         |
| <i>Cypripedium acaule</i>                                                                        | pink ladyslipper              | U              | -              | G5          | S4         |
| <i>Liatris secunda</i>                                                                           | sandhills gay-feather         | tracked        | -              | G4G5        | S1?        |
| <i>Macbridea caroliniana</i>                                                                     | Carolina bogmint              | tracked        | SC             | G2G3        | S1?        |
| <i>Nestronia umbellula</i>                                                                       | Indian-olive                  | T              | SC             | G4          | S2         |
| <i>Rhododendron flammeum</i>                                                                     | Oconee azalea                 | tracked        | -              | G3          | S3         |
| <i>Sarracenia rubra</i> var. <i>rubra</i>                                                        | sweet pitcherplant            | E              | -              | G3          | S2         |
| <i>Silene caroliniana</i>                                                                        | Carolina pink                 | tracked        | -              | G5          | S2?        |
| <i>Stewartia malacodendron</i>                                                                   | silky camelia                 | R              | -              | G4          | S2         |
| <i>Stylisma pickeringii</i> var. <i>pickeringii</i>                                              | Pickering's morning-glory     | T              | SC             | G4?T2T3     | S2         |
| <i>Warea cuneifolia</i>                                                                          | sandhill-cress                | tracked        | -              | G4          | S3         |
| Source: Directorate of Public Works, U.S. Army Signal Center & Fort Gordon, Fort Gordon, Georgia |                               |                |                |             |            |

Table 7. Munitions used in 2002 at Fort Stewart, Georgia.

| DOD Identification Code | Description of Ammunition                    | Quantity Fired |
|-------------------------|----------------------------------------------|----------------|
| A010                    | CTG, 10 GAGE BLANK F/37MM GUN                | 4729           |
| A011                    | CTG, 12 GAGE #00 BUCK                        | 8383           |
| A059                    | CTG, 5.56MM BALL M855 10/CLIP                | 2259948        |
| A060                    | CTG, 5.56MM DUMMY, M199 CTN PK               | 7000           |
| A062                    | CTG, 5.56MM BALL M855 LNKD                   | 125004         |
| A063                    | CTG, 5.56MM TR M856 SNGL RD                  | 76389          |
| A064                    | CTG, 5.56MM 4 BALL M855/1 TR M856 LNKD       | 605107         |
| A065                    | CTG, 5.56MM BALL PRAC M862 SNGL RD           | 35161          |
| A066                    | CTG, 5.56MM BALL M193 CTN PACK               | 910497         |
| A068                    | CTG, 5.56MM TR M196 CTN PACK                 | 40176          |
| A071                    | CTG, 5.56MM BALL M193 10/CLIP                | 1100           |
| A072                    | CTG, 5.56MM TR M196 10/CLIP                  | 54462          |
| A075                    | CTG, 5.56MM BLANK M200 LNKD                  | 479899         |
| A080                    | CTG, 5.56MM BLANK M200 SNGL RD               | 37272          |
| A090                    | CTG, CAL .22 TR PRAC M861                    | 400            |
| A107                    | CTG, CAL .22 LR HIGH VELOCITY                | 7689           |
| A111                    | CTG, 7.62MM, BLANK, M82, LNK                 | 20376          |
| A112                    | CTG, 7.62MM BLANK M82 CTN PACK               | 9300           |
| A127                    | CTG, 7.62MM 4 BALL M59/M80/1 TR M62 LNKD     | 114020         |
| A130                    | CTG, 7.62MM BALL M59/M80 5/CLIP              | 11223          |
| A131                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD         | 1032002        |
| A136                    | CTG, 7.62MM BALL M118 MATCH CTN PACK         | 4190           |
| A143                    | CTG, 7.62MM BALL M80 LNKD                    | 33362          |
| A146                    | CTG, 7.62MM TR M62 LNKD                      | 16063          |
| A165                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD F/M-GUN | 5905           |
| A254                    | SUBCAL GUSTAFF                               | 200            |
| A353                    | CTG 9MM TRACER SUBCAL FOR AT4                | 23             |
| A358                    | CTG, 9MM TP-T M939 F/AT-4 TRNR               | 12479          |
| A360                    | CTG, 9MM BALL M1 PARABELLUM                  | 136896         |
| A363                    | CTG, 9MM BALL M882                           | 240095         |
| A520                    | CTG, CAL .50 4 BALL M33/1 TR M17 LNKD        | 61755          |
| A533                    | CTG, CAL .50 API M8 AC LNKD                  | 3              |
| A540                    | CTG, CAL .50 4 API M8/1 TR M1/M17 LNKD       | 9808           |
| A546                    | CTG, CAL .50 BALL M2 LNKD                    | 1200           |
| A555                    | CTG, CAL .50 BALL M2/M33 LNKD                | 16907          |
| A557                    | CTG, CAL .50 4 BALL M33/M2/1 TR M17/M10 LNKD | 391965         |
| A585                    | CTG, CAL .50 API-T M20 LNKD                  | 200            |
| A593                    | CTG CAL.50 LKD 4 AP& 1TRACER                 | 1309           |
| A598                    | CTG, CAL .50 BLANK M1E1 LNKD                 | 960            |
| A606                    | CTG, CAL .50 API MK211 SNGL RD               | 500            |
| A608                    | CTG, CAL .50 4 API MK211/1 TR M17 LNKD       | 4000           |

| <b>DOD Identification Code</b> | <b>Description of Ammunition</b>                  | <b>Quantity Fired</b> |
|--------------------------------|---------------------------------------------------|-----------------------|
| A662                           | CTG, 20MM HEI M56 SERIES LNKD (04)                | 700                   |
| A857                           | CTG, 20MM 7 TP M55A2/1 TP-T M220 LNKD             | 300                   |
| A896                           | CTG, 20MM 4 TP M55A2/1 TP-T M220 LNKD             | 1018                  |
| A940                           | CTG, 25MM TPDS-T M910 (08)                        | 43894                 |
| A974                           | CTG, 25MM APDS-T M791 LNKD                        | 950                   |
| A975                           | CTG, 25MM HEI-T M792 LNKD (04)                    | 2194                  |
| A976                           | CTG, 25MM TP-T M793 LNKD                          | 38164                 |
| AA11                           | 7.62MM NATO M118                                  | 200                   |
| AX11                           | 9MM SUBCAL FOR SMAW                               | 3800                  |
| B103                           | CTG, 30MM 5 API PGU-14A/B/1 HEI PGU-13/B LNKD(04) | 381                   |
| B120                           | CTG, 30MM TP M788 LNKD RHF                        | 14261                 |
| B134                           | DUMMY CTG, 30MM                                   | 867                   |
| B470                           | CTG, 40MM HE M384 SERIES LNKD (12)                | 2657                  |
| B480                           | CTG, 40MM TP M385 SERIES LNKD F/HELI LAUNCHER     | 171                   |
| B509                           | CTG, 40MM YLW SMK M716                            | 13                    |
| B519                           | CTG, 40MM TP M781                                 | 46381                 |
| B542                           | CTG, 40MM HEDP M430 LNKD (04)                     | 8425                  |
| B546                           | CTG, 40MM HEDP M433 (PA120 MTL CNTR)              | 2633                  |
| B576                           | CTG, 40MM TP M385 LNKD                            | 12                    |
| B584                           | CTG, 40MM TP M918 LNKD                            | 49947                 |
| B592                           | CTG, 40MM TP M918 SNGL RD                         | 50                    |
| B642                           | CTG, 60MM HE XM720 (08)                           | 1188                  |
| C045                           | REPAIR KIT AMMO 81MM 7/B                          | 34                    |
| C226                           | CTG, 81MM ILLUM M301 SERIES (08)                  | 439                   |
| C228                           | CTG 81MM TP                                       | 584                   |
| C256                           | CTG, 81MM HE M374 SERIES W/PD FUZE (08)           | 1250                  |
| C263                           | CTG DUMMY 90MM M12                                | 232                   |
| C276                           | CTG, 81MM SMK WP M375 W/PD FUZE (12)              | 814                   |
| C379                           | CTG120MM W/MULTIPLEOPTION FUZE                    | 197                   |
| C382                           | CTG, 84MM HE, FFV 441B FOR RAAWS                  | 24                    |
| C384                           | CTG, 84MM, ILLUM, FFV545B FOR RAAWS (08)          | 31                    |
| C385                           | CTG, 84MM, SMOKE, FFV469B FOR RAAWS (12)          | 8                     |
| C386                           | CTG, 84MM, TP, FFV552 FOA RAAWS (08)              | 3                     |
| C387                           | 84MM HEDP                                         | 2                     |
| C445                           | CTG, 105MM HE M1 W/O FUZE (12)                    | 803                   |
| C449                           | CTG, 105MM ILLUM M314 SERIES (08)                 | 87                    |
| C520                           | CTG, 105MM TPDS-T M724A1 (04)                     | 20                    |
| C623                           | CTG, 120MM HE XM933                               | 858                   |
| C708                           | CTG, 4.2 IN SMK WP M2/M328 SERIES W/PD FUZE (12)  | 20                    |
| C784                           | CTG, 120MM TP-T                                   | 5753                  |
| C785                           | CTG, 120MM TPCSDS-T M865 (METAL CNTR) (08)        | 5154                  |
| C788                           | CTG, 120MM HE M57 W/FUZE PD M935 (08)             | 1207                  |

| <b>DOD Identification Code</b> | <b>Description of Ammunition</b>                    | <b>Quantity Fired</b> |
|--------------------------------|-----------------------------------------------------|-----------------------|
| C789                           | CTG, 120MM SMOKE, WP, M68 (04)                      | 303                   |
| C790                           | CTG, 120MM ILLUM, M91 (02)                          | 12                    |
| C876                           | CTG, 81MM, M880                                     | 775                   |
| C995                           | CTG & LAUNCHER, 84MM M136 AT-4 (12)                 | 1387                  |
| D445                           | CANISTER, SMK HC M1 F/155MM M116 SERIES             | 70                    |
| D502                           | PROJ, 155MM HE ADAM M731 (12)                       | 1                     |
| D505                           | PROJ, 155MM ILLUM M485 SERIES                       | 658                   |
| D513                           | PROJ, 155MM PRAC M804                               | 161                   |
| D528                           | PROJ, 155MM SMK WP M825 (02)                        | 166                   |
| D544                           | PROJ, 155MM HE M107 (18)                            | 5890                  |
| D550                           | PROJ, 155MM SMK WP M105/M110 SERIES (12)            | 88                    |
| D563                           | PROJ, 155MM HE APER M483 SERIES (18)                | 733                   |
| D579                           | PROJ, 155MM HE RAP M549 SERIES (COMP B) (18)        | 8                     |
| E485                           | BOMB, GP 500 LB MK82 MOD 1 TRITONAL                 | 25                    |
| F244                           | BOMB GP 500LB MK82 INERT                            | 24                    |
| G811                           | BODY, PRACTICE HAND GRENADE f/M69                   | 500                   |
| G826                           | GRENADE, LAUNCHER SMK IR SCREENING M76 (02)         | 8                     |
| G878                           | FUZE, HAND GREN PRAC M228                           | 7694                  |
| G881                           | GRENADE, HAND FRAG M67 (04)                         | 5790                  |
| G911                           | GRENADE, HAND OFF MK3A2                             | 10                    |
| G945                           | GRENADE, HAND SMK YLW M18                           | 12                    |
| G963                           | GRENADE, HAND RIOT CS M7 SERIES                     | 1                     |
| G982                           | GRENADE, HAND, PRACTICE                             | 32                    |
| GLD                            | GROUND LASER DESIGNATOR                             | 252                   |
| H180                           | ROCKET, 2.75" FLARE W/M275 WHD AND MK 40 MTR        | 597                   |
| H185                           | ROCKET, POD, REDUCED RANGE PRAC. M28A1 MLRS         | 140                   |
| H463                           | ROCKET, 2.75 IN MPSM PRAC W/WHD M267 (HYDRA) (04)   | 563                   |
| H464                           | ROCKET, 2.75 IN MPSM W/WHD M261 (HYDRA-70) (09)     | 120                   |
| H519                           | ROCKET, 2.75 IN SMK WP W/WHD M156 (04)              | 20                    |
| H557                           | ROCKET, 66MM HEAT M72A2                             | 6                     |
| H974                           | ROCKET, 2.75" WHD M267, FZ M439, MTR MK66 MOD3 (04) | 380                   |
| H975                           | ROCKET, 2.75" PRAC M274 MK66 MOD 3                  | 2543                  |
| HA16                           | 84MM HEAT                                           | 20                    |
| J106                           | ROCKET MOTOR, 2.75 IN MK125 SERIES                  | 8                     |
| J143                           | ROCKET MOTOR, 5 IN MK22 MOD 4 (FOR MICLIC)          | 12                    |
| K042                           | MINE, CANISTER PRAC XM88 (VOLCANO)                  | 6                     |
| K143                           | MINE, APERS M18A1 W/M57 FIRING DEVICE               | 188                   |
| K180                           | MINE, AT HEAVY M15                                  | 3                     |
| K181                           | MINE, AT HEAVY M21                                  | 197                   |
| K250                           | MINE, AT HEAVY M19 NON-METALLIC                     | 3                     |

| <b>DOD Identification Code</b> | <b>Description of Ammunition</b>                            | <b>Quantity Fired</b> |
|--------------------------------|-------------------------------------------------------------|-----------------------|
| K765                           | RIOT CONTROL AGENT, CS                                      | 781                   |
| K768                           | RIOT CONTROL AGENT, CS-1                                    | 429                   |
| L312                           | SIGNAL, ILLUM GRND WHT STAR PARA M127A1                     | 26                    |
| L602                           | SIM FLASH ARTY M21 9/CT IN BG 162/B                         | 1                     |
| M023                           | CHG, DEMO BLOCK M112 1 1/4 LB COMP C-4                      | 3100                  |
| M024                           | CHG, DEMO BLOCK M118 2 LB PETN                              | 100                   |
| M028                           | DEMO KIT, BANGALORE TORP M1A2                               | 50                    |
| M030                           | CHG, DEMO BLOCK TNT 1/4 LB                                  | 100                   |
| M039                           | CHG, DEMO BLOCK 40 LB CRATERING                             | 289                   |
| M131                           | CAP, BLASTING NON-ELEC M7                                   | 30                    |
| M420                           | CHG, DEMO SHAPED M2 SERIES 15 LB                            | 48                    |
| M421                           | CHG, DEMO SHAPED M3 SERIES 40 LB                            | 593                   |
| M456                           | CORD, DET, PETN, TYPE 1 CL E (NEW=1000 FT)                  | 158                   |
| M670                           | FUZE, BLASTING TIME M700                                    | 45                    |
| M766                           | IGNITER, M2/M60 F/TIME BLASTING FUSE                        | 40                    |
| M918                           | CTG 40MM TP UNLINKED F/CEV                                  | 12519                 |
| M996                           | CHG, DEMO RIGID LINEAR MK87 MOD 0                           | 6                     |
| MD15                           | CORD, DET FCDC                                              | 2887                  |
| ML03                           | FIRING DEVICE, DEMO MULTI-PURPOSE M142                      | 111                   |
| ML15                           | CHG, DEMO FLEX LINEAR SHAPED 225 GR/FT                      | 30                    |
| PA79                           | GUIDED MISSILE, SURF ATTCK AGM-114A REDUCD SMK (HELLFIRE)   | 145                   |
| PB94                           | GUIDED MISSILE, SURF ATTACK BGM-71A2 STD RANGE (TOW)        | 22                    |
| PB96                           | GUIDED MISSILE, PRAC BTM-71A2 STD RANGE (TOW)               | 15                    |
| PD68                           | GUIDED MISSILE, SURF ATTACK AGM-114C MIN SMK (HELLFIRE)     | 106                   |
| PL23                           | GUIDED MISSILE W/LNCHR SURF ATTACK M222 (DRAGON) (04)       | 8                     |
| PL34                           | GUIDED MISSILE SURFACE ATTACK AAWS-M (JAVELIN)              | 4                     |
| PL90                           | GUIDED MISSILE ROUND, INTER-AERIAL FIM 92A (STINGER-BASIC)  | 76                    |
| PL93                           | GUIDED MISSILE SUBSYS, INTER-AERIAL FIM 92A (STINGER-BASIC) | 4                     |
| PV04                           | GUIDED MISSILE, PRAC BTM-71A-2B (BASIC)                     | 57                    |
| X104                           | 12GAUGEHAT                                                  | 40                    |
| X281                           | 7.62MM 168 GR MATCH                                         | 14                    |
| X338                           | 5.56FLANGE                                                  | 3400                  |
| X471                           | MM51 ECT 600 GR                                             | 43                    |
| X472                           | MK144 ECT 1200 GR                                           | 24                    |
| X577                           | INITIATOR SHOCK TUBE                                        | 15                    |
| X589                           | N-EL DIR SHOOT 6.4 SEC                                      | 25                    |
| TOTAL ROUNDS:                  |                                                             | 7,068,430             |

Table 8. Munitions used in 2002 at Fort Campbell, Kentucky.

| DOD Identification Code | Description of Ammunition | Quantity Fired |
|-------------------------|---------------------------|----------------|
| 0171                    | 7.62BALL                  | 167,347        |
| A011                    | 12GA,00BCK                | 143            |
| A017                    | 12GA, #9                  | 3,809          |
| A059                    | 5.56M/M855                | 1,277,173      |
| A060                    | 5.56MBLK                  | 300            |
| A062                    | 5.56MLINKD                | 1,428,847      |
| A063                    | 5.56MTM856                | 169,019        |
| A064                    | 5.56M4/1                  | 368,043        |
| A065                    | 5.56 BALL                 | 2,377,501      |
| A066                    | 5.56MBAL                  | 781,939        |
| A068                    | 5.56MTM196                | 2,250          |
| A071                    | 5.56M/M193                | 9,112          |
| A072                    | 5.56M,TR                  | 5,399          |
| A075                    | 5.56MBLSAW                | 935,318        |
| A076                    | 5.56 DUMMY                | 3,500          |
| A080                    | 5.56MBM200                | 462,388        |
| A083                    | 7.62X54M                  | 2,550          |
| A107                    | 7.62M39BAL                | 310,570        |
| A111                    | 7.62MBLM82                | 310,325        |
| A112                    | 7.62MBM82                 | 126,086        |
| A127                    | 7.62M,4/1                 | 10,280         |
| A130                    | 7.62MBALL                 | 746,056        |
| A131                    | 7.62ML4/1                 | 668,621        |
| A135                    | 7.62MBLK                  | 1,400          |
| A136                    | 7.62MBM118                | 49,742         |
| A143                    | 7.62MLKDB                 | 157,523        |
| A151                    | 7.62MMLKD                 | 57,669         |
| A165                    | 7.62MM4/1                 | 295,825        |
| A171                    | 7.62 BALL                 | 280,222        |
| A353                    | AT4SUBCAL                 | 3,832          |
| A358                    | 9MM AT4                   | 19,497         |
| A360                    | 9MMB                      | 425,767        |
| A363                    | 9MMBM882                  | 456,219        |
| A520                    | .50 4&1B/T                | 275            |
| A525                    | CAL .50                   | 45,125         |
| A531                    | .50APIM8AC                | 2,456          |
| A540                    | .50 4&1A/T                | 35,333         |
| A546                    | .50 BALL                  | 38,249         |
| A552                    | .50BALL,CT                | 172,848        |
| A555                    | .50 BALL                  | 2,083          |
| A557                    | .50 4&1B/T                | 50,420         |

| <b>DOD<br/>Identification<br/>Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|----------------------------------------|----------------------------------|-----------------------|
| A576                                   | .50 API                          | 16,098                |
| A596                                   | .504&1A/T                        | 1,828                 |
| A602                                   | .50CLBL4/1                       | 73,715                |
| A965                                   | 25.4MDEC                         | 700                   |
| AA33                                   | 5.56COMPAC                       | 8,100                 |
| B103                                   | 30MMAPIHEI                       | 800                   |
| B118                                   | 30MTP788                         | 76,280                |
| B120                                   | 30MMTP                           | 44,240                |
| B129                                   | 30HEDPSTR                        | 4,920                 |
| B470                                   | 40MM                             | 1,990                 |
| B480                                   | 40MMTPHEL                        | 418                   |
| B508                                   | 40MMGRDGRE                       | 100                   |
| B519                                   | 40MMTPM781                       | 103,299               |
| B535                                   | 40MM ILLUM                       | 295                   |
| B542                                   | 40MMLKD430                       | 3,811                 |
| B546                                   | 40MMHEDP                         | 28,096                |
| B571                                   | 40MMHE RW                        | 865                   |
| B576                                   | 40MMTPLKD                        | 4,762                 |
| B584                                   | 40MMPRLKD                        | 8,549                 |
| B627                                   | 60MMULUM                         | 65                    |
| B629                                   | 60MMTP                           | 61                    |
| B630                                   | 60MSMKPW                         | 214                   |
| B642                                   | 60MMHE                           | 3,122                 |
| B643                                   | 60MHEM888                        | 1,453                 |
| B645                                   | 60MTPRAC                         | 962                   |
| B646                                   | 60MSMKPW                         | 2                     |
| B647                                   | 60MILLUM                         | 152                   |
| B653                                   | 60MPRASRM                        | 1,539                 |
| C045                                   | 81MM PRAC                        | 2,091                 |
| C226                                   | 81MMILLUM                        | 561                   |
| C228                                   | 81MMHE                           | 1,657                 |
| C256                                   | 81MMHE                           | 1,417                 |
| C276                                   | 81MMSMKWP                        | 154                   |
| C445                                   | 105MMHER                         | 11,947                |
| C449                                   | 105MMILHOW                       | 1,092                 |
| C452                                   | 105MSMK                          | 294                   |
| C463                                   | 105MHEM548                       | 1,469                 |
| C479                                   | 105MSMKHCE                       | 168                   |
| C511                                   | 105MM/M490                       | 12                    |
| C868                                   | 81MHEM821                        | 381                   |
| C876                                   | M203                             | 25                    |
| C995                                   | 84MMAT4                          | 18                    |

| <b>DOD<br/>Identification<br/>Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|----------------------------------------|----------------------------------|-----------------------|
| D505                                   | 155MM ILL                        | 336                   |
| D528                                   | 155MM SMK                        | 21                    |
| D544                                   | 155MM HE                         | 878                   |
| D563                                   | 155MM HE                         | 371                   |
| D579                                   | 155MM HE                         | 45                    |
| D680                                   | 81INHE106                        | 55                    |
| G881                                   | FRAGM67                          | 4,144                 |
| G930                                   | SMK HC                           | 18                    |
| G940                                   | SMK GREEN                        | 7                     |
| G945                                   | GRNSMY                           | 16                    |
| G950                                   | SMK RED                          | 2                     |
| G963                                   | HD RIOT CS                       | 6                     |
| G982                                   | GRNHNDPRAC                       | 1                     |
| GG09                                   | GRNSMKM90                        | 2                     |
| H180                                   | 2.75M257                         | 6,743                 |
| H181                                   | 2.75FLARE                        | 501                   |
| H459                                   | 2.75FLECH                        | 334                   |
| H463                                   | 2.75MPSPMPR                      | 2,145                 |
| H464                                   | 2.75MPSPM                        | 170                   |
| H490                                   | 2.75HEW/WH                       | 4,943                 |
| H519                                   | 2.75WPRT                         | 549                   |
| H557                                   | 66MMAT                           | 95                    |
| H708                                   | 35MMSPL                          | 1,005                 |
| H972                                   | 2.75HY70                         | 1,834                 |
| H974                                   | 2.75HY70                         | 4,005                 |
| H975                                   | 2.75HY70A                        | 361                   |
| HA08                                   | RKTASSLT83                       | 8                     |
| HA13                                   | 2.75PRAC27                       | 2,234                 |
| HA17                                   | 2.75PRSM26                       | 113                   |
| J106                                   | 2.75FBAT                         | 276                   |
| K030                                   | IGNMNM39                         | 67                    |
| K042                                   | MA8MINE                          | 0                     |
| K143                                   | CLAYMORE                         | 644                   |
| K180                                   | M15AT                            | 15                    |
| K181                                   | M21MINE                          | 21                    |
| K250                                   | M19MINE                          | 203                   |
| K765                                   | CSGAS                            | 880                   |
| K768                                   | CS-1GAS                          | 223                   |
| L307                                   | SIG WHITE                        | 22                    |
| L314                                   | STARGRN                          | 35                    |
| L598                                   | FLASHBOOB                        | 44                    |
| L601                                   | SIMGRE                           | 1,500                 |

| <b>DOD<br/>Identification<br/>Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|----------------------------------------|----------------------------------|-----------------------|
| L602                                   | ARTYSIM                          | 55                    |
| M023                                   | C4 1-1/4                         | 7,807                 |
| M024                                   | DEMOBLK                          | 144                   |
| M028                                   | BANGTORP                         | 359                   |
| M031                                   | TNT 1/2                          | 892                   |
| M032                                   | TNT 1LB                          | 195                   |
| M034                                   | DEMO CH                          | 3,202                 |
| M039                                   | 40LB CRA                         | 628                   |
| M130                                   | BLCAPM6                          | 100                   |
| M18A                                   |                                  | 84                    |
| M241                                   | DESTM10                          | 820                   |
| M420                                   | SHAPCR15LB                       | 317                   |
| M421                                   | SHAPCR40LB                       | 31                    |
| M448                                   | DETPERC                          | 52                    |
| M450                                   | DETM1A2                          | 1,475                 |
| M591                                   | DYNAMITEM1                       | 200                   |
| M642                                   | 60MMMORTHE                       | 290                   |
| M670                                   | TIMEFUSE                         | 48                    |
| M766                                   | PULLFUSE                         | 3,049                 |
| M914                                   | M68A2                            | 18                    |
| M918                                   | 40MMTP                           | 13,738                |
| M998                                   | DEMO CH                          | 40                    |
| MD15                                   | DETCORD-15                       | 3,960                 |
| MD16                                   | DETCORD-16                       | 2,000                 |
| ML15                                   | SHPD 225                         | 180                   |
| ML47                                   | CAPBLSTM11                       | 44                    |
| MN02                                   | CAPBLSTM12                       | 5                     |
| MN06                                   | CAPBLSTM14                       | 236                   |
| MN08                                   | CPBLSTM81                        | 52                    |
| MS52                                   | CORDDET                          | 32,400                |
| MS53                                   | DETCORD-53                       | 4,000                 |
| MS54                                   | DETCORD-54                       | 2,300                 |
| N285                                   | FUSE577                          | 47                    |
| PD68                                   | HELFIRE114                       | 24                    |
| PV04                                   | TOWINERT                         | 119                   |
| QA06                                   | 5.56MBAL                         | 29,180                |
| R112                                   | 7.62MMBLK                        | 1,317                 |
| R113                                   | 5.56MM BLK                       | 2,200                 |
| UN55                                   | 5.54                             | 6,572                 |
| Z133                                   | UKN                              | 1,966                 |
| Z200                                   | UKN                              | 1,225                 |
| Z219                                   | UKN                              | 60,000                |

| <b>DOD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| Z221                           | UKN                              | 496                   |
| TOTAL ROUNDS:                  |                                  | 12,885,522            |

Table 9. Munitions used in 2002 at Fort Knox, Kentucky.

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| A011                           | 12GA,00BCK                       | 3,146                 |
| A014                           | 12GA, #7                         | 251                   |
| A014                           | 12GA, 7.5                        | 480                   |
| A017                           | 12GA, #9                         | 1,140                 |
| A017                           | 12GA,9                           | 968                   |
| A059                           | 5.56M/M855                       | 1,162,431             |
| A059                           | 5.56M/M885                       | 1,850                 |
| A060                           | 5.56MBLK                         | 800                   |
| A062                           | 5.56MLINKD                       | 22,210                |
| A063                           | 5.56MTM856                       | 89,471                |
| A064                           | 5.56M4/1                         | 585,722               |
| A066                           | 5.56MBAL                         | 308,449               |
| A068                           | 5.56MTM196                       | 19,849                |
| A071                           | 5.56M/M193                       | 504,728               |
| A072                           | 5.56M,TR                         | 12,129                |
| A075                           | 5.56MBLSAW                       | 169,997               |
| A080                           | 5.56MBM200                       | 268,471               |
| A090                           | .22 CAL                          | 3,970                 |
| A107                           | 7.62M39BAL                       | 2,500                 |
| A111                           | 7.62MBLM82                       | 126,156               |
| A112                           | 7.62MBM82                        | 3,698                 |
| A127                           | 7.62M,4/1                        | 18,933                |
| A130                           | 7.62MBPACK                       | 1,600                 |
| A131                           | 7.62ML4/1                        | 1,081,609             |
| A136                           | 7.62MBM118                       | 520                   |
| A143                           | 7.62MLKDB                        | 115,813               |
| A146                           | 7.62MLTM62                       | 4,200                 |
| A151                           | 7.62MMLKD                        | 188,820               |
| A165                           | 7.62MM4/1                        | 58,200                |
| A171                           | 7.62 BALL                        | 3,975                 |
| A254                           | 762 SUBCAL                       | 120                   |
| A257                           | 7.62 LINK                        | 115,000               |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| A353                           | AT4SUBCAL                        | 110                   |
| A358                           | 9MM AT4                          | 9,444                 |
| A358                           | AT4 9MM                          | 11,797                |
| A360                           | 9MMB                             | 72,636                |
| A363                           | 9MMBM882                         | 209,858               |
| A400                           | .38CALSPB                        | 275                   |
| A404                           | .38CALSWAD                       | 400                   |
| A475                           | .45CALBALL                       | 20,275                |
| A520                           | .50LKD4/IT                       | 40,396                |
| A540                           | .50 4&1A/T                       | 28,624                |
| A546                           | .50 BALL                         | 2,100                 |
| A555                           | .50 BALL                         | 5,959                 |
| A555                           | .50BALL                          | 2,800                 |
| A557                           | .50 4&1B/T                       | 87,981                |
| A557                           | .50LKD4/IT                       | 39,179                |
| A576                           | .50 API                          | 8,798                 |
| A585                           | .50 API-T                        | 97                    |
| A587                           | .50 API-T                        | 51,948                |
| A598                           | .50 BLK                          | 7,100                 |
| A599                           | .50 BLK                          | 6                     |
| A662                           | 20MM HEI                         | 1,000                 |
| A940                           | 25MMTPDS                         | 14,400                |
| A976                           | 25MM TPT                         | 28,133                |
| AA06                           | 5.56MM                           | 4,000                 |
| AA06                           | 50 CAL API                       | 3,475                 |
| AA12                           | 9MMSIMM                          | 1,160                 |
| AA33                           | 5.56M/M855                       | 2,128,652             |
| AA45                           | 5.56MM                           | 291,166               |
| AA48                           | 5.56MM                           | 11,147                |
| AA58                           | 50 SLAP                          | 57                    |
| B519                           | 40MMTPM781                       | 29,712                |
| B535                           | 40MM ILLUM                       | 2,539                 |
| B542                           | 40MMLKD430                       | 3,864                 |
| B546                           | 40MMHEDP                         | 1,782                 |
| B568                           | 40MMHEDO                         | 490                   |
| B574                           | 40MM HE                          | 916                   |
| B576                           | 40MMTPLKD                        | 6,704                 |
| B584                           | 40MMPRLKD                        | 36,509                |
| B629                           | 60MMTP                           | 52                    |
| B630                           | 60MMWP                           | 62                    |
| B643                           | 60MM HE                          | 296                   |
| BA02                           | 40MM HEI                         | 96                    |
| C256                           | 81MMHE                           | 276                   |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| C382                           | 84 MM HE                         | 5                     |
| C382                           | 84MMHE                           | 24                    |
| C383                           | 84MM HEAT                        | 54                    |
| C384                           | 84MM ILLUM                       | 29                    |
| C385                           | 84MM SMK                         | 34                    |
| C386                           | 84MM TPT                         | 157                   |
| C387                           | 84MM HEDP                        | 32                    |
| C432                           | 105MM HE                         | 393                   |
| C449                           | 105MMILHOW                       | 91                    |
| C511                           | 105MM/M490                       | 34                    |
| C520                           | 105MMTPDST                       | 55                    |
| C623                           | 120 W/PD                         | 122                   |
| C623                           | 120MM745                         | 63                    |
| C624                           | 120MM SMK                        | 48                    |
| C784                           | 120 TP-T                         | 1,382                 |
| C784                           | 120MMTP-T                        | 2,345                 |
| C785                           | 120 TPCSDS                       | 2,427                 |
| C785                           | 120MMTPCSD                       | 4,814                 |
| C789                           | 120 SMK/WP                       | 7                     |
| C868                           | 81MM HE                          | 531                   |
| C871                           | 81MM ILLUM                       | 69                    |
| C876                           | M203                             | 47                    |
| C995                           | 84MMAT4                          | 92                    |
| D505                           | 155MM ILL                        | 195                   |
| D513                           | 155MM TNG                        | 1                     |
| D544                           | 155MM HE                         | 6                     |
| DWBS                           | FLASH BANG                       | 230                   |
| G811                           | GRNM69                           | 11                    |
| G878                           | GRNPRM228                        | 44,457                |
| G881                           | FRAGM67                          | 6,479                 |
| G922                           | GRNRCCS                          | 1                     |
| G940                           | SMK GREEN                        | 240                   |
| G945                           | GRNSMY                           | 186                   |
| G945                           | SMK YELLOW                       | 17                    |
| G950                           | SMK RED                          | 27                    |
| G955                           | SMKVIOL                          | 114                   |
| G963                           | HD RIOT CS                       | 28                    |
| G982                           | SMOKE                            | 167                   |
| H163                           | HYDRA 70HE                       | 376                   |
| H164                           | HYDRA 70                         | 56                    |
| H557                           | 66MMAT                           | 557                   |
| H974                           | 2.75HY70                         | 92                    |
| H975                           | 2.75HY70A                        | 182                   |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| HA16                           | 84MM HE                          | 539                   |
| K143                           | CLAYMORE                         | 226                   |
| L305                           | SIGGREENST                       | 1                     |
| L306                           | SIGILLUM                         | 17                    |
| L307                           | SIG WHITE                        | 5                     |
| L311                           | PARAGR N                         | 4                     |
| L312                           | PARAWHITES                       | 1,606                 |
| L367                           | SIMLCHING                        | 4                     |
| L495                           | TRIPSUR                          | 240                   |
| L498                           | TUBEPRIM                         | 198                   |
| L594                           | MK19                             | 372                   |
| L594                           | SIM ARTY                         | 25                    |
| L598                           | FLASHBOOB                        | 29                    |
| L599                           | FLASHILLUM                       | 13                    |
| L601                           | SIMGRE                           | 819                   |
| L602                           | HOFFMAN                          | 899                   |
| LASR                           | FLASHSIM                         | 2,018                 |
| M023                           | C4 1-1/4                         | 579                   |
| M024                           | DEMOBLK                          | 8                     |
| M030                           | M1A4-1/4                         | 769                   |
| M030C                          | TNT 1/4 LB                       | 226                   |
| M031                           | TNT 1/2                          | 293                   |
| M032                           | TNT 1LB                          | 86                    |
| M039                           | 40LB CRA                         | 3                     |
| M130                           | BLCAPM6                          | 840                   |
| M131                           | BLCAPM7                          | 8,419                 |
| M420                           | SHAPCR15LB                       | 3                     |
| M456                           | REINDET                          | 5,706                 |
| M670                           | TIMEFUSE                         | 664                   |
| M766                           | PULLFUSE                         | 37                    |
| M918                           | 40MMTP                           | 160                   |
| M970                           | SUBCAL                           | 230                   |
| ML45                           | BLCAP                            | 66                    |
| ML47                           | M11 BL CAP                       | 1,096                 |
| MN02                           | M12 BL CAP                       | 189                   |
| MN06                           | MK19                             | 553                   |
| MN08                           | MK19                             | 580                   |
| MN11                           | TIMEFZE                          | 4                     |
| MNO6                           | M14 BL CAP                       | 869                   |
| MNO8                           | IGN FUSE                         | 958                   |
| MS52                           | CORDDDET                         | 5                     |
| PB18                           | TOWPRA                           | 16                    |
| PB94                           | TOW HEAT                         | 3                     |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| PV04                           | TOWINERT                         | 41                    |
| R112                           | 7.62MMBLK                        | 11,000                |
| R113                           | 5.56MM BLK                       | 9,000                 |
| R116                           | ARTYSIM                          | 1                     |
| X104                           | 12HATTON                         | 67                    |
| X281                           | 7.62 MATCH                       | 1,500                 |
| X551                           | DET                              | 18                    |
| X577                           | SHKTUBE                          | 18                    |
| X640                           | DEMOSHEET                        | 6                     |
| TOTAL ROUNDS:                  |                                  | 8,160,782             |

Table 10. Munitions used in 2002 at fort Polk, Louisiana.

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| A011                           | CTG, 12 GAGE M162 #0             | 5,476                 |
| A014                           | CTG, 12 GAGE #7 1/2              | 35,850                |
| A015                           | CTG, 12 GAGE #8 SHOT             | 850                   |
| A017                           | CTG, 12 GAGE #9 SHOT             | 18,350                |
| A020                           | CTG, 12 GAGE #4 SHOT             | 325                   |
| A046                           | CTG, 20 GAGE SKEET #             | 24,952                |
| A058                           | CTG, 5.56MM BALL M85             | 16,435                |
| A059                           | CTG, 5.56MM BALL M85             | 742,138               |
| A062                           | CTG, 5.56MM BALL M85             | 118,400               |
| A063                           | CTG, 5.56MM TR M856              | 64,277                |
| A064                           | CTG, 5.56MM 4 BALL M             | 396,511               |
| A065                           | CTG, 5.56MM SRTA BAL             | 56,868                |
| A066                           | CTG, 5.56MM BALL M19             | 40,035                |
| A068                           | CTG, 5.56MM TR M196              | 12,202                |
| A070                           | CTG, 5.56MM HPT M197             | 3,028                 |
| A071                           | CTG, 5.56MM BALL M19             | 44,091                |
| A072                           | CTG, 5.56MM TR M196              | 1,200                 |
| A073                           | CTG, 5.56MM 4 BALL M             | 3,927                 |
| A075                           | CTG, 5.56MM BLANK M2             | 146,534               |
| A080                           | CTG, 5.56MM BLANK M2             | 147,505               |
| A084                           | CTG, CAL .22 BALL SH             | 460                   |
| A086                           | CTG, CAL .22 BALL LR             | 47,331                |
| A091                           | CTG, CAL .22 BALL LR             | 4,035                 |
| A093                           | CTG, CAL .22 BALL LR             | 1,850                 |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| A102                           | CTG, 7.62MM BALL F/A             | 420                   |
| A111                           | CTG, 7.62MM, BLANK,              | 126,487               |
| A119                           | CTG, 7.62MM BALL M80             | 15,350                |
| A127                           | CTG, 7.62MM 4 BALL M             | 22,800                |
| A131                           | CTG, 7.62MM 4 BALL M             | 547,325               |
| A136                           | CTG, 7.62MM BALL M11             | 8,067                 |
| A143                           | CTG, 7.62MM BALL M80             | 113,137               |
| A165                           | CTG, 7.62MM 4 BALL M             | 24,000                |
| A171                           | CTG, 7.62MM MATCH M8             | 2,107                 |
| A181                           | CTG, CAL .30 BALL M1             | 70                    |
| A246                           | CTG, CAL .30 BALL M7             | 528                   |
| A257                           | CTGS,7.62MM,9BALL M8             | 57,750                |
| A358                           | CTG, 9MM TP-T M939 F             | 10,804                |
| A362                           | CTG, 9MM BALL MK144              | 450                   |
| A363                           | CTG, 9MM BALL M882               | 148,131               |
| A397                           | CTG, CAL .38 SPEC PG             | 1,280                 |
| A400                           | CTG, CAL .38 SPEC BA             | 50                    |
| A409                           | CTG, CAL .38 SPEC BA             | 960                   |
| A413                           | CTG, CAL .38 SPEC BA             | 1,800                 |
| A471                           | CTG, CAL .45 BALL MA             | 7,170                 |
| A475                           | CTG, CAL .45 BALL M1             | 36,857                |
| A483                           | CTG, CAL .45 BALL M1             | 2,210                 |
| A520                           | CTG, CAL .50 4 BALL              | 14,148                |
| A530                           | CTG, CAL .50 4 AP M2             | 500                   |
| A540                           | CTG, CAL .50 4 API M             | 28,903                |
| A551                           | CTG, CAL .50 API/API             | 290                   |
| A552                           | CTG, CAL .50 BALL M2             | 3,813                 |
| A555                           | CTG, CAL .50 BALL M2             | 22,693                |
| A557                           | CTG, CAL .50 4 BALL              | 255,866               |
| A576                           | CTG, CAL .50 4 API M             | 4,023                 |
| A580                           | CTG, CAL .50 TR M1/M             | 4,906                 |
| A584                           | CTG, CAL .50 BALL M3             | 256                   |
| A598                           | CTG, CAL .50 BLANK M             | 4,147                 |
| A602                           | CTG, CAL .50 SRTA 4              | 3,479                 |
| A926                           | CTG, 20MM TP M55A2 L             | 1,497                 |
| A940                           | CTG, 25MM TPDS-T M91             | 12,857                |
| A967                           | DUMMY CTG, 25MM, M28             | 73                    |
| A976                           | CTG, 25MM TP-T M793              | 5,789                 |
| AA11                           | CARTRIDGE,7.62MM NAT             | 758                   |
| AA33                           | CTG, 5.56MM, BALL, 1             | 516,436               |
| AA49                           | CARTRIDGE, 9MM, BALL             | 44,875                |
| B022                           | CTG, 30MM TP XM954 L             | 840                   |
| B103                           | CTG, 30MM 5 API PGU-             | 300                   |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| B104                           | CTG, 30MM HEI PGU-13             | 5,400                 |
| B116                           | CTG, 30MM TP PGU-15/             | 16,785                |
| B118                           | CTG, 30MM TP M788 SN             | 2,240                 |
| B119                           | CTG, 30MM TP M788 LN             | 540                   |
| B477                           | CTG, 40MM WHT SMK CA             | 20                    |
| B504                           | CTG, 40MM GRN STAR P             | 378                   |
| B508                           | CTG, 40MM GRN SMK M7             | 227                   |
| B509                           | CTG, 40MM YLW SMK M7             | 241                   |
| B519                           | CTG, 40MM TP M781                | 28,798                |
| B529                           | CTG, 40MM HE M383/HE             | 30                    |
| B535                           | CTG, 40MM ILLUM WHT              | 75                    |
| B542                           | CTG, 40MM HEDP M430              | 2,219                 |
| B546                           | CTG, 40MM HEDP M433              | 1,594                 |
| B554                           | CTG, 40MM HE-SD                  | 653                   |
| B564                           | CTG, 40MM BL-T 4/CLI             | 12                    |
| B568                           | CTG, 40MM HE M406                | 63                    |
| B574                           | CTG, 40MM HE M386                | 173                   |
| B577                           | CTG, 40MM TP M407A1              | 88                    |
| B578                           | CTG, 40MM TP M387                | 1,129                 |
| B584                           | CTG, 40MM TP M918 LN             | 50,112                |
| B627                           | CTG, 60MM ILLUM M83A             | 77                    |
| B630                           | CTG, 60MM SMK WP M30             | 40                    |
| B642                           | CTG, 60MM HE XM720               | 1,583                 |
| B643                           | CTG, 60MM HE M888                | 150                   |
| B646                           | CTG, 60MM SMK WP M72             | 40                    |
| B647                           | CTG, 60MM ILLUM M721             | 20                    |
| C009                           | CTG, IGN M285 F/81MM             | 30                    |
| C222                           | CTG, 81MM HE M362 SE             | 246                   |
| C234                           | CTG, 81MM SMOKE, WP,             | 80                    |
| C236                           | CTG, 81MM HE M374 SE             | 49                    |
| C256                           | CTG, 81MM HE M374 SE             | 1,481                 |
| C276                           | CTG, 81MM SMK WP M37             | 464                   |
| C382                           | CTG, 84MM HE, FFV 44             | 6                     |
| C384                           | CTG, 84MM, ILLUM, FF             | 6                     |
| C385                           | CTG, 84MM, SMOKE, FF             | 4                     |
| C434                           | CHG, PROP 105MM M1               | 149                   |
| C445                           | CTG, 105MM HE M1 W/O             | 2,981                 |
| C449                           | CTG, 105MM ILLUM M31             | 146                   |
| C479                           | CTG, 105MM SMK HC M8             | 415                   |
| C623                           | CTG, 120MM HE XM933              | 809                   |
| C624                           | CTG, 120MM SMK                   | 595                   |
| C6XX                           | CTG, 120MM FRTR                  | 111                   |
| C784                           | CTG, 120MM TP-T                  | 499                   |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| C785                           | CTG, 120MM TPCSDS-T              | 953                   |
| C787                           | CTG, 120MM HEAT-MP-T             | 26                    |
| C788                           | CTG, 120MM HE M57 W/             | 36                    |
| C868                           | CTG 81MM HE M821 FZ              | 1,275                 |
| C870                           | CTG, 81MM SMK                    | 120                   |
| C871                           | CTG, 81MM ILLUM M853             | 333                   |
| C995                           | CTG & LAUNCHER, 84MM             | 342                   |
| CA09                           | CARTRIDGE, 120MM FUL             | 50                    |
| D503                           | PROJ, 155MM HE RAAM-             | 68                    |
| D505                           | PROJ, 155MM ILLUM M4             | 102                   |
| D510                           | PROJ, 155MM HEAT M71             | 2                     |
| D528                           | PROJ, 155MM SMK WP M             | 110                   |
| D534                           | CHG, PROP 155MM WB M             | 3                     |
| D541                           | CHG, PROP 155MM WB M             | 76                    |
| D543                           | PROJ, 155MM H OR HD              | 17                    |
| D544                           | PROJ, 155MM HE M107              | 3,385                 |
| D545                           | PROJ, 155MM ILLUM M1             | 38                    |
| D548                           | PROJ, 155MM SMK HC M             | 5                     |
| D550                           | PROJ, 155MM SMK WP M             | 156                   |
| D554                           | PROJ, 155MM SMK VIO              | 6                     |
| E485                           | BOMB, GP 500 LB MK82             | 237                   |
| E969                           | BOMB, PRAC 25 LB BDU             | 535                   |
| F013                           | Bomb Practice BDU-50             | 48                    |
| F126                           | BOMB, GP 2000 LB MK8             | 2                     |
| F128                           | BOMB, GP 2000 LB MK8             | 2                     |
| F238                           | BOMB, GP 500 LB MK82             | 6                     |
| F275                           | BOMB, GP 2000 LB MK8             | 8                     |
| F281                           | BOMB, GP MK84                    | 16                    |
| G878                           | FUZE, HAND GREN PRAC             | 2,842                 |
| G881                           | GRENADE, HAND FRAG M             | 910                   |
| G883                           | GRENADE, HAND FRAG M             | 53                    |
| G929                           | GRENADE, HAND RIOT S             | 44                    |
| G932                           | GRENADE, HAND SMK RE             | 48                    |
| G940                           | GRENADE, HAND SMK GR             | 446                   |
| G945                           | GRENADE, HAND SMK YL             | 357                   |
| G950                           | GRENADE, HAND SMK RE             | 3                     |
| G955                           | GRENADE, HAND SMK VI             | 487                   |
| G963                           | GRENADE, HAND RIOT C             | 4                     |
| G982                           | GRENADE, HAND, PRACT             | 726                   |
| G995                           | GRENADE, RIFLE SMK G             | 62                    |
| H162                           | ROCKET, 2.75 IN HE               | 128                   |
| H463                           | ROCKET, 2.75 IN MPSM             | 26                    |
| H583                           | ROCKET, HE. 2.75 INC             | 2                     |

| DoD Identification Code | Description of Ammunition | Quantity Fired |
|-------------------------|---------------------------|----------------|
| H828                    | ROCKET, 2.75 IN PRAC      | 12             |
| H850                    | WARHEAD, SMK WP E12       | 4              |
| H851                    | WARHEAD, HEDP XM247       | 21             |
| H855                    | WARHEAD, SMK WP M156      | 87             |
| H971                    | ROCKET, 2.75 IN IMPA      | 41             |
| H972                    | ROCKET, 2.75 IN SMK       | 432            |
| H974                    | ROCKET, 2.75" WHD M2      | 497            |
| H975                    | ROCKET, 2.75" PRAC M      | 414            |
| HA13                    | ROCKET, PRACTICE, 2.      | 297            |
| J102                    | ROCKET MOTOR, 2.75 I      | 45             |
| J143                    | ROCKET MOTOR, 5 IN M      | 3              |
| K143                    | MINE, APERS M18A1 W/      | 451            |
| K145                    | MINE, APERS M18A1 W/      | 5              |
| K180                    | MINE, AT HEAVY M15        | 22             |
| K181                    | MINE, AT HEAVY M21        | 67             |
| K250                    | MINE, AT HEAVY M19 N      | 19             |
| K758                    | RIOT CONTROL AGENT,       | 5              |
| K765                    | RIOT CONTROL AGENT,       | 512            |
| K768                    | RIOT CONTROL AGENT,       | 67             |
| K861                    | SMOKE POT, GRND TYPE      | 4              |
| K866                    | SMOKE POT, M5 HC (10      | 5              |
| L119                    | SIGNAL KIT, PERS DIS      | 44             |
| L307                    | SIGNAL, ILLUM GRND W      | 375            |
| L311                    | SIGNAL, ILLUM GRND R      | 11             |
| L312                    | SIGNAL, ILLUM GRND W      | 306            |
| L314                    | SIGNAL, ILLUM GRND G      | 453            |
| L367                    | SIMULATOR, ANTI-TANK      | 50             |
| L425                    | FLARE, SURF AIRPORT       | 12             |
| L495                    | FLARE, SURF TRIP PAR      | 197            |
| L592                    | SIMULATOR, ANTI-TANK      | 8,600          |
| L594                    | SIMULATOR, PROJ GRND      | 336            |
| L598                    | SIMULATOR, EXPL BOOB      | 218            |
| L599                    | SIMULATOR, EXPL BOOB      | 50             |
| L600                    | SIMULATOR, BOOBY TRA      | 110            |
| L601                    | SIMULATOR, HAND GREN      | 161            |
| L602                    | SIM FLASH ARTY M21 9      | 1,540          |
| L610                    | SIMULATOR, HAND GREN      | 20             |
| L709                    | SIMULATOR, TARGET, H      | 10             |
| L715                    | SIMULATOR, MISSILE M      | 137            |
| L720                    | SIMULATOR, TARGET KI      | 58             |
| M020                    | CHG, DEMO SHAPED MK4      | 1              |
| M023                    | CHG, DEMO BLOCK M112      | 2,615          |
| M024                    | CHG, DEMO BLOCK M118      | 50             |

| <b>DoD Identification Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|--------------------------------|----------------------------------|-----------------------|
| M028                           | DEMO KIT, BANGALORE              | 181                   |
| M029                           | CHG, DEMO SHAPED FLE             | 14                    |
| M030                           | CHG, DEMO BLOCK TNT              | 36                    |
| M039                           | CHG, DEMO BLOCK 40 L             | 49                    |
| M046                           | CHG, DEMO LINEAR MK8             | 3                     |
| M110                           | CAP, BLASTING ELEC H             | 10                    |
| M420                           | CHG, DEMO SHAPED M2              | 33                    |
| M421                           | CHG, DEMO SHAPED M3              | 38                    |
| M431                           | CHG, DEMO SNAKE M2A1             | 109                   |
| M455                           | CORD, DET PETN                   | 3,157                 |
| M456                           | CORD, DET, PETN, TYP             | 35,764                |
| M457                           | CORD, DET, 1000 FT S             | 350                   |
| M670                           | FUZE, BLASTING TIME              | 300                   |
| M856                           | SQUIB, ELEC S-75                 | 84                    |
| ML45                           | HOLDER, BLASTING CAP             | 1,343                 |
| ML47                           | CAP, BLASTING                    | 2,521                 |
| MN02                           | CAP, BLASTING                    | 139                   |
| MN03                           | CAP, BLASTING                    | 247                   |
| MN06                           | CAP, BLASTING                    | 839                   |
| MN08                           | IGNITER, TIME BLASTI             | 1,562                 |
| MN60                           | IGNITER, ELEC MATCH              | 206                   |
| MS60                           | CORD, DET SMDC                   | 20                    |
| N285                           | FUZE, MTSQ M577/577A             | 520                   |
| N286                           | FUZE, MTSQ M582 MTL              | 330                   |
| N340                           | FUZE, PD M739 NON-PR             | 2,697                 |
| N464                           | FUZE, PROX M732                  | 16                    |
| PB25                           | TOW TP                           | 86                    |
| PB96                           | GUIDED MISSILE, PRAC             | 28                    |
| PB97                           | GUIDED MISSILE, SURF             | 5                     |
| PB99                           | GUIDED MISSILE, PRAC             | 9                     |
| PD62                           | GUIDED MISSILE, SURF             | 9                     |
| PE64                           | GUIDED MISSILE, PRAC             | 211                   |
| PL23                           | GUIDED MISSILE W/LNC             | 1                     |
| PU67                           | MISSILE,IMPROVED TOW             | 1                     |
| PV47                           | GUIDED MISSILE, SURF             | 79                    |
| X290                           | TACTICAL GRENADE, FL             | 525                   |
| X293                           | FUZE, MODEL M201FB               | 338                   |
| Z762                           | 7.62MM SRTA BALL FRA             | 36,270                |
| TOTAL ROUNDS:                  |                                  | 4,228,179             |

Table 11. Munitions used in 2002 at Camp Shelby, Mississippi.

| DoD Identification Code | Description of Ammunition | Quantity Fired |
|-------------------------|---------------------------|----------------|
| A010                    | 10GA,BLKB                 | 301            |
| A011                    | 12GA,00BCK                | 3,519          |
| A017                    | 12GA, #                   | 36             |
| A059                    | 5.56M/M855                | 314,623        |
| A062                    | 5.56MLINKD                | 45,703         |
| A063                    | 5.56MTM856                | 7,507          |
| A064                    | 5.56M4/1B                 | 62,100         |
| A068                    | 5.56MTM196                | 10,032         |
| A071                    | 5.56M/M193                | 15,042         |
| A072                    | 5.56M,TRB                 | 500            |
| A075                    | 5.56MBLSAW                | 5,200          |
| A080                    | 5.56MBM200                | 3,000          |
| A091                    | .22LMATCH                 | 480            |
| A107                    | 7.62M39BAL                | 22,899         |
| A111                    | 7.62MBLM82                | 200            |
| A127                    | 7.62M,4/1                 | 13,200         |
| A130                    | 7.62MBPACK                | 10,506         |
| A131                    | 7.62ML4/1                 | 217,607        |
| A131                    | 7.62ML4/1                 | 46,520         |
| A136                    | 7.62MBM118                | 300            |
| A140                    | 7.62MTPACK                | 200            |
| A143                    | 7.62MLKDB                 | 17,870         |
| A151                    | 7.62MMLKD                 | 22,049         |
| A165                    | 7.62MM4/1                 | 71,465         |
| A181                    | .30C20CTB                 | 200            |
| A182                    | .30C10CLB                 | 386            |
| A353                    | AT4SUBCAL                 | 250            |
| A358                    | 9MM AT4                   | 2,300          |
| A360                    | 9MMBB                     | 9,765          |
| A360                    | 9MMBB                     | 6,000          |
| A363                    | 9MMBM882B                 | 50,913         |
| A475                    | .45CALBALL                | 7,000          |
| A520                    | .50 4&1                   | 13,969         |
| A546                    | .50 BAL                   | 8,425          |
| A555                    | .50 BAL                   | 58,521         |
| A557                    | .50 4&1                   | 56,364         |
| A576                    | .50 API                   | 49,850         |
| A587                    | .50 API                   | 1,600          |
| A602                    | .50 SRT                   | 6,200          |
| A652                    | 20MMLKDTP                 | 4,875          |
| A940                    | 25MMTPDSB                 | 60             |
| A975                    | 25MM HE                   | 192            |

| <b>DoD<br/>Identification<br/>Code</b> | <b>Description of Ammunition</b> | <b>Quantity Fired</b> |
|----------------------------------------|----------------------------------|-----------------------|
| A976                                   | 25MM TP                          | 1,032                 |
| AG01                                   | SMKY SA                          | 50                    |
| AG02                                   | 2.75 RX                          | 246                   |
| B120                                   | 30MMTP                           | 17,600                |
| B470                                   | 40MMB                            | 256                   |
| B470                                   | 40MMB                            | 75                    |
| B480                                   | 40MMTPHEL                        | 227                   |
| B519                                   | 40MMTPM781                       | 8,062                 |
| B535                                   | 40MM IL                          | 44                    |
| B542                                   | 40MMLKD430                       | 27,578                |
| B546                                   | 40MMHEDPB                        | 2,745                 |
| B576                                   | 40MMTPLKD                        | 7,901                 |
| B584                                   | 40MMPRLKD                        | 8,140                 |
| B584                                   | 40MMPRLKD                        | 1,344                 |
| B630                                   | 60MMWP                           | 72                    |
| B642                                   | 60MMHE                           | 1,319                 |
| B647                                   | 60MMILLUM                        | 227                   |
| C226                                   | 81MMILLUM                        | 514                   |
| C226                                   | 81MMILLUM                        | 18                    |
| C228                                   | 81MMHE                           | 287                   |
| C256                                   | 81MMHE                           | 408                   |
| C276                                   | 81MMSMKWP                        | 30                    |
| C511                                   | 105MM/M490                       | 28                    |
| C520                                   | 105MMTPDST                       | 48                    |
| C623                                   | 120 W/P                          | 18                    |
| C784                                   | 120 TP-                          | 346                   |
| C785                                   | 120 TPC                          | 554                   |
| C788                                   | 120 HE/                          | 22                    |
| C789                                   | 120 SMK                          | 24                    |
| C995                                   | 84MMAT4                          | 124                   |
| D505                                   | 155MM I                          | 310                   |
| D513                                   | 155MM T                          | 447                   |
| D528                                   | 155MM S                          | 265                   |
| D544                                   | 155MM H                          | 6,044                 |
| D550                                   | 155MM C                          | 123                   |
| D579                                   | 155MM H                          | 77                    |
| E969                                   | BDU33A/BB                        | 2,310                 |
| F244                                   | 500LBMK82P                       | 44                    |
| G900                                   | GRNINCENB                        | 4                     |
| G940                                   | SMK GRE                          | 32                    |
| G955                                   | SMKVIOL                          | 48                    |
| H108                                   | MRLSPR                           | 78                    |
| J143                                   | MK22MIC/IC                       | 4                     |

| DoD Identification Code | Description of Ammunition | Quantity Fired |
|-------------------------|---------------------------|----------------|
| K042                    | MA8MINE                   | 24             |
| K143                    | CLAYMOREB                 | 39             |
| L307                    | SIG WHI                   | 12             |
| L312                    | PARAWHITES                | 41             |
| L314                    | STARGRN                   | 12             |
| L601                    | SIMGRE                    | 115            |
| L602                    | ARTYSIM                   | 207            |
| M023                    | C4 1-1/                   | 1,390          |
| M028                    | BANGTORPB                 | 38             |
| M030                    | M1A4-1/4B                 | 367            |
| M032                    | TNT 1LB                   | 302            |
| M034                    | DEMO CH                   | 60             |
| M039                    | 40LB CR                   | 40             |
| M130                    | BLCAPM6                   | 122            |
| M131                    | BLCAPM7                   | 136            |
| M174                    | .50 CAL                   | 32             |
| M420                    | SHAPCR15LB                | 20             |
| M421                    | SHAPCR40LB                | 11             |
| M456                    | REINDET                   | 5,580          |
| M591                    | DYNAMITEM1                | 212            |
| M670                    | TIMEFUSEB                 | 310            |
| M757                    | INCREM-16                 | 1              |
| M766                    | PULLFUSEB                 | 9              |
| M918                    | 40MMTP                    | 566            |
| ML04                    | CUTTER                    | 3              |
| ML45                    |                           | 308            |
| ML47                    |                           | 738            |
| MN02                    |                           | 199            |
| MN08                    |                           | 369            |
| MNO6                    | BLAST C                   | 185            |
| PB96                    | TOWPRA                    | 6              |
| PL23                    | DRAGON                    | 30             |
| TOTAL ROUNDS:           |                           | 1,268,338      |

Table 12. Munitions used in 2002 at Fort Leonard Wood, Missouri.

| DoD Identification Code | Description of Ammunition                    | Quantity Fired Sept -Dec 2002 | Annual Estimate of Quantity Fired <sup>1</sup> |
|-------------------------|----------------------------------------------|-------------------------------|------------------------------------------------|
| A010                    | CTG, 10 GAGE BLANK F/37MM GUN                | 4,400                         | 13,200                                         |
| A011                    | CTG, 12 GAGE #00 BUCK                        | 13,896                        | 41,688                                         |
| A058                    | CTG, 5.56MM BALL M855 SNGL RD                | 160,780                       | 482,340                                        |
| A059                    | CTG, 5.56MM BALL M855 10/CLIP                | 6,341,421                     | 19,024,263                                     |
| A062                    | CTG, 5.56MM BALL M855 LNKD                   | 7,200                         | 21,600                                         |
| A063                    | CTG, 5.56MM TR M856 SNGL RD                  | 6,900                         | 20,700                                         |
| A064                    | CTG, 5.56MM 4 BALL M855/1 TR M856 LNKD       | 1,027,203                     | 3,081,609                                      |
| A066                    | CTG, 5.56MM BALL M193 CTN PACK               | 55,750                        | 167,250                                        |
| A068                    | CTG, 5.56MM TR M196 CTN PACK                 | 443,441                       | 1,330,323                                      |
| A070                    | CTG, 5.56MM HPT M197 SNGL RD                 | 53,622                        | 160,866                                        |
| A071                    | CTG, 5.56MM BALL M193 10/CLIP                | 3,447,649                     | 10,342,947                                     |
| A073                    | CTG, 5.56MM 4 BALL M193/1 TR M196 LNKD       | 25,200                        | 75,600                                         |
| A075                    | CTG, 5.56MM BLANK M200 LNKD                  | 295,530                       | 886,590                                        |
| A079                    | CTG, 5.56MM BLANK M755 F/GREN LNCHR          | 24,600                        | 73,800                                         |
| A080                    | CTG, 5.56MM BLANK M200 SNGL RD               | 732,016                       | 2,196,048                                      |
| A084                    | CTG, CAL .22 BALL SHORT                      | 25,800                        | 77,400                                         |
| A085                    | CTG, CAL .22 SHORT BLANK                     | 16,800                        | 50,400                                         |
| A086                    | CTG, CAL .22 BALL LR                         | 40                            | 120                                            |
| A102                    | CTG, 7.62MM BALL F/AK47 SNGL RD              | 10,200                        | 30,600                                         |
| A110                    | CTG, 762MM BLANK M82                         | 100                           | 300                                            |
| A111                    | CTG, 7.62MM, BLANK, M82, LNK                 | 33,145                        | 99,435                                         |
| A131                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD         | 21,600                        | 64,800                                         |
| A136                    | CTG, 7.62MM BALL M118 MATCH CTN PACK         | 15,755                        | 47,265                                         |
| A149                    | CTG, 7.62MM BALL M80 8/CLIP                  | 16,000                        | 48,000                                         |
| A151                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD         | 519,508                       | 1,558,524                                      |
| A165                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD F/M-GUN | 18,000                        | 54,000                                         |
| A169                    | CTG, 7.62MM SHORT RANGE MATCH SNGL RD        | 10,000                        | 30,000                                         |
| A352                    | CTG, CAL .32 LINE THROWING                   | 2,400                         | 7,200                                          |
| A358                    | CTG, 9MM TP-T M939 F/AT-4 TRNR               | 71,468                        | 214,404                                        |
| A363                    | CTG, 9MM BALL M882                           | 1,139,592                     | 3,418,776                                      |
| A403                    | CTG, CAL .38 SPEC BLANK                      | 450                           | 1,350                                          |
| A471                    | CTG, CAL .45 BALL MATCH                      | 405                           | 1,215                                          |
| A598                    | CTG, CAL .50 BLANK M1E1 LNKD                 | 2,600                         | 7,800                                          |
| A701                    | CTG, 20MM HEI M56A3 SERIES LNKD (04)         | 42,154                        | 126,462                                        |
| A894                    | CTG, 20MM TP M55A2 LNKD                      | 30,000                        | 90,000                                         |
| AA29                    | CTG, SHOT GUN 12GAUGE, BEAN BAG              | 2,005                         | 6,015                                          |
| AA31                    | CTG, SHOTGUN 12 GAUGE, RUBBER FIN            | 2,005                         | 6,015                                          |
| AA33                    | CTG, 5.56MM BALL M855 10/CLIP                | 105,798                       | 317,394                                        |
| AA48                    | CTG 5.56MM Ball M855 C PAK-LF                | 3,843                         | 11,529                                         |
| AA49                    | CARTRIDGE, 9MM BALL M882                     | 18,618                        | 55,854                                         |
| B116                    | CTG, 30MM TP PGU-15/B LNKD RHF               | 22,840                        | 68,520                                         |

| DoD Identification Code | Description of Ammunition                         | Quantity Fired Sept -Dec 2002 | Annual Estimate of Quantity Fired <sup>1</sup> |
|-------------------------|---------------------------------------------------|-------------------------------|------------------------------------------------|
| B519                    | CTG, 40MM TP M781                                 | 54,780                        | 164,340                                        |
| B542                    | CTG, 40MM HEDP M430 LNKD (MK19) (04)              | 1,200                         | 3,600                                          |
| B584                    | CTG, 40MM TP M918 LNKD                            | 78,052                        | 234,156                                        |
| BA07                    | CTG, 40MM FOAM RUBBER BATON                       | 2,011                         | 6,033                                          |
| BA08                    | CTG, 40MM RUBBER BALL                             | 426                           | 1,278                                          |
| C002                    | CTG, 75MM HE M334 (08)                            | 3                             | 9                                              |
| C395                    | CANISTER, SMK GRN F/105MM M84                     | 3                             | 9                                              |
| C995                    | CTG & LAUNCHER, 84MM M136 AT-4 (12)               | 92                            | 276                                            |
| DWBS                    | GRENADE, NON-LETHAL MK 141 CROWD CONTRL           | 703                           | 2,109                                          |
| E950                    | BOMB, PRAC MINIATURE MK23 MOD 1                   | 24                            | 72                                             |
| E969                    | BOMB, PRAC 25 LB BDU-33 80/PL                     | 6,455                         | 19,365                                         |
| G042                    | INITIATOR, BOMB FUZE                              | 126                           | 378                                            |
| G874                    | FUZE, HAND GREN M201A1                            | 1,122                         | 3,366                                          |
| G878                    | FUZE, HAND GREN PRAC M228                         | 2,489                         | 7,467                                          |
| G880                    | GRENADE, HAND FRAG M61 (04)                       | 404                           | 1,212                                          |
| G881                    | GRENADE, HAND FRAG M67 (04)                       | 21,351                        | 64,053                                         |
| G922                    | GRENADE, HAND RIOT CS M47E3                       | 32                            | 96                                             |
| G930                    | GRENADE, HAND SMK HC AN-M8                        | 10                            | 30                                             |
| G932                    | GRENADE, HAND SMK RED M48E3                       | 72                            | 216                                            |
| G940                    | GRENADE, HAND SMK GRN M18                         | 826                           | 2,478                                          |
| G945                    | GRENADE, HAND SMK YLW M18                         | 928                           | 2,784                                          |
| G950                    | GRENADE, HAND SMK RED M18                         | 234                           | 702                                            |
| G955                    | GRENADE, HAND SMK VIO M18                         | 968                           | 2,904                                          |
| G963                    | GRENADE, HAND RIOT CS M7 SERIES                   | 643                           | 1,929                                          |
| G978                    | GRENADE LAUNCHER, SMOKE XM82 (02)                 | 96                            | 288                                            |
| G982                    | GRENADE, HAND, PRACTICE                           | 569                           | 1,707                                          |
| GG04                    | GRENADE, HAND, RUBBER BALL                        | 703                           | 2,109                                          |
| H463                    | ROCKET, 2.75 IN MPSM PRAC W/WHD M267 (HYDRA) (04) | 24                            | 72                                             |
| H663                    | 2.75 inch Rocket Inert warhead                    | 788                           | 2,364                                          |
| K001                    | ACTIVATOR, M1 F/AT MINE M15                       | 14                            | 42                                             |
| K010                    | BRSTR, INCD M4                                    | 36                            | 108                                            |
| K042                    | MINE, CANISTER PRAC XM88 (VOLCANO)                | 48                            | 144                                            |
| K051                    | FUZE, M604 F/AT PRAC MINE M10A1, M12, M20         | 14                            | 42                                             |
| K121                    | MINE, APERS M14                                   | 42                            | 126                                            |
| K143                    | MINE, APERS M18A1 W/M57 FIRING DEVICE             | 186                           | 558                                            |
| K180                    | MINE, AT HEAVY M15 W/FUZE M603                    | 12                            | 36                                             |
| K181                    | MINE, AT HEAVY M21 W/F M607                       | 12                            | 36                                             |
| K250                    | MINE, AT HEAVY M19 NON-METALLIC W/FUZE M606       | 12                            | 36                                             |
| K511                    | SMOKE POT, FLOATING, PRACTICE                     | 220                           | 660                                            |
| K765                    | RIOT CONTROL AGENT, CS CAPSULE                    | 16                            | 48                                             |
| K917                    | THICKENING COMPOUND M4                            | 64                            | 192                                            |

| DoD Identification Code | Description of Ammunition                  | Quantity Fired Sept -Dec 2002 | Annual Estimate of Quantity Fired <sup>1</sup> |
|-------------------------|--------------------------------------------|-------------------------------|------------------------------------------------|
| L108                    | DISPENSER, FLARE AIRCRAFT, SUU 40/A        | 100                           | 300                                            |
| L190                    | SIGNAL, ILLUM MARINE GRN STAR MK1 MOD 0    | 16                            | 48                                             |
| L213                    | SIGNAL, SMK MARINE RED MK21 MOD 0          | 160                           | 480                                            |
| L302                    | SIGNAL, ILLUM GRND WHT STAR F/LAU LX11     | 10                            | 30                                             |
| L305                    | SIGNAL, ILLUM GRND GRN STAR M195           | 22                            | 66                                             |
| L307                    | SIGNAL, ILLUM GRND WHT STAR CLUSTER M159   | 333                           | 999                                            |
| L311                    | SIGNAL, ILLUM GRND RED STAR PARA M126      | 50                            | 150                                            |
| L312                    | SIGNAL, ILLUM GRND WHT STAR PARA M127A1    | 6,259                         | 18,777                                         |
| L314                    | SIGNAL, ILLUM GRND GRN STAR CLUSTER M125A1 | 82                            | 246                                            |
| L316                    | SIGNAL, ILLUM GRND WHT STAR CLUSTER M18A1  | 14                            | 42                                             |
| L324                    | SIGNAL, SMK GRND GRN PARA M128A1           | 48                            | 144                                            |
| L441                    | FLARE, PARA LUU-2B/B                       | 33                            | 99                                             |
| L495                    | FLARE, SURF TRIP PARA YLW M49 SERIES       | 312                           | 936                                            |
| L527                    | SIGNAL, SMK & ILLUM MARINE GRN-GRN MK39    | 10                            | 30                                             |
| L554                    | MARKER, LOCATION MARINE MK25 MODS          | 14                            | 42                                             |
| L592                    | SIMULATOR, ANTI-TANK LNCHR (TOW)           | 40                            | 120                                            |
| L594                    | SIMULATOR, PROJ GRND BURST M115A2 (04)     | 5,910                         | 17,730                                         |
| L595                    | SIMULATOR, PROJ AIR BURST M9 SPAL          | 15                            | 45                                             |
| L598                    | SIMULATOR, EXPL BOOBY TRAP FLASH M117      | 490                           | 1,470                                          |
| L599                    | SIMULATOR, EXPL BOOBY TRAP ILLUM M118      | 150                           | 450                                            |
| L600                    | SIMULATOR, BOOBY TRAP WHISTLING M119       | 1,005                         | 3,015                                          |
| L601                    | SIMULATOR, HAND GREN M116A1                | 4                             | 12                                             |
| L602                    | SIM FLASH ARTY M21 9/CT IN BG 162/B        | 8                             | 24                                             |
| M015                    | CTG, IMPULSE MK24 MOD 0                    | 12                            | 36                                             |
| M023                    | CHG, DEMO BLOCK M112 1 1/4 LB COMP C-4     | 5,913                         | 17,739                                         |
| M028                    | DEMO KIT, BANGALORE TORP M1A2              | 151                           | 453                                            |
| M030                    | CHG, DEMO BLOCK TNT 1/4 LB                 | 8,269                         | 24,807                                         |
| M032                    | CHG, DEMO BLOCK TNT 1 LB                   | 938                           | 2,814                                          |
| M039                    | CHG, DEMO BLOCK 40 LB CRATERING            | 267                           | 801                                            |
| M117                    | CAP, BLASTING ELEC NO 7 DELAY              | 54                            | 162                                            |
| M118                    | CAP, BLASTING ELEC NO 8 DELAY              | 60                            | 180                                            |
| M127                    | CAP, BLASTING ELEC NO 8 DELAY              | 5                             | 15                                             |
| M420                    | CHG, DEMO SHAPED M2 SERIES 15 LB           | 133                           | 399                                            |
| M421                    | CHG, DEMO SHAPED M3 SERIES 40 LB           | 167                           | 501                                            |
| M455                    | CORD, DET PETN                             | 150                           | 450                                            |
| M456                    | CORD, DET, PETN, TYPE 1 CL E (NEW=1000 FT) | 281,368                       | 844,104                                        |
| M457                    | CORD, DET, 1000 FT SPOOL 2000 FT/B         | 2,000                         | 6,000                                          |
| M591                    | DYNAMITE, MILITARY M1                      | 19,032                        | 57,096                                         |
| M832                    | CHG, DEMO SHAPED MK74 MOD 1                | 6                             | 18                                             |
| ML45                    | HOLDER, BLASTING CAP                       | 361                           | 1,083                                          |
| ML47                    | CAP, BLASTING                              | 2,659                         | 7,977                                          |
| MN02                    | CAP, BLASTING                              | 2,167                         | 6,501                                          |

| DoD Identification Code | Description of Ammunition       | Quantity Fired Sept -Dec 2002 | Annual Estimate of Quantity Fired <sup>1</sup> |
|-------------------------|---------------------------------|-------------------------------|------------------------------------------------|
| MN03                    | CAP, BLASTING                   | 75                            | 225                                            |
| MN06                    | CAP, BLASTING                   | 648                           | 1,944                                          |
| MN07                    | CAP, BLASTING                   | 570                           | 1,710                                          |
| MN08                    | IGNITER, TIME BLASTING CAP      | 2,968                         | 8,904                                          |
| MN60                    | IGNITER, ELEC MATCH M79 350/BX  | 784                           | 2,352                                          |
| MN68                    | BOOSTER DEMO 10FT, DET CORD M15 | 7,941                         | 23,823                                         |
| MS48                    | CORD ASSEMBLY, DET F/COBRA SMDC | 42                            | 126                                            |
|                         | TOTAL ROUNDS:                   | 15,298,369                    | 45,895,107                                     |

<sup>1</sup> An annual estimate of the quantity fired was calculated by multiplying the quantity fired in the four months of September through December 2002 by three.

Table 13. Munitions used in 2002 at Fort Bragg, North Carolina.

| DoD Identification Code | Description of Ammunition                    | Quantity Fired |
|-------------------------|----------------------------------------------|----------------|
| A010                    | CTG, 10 GAGE BLANK F/37MM GUN                | 1,000          |
| A011                    | CTG, 12 GAGE #00 BUCK                        | 17,998         |
| A015                    | CTG, 12 GAGE #8 SHOT                         | 9,700          |
| A017                    | CTG, 12 GAGE #9 SHOT                         | 12,337         |
| A057                    | CTG, 28 GAGE SKEET #9 SHOT                   | 2,000          |
| A058                    | CTG, 5.56MM BALL M855 SNGL RD                | 20,574         |
| A059                    | CTG, 5.56MM BALL M855 10/CLIP                | 7,906,961      |
| A062                    | CTG, 5.56MM BALL M855 LNKD                   | 1,484,222      |
| A063                    | CTG, 5.56MM TR M856 SNGL RD                  | 295,756        |
| A064                    | CTG, 5.56MM 4 BALL M855/1 TR M856 LNKD       | 2,182,052      |
| A065                    | CTG, 5.56MM BALL PRAC M862 SNGL RD, BLUE TIP | 132,894        |
| A066                    | CTG, 5.56MM BALL M193 CTN PACK               | 1,526,774      |
| A068                    | CTG, 5.56MM TR M196 CTN PACK                 | 51,780         |
| A070                    | CTG, 5.56MM HPT M197 SNGL RD                 | 3,820          |
| A071                    | CTG, 5.56MM BALL M193 10/CLIP                | 735,863        |
| A072                    | CTG, 5.56MM TR M196 10/CLIP                  | 4,000          |
| A073                    | CTG, 5.56MM 4 BALL M193/1 TR M196 LNKD       | 6,794          |
| A075                    | CTG, 5.56MM BLANK M200 LNKD                  | 896,623        |
| A079                    | CTG, 5.56MM BLANK M755 F/GREN LNCHR          | 4,200          |
| A080                    | CTG, 5.56MM BLANK M200 SNGL RD               | 70,544,270     |
| A084                    | CTG, CAL .22 BALL SHORT                      | 44,990         |
| A085                    | CTG, CAL .22 SHORT BLANK                     | 3,440          |
| A088                    | CTG, CAL .22 HORNET SOFT POINT               | 4,994          |
| A106                    | CTG, CAL .22 BALL LR STD VELOCITY            | 949            |

| DoD Identification Code | Description of Ammunition                     | Quantity Fired |
|-------------------------|-----------------------------------------------|----------------|
| A110                    | CTG, 762MM BLANK M82                          | 12,147         |
| A111                    | CTG, 7.62MM, BLANK, M82, LNK                  | 356,391        |
| A112                    | CTG, 7.62MM BLANK M82 CTN PACK                | 43             |
| A122                    | CTG, 7.62MM BALL M59/M80 CTN PACK             | 2,722          |
| A128                    | CTG, 7.62MM BALL M80 LNKD                     | 500            |
| A130                    | CTG, 7.62MM BALL M59/M80 5/CLIP               | 57,905         |
| A131                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD          | 1,402,395      |
| A136                    | CTG, 7.62MM BALL M118 MATCH CTN PACK          | 74,968         |
| A140                    | CTG, 7.62MM TR M62 CTN PACK                   | 4,580          |
| A143                    | CTG, 7.62MM BALL M80 LNKD                     | 366,317        |
| A146                    | CTG, 7.62MM TR M62 LNKD                       | 1,000          |
| A149                    | CTG, 7.62MM BALL M80 8/CLIP                   | 700            |
| A151                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD          | 18,300         |
| A152                    | CTG, 7.62MM BALL M80 LNKD                     | 4,000          |
| A159                    | DUMMY CTG, 7.62MM, M60 LNKD                   | 400            |
| A164                    | CTG, 7.62MM BALL M80 LNKD F/MINIGUN           | 8,100          |
| A165                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD F/M-GUN  | 58,958         |
| A166                    | CTG, 7.62MM BALL M80 CTN PACK                 | 1,840          |
| A168                    | CTG, 7.62MM 9 BALL M80/1 TR M62 LNKD          | 5,000          |
| A170                    | CTG, 7.62MM LONG RANGE MATCH SNGL RD          | 500            |
| A171                    | CTG, 7.62MM MATCH M852 CTN PACK               | 122,228        |
| A181                    | CTG, CAL .30 BALL M1 CTN PACK                 | 2,000          |
| A209                    | CTG, CAL .30 4 AP M2/1 TR M1 LNKD             | 10,000         |
| A219                    | CTG, CAL .30 4 BALL M2/1 TR M1 BELTED         | 400            |
| A236                    | CTG, CAL .30 TR M25 LNKD                      | 7,000          |
| A237                    | CTG, CAL .30 HPT M1 SNGL RD                   | 2,300          |
| A350                    | CTG, CAL .32 BALL AUTO                        | 500            |
| A358                    | CTG, 9MM TP-T M939 F/AT-4 TRNR                | 22,563         |
| A363                    | CTG, 9MM BALL M882                            | 2,173,865      |
| A364                    | CTG, 9MM HPT XM905                            | 364            |
| A365                    | CTG, 14.5MM TRAINER M181 3 SEC DELAY          | 1,800          |
| A471                    | CTG, CAL .45 BALL MATCH                       | 570            |
| A475                    | CTG, CAL .45 BALL M1911                       | 8,400          |
| A518                    | CTG, CAL .50, LNKD, 100 ROUND BELT            | 1,736          |
| A519                    | CTG, CAL .50 SABOT LT ARMOR PENETRATOR "SLAP" | 359            |
| A530                    | CTG, CAL .50 4 AP M2/1 TR M17 LNKD            | 2,033          |
| A531                    | CTG, CAL .50 API M8 AC SNGL RD                | 300            |
| A540                    | CTG, CAL .50 4 API M8/1 TR M1/M17 LNKD        | 91,730         |
| A542                    | CTG, CAL .50 API-T M20 MG CTN PACK            | 8,476          |
| A546                    | CTG, CAL .50 BALL M2 LNKD                     | 4,578          |
| A552                    | CTG, CAL .50 BALL M2 CTN PACK                 | 29,058         |
| A554                    | CTG, CAL .50 BALL M2 LNKD                     | 9,000          |

| DoD Identification Code | Description of Ammunition                     | Quantity Fired |
|-------------------------|-----------------------------------------------|----------------|
| A555                    | CTG, CAL .50 BALL M2/M33 LNKD                 | 110,330        |
| A557                    | CTG, CAL .50 4 BALL M33/M2/1 TR M17/M10 LNKD  | 577,630        |
| A559                    | CTG, CAL .50 BLANK M1 LNKD                    | 321            |
| A574                    | CTG, CAL .50 SPOTTER TR M48 SERIES SNGL RD    | 410            |
| A576                    | CTG, CAL .50 4 API M8/1 API-T M20 LNKD        | 24,700         |
| A580                    | CTG, CAL .50 TR M1/M17 CTN PACK               | 352            |
| A584                    | CTG, CAL .50 BALL M33 LNKD                    | 1,444          |
| A596                    | CTG, CAL .50 4 AP M8/1 TR M1/M10/M17 LNKD     | 350            |
| A598                    | CTG, CAL .50 BLANK M1E1 LNKD                  | 12,737         |
| A599                    | CTG, CAL .50 BLANK M1E1 LNKD                  | 600            |
| A603                    | CTG, CAL .50 BALL M858 LNKD                   | 9,549          |
| A664                    | CTG, 20MM 9 TP M55A2/1 TP-T M220 LNKD         | 1,140          |
| A763                    | CTG, 20MM, TUNGSTEIN PENETRATOR, MK149, LKD   | 100            |
| A940                    | CTG, 25MM TPDS-T M910 (08)                    | 2,175          |
| A976                    | CTG, 25MM TP-T M793 LNKD                      | 2,420          |
| AA11                    | CTG 7.62MM BALL                               | 62,117         |
| AA33                    | CTG, 5.56MM BALL M855 10/CLIP                 | 1,905,506      |
| B020                    | CTG, 30MM TP XM954 SNGL RD                    | 2,900          |
| B023                    | CTG, 30MM HEDP XM953 LNKD RHF (04)            | 4,600          |
| B025                    | CTG, 30MM HPT XM956 SNGL RD (04)              | 1,600          |
| B104                    | CTG, 30MM HEI PGU-13A/B LNKD RHF (04)         | 400            |
| B113                    | CTG, 30MM TP MK4Z LNKD LHF                    | 400            |
| B118                    | CTG, 30MM TP M788 SNGL RD (M592 CNTR)         | 50,996         |
| B120                    | CTG, 30MM TP M788 LNKD RHF                    | 500            |
| B127                    | CTG, 30MM HPT SNGL RD                         | 200            |
| B128                    | CTG, 30MM API-T PGU-14/B LNKD RHF             | 600            |
| B129                    | CTG, 30MM HEDP M789 CTN PACK (04)             | 2,042          |
| B131                    | CTG, 30MM HEDP M789 LNKD LHF (04)             | 600            |
| B134                    | DUMMY CTG, 30MM                               | 4,603          |
| B137                    | CTG, 30MM TP M950 SNGL RD                     | 400            |
| B138                    | CTG, 30MM TP M950 LNKD RHF                    | 600            |
| B140                    | CTG, 30MM HEDP M949 SNGL RD (04)              | 52             |
| B141                    | CTG, 30MM HEDP M949 LNKD RHF (04)             | 200            |
| B144                    | CTG, 30MM HEDP XM952 LNKD LHF (04)            | 300            |
| B470                    | CTG, 40MM HE M384 SERIES LNKD (12)            | 44             |
| B481                    | CTG, 40MM HE M384/M684 LNKD                   | 300            |
| B504                    | CTG, 40MM GRN STAR PARA M661                  | 920            |
| B508                    | CTG, 40MM GRN SMK M715                        | 400            |
| B511                    | CTG, 40MM TP M813 4/CLIP (02)                 | 132            |
| B518                    | CTG, 40MM HE-PFPX M822 4/CLIP (04)            | 174            |
| B519                    | CTG, 40MM TP M781                             | 111,664        |
| B529                    | CTG, 40MM HE M383/HE-T M677 LNKD F/HELI LNCHR | 30             |

| DoD Identification Code | Description of Ammunition                   | Quantity Fired |
|-------------------------|---------------------------------------------|----------------|
| B535                    | CTG, 40MM ILLUM WHT STAR PARA M583          | 427            |
| B536                    | CTG, 40MM ILLUM WHT STAR CLSTR M585         | 400            |
| B542                    | CTG, 40MM HEDP M430 LNKD (04)               | 19,619         |
| B546                    | CTG, 40MM HEDP M433 (PA120 MTL CNTR)        | 8,270          |
| B557                    | CTG, 40MM HEI-SD 4/CLIP (08)                | 2,500          |
| B558                    | CTG, 40MM HEI-T-NSD 4/CLIP (08)             | 24             |
| B561                    | CTG, 40MM HE-P (08)                         | 274            |
| B563                    | CTG, 40MM BL-P (08)                         | 40             |
| B567                    | CTG, 40MM CHEM AGENT CS M651E1              | 32             |
| B568                    | CTG, 40MM HE M406 (04)                      | 8,399          |
| B571                    | CTG, 40MM HE M383E1 LNKD (12)               | 7,950          |
| B576                    | CTG, 40MM TP M385 LNKD                      | 196            |
| B578                    | CTG, 40MM TP M387 (04)                      | 362            |
| B584                    | CTG, 40MM TP M918 LNKD                      | 134,314        |
| B627                    | CTG, 60MM ILLUM M83A3 (08)                  | 1,658          |
| B630                    | CTG, 60MM SMK WP M302 SERIES (12)           | 884            |
| B632                    | CTG, 60MM HE M49 SERIES (08)                | 746            |
| B642                    | CTG, 60MM HE XM720 (08)                     | 1,088          |
| B643                    | CTG, 60MM HE M888 (08)                      | 11,931         |
| B645                    | CTG, 60MM TP SHORT M840                     | 373            |
| B646                    | CTG, 60MM SMK WP M722                       | 824            |
| B647                    | CTG, 60MM ILLUM M721 (08)                   | 198            |
| B653                    | REPAIR KIT, CTG, 60MM M840                  | 25             |
| C045                    | REPAIR KIT AMMO 81MM 7/B                    | 120            |
| C225                    | CTG, 81MM HE M43A1 W/PD FUZE M525 (08)      | 248            |
| C226                    | CTG, 81MM ILLUM M301 SERIES (08)            | 617            |
| C227                    | CTG, 81MM TP M43A1 W/PD FUZE (08)           | 7              |
| C230                    | CTG, 81MM SMK WP M57/57A1 W/PD FUZE (12)    | 20             |
| C236                    | CTG, 81MM HE M374 SERIES W/O FUZE (08)      | 202            |
| C256                    | CTG, 81MM HE M374 SERIES W/PD FUZE (08)     | 1,711          |
| C275                    | CTG, 90MM APER-T M580 SERIES (12)           | 10             |
| C276                    | CTG, 81MM SMK WP M375 W/PD FUZE (12)        | 1,021          |
| C279                    | CHG, PROP M90A1 F/81 MM                     | 80             |
| C282                    | CTG, 90MM HEAT M371A1 (12)                  | 248            |
| C353                    | CTG, 3 IN 50 CAL VT FCL MK31 FLASHLESS (08) | 1,000          |
| C380                    | CTG, 120MM APFSDS-T M829A1 (08)             | 438            |
| C382                    | CTG, 84MM HE, FFV 441B FOR RAAWS            | 50             |
| C410                    | CTG, 90MM CANISTER APER M5 (08)             | 2              |
| C440                    | CTG, 105MM BLANK M395                       | 4              |
| C444                    | CTG, 105MM HE M1 W/PD FUZE (12)             | 1,501          |
| C445                    | CTG, 105MM HE M1 W/O FUZE (12)              | 25,515         |
| C448                    | CTG, 105MM HEP-T M327                       | 28             |
| C449                    | CTG, 105MM ILLUM M314 SERIES (08)           | 1,877          |

| DoD Identification Code | Description of Ammunition                    | Quantity Fired |
|-------------------------|----------------------------------------------|----------------|
| C452                    | CTG, 105MM SMK HC M84 SERIES (12)            | 286            |
| C454                    | CTG, 105MM SMK WP M60 SERIES (12)            | 378            |
| C463                    | CTG, 105MM HE RAP XM548 (12)                 | 87             |
| C477                    | CTG, 105MM SMK WP M60 SERIES W/O FUZE (12)   | 55             |
| C479                    | CTG, 105MM SMK HC M84A1 (12)                 | 487            |
| C542                    | CTG, 105MM ILLUM M314A3 1/CNT                | 12             |
| C601                    | CTG, 90MM CANISTER APER M377 (08)            | 2              |
| C623                    | CTG, 120MM HE XM933                          | 1,688          |
| C650                    | CTG, 106MM HEAT M344A1 W/PIBD FUZE (12)      | 195            |
| C660                    | CTG, 106MM APERS-T M581 (12)                 | 2              |
| C697                    | CTG, 4.2 IN HE M329A2 W/O FUZE               | 64             |
| C784                    | CTG, 120MM TP-T                              | 411            |
| C785                    | CTG, 120MM TPCSDS-T M865 (METAL CNTR) (08)   | 823            |
| C788                    | CTG, 120MM HE M57 W/FUZE PD M935 (08)        | 377            |
| C868                    | CTG 81MM HE M821 FZ M734 2/B, M984 3/CNT     | 6,341          |
| C870                    | CTG, 81MM SMK                                | 113            |
| C871                    | CTG, 81MM ILLUM M853A1 W/FUZE MTSQ M772 (04) | 572            |
| C876                    | CTG, 81MM, M880                              | 838            |
| C877                    | CTG, 81MM HE, M983 W/FUZE, PD                | 9              |
| C878                    | CTG, 81MM HE, M984 W/FUZE MULTI-OPTION       | 348            |
| C995                    | CTG & LAUNCHER, 84MM M136 AT-4 (12)          | 1,343          |
| D454                    | CANISTER, SMK YLW M4 F/155MM M116            | 10             |
| D505                    | PROJ, 155MM ILLUM M485 SERIES                | 1,420          |
| D510                    | PROJ, 155MM HEAT M712 (COPPERHEAD)           | 11             |
| D514                    | PROJ, 155MM HE RAAM-S M741A1                 | 21             |
| D528                    | PROJ, 155MM SMK WP M825 (02)                 | 310            |
| D529                    | PROJ, 155MM HE M795 (18)                     | 26             |
| D534                    | CHG, PROP 155MM WB M119/119E4 W/PRIMER       | 13             |
| D540                    | CHG, PROP 155MM GB M3 SERIES                 | 199            |
| D541                    | CHG, PROP 155MM WB M4 SERIES                 | 84             |
| D543                    | PROJ, 155MM H OR HD M110 (12)                | 24             |
| D544                    | PROJ, 155MM HE M107 (18)                     | 16,677         |
| D545                    | PROJ, 155MM ILLUM M118                       | 79             |
| D550                    | PROJ, 155MM SMK WP M105/M110 SERIES (12)     | 291            |
| D554                    | PROJ, 155MM SMK VIO M116                     | 17             |
| D579                    | PROJ, 155MM HE RAP M549 SERIES (COMP B) (18) | 32             |
| E480                    | BOMB, GP 500 LB MK82 MOD 1                   | 10             |
| E969                    | BOMB, PRAC 25 LB BDU-33 80/PL                | 1,823          |
| F126                    | BOMB, GP 2000 LB MK84 MOD 2                  | 4              |
| F238                    | BOMB, GP 500 LB MK82 MOD 1 MINOL             | 6              |
| G811                    | BODY, PRACTICE HAND GRENADE f/M69            | 4,064          |

| DoD Identification Code | Description of Ammunition                           | Quantity Fired |
|-------------------------|-----------------------------------------------------|----------------|
| G840                    | CTG, GREN MRTR TNG CAL .22                          | 4              |
| G878                    | FUZE, HAND GREN PRAC M228                           | 21,064         |
| G880                    | GRENADE, HAND FRAG M61 (04)                         | 242            |
| G881                    | GRENADE, HAND FRAG M67 (04)                         | 11,740         |
| G892                    | GRENADE, HAND FRAG MK2A1                            | 2              |
| G900                    | GRENADE, HAND INCD TH-3 AN-M14                      | 216            |
| G910                    | GRENADE, HAND OFFENSIVE MK3 SERIES                  | 60             |
| G918                    | GRENADE, HAND PRAC M69                              | 2              |
| G930                    | GRENADE, HAND SMK HC AN-M8                          | 11             |
| G940                    | GRENADE, HAND SMK GRN M18                           | 631            |
| G945                    | GRENADE, HAND SMK YLW M18                           | 357            |
| G950                    | GRENADE, HAND SMK RED M18                           | 455            |
| G955                    | GRENADE, HAND SMK VIO M18                           | 171            |
| G963                    | GRENADE, HAND RIOT CS M7 SERIES                     | 3              |
| G980                    | GRENADE, RIFLE PRACTICE                             | 24             |
| G982                    | GRENADE, HAND, PRACTICE                             | 2,530          |
| G995                    | GRENADE, RIFLE SMK GRN M22                          | 22             |
| H108                    | ROCKET POD, 298MM PRACTICE M28 (MLRS)               | 81             |
| H115                    | ROCKET, 2.75 IN SMK WP W/WHD M156 (HYDRA-70)        | 110            |
| H162                    | ROCKET, 2.75 IN HE                                  | 294            |
| H163                    | ROCKET, 2.75 IN HE W/WHD M151 (HYDRA)               | 224            |
| H185                    | ROCKET, POD, REDUCED RANGE PRAC. M28A1 MLRS         | 289            |
| H305                    | ROCKET MOTOR, M3 OR M3A2                            | 2              |
| H459                    | ROCKET, 2.75 IN APER W/FLECHETTE WHD WDU-4A/A       | 28             |
| H463                    | ROCKET, 2.75 IN MPSM PRAC W/WHD M267 (HYDRA) (04)   | 472            |
| H485                    | ROCKET, 2.75 IN HE                                  | 39             |
| H490                    | ROCKET, 2.75 IN HE W/WHD M151                       | 2,157          |
| H513                    | ROCKET, 2.75 IN PRAC                                | 88             |
| H554                    | ROCKET, 66MM HE M72A1                               | 65             |
| H557                    | ROCKET, 66MM HEAT M72A2                             | 346            |
| H828                    | ROCKET, 2.75 IN PRAC W/WHD WTU-1/B (12)             | 3,045          |
| H913                    | WARHEAD, HE MK78-0 F/5 IN RCKT                      | 50             |
| H971                    | ROCKET, 2.75 IN IMPACT SIG PRAC W/MK40 4/CNT        | 67             |
| H972                    | ROCKET, 2.75 IN SMK PRAC M274 (HYDRA)               | 342            |
| H973                    | ROCKET, 2.75 IN IMP SIG PRAC M274 WHD 4/CNT         | 100            |
| H974                    | ROCKET, 2.75" WHD M267, FZ M439, MTR MK66 MOD3 (04) | 5,432          |
| H975                    | ROCKET, 2.75" PRAC M274 MK66 MOD 3                  | 6,417          |
| HX05                    | ROCKET, 83MM ASSAULT MK3 MODS (SMAW)                | 3              |
| J143                    | ROCKET MOTOR, 5 IN MK22 MOD 4 (FOR MICLIC)          | 2              |

| DoD Identification Code | Description of Ammunition                     | Quantity Fired |
|-------------------------|-----------------------------------------------|----------------|
| K040                    | CHG, SPOTTING F/MINE AP PRAC M8               | 4              |
| K055                    | Fuze, Mine Comb.                              | 24             |
| K143                    | MINE, APERS M18A1 W/M57 FIRING DEVICE         | 1,343          |
| K180                    | MINE, AT HEAVY M15                            | 242            |
| K181                    | MINE, AT HEAVY M21                            | 187            |
| K250                    | MINE, AT HEAVY M19 NON-METALLIC               | 159            |
| K866                    | SMOKE POT, M5 HC (10-20 MIN BURN)             | 41             |
| K917                    | THICKENER, M4                                 | 53             |
| L301                    | SIGNAL, SMK GRND MARINE F/LUU-10/B            | 5              |
| L302                    | SIGNAL, ILLUM GRND WHT STAR F/LAU LX11        | 1              |
| L305                    | SIGNAL, ILLUM GRND GRN STAR M195              | 35             |
| L306                    | SIGNAL, ILLUM GRND RED STAR CLUSTER M158      | 29             |
| L307                    | SIGNAL, ILLUM GRND WHT STAR CLUSTER M159      | 193            |
| L311                    | SIGNAL, ILLUM GRND RED STAR PARA M126         | 29             |
| L312                    | SIGNAL, ILLUM GRND WHT STAR PARA M127A1       | 291            |
| L314                    | SIGNAL, ILLUM GRND GRN STAR CLUSTER M125A1    | 186            |
| L351                    | SIMULATOR, PROJ AIR BURST M27A1B1             | 1              |
| L367                    | SIMULATOR, ANTI-TANK WPNS EFFECT M22 (ATWESS) | 4              |
| L411                    | FLARE, ACFT PARA LUU-2B/LUU-2A/B              | 10             |
| L442                    | FLARE, ACFT PARA LUU-2B/B                     | 8              |
| L495                    | FLARE, SURF TRIP PARA YLW M49 SERIES          | 36             |
| L508                    | FLARE, WARNING RR SIGNAL RED M72              | 10             |
| L584                    | MARKER, LOCATION MARINE MK38 MOD 1            | 592            |
| L588                    | MARKER, LOCATION MARINE YLW MK77 MOD 0        | 20             |
| L592                    | SIMULATOR, ANTI-TANK LNCHR (TOW)              | 59             |
| L594                    | SIMULATOR, PROJ GRND BURST M115A2 (04)        | 522            |
| L596                    | SIMULATOR, FLASH ARTY M110                    | 16             |
| L598                    | SIMULATOR, EXPL BOOBY TRAP FLASH M117         | 119            |
| L599                    | SIMULATOR, EXPL BOOBY TRAP ILLUM M118         | 25             |
| L600                    | SIMULATOR, BOOBY TRAP WHISTLING M119          | 61             |
| L601                    | SIMULATOR, HAND GREN M116A1                   | 528            |
| L603                    | SIMULATOR, FLASH ARTY XM24                    | 3              |
| L605                    | SIMULATOR, ATOMIC EXPLOSION M142              | 40             |
| L720                    | SIMULATOR, TARGET KILL M26 60/B               | 40             |
| M008                    | CTG, IMPULSE M270                             | 8              |
| M009                    |                                               | 12             |
| M023                    | CHG, DEMO BLOCK M112 1 1/4 LB COMP C-4        | 23,847         |
| M024                    | CHG, DEMO BLOCK M118 2 LB PETN                | 155            |
| M025                    | CHG, DEMO LINEAR M58 COMP C-4                 | 107            |
| M026                    | DEMO KIT, BANGALORE TORP M1A1                 | 345            |
| M028                    | DEMO KIT, BANGALORE TORP M1A2                 | 1,436          |
| M030                    | CHG, DEMO BLOCK TNT 1/4 LB                    | 1,330          |

| DoD Identification Code | Description of Ammunition                  | Quantity Fired |
|-------------------------|--------------------------------------------|----------------|
| M032                    | CHG, DEMO BLOCK TNT 1 LB                   | 3,498          |
| M039                    | CHG, DEMO BLOCK 40 LB CRATERING            | 757            |
| M078                    | CAP, BLASTING, ELEC M4                     | 24             |
| M093                    | CAP, BLASTING ELEC NO 13 DELAY             | 2              |
| M104                    | CAP, BLASTING ELEC NO 4 DELAY              | 2              |
| M107                    | CAP, BLASTING ELEC NO 5 DELAY              | 3              |
| M108                    | CAP, BLASTING ELEC NO 6 DELAY              | 1              |
| M118                    | CAP, BLASTING ELEC NO 8 DELAY              | 58             |
| M125                    | CAP, BLASTING, ELEC NO. 8                  | 2              |
| M130                    | CAP, BLASTING ELEC M6                      | 1,689          |
| M131                    | CAP, BLASTING NON-ELEC M7                  | 3,943          |
| M138                    | CAP, BLASTING ELEC HIGH ALTITUDE E81       | 2              |
| M174                    | CTG, .50 CAL BLANK ELEC INIT               | 157            |
| M241                    | DESTRUCTOR, EXPL UNIVERSAL M10             | 52             |
| M327                    | COUPLING BASE, FIRING DEVICE W/PRIMER      | 5              |
| M420                    | CHG, DEMO SHAPED M2 SERIES 15 LB           | 234            |
| M421                    | CHG, DEMO SHAPED M3 SERIES 40 LB           | 736            |
| M450                    | DETONATOR, PERC M1A2 15 SEC DELAY          | 8              |
| M455                    | CORD, DET PETN                             | 2,000          |
| M456                    | CORD, DET, PETN, TYPE 1 CL E (NEW=1000 FT) | 234,166        |
| M521                    | CTG, IMPULSE MK82 MOD 0                    | 4              |
| M591                    | DYNAMITE, MILITARY M51                     | 1,987          |
| M613                    | CORD, DET                                  | 1,725          |
| M617                    | FIRING DEVICE, DEMO ASSORTED DELAY         | 11             |
| M626                    | FIRING DEVICE, DEMO PRESSURE M1A1          | 12             |
| M667                    | CTG, IMPULSE                               | 100            |
| M670                    | FUZE, BLASTING TIME M700                   | 21,204         |
| M726                    | INITIATOR, CTG ACTUATED                    | 6              |
| M727                    | INITIATOR, CTG ACTUATED                    | 68             |
| M756                    | CHG, ASSY DEMO M37                         | 22             |
| M757                    | CHG, ASSY DEMO M183 COMP C-4 8 X 2 1/2 LB  | 167            |
| M763                    | INITIATOR, PROP INITIATED M113             | 180            |
| M766                    | IGNITER, M2/M60 F/TIME BLASTING FUSE       | 4,357          |
| M769                    | CTG, DELAY CCU-4/A                         | 5              |
| M855                    | CAP, BLASTING ELEC                         | 20,047         |
| M865                    | CANISTER, CTG ACTUATED M1A2                | 9              |
| M880                    | CANISTER, CTG ACTUATED M9                  | 2,540          |
| M881                    | CANISTER, CTG ACTUATED M13                 | 1,000          |
| M928                    | ROCKET MOTOR, MK82 MOD 0                   | 128            |
| M929                    | ROCKET MOTOR, MK83 MOD 0                   | 40             |
| M933                    | ROCKET MOTOR, MK92 MOD 0/1                 | 46             |
| M934                    | IGNITION ELEMENT, ELEC                     | 18             |
| M939                    | ROCKET MOTOR, MK87 MOD 0                   | 1,133          |

| DoD Identification Code | Description of Ammunition                                 | Quantity Fired |
|-------------------------|-----------------------------------------------------------|----------------|
| M977                    | CORD, DET LIGHTWEIGHT 2000 FT/B                           | 351            |
| M995                    | CHG, DEMO RIGID LINEAR MK86 MOD 0                         | 30             |
| ML03                    | FIRING DEVICE, DEMO MULTI-PURPOSE M142                    | 86             |
| ML04                    | CUTTER, HE MK23 MOD 0                                     | 18             |
| ML11                    | CHG, DEMO FLEX LINEAR SHAPED 40 GR/FT                     | 7              |
| ML13                    | CHG, DEMO FLEX LINEAR SHAPED 75 GR/FT                     | 14             |
| ML15                    | CHG, DEMO FLEX LINEAR SHAPED 225 GR/FT                    | 60             |
| ML45                    | HOLDER, BLASTING CAP                                      | 392            |
| ML47                    | CAP, BLASTING, NON-ELEC, 30 FT.                           | 7,283          |
| MM26                    | CHG, DEMO, TUBE 200/BX                                    | 22             |
| MM35                    | CHG, DEMO, LINEAR SHAPED 6FT                              | 10             |
| MM51                    | CHG, DEMOLITION (NEW = 600 GRAINS PER FOOT)               | 8              |
| MN02                    | CAP, BLASTING, NON-ELEC, 500 FT.                          | 4,282          |
| MN03                    | CAP, BLASTING, NON-ELEC, 1000 FT.                         | 7,282          |
| MN06                    | CAP, BLASTING, DEL, M14                                   | 4,021          |
| MN07                    | CAP, BLASTING, NON-ELEC, 25 SEC.                          | 161            |
| MN08                    | IGNITER, TIME BLASTING CAP, M81                           | 5,128          |
| MN11                    | TIME DEL FIRING DEVICE                                    | 174            |
| MS56                    | CORD ASSEMBLY, DET F/COBRA SMDC                           | 500            |
| MU42                    | CORD, DET 100 GRAIN                                       | 1,500          |
| N384                    | FUZE, TIME M84                                            | 50             |
| NONE                    | NOT APPLICABLE                                            | 2              |
| PB18                    | GUIDED MISSILE, SURF ATTACK PRAC BTM-71-A STD RANGE (TOW) | 34             |
| PB25                    | TOW TP                                                    | 20             |
| PE63                    | GUIDED MISSILE, PRAC BTM-71A-2A STD RANGE (TOW)           | 1              |
| PE64                    | GUIDED MISSILE, PRAC BTM-71A-3A EXT RANGE (TOW)           | 214            |
| PL34                    | GUIDED MISSILE SURFACE ATTACK AAWS-M (JAVELIN)            | 4              |
| X100                    | 500 LB PRACTICE BOMB                                      | 4              |
| X236                    | SIM-MUNITIONS, RED                                        | 49,455         |
| X237                    | SIM-MUNITIONS, BLUE                                       | 12,740         |
| Z204                    | 7.62 x 39mm rifle blank                                   | 6,200          |
| Z219                    | 85mm                                                      | 212            |
| TOTAL ROUNDS:           |                                                           | 94,433,096     |

Table 14. Munitions used in 2002 at Fort Sill, Oklahoma.

| DoD Identification Code | Description of Ammunition                    | Quantity Fired |
|-------------------------|----------------------------------------------|----------------|
| G878                    | FUZE, HAND GREN PRAC M228                    | NI             |
| G881                    | GRENADE, HAND FRAG M67                       | NI             |
| G900                    | GRENADE, HAND INCD TH-3 AN-M14               | NI             |
| G940                    | GRENADE, HAND SMK GRN M18                    | NI             |
| G945                    | GRENADE, HAND SMK YLW M18                    | NI             |
| G950                    | GRENADE, HAND SMK RED M18                    | NI             |
| G955                    | GRENADE, HAND SMK VIO M18                    | NI             |
| G963                    | GRENADE, HAND SMK RIOT CS M7                 | NI             |
| G982                    | GRENADE, HAND PRAC SMK TA XM83               | NI             |
| K866                    | FUZE, SMOKE POT M209 ELEC                    | NI             |
| A010                    | CTG, 10 GAGE BLANK F/37MM                    | NI             |
| A011                    | CTG, 12 GAGA #00 BUCK                        | NI             |
| A059                    | CTG, 5.56MM BALL M855 10/CLIP                | NI             |
| A062                    | CTG, 5.56MM BALL M855 LNKD                   | NI             |
| A063                    | CTG, 5.56MM TR M856 SNGL RD                  | NI             |
| A064                    | CTG, 5.56MM 4 BALL M855/1 TR M856 LNKD       | NI             |
| A066                    | CTG, 5.56MM BALL M193 CTN PACK               | NI             |
| A068                    | CTG, 5.56MM TR M196 CTG PACK                 | NI             |
| A071                    | CTG, 5.56MM BALL M193 10/CLIP                | NI             |
| A075                    | CTG, 5.56MM BLANK M200 LNDK                  | NI             |
| A080                    | CTG, 5.56MM BLANK M200 SNGL RD               | NI             |
| A111                    | CTG, 7.72MM BLANK M82 LNKD                   | NI             |
| A131                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD         | NI             |
| A136                    | CTG, 7.62MM BALL M118 MATCH CTN PACK         | NI             |
| A143                    | CTG, 7.62MM BALL M80 LNKD                    | NI             |
| A151                    | CTG, 7.62MM 4 BALL M80/1 TR M62 LNKD         | NI             |
| A164                    | CTG, 7.62MM BALL M80 LNKD                    | NI             |
| A678                    | CTG, 7.62MM BALL M80 8/CLIP                  | NI             |
| A358                    | CTG, 9MM TP-T M939 F/AT-4 TRNR               | NI             |
| A363                    | CTG, 9MM BALL M882                           | NI             |
| A555                    | CTG, CAL .50 BALL M2/M33 LNKD                | NI             |
| A557                    | CTG, CAL .50 4 BALL M33/M2/1 TR M17/M10 LNKD | NI             |
| A598                    | CTG, CAL .50BLANK M1E1 LNKD                  | NI             |
| AA33                    | CTG, 5.56MM BALL M855 10/CLIP COM PACK       | NI             |
| AA49                    | CTG, 9MM Ball COM PACK                       | NI             |
| B519                    | CTG, 40MM TP M781                            | NI             |
| B546                    | CTG, 40MM HEDP M433 (PA120 MTL CNTR)         | NI             |
| B584                    | CTG, 40MM TP M918 LNKD                       | NI             |
| C025                    | CTG, 75MM BLANK M337A2                       | NI             |
| C440                    | CTG, 105MM BLANK M395                        | NI             |
| C445                    | CTG, 105MM HE M1 W/O FUZE                    | NI             |
| C449                    | CTG, 105MM ILLUM M314 SERIES                 | NI             |
| C454                    | CTG, 105MM SMK WP M60 SERIES                 | NI             |

| DoD Identification Code   | Description of Ammunition                  | Quantity Fired |
|---------------------------|--------------------------------------------|----------------|
| C479                      | CTG, 105MM SMK HC M84A1                    | NI             |
| D505                      | PROJ, 155MM ILLUM M485                     | NI             |
| D510                      | PROJ, 155MM HEAT M712 (COPPERHEAD)         | NI             |
| D528                      | PROJ, 155MM SMK WP M825                    | NI             |
| D540                      | CHG PROP 155MM GB M3                       | NI             |
| D541                      | CHG PROP 155MM WB M4                       | NI             |
| D544                      | PROJ 155MM HE M107                         | NI             |
| D550                      | PROJ 155MM WP M105/M110                    | NI             |
| E511                      | BOMB, INERT PRACTICE 1000LB, MK-83         | NI             |
| E969                      | BOMB, PRACTICE 25LB, BDU-33                | NI             |
| F013                      | BOMB, INERT PRACTICE 500LB, BDU-50         | NI             |
| F470                      | CTG, SIGNAL PRAC BOMB CXU 3A/B             | NI             |
| F562                      | CTG, SIGNAL PRAC BOMB MK-4 MOD 3           | NI             |
| H185                      | RCKT POD, 298MM PRACTICE M28A1 RR (MLRS)   | NI             |
| K143                      | MINE, APERS M18A1 W/M57 FIRING DEVICE      | NI             |
| K145                      | MINE, APERS M18A1 W/O FIRING DEVICE        | NI             |
| K765                      | RIOT CONTROL AGENT, CS-2                   | NI             |
| L305                      | SIGNAL, ILLUM GRND GRN STAR M195           | NI             |
| L306                      | SIGNAL, ILLUM GRND RED STAR CLUSTER M158   | NI             |
| L307                      | SIGNAL, ILLUM GRND WHT STAR CLUSTER M159   | NI             |
| L311                      | SIGNAL, ILLUM GRND RED STAR PARA M126      | NI             |
| L312                      | SIGNAL, ILLUM GRND WHT STAR PARA M127A1    | NI             |
| L314                      | SIGNAL, ILLUM GRND GRN STAR CLUSTER M125A1 | NI             |
| L495                      | FLARE, SURF TRIP PARA YLW M49              | NI             |
| L594                      | SIMULATOR, PROJ GRND BURST M115A2          | NI             |
| L595                      | SIMULATOR, PROJ AIR BURST M9 SPAL          | NI             |
| L598                      | SIMULATOR, EXPL BOOBY TRAP FLASH M117      | NI             |
| L599                      | SIMULATOR, EXPL BOOBY TRAP ILLUM M118      | NI             |
| L600                      | SIMULATOR, BOOBY TRAP WHISTLING M119       | NI             |
| L601                      | SIMULATOR, HAND GREN M116A1                | NI             |
| M030                      | CHG, DEMO BLOCK TNT 1/4 LB                 | NI             |
| M130                      | CAP, BLASTING ELECT M6                     | NI             |
| M587                      | DYNAMITE, GELATIN 40%                      | NI             |
| MN32                      | DYNAMITE, 60% AMMONIUM NITRATE (NEW/STICK) | NI             |
| N278                      | FUZE, MTSQ M564                            | NI             |
| N285                      | FUZE, MTSQ M577A1                          | NI             |
| N286                      | FUZE, MTSQ M582                            | NI             |
| N289                      | FUZE, ELECTRONIC TIMR M762                 | NI             |
| N290                      | FUZE, ET M767                              | NI             |
| N335                      | FUZE, PD M557                              | NI             |
| N340                      | FUZE, PD M739                              | NI             |
| N464                      | FUZE, PROX M732                            | NI             |
| N523                      | PRIMER, PERC M82                           | NI             |
| Note: NI = No Information |                                            |                |

Table 15. Munitions used in 2002 at Fort Jackson, South Carolina.

| DoD Identification Code | Quantity Fired |
|-------------------------|----------------|
| A011                    | 13,396         |
| A017                    | 4,150          |
| A059                    | 3,514,104      |
| A062                    | 61,520         |
| A063                    | 4,821          |
| A064                    | 1,389,360      |
| A066                    | 7,810,361      |
| A068                    | 283,692        |
| A071                    | 3,099,373      |
| A073                    | 61,934         |
| A075                    | 2,400          |
| A080                    | 906,658        |
| A111                    | 1,405          |
| A112                    | 60             |
| A129                    | 0              |
| A130                    | 45             |
| A131                    | 38,643         |
| A136                    | 500            |
| A143                    | 8,122          |
| A146                    | 4,940          |
| A151                    | 573,859        |
| A164                    | 8,000          |
| A171                    | 3,275          |
| A358                    | 135,373        |
| A363                    | 106,498        |
| A540                    | 2,573          |
| A555                    | 4,863          |
| A557                    | 61,200         |
| A584                    | 970            |
| A940                    | 1,448          |
| A976                    | 1,777          |
| AA11                    | 100            |
| AA33                    | 3,058,786      |
| AA49                    | 12,272         |
| B120                    | 0              |
| B519                    | 80,202         |
| B542                    | 84             |
| B546                    | 689            |
| B568                    | 64             |
| B576                    | 575            |
| B584                    | 7,011          |
| C025                    | 42             |

| <b>DoD<br/>Identification<br/>Code</b> | <b>Quantity Fired</b> |
|----------------------------------------|-----------------------|
| C226                                   | 42                    |
| C256                                   | 74                    |
| C276                                   | 20                    |
| C995                                   | 195                   |
| D505                                   | 82                    |
| D528                                   | 43                    |
| D541                                   | 60                    |
| D544                                   | 848                   |
| D550                                   | 3,080                 |
| G811                                   | 1                     |
| G878                                   | 269,785               |
| G881                                   | 42,795                |
| G882                                   | 2                     |
| G900                                   | 411                   |
| G922                                   | 1                     |
| G930                                   |                       |
| G932                                   | 172                   |
| G940                                   | 180                   |
| G945                                   | 186                   |
| G950                                   | 6                     |
| G955                                   | 295                   |
| G963                                   | 18                    |
| G982                                   | 4,255                 |
| J143                                   | 1                     |
| K143                                   | 12                    |
| K145                                   | 356                   |
| K765                                   | 4,095                 |
| L306                                   | 224                   |
| L307                                   | 16                    |
| L312                                   | 4,042                 |
| L495                                   | 36                    |
| L594                                   | 2,243                 |
| L596                                   | 5                     |
| L598                                   | 7                     |
| L599                                   | 23                    |
| L601                                   | 203                   |
| M023                                   | 508                   |
| M028                                   | 2                     |
| M039                                   | 5                     |
| M116                                   | 2                     |
| M420                                   | 30                    |
| M456                                   | 2,000                 |
| M914                                   | 1                     |

| <b>DoD<br/>Identification<br/>Code</b> | <b>Quantity Fired</b> |
|----------------------------------------|-----------------------|
| ML45                                   | 265                   |
| ML47                                   | 300                   |
| MN02                                   | 39                    |
| MN03                                   | 26                    |
| MN06                                   | 293                   |
| MN08                                   | 250                   |
| N340                                   | 60                    |
| <b>TOTAL ROUNDS</b>                    | <b>21,602,740</b>     |

**Table 16. Munitions used in 2002 at Camp Bullis, Texas.**

| <b>DoD<br/>Identification<br/>Code</b> | <b>Quantity Fired</b> |
|----------------------------------------|-----------------------|
| A011                                   | 7,793                 |
| A017                                   | 150                   |
| A020                                   | 760                   |
| A059                                   | 22,536                |
| A062                                   | 1,524,165             |
| A063                                   | 10,764                |
| A070                                   | 12,930                |
| A071                                   | 699,180               |
| A072                                   | 43,253                |
| A073                                   | 23,590                |
| A080                                   | 200                   |
| A091                                   | 1,050                 |
| A093                                   | 1,300                 |
| A102                                   | 33,000                |
| A106                                   | 500                   |
| A119                                   | 501                   |
| A127                                   | 200                   |
| A128                                   | 2,397,251             |
| A130                                   | 500                   |
| A136                                   | 59,188                |
| A169                                   | 300                   |
| A171                                   | 602                   |
| A321                                   | 1,300                 |
| A360                                   | 3,050                 |
| A362                                   | 850                   |
| A363                                   | 337,993               |
| A366                                   | 100                   |

| DoD Identification Code | Quantity Fired |
|-------------------------|----------------|
| A400                    | 1,850          |
| A413                    | 250            |
| A415                    | 100            |
| A471                    | 3,350          |
| AAAA                    | 43,886         |
| B480                    | 371            |
| B519                    | 4,112          |
| BBBB                    | 400            |
| G880                    | 102            |
| G881                    | 12,901         |
| G883                    | 207            |
| H708                    | 393            |
| K143                    | 86             |
| M023                    | 121            |
| M043                    | 150            |
| M097                    | 10             |
| M098                    | 10             |
| M418                    | 21             |
| Z084                    | 100            |
| TOTAL ROUNDS: 5,251,426 |                |

Table 17. Munitions used in 2002 at Fort Hood, Texas.

| DoD Identification Code | Description of Ammunition          | Quantity Fired |
|-------------------------|------------------------------------|----------------|
| 15SG                    | STINGER TM GRENADE                 | 10,600         |
| 23BR                    | BEAN BAG ROUND 12 GAUGE            | 3,200          |
| 40A                     | DETERGENT MARKING ROUND            | 48             |
| A011                    | CTG, 12 GAUGE SHOTGUN, #00 BUCK    | 184            |
| A017                    | CTG, 12 GAUGE SHOTGUN, #9          | 100            |
| A055                    | CTG, 410 GAUGE M35 #6 SHOT         | 840            |
| A058                    | CTG, 5.56MM BALL M855 SNGL RD      | 1,030          |
| A059                    | CTG, 5.56MM BALL, M855 10/CLIP     | 1,445,114      |
| A060                    | CTG, 5.56MM DUMMY, M199 CTN PK     | 1,440          |
| A062                    | CTG, 5.56MM BALL M855 LINKED       | 268,532        |
| A063                    | CTG, 5.56MM TRACER M856/M16A2      | 144,702        |
| A064                    | CTG, 5.56MM 4/1, 855/856, M249     | 515,162        |
| A065                    | CTG, 5.56MM BALL PRAC M862 SNGL RD | 9,460          |
| A066                    | CTG 5.56MM BALL                    | 490,787        |
| A068                    | CTG 5.56MM TRACER RIFLE M196       | 2,200          |

| DoD Identification Code | Description of Ammunition                 | Quantity Fired |
|-------------------------|-------------------------------------------|----------------|
| A070                    | CTG, 5.56MM HPT M197 SNGL RD              | 800            |
| A071                    | CTG 5.56MM BALL M193                      | 108,515        |
| A075                    | CTG 5.56MM BLANK LKD SAW                  | 20,661         |
| A080                    | CTG 5.56MM BLANK M200                     | 52,870         |
| A111                    | CTG 7.62MM BLANK LINKED M82               | 14,181         |
| A130                    | CTG 7.62MM BALL CT PACK                   | 2,600          |
| A131                    | CTG 7.62MM LKD 4BALL&1TRACER              | 1,257,189      |
| A136                    | CTG 7.62MM BALL M118                      | 2,430          |
| A143                    | CTG 7.62MM LKD BALL                       | 279,020        |
| A146                    | CTG 7.62MM LINKED TRACER M62              | 4,850          |
| A165                    | CTG 7.62MM LKD 4BALL&1TRACER              | 3,000          |
| A171                    | 7.62MM MATCH M852                         | 840            |
| A353                    | CTG 9MM TRACER SUBCAL FOR AT4             | 2,179          |
| A358                    | CTG 9MM TRACER SUBCAL FOR AT4             | 9,880          |
| A363                    | CTG 9MM BALL M882                         | 395,890        |
| A519                    | CTG.CAL.50 SABOT LT ARMOR PENE            | 60             |
| A531                    | CTG, CAL .50 API M8 AC SNGL RD            | 782            |
| A540                    | CTG CAL.50 LKD 4API & 1TRACER             | 66,360         |
| A546                    | CTG CAL.50 BALL                           | 700            |
| A550                    | CTG, CAL .50 AP/API-T LNKD                | 150            |
| A551                    | CTG, CAL .50 API/API-T M8/M1/M20 LNKD     | 2,000          |
| A552                    | CTG, CAL .50 BALL M2 CTN PACK             | 3,355          |
| A554                    | CTG, CAL .50 BALL M2 LNKD                 | 2,000          |
| A555                    | CTG. CAL .50 BALL M2                      | 69,973         |
| A557                    | CTG CAL.50 LKD 4 BALL & 1 TR              | 520,264        |
| A576                    | CTG CAL.50 LKD 4API&1API-T                | 12,310         |
| A577                    | CTG, CAL .50 4 API M8/1 API-T M20 LNKD    | 12             |
| A583                    | CTG, CAL .50 4 BALL M2/1 TR M1 LNKD       | 9,343          |
| A584                    | CTG, CAL .50 BALL M33 LNKD                | 937            |
| A596                    | CTG, CAL .50 4 AP M8/1 TR M1/M10/M17 LNKD | 449            |
| A675                    | CTG, 20MM APDS M103/MK149 LNKD RHF (04)   | 1,584          |
| A940                    | CTG 25MM TPDS-T M910                      | 84,481         |
| A967                    | DUMMY CTG, 25MM, M28 LNKD                 | 634            |
| A974                    | CTG 25MM APDS-T                           | 30             |
| A975                    | CTG 25MM HEI-T                            | 30             |
| A976                    | CTG 25MM TPT                              | 66,161         |
| A979                    | CTG, 25MM API PGU-20/U SNGL RD            | 173            |
| AA33                    | CTG, 5.56MM BALL M855 CLIP                | 647,555        |
| AX11                    | 9MM SUBCAL FOR SMAW                       | 50             |
| B110                    | CTG, 30MM TP T239 SNGL RD (04)            | 6,031          |
| B113                    | CTG, 30MM TP MK4Z LNKD LHF                | 3,580          |
| B118                    | CTG, 30MM TP M788 SNGL RD (M592 CNTR)     | 42,882         |
| B516                    | TRACER, PROJ MK11 MOD 0 F/40MM            | 300            |

| DoD Identification Code | Description of Ammunition                        | Quantity Fired |
|-------------------------|--------------------------------------------------|----------------|
| B519                    | CTG 40MM TP M781                                 | 40,032         |
| B535                    | CTG 40MMILLUM WHITESTAR PARACH                   | 31             |
| B542                    | CTG 40MM HEDP M430 LKD                           | 500            |
| B545                    | CTG, 40MM BLANK SALUTING                         | 2,303          |
| B546                    | CTG 40MM HE DUAL PURPOSE                         | 2,355          |
| B557                    | CTG, 40MM HEI-SD 4/CLIP (08)                     | 100            |
| B568                    | CTG 40MMHE DUAL PURPOSE                          | 83             |
| B584                    | CTG 40MM PRACT (LINKED)                          | 82,951         |
| B642                    | CTG 60MM MORTAR HE                               | 14             |
| B643                    | CTG, 60MM HE M888                                | 98             |
| B647                    | CTG, 60MM ILLUM M721                             | 10             |
| BINO                    | BINOCULARS                                       | 12             |
| C045                    | K11, REFURBISH CTG, 81MM PRAC                    | 389            |
| C226                    | CTG 81MM ILLUM                                   | 179            |
| C227                    | 81MM TP W/PD FUZE                                | 172            |
| C256                    | CTG 81MM HE                                      | 2,100          |
| C262                    | CTG, 90MM CANISTER APER M336 (08)                | 262            |
| C267                    | CTG, 90MM HE M71 W/O FUZE (12)                   | 80             |
| C276                    | CTG 81MM SMK WP                                  | 511            |
| C341                    | CTG, 3 IN 50 CAL BL-P MK29/27/185 FLASHLESS (08) | 6              |
| C379                    | CTG120MM W/MULTIPLEOPTION FUZE                   | 272            |
| C623                    | CTG 120MM PD FUZE 745                            | 2,408          |
| C624                    | CTG, 120MM SMK                                   | 590            |
| C784                    | CTG 120MM TP-T                                   | 6,883          |
| C785                    | CTG 120MM TPCSDS-T                               | 11,464         |
| C787                    | M830 HEAT-MP-T                                   | 65             |
| C788                    | CTG 120MM HE M57 W/FUZE PDM935                   | 76             |
| C791                    | CTG, 120MM HEAT-MP-T, M830 E1                    | 8              |
| C807                    | PROJ & PROP CHG, 120MM HEAT-T M469               | 175            |
| C869                    | CTG, 81MMHE, M889 W/FUZE                         | 210            |
| C871                    | CTG, 81MMILLUM M853A1 W/FUZE                     | 59             |
| C875                    | CTG, 81MMPRAC M879 W/FUZE                        | 40             |
| C876                    | M303                                             | 92             |
| C878                    | CTG, 81MM HE, M984 W/FUZE MULTI-OPTION           | 82             |
| C995                    | LAUNCHER & CARTRI 84MM AT-4                      | 209            |
| CA09                    | CTG, 120MM PRAC FR M931                          | 100            |
| D505                    | PROJECTILE 155MM ILLUM                           | 686            |
| D510                    | PROJ 155M HEAT COPPERHEAD M712                   | 26             |
| D528                    | PROJ 155MM SMOKE M825                            | 565            |
| D540                    | CHG, PROP 155MM GB M3 SERIES                     | 194            |
| D544                    | PROJECTILE 155MM HE M107                         | 8,220          |
| D550                    | PROJECTILE155MMCHEMICAL M110A1                   | 168            |
| D554                    | PROJ, 155MM SMK VIO M116                         | 242            |

| DoD Identification Code | Description of Ammunition                    | Quantity Fired |
|-------------------------|----------------------------------------------|----------------|
| D579                    | PROJ 155MM HE M549 (RAP)                     | 36             |
| D582                    | PROJ, 6 INCH, VT-NF, MK34                    | 18             |
| E969                    | BOMB, PRACTICE, 25LB, BDU33A/B               | 36             |
| G878                    | FUZE HAND GRENADE PRACT M228                 | 7,871          |
| G880                    | GRENADE HD FRAG M61                          | 60             |
| G881                    | GRENADE HAND FRAG M67                        | 426            |
| G945                    | GRENADE HD SMOKE YELLOW                      | 8              |
| G950                    | GRENADE HD SMOKE RED                         | 4              |
| G955                    | GRENADE HD SMOKE VIOLET                      | 7              |
| H115                    | ROCKET, 2.75 IN SMK WP W/WHD M156 (HYDRA-70) | 144            |
| H185                    | ROCKET, POD, REDUCED RANGE PRAC. M28A1 MLRS  | 76             |
| H972                    | RKT 2.75" PRACTICE HYDRA 70                  | 176            |
| H974                    | RKT 2.75" PRACT HYDRA 70                     | 342            |
| H975                    | RKT 2.75" PRACTICE HYDRA 70                  | 2,351          |
| HX07                    | ROCKET, 83MM HEAA PRAC (SMAW)                | 7              |
| J143                    | RKT MOTOR 5" MK22 MICLIC                     | 12             |
| K143                    | MINEAP NONBOUNDING M18A1CLAYMO               | 1,073          |
| K145                    | MINE, APERS M18A1 W/O FIRING DEVICE          | 8              |
| K180                    | MINE AT HEAVY M15                            | 33             |
| K181                    | MINE AT M21                                  | 24             |
| K250                    | MINE AT HEAVY EMPTY M19                      | 29             |
| K765                    | GREN RIOT CONTROL AGENT CS                   | 98             |
| K768                    | GREN RIOT CONTROL AGENT CS-1                 | 6              |
| K867                    | SMOKE POT FLOATING HC M4A2                   | 15             |
| L306                    | SIGNAL ILLUM REDSTAR PARACHUTE               | 1              |
| L307                    | SIGNAL ILLUM WHITE STAR M159                 | 505            |
| L312                    | SIGNAL ILLUM WHITE STAR PARA                 | 8              |
| L313                    | SIGNAL, ILLUM GRND AMBER STAR CLUSTER M22A1  | 3              |
| L314                    | SIGNAL ILLUM GREEN STAR                      | 14             |
| L324                    | SIGNAL, SMK GRND GRN PARA M128A1             | 2              |
| L495                    | FLARE SURFACE TRIP                           | 3              |
| L594                    | SIMULATOR, PROJ GRND BURST M115A2 (04)       | 22             |
| L598                    | SIM EXPL BOOBYTRAP FLASH                     | 4              |
| L601                    | SIM HAND GRENADE                             | 25             |
| L602                    | SIM FLASH ARTILLERY (HOFFMAN)                | 402            |
| M008                    | CTG, IMPULSE M270                            | 62             |
| M023                    | CHARGE DEMO BLK C4 1 1/4 LB                  | 6,442          |
| M028                    | DEMO KIT BANGALORE TORPEDO                   | 257            |
| M030                    | CHARGE DEMO 1/4 LB M1A4                      | 100            |
| M032                    | CHARGE DEMO TNT 1LB M1A4                     | 34             |
| M038                    | CHG, DEMO BLOCK M5A1 2 1/2 LB COMP C-3       | 15             |
| M039                    | CHARGE DEMO 40LB CRATER                      | 176            |
| M056                    | CHG, DEMO BLOCK MK36 4 LB COMP H-6           | 1,000          |

| DoD Identification Code | Description of Ammunition                   | Quantity Fired |
|-------------------------|---------------------------------------------|----------------|
| M118                    | CAP, BLASTING ELEC NO 8 DELAY               | 301            |
| M130                    | CAPBLASTING ELEC M6                         | 87             |
| M131                    | CAPBLASTING NON-ELEC M7                     | 288            |
| M171                    | CTG, POWDER ACTUATED CAL .22                | 240            |
| M282                    | CTG, DELAY MK4 MOD 2                        | 18             |
| M327                    | COUPLING BASE, FIRING DEVICE W/PRIMER       | 15             |
| M420                    | CHARGE DEMO SHAPED 15LB                     | 142            |
| M421                    | CHARGE DEMO SHAPED 40LB                     | 4              |
| M455                    | CORD, DET PETN                              | 900            |
| M456                    | CORD DETONATING REINFORCED                  | 20,537         |
| M670                    | FUSE BLASTING TIME                          | 2,608          |
| M766                    | IGNITER TIME BLASTING FUSE PUL              | 40             |
| M852                    | SQUIB, ELEC MK13 MOD 0                      | 650            |
| M880                    | CANISTER, CTG ACTUATED M9                   | 314            |
| M881                    | CANISTER, CTG ACTUATED M13                  | 1,800          |
| M914                    | CHARGELINE MINE CLEARING M68A2              | 4              |
| M918                    | CTG 40MM TP UNLINKED F/CEV                  | 190            |
| ML45                    | NON-ELECT BLASTING CAP M11                  | 527            |
| ML47                    | BLASTING CAP HOLDER M9                      | 1,822          |
| MN02                    | NON-ELECT BLASTING CAP M12                  | 294            |
| MN03                    | NON-ELECT BLASTING CAP M13                  | 263            |
| MN06                    | NON-ELECT BLASTING CAP M14                  | 714            |
| MN08                    | IGNITER TIME FUZE                           | 1,145          |
| N100                    | NO DODIC                                    | 11             |
| N279                    | FUZE, MTSQ M518 W/BOOSTER (04)              | 30             |
| PB96                    | GM TOW PRACT                                | 12             |
| PB99                    | TOW PRACTICE                                | 20             |
| PV18                    | GUIDED MISSILE, SURF ATTACK BGM-71F (TOW28) | 27             |
| R120                    | LASER GLD                                   | 8              |
| TOTAL ROUNDS:           |                                             | 6,810,458      |

## 3 Problem Formulation

### Selection of Assessment Endpoints

An assessment endpoint is an explicit expression of the actual environmental value to be protected (USEPA 1992) at each of the installations. Assessment endpoints typically cannot be directly measured. Therefore, researchers selected measurement endpoints that are measurable biological responses to the contaminants of concern that can be used to make inferences about the assessment endpoint.

The primary assessment endpoint for this risk assessment is the protection and sustainability of selected threatened and endangered species at the installations. The following list identifies the threatened and endangered species of concern at each installation:

### Selection of Measurement Endpoints

The USEPA provides a list of recommended considerations when developing measurement endpoints. Criteria for measurement endpoints can include those that allow for and:

- Correspond closely to the assessment endpoint. In this instance the measurement endpoints are representative of, correlated with, and applicable to the assessment endpoint.
- Are specific to the site. Specific threatened and endangered species have been identified for each installation.
- Are specific to the stressor. While other contaminants may influence the measurement endpoints, this research focuses on modeled concentrations of S&Os and MUCs to assess the measurement endpoint. The effects values applied are specific to the contaminants of concern.
- Include an objective measure for judging environmental harm. In ecological risk assessment TRVs, and any other criteria (e.g., sediment, water) specific to the contaminants of concern are independently derived benchmarks.
- Are sensitive for detecting changes. The benchmarks used to judge the measures of effect have a dose-response relationship to the contaminants, indicating sensitivity to changes in concentration or dose.

- Are quantitative. The estimates of body burden and dose are quantitative estimates of exposure.
- Include a correlation between stressor and response. The ecological risk assessment will include an analysis of correlation between levels of exposure to a stressor and levels of response, and will evaluate the strength of that correlation through sensitivity analyses.
- Use standard methods. There are no externally recognized methods for benchmark development in EPA or USACE regulations. Methods suggested in the current toxicological literature were used.

The measurement endpoints associated with the assessment endpoints are as follows:

- Measurement Endpoint: modeled doses of S&Os and MUCs to each receptor (i.e., selected threatened and endangered species).
- Measurement Endpoint: modeled concentrations of S&Os and MUCs in plants/tree leaves that serve as a food base for the selected threatened and endangered species.

## Profiles for Receptors of Concern

This section provides brief summaries of biological information for the threatened and endangered species of concern. Table 18\* provides the exposure parameters used in the modeling, and Table 19 shows the availability of detailed dietary information for the threatened and endangered species of concern.

### ***Indiana Bat***

#### **Taxonomy**

Class: Mammalia  
 Order: Chiroptera  
 Family: Vespertilionidae  
 Genus: Myotis  
 Species: sodalis  
 Common Names: Indiana Myotis, Social Bat, Kentucky Brown Bat

#### **Description**

Physical characteristics of the Indiana bat are provided in Table 18.

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\* Tables and Figures are grouped at the end of the chapter, beginning on page 104.

### **Status**

The Indiana bat was listed as endangered throughout its range in 1967 by the U.S. Fish and Wildlife Service (USFWS). Individual states have listed the Indiana bat as endangered, including: New York, New Jersey Georgia, Florida, Mississippi, North Carolina, South Carolina, and Indiana.

### **Range**

Figure 13 shows the range and priority hibernacula of the Indiana bat.

### **Life History and Ecology**

**Migration.** The Indiana bat migrates between winter hibernacula and summer roosting habitat. Northern migration occurs in late March to early April from hibernacula to roosting locations, and southern migration occurs in late summer (Evans et al. 1998). Indiana bats will migrate approximately 482 k (300 mi) (Barbour and Davis 1969).

**Hibernation.** Hibernation lasts from October to late April in caves and abandoned mineshafts. Suitable hibernacula will be between 4° and 8° C (29° to 46° F) and relative humidity from 66 to 95 % (Evans et al. 1998). During hibernation, Indiana bats form large clusters consisting of between 500 and 1000 individuals on the ceilings and walls of the hibernacula. Individuals will spontaneously awaken ever 8 to 15 days to change position among the hibernacula, during which time they will occasionally forage for insects (Evans et al. 1998).

**Reproduction.** Mating occurs in the first 10 days of October at night on the ceilings of hibernacula (USFWS 1999). Ovulation, fertilization, and implantation are not believed to occur until after hibernation breaks in early spring (Thomson 1982). Females form maternity colonies in suitable roosts, which generally include less than 50 reproductive females. Birthing occurs in June and July when the female will give birth to a single offspring. Juvenile Indiana bats are weaned and become volant within 37 days after birth (Humphrey et al. 1977).

**Roosting Habitat.** Roosting occurs under the bark of hollow areas in a hardwood bole. Ideal roosting trees are located within floodplain deciduous forests or in upland stands adjacent to riparian or floodplain forests with at least 30 percent canopy cover and permanent water within 0.5 km (Garner and Gardner 1992). Hardwood boles of species such as cottonwood, oak, hickory, and elm are highly suitable roosts. Tagged Indiana bats have been found to return to the same roost trees over successive years (Humphrey et al. 1977, Garner and Gardner 1992).

**Foraging.** Indiana bats are primarily insectivorous, feeding on moths (Lepidoptera), beetles (Coleoptera), flies and midges (Diptera) in the forest canopy (Evans et al. 1998). Ideal foraging areas are closed canopy riparian forests. Foraging has been observed in the canopy of riparian forest, around upland slopes and ridges, in early successions openings in the forest, over impounded water, and in forest /agricultural transition zones (Evans et al. 1998). Streams without riparian vegetation are not suitable foraging areas (Cope et al. 1978). Foraging ranges for females is dependant of reproductive state. During lactation, foraging range averaged 94.2 ha, and post lactation foraging range averaged 212.7 ha (Evans et al. 1998). Juveniles have an average foraging range of 28.5 ha (Evans et al. 1998). Males will travel up to 1.5 km from roosts to foraging areas (Evans et al. 1998).

**Predators.** Known predators include mink (*Mustella visio*), screech owl (*Otus asio*), and black rat snake (*Elaphe obseleta obseleta*) (Evans et al. 1998).

### **Gray Bat**

#### **Taxonomy**

Class: Mammalia  
Order: Chiroptera  
Family: Vespertilionidae  
Genus: Myotis  
Species: grisescens

#### **Description**

Physical characteristics of the gray bat are provided in Table 18.

#### **Status**

The gray bat was listed as endangered throughout its range in 1967. Individual states have listed the gray bat as endangered, including: Arkansas, Florida, Georgia, Mississippi, Tennessee, Indiana, Illinois, Kentucky, Missouri, and North Carolina.

#### **Range**

Figure 14 shows the range of the gray bat.

### Life History and Ecology

**Migration.** The gray bat lives in caves year round, but migrates between summer roosting caves and winter hibernacula (Gore 1992). Adult females break hibernation and begin northern migration first in late March to early April, followed by males and juveniles in mid March to mid April (Mitchell 1998). Southern migration to hibernacula occurs for females in early September, followed by males and juveniles in mid October (Tuttle 1976). Migration distances range from 17 to 500 km (11 to 310 miles) in large flocks that will stop to rest in suitable caves en route (Mitchell 1998).

**Hibernation.** Suitable hibernation caves are deep and vertical and average 10° C (50 °F) (Mitchell 1998). Females enter hibernation after mating, while males will remain active for several weeks after mating. Most gray bats are in hibernation by November. Hibernation occurs on the ceilings of large rooms within the caves. Individuals form large clusters of several thousand bats that will be several layers deep (Gore 1992). Gray bats will return to the same hibernacula over successive years (Tuttle 1976).

**Reproduction.** Mating occurs when males arrive at the winter hibernacula, but ovulation and fertilization does not occur until after females have broken hibernation the following spring (Mitchell 1998). After migration, females congregate in maternity caves, while males and yearlings congregate in separate sections of the roosting cave. The maternity section is located in the warmest areas of the roosting cave (Tuttle 1976). The gray bat has a gestation period of 60 to 70 days (Saugey 1978), after which females will give birth to one offspring. The offspring cling to the females for approximately 1 week and then remain in the nursery cave while the female forages (Burt and Grossenheider 1976). Young become volant after 4 weeks and are weaned shortly after, usually in late June to mid July (Mitchell 1998). Gray bats become sexually mature at age 2, and have a potential longevity of 17 years (Mitchell 1998).

**Roosting Habitat.** Roosting caves range from 14° to 25° C (57 °F to 77 °F) and are similar in shape to hibernation caves (Mitchell 1998). During maternity, females live in separate cave sections from males and juveniles. After the young are fledged, bats of all sexes and ages will share the same cave sections. Ideal roosts will be located within 1 km of a major water body, and very few roosts will be found past 4 km from major water bodies (Tuttle 1976). Forested areas surrounding the cave entrance and/or on routes to foraging areas are advantageous for gray bats. Juveniles will use forested areas close to the cave for foraging. Adults will use the canopy as cover from predators during movement to and from foraging areas (Mitchell 1998).

**Foraging.** Gray bats feed exclusively on insects and will consume 55 families of insects comprising 15 orders, including flies (Diptera), beetles (Coleoptera), caddisflies (Trichoptera), moths (Lepidoptera), wasps (Hymenoptera), stoneflies (Plecoptera), leafhoppers (Homoptera), and mayflies (Ephemeroptera) as the primary food sources (Mitchell 1998). Gray bats emerge from caves in early evening and follow direct overland routes to foraging areas over water bodies and associated wetland areas. Foraging occurs between 2 and 5 m of the water surface (Mitchell 1998). In early evening, gray bats feed in slowly traveling groups while insect abundance is at a peak, after which the bats will become territorial. Foraging areas will be occupied by 1 to 15 individuals. Foraging areas are located between 2 to 28 km from roosting sites, and bats will return to successful foraging areas each year (Mitchell 1998).

**Predators.** The screech owl is primary predator of the gray bat (Mitchell, 1998).

### ***Gopher Tortoise***

#### **Taxonomy**

Class: Reptilia  
Order: Testudines  
Family: Testudinidae  
Genus: Gopherus  
Species: polyphemus  
Common Names: Gopher, Hoover Chicken

#### **Description**

Physical characteristics of the gopher tortoise are provided in Table 18.

#### **Status**

The Western population (i.e., west of the Tombigby and Mobile Rivers in Alabama) of the gopher tortoise was listed as threatened in 1987. The Eastern population is not listed as threatened or endangered, but is considered a species of concern.

#### **Range**

Figure 15 shows the range of the gopher tortoise.

#### **Life History and Ecology**

**General.** The gopher tortoise is a terrestrial turtle that requires habitat with soft soils for burrowing, herbaceous vegetation for foraging, and sunny areas for nesting

and thermoregulation (Wilson et al. 1997). Five age classes of the tortoise have been identified: eggs, hatchlings (up to 1 year), juveniles (1 to 4 years), subadults (5 to 15 years), and adults (16+ years) (Wilson 1991).

**Burrowing.** The gopher tortoise relies primarily on burrowing for survival. Burrows are generally straight and unbranched measuring 5 meters in length, sloping downward near a single entrance and leveling off at an inner chamber large enough to allow the tortoise to turn around (Wilson et al. 1997). Burrows provide shelter from predators, fire, and extreme temperatures. Gopher tortoises prefer well-drained sandy soils for burrowing but will dig shorter burrows in more clayey soils (Wilson et al. 1997). A large number of species are dependent on gopher tortoise burrows for refuge, including over 60 vertebrate and 300 invertebrate species (Jackson and Milstrey 1989).

**Reproduction and Development.** Sexual maturity is dependant on carapace length rather than age in the gopher tortoise. Females are sexually mature at carapace length of 22.5 to 26.5 cm (8.86 to 10.43 in.), typically between ages 10 and 21 yrs (Ernst et al. 1994).

Mating occurs during fall and spring, with peak mating occurring in May and June (Wilson et al. 1997). Dominant males will mate with several females after performing a courtship behavior of bobbing his head and biting the female's forelegs, head, and carapace anterior (Wilson et al. 1997). Ovulation occurs in late spring and is complete by late May (Iverson 1980). The female will dig a nest in a sunny area, which can be in the spoil mounds by the entrance to her burrow or several feet away from the burrow (Wilson et al. 1997). Nesting occurs from late April to mid July with a peak nesting period between May and mid June (Wilson et al. 1997). Nests are approximately 12.6 cm deep from the surface to the uppermost egg and will contain a single clutch of 1 to 25 eggs (Wilson et al. 1997). Clutch size increases with the female's carapace size and will most often contain 4 to 9 eggs (Wilson et al. 1997). Eggs incubate between 80 and 100 days before hatching, which occurs from late August through early October (Wilson et al. 1997). Hatchlings are 4 to 5 cm long at emergence from the nest and will dig their own burrows within a few meters of the nesting area (Wilson et al. 1997).

Gopher tortoises exhibit no parental care for eggs or juveniles, leaving the young open to predation. Raccoon, skunk, armadillo, fox, opossum, snakes, and fire ants (*Solenopsis invicta*) are predators of gopher tortoise egg nests and juveniles, which have soft shells up to age 5 to 7 yrs (Wilson et al. 1997).

**Foraging.** Gopher tortoises are primarily herbivorous; feeding of grasses and herbaceous plants, but will also consumes fruits, feces, and carrion if encountered during

foraging (Wilson et al. 1997). Water is consumed when available, usually when pooled at the mouth of the burrow, and rocks will be consumed to provide minerals (Wilson et al. 1997). A gopher tortoise has a well-defined home range used for foraging, which will increase with age when necessary but is more dependant, inversely correlated, with food resource abundance. The estimated range of foraging activity size is as follows: adult males between 0.45 to 1.27 ha (1.11 to 3.14 acres), adult females between 0.08 to 0.56 ha (0.2 to 1.38 acres), and juveniles between 0.01 to 0.36 ha (Wilson et al. 1997). Gopher tortoise foraging activity is both unimodal and bimodal depending on geographic location, age, and temperature. Bimodal foraging generally occurs between 1000 to 1200 hrs and again at 1600 to 1800 hrs (Douglas and Layne 1978). Unimodal foraging generally occurs between 1000 and 1400 hrs (Douglas and Layne 1978). There is no evidence of nocturnal activity. Gopher tortoises are most active during spring and summer months.

**Predation.** Adult gopher tortoises have few predators due to their size and structure. Eggs and juveniles are heavily preyed upon, as discussed above.

### ***Desert Tortoise***

#### **Taxonomy**

|          |              |
|----------|--------------|
| Class:   | Reptilia     |
| Order:   | Chelonia     |
| Family:  | Testudinidae |
| Genus:   | Gopherus     |
| Species: | agassizii    |

#### **Description**

Physical characteristics of the desert tortoise are provided in Table 18.

#### **Status**

The desert tortoise is listed as threatened except for populations in Arizona south and east of the Colorado River and in Mexico.

#### **Range**

Figure 16 shows the range of the desert tortoise.

The desert tortoise occurs in the Mohave and Sonoran deserts in southwestern Utah, southern Nevada, southeastern California, western Arizona, and Mexico.

### Life History and Ecology

**General.** Three distinct subpopulations of the desert tortoise have been identified by home range: the Mohave Desert population, the Sonoran Desert population, and the tropical Sonora and Sinaloa population of northwestern Mexico (Lawler 2003). Habitat of the desert tortoise ranges from sandy flats to rocky foothills and includes alluvial fans, washes, and canyons with suitable soils for den construction from near sea level to 3500 ft above sea level (Lawler 2003). Home range depends on food availability, age, and sex of the tortoise.

**Burrowing.** Burrowing habits of the desert tortoise vary between the subpopulations. The Mohave Desert population constructs the most extensive burrows, often digging up to 35 ft long half-moon shaped entrances tall enough to allow for easy entrance (Lawler 2003). Burrows are shared between approximately 5 individuals and are dug at the base of rocks or bushes on sloped terrain. Most burrows have a relative humidity of 40 percent, which aids in water conservation (Lawler 2003). The southern populations, including the Sonoran and tropical Sonoran/Sinaloa populations, burrow little if at all, depending on terrain. If suitable soils are present, the tortoise will dig burrows up to 6 ft deep on the slopes of rocky foothills (Lawler 2003). More commonly, the tortoise will utilize existing refuges such as under rocks or another animal's burrow.

**Foraging.** The desert tortoise consumes a variety of grasses, perennials, annual wildflowers, cactus fruits, and other herbaceous plants. Rocks and soils are also ingested, possibly as source of nutrients or as gastroliths to aid digestion (Lawler 2003). The tortoise will vary foraging activities around ambient temperature and season to avoid the hottest and driest periods of the day.

**Water Conservation.** The desert tortoise has developed several habits and adaptations to successfully survive in arid climates. The primary means of water intake is through consumed vegetation (Lawler 2003). The tortoise has also been observed digging small pits close to their burrows to trap rainwater, often just before a rainfall event (Burg and Roy 2003). The desert tortoise is able to precipitate and expel solid urates from a bladder that can hold approximately forty percent their body weight (Lawler 2003). Northern populations will sometimes go dormant during the hottest and driest parts of summer to conserve water (Lawler 2003).

**Reproduction.** In the desert tortoise sexual maturity is dependant on carapace length rather than age. Sexual maturity is reached between 12-20 yrs (Burg and Roy 2003). Males court females by extensive head bobbing and biting the legs, head, and anterior carapace of the females. Mating occurs from early spring to early fall with the greatest frequency in late summer (Lawler 2003). Females can

store sperm in their cloacae for later fertilization if environmental conditions are not suitable for egg laying. Nests are dug within burrows or close to the burrow entrance. Females will urinate on the nests before and after egg laying and again after the nests have been covered, either to camouflage the nest's scent from predators or to prevent egg desiccation (Lawler 2003). Nesting primarily occurs during May. Females lay clutches of 1 to 14 eggs and will defend nests from predators during the 90- to 135-day incubation period (Lawler 2003). Southern tortoise populations may lay a second clutch in June of the same year. Hatchlings have high mortality rates due to predation and environmental conditions.

Hibernation. Northern populations hibernate during winters. Southern population may not hibernate due to mild winters (Lawler 2003).

### **Red-cockaded Woodpecker**

#### **Taxonomy**

|          |            |
|----------|------------|
| Class:   | Aves       |
| Order:   | Piciformes |
| Family:  | Picidae    |
| Genus:   | Picoides   |
| Species: | borealis   |

#### **Description**

Physical characteristics of the red-cockaded woodpecker are provided in Table 18.

#### **Status**

The red-cockaded woodpecker is listed as endangered in its entire range.

#### **Range**

Figure 17 shows the range of the red-cockaded woodpecker.

#### **Life History and Ecology**

Habitat. The red-cockaded woodpecker exclusively inhabits mature pine woodlands with a preference for using longleaf pine (*Pinus palustris*) for roosting and nesting (USFWS 2003). Optimum habitat is characterized as broad savanna with a scattered overstory of large pines and dense groundcover containing grasses, forbs, and shrubs (Jackson 1994).

**Social Structure.** Red-cockaded woodpeckers are non-migratory, cooperative birds that form small groups consisting of one breeding pair and up to four “helper” individuals. Helpers are often juvenile males from the previous breeding season that assist in egg incubation, feeding nestlings and fledglings, and defending territories (Jackson 1994). Each member of a group has an individual roost cavity in a cluster of 1 to 20 cavity trees within a 3- to 60-acre area (USFWS 2003). The group will defend a well-defined home range of approximately 15 to 225 ha (average 70 ha) by singing, drumming with their beaks, and males raising their red cockades on each side of the head (USFWS 2003). Both males and females will display threat behavior during breeding season if there is an intruder in the nesting area. Red-cockaded woodpecker individuals will disperse from the group to join another group primarily after fledging but also due to mate loss or an apparent avoidance of inbreeding within the group. Young females will most often disperse. Fledgling males will disperse the farthest on average (5.1 km), and helper males will disperse the shortest distance on average (1.8 km) (USFWS 2003).

**Roost/Nest Cavities.** While red-cockaded woodpeckers will excavate new roost and nest cavities, they rely primarily on cavities made available due to dispersion. The dispersal of individuals within each group regularly frees cavities for individuals from other groups to occupy. Cavity excavation can take several months to years (USFWS 2003). Cavities are excavated at an upward angle through the sapwood of a cavity tree to allow for pitch drainage and to prevent rainwater from flooding. When excavation has passed through the sapwood into the heartwood, the cavity will turn downward to a gourd-shaped chamber approximately 15 to 25 cm deep by 2 to 13 cm wide (USFWS 2003). The average distance between cavity trees is between 58 and 104 m (USFWS 2003).

**Reproduction.** Mated pairs of the red-cockaded woodpecker are monogamous. Copulation typically occurs between March and May (USFWS 2003). Egg laying occurs in April through early May with a single female laying between 2 and 5 eggs (3 to 4 average) (USFWS 2003). The nest is most often located in the breeding male’s nest cavity. Incubation lasts 10 to 12 days and nestlings will remain in the nest for 26 to 29 days (USFWS 2003). Nesting activity is usually finished completely by early July. Fledglings are able to follow adults on extended foraging trips 3 to 5 days after fledging, but may still beg and receive food from adults up to several months after fledging (USFWS 2003). Hatchling mortality can be relatively high due to predation, primarily by snakes.

**Foraging.** Red-cockaded woodpeckers are primarily insectivorous but will supplement with fruits and berries. Wood boring insects can comprise a large part of the woodpecker’s diet, which will also include beetles, ants, roaches, caterpillars, and spiders (USFWS 2003). Most foraging occurs on mature pine trees or in open pine

habitats. Food is located by sight and by probing cavities with the woodpecker's long tongue (USFWS 2003). Individuals will ascend trees in a spiral pattern while prying up pieces of bark with the claws and beak to expose prey. The red-cockaded woodpecker will occasionally catch airborne insects while in flight.

Predation. Most predation of red-cockaded woodpeckers occurs on nestling and fledglings. Accipiter hawks will prey on adults (USFWS 2003).

### ***Black-capped Vireo***

#### **Taxonomy**

|          |               |
|----------|---------------|
| Class:   | Aves          |
| Order:   | Passeriformes |
| Family:  | Vireonidae    |
| Genus:   | Vireo         |
| Species: | atricapilla   |

#### **Description**

Physical characteristics of the black-capped vireo are provided in Table 18.

#### **Status**

The U.S. Fish and Wildlife Service listed the black-capped vireo as endangered in 1987.

#### **Range**

Figure 18 shows the range of the black-capped vireo.

#### **Life History and Ecology**

Habitat. The black-capped vireo migrates between winter grounds on the western coast of Mexico and breeding grounds of northeast Mexico, central Texas, and some sparse remaining habitat of southwest Oklahoma (Guilfoyle 2002). Optimal breeding grounds are low thickets in scrub oak-juniper woodlands in arid hilly areas near water (Drake 2000). Territory size ranges between 1 and 10 acres with most being 2 to 4 acres (Damude 2003). Nests are built on forked twigs approximately 2 to 6 ft above the ground (Guilfoyle 2002).

**Migration.** The black-capped vireo arrives in its breeding ground in early March, and arrives at its winter grounds by late September. Adult males arrive at the breeding ground before and depart after females and young males (Guilfoyle 2002).

**Reproduction.** The breeding period begins mid-April and ends by early August (Guilfoyle 2002). Monogamous mating pairs are formed when the females arrive at the breeding grounds. Females then begin to build the nests with some help from the males. Nests are compact and cup-like, consisting of leaves, coarse grasses, tree bark, and spider cocoons bound with plant fibers, spider webs, and caterpillar wool (Drake 2000). Nest construction takes 6 to 9 days (Drake 2000). Females lay clutches of 3 to 5 eggs, which are incubated by both males and females for 14 to 17 days (Drake 2000). Males bring approximately 75 percent of the food for hatchlings, which fledge 10 to 12 days after hatching (Drake 2000). Black-capped vireo chicks have a low success ratio of 1 to 2 chicks per pair (Drake 2000). This low success ratio is highly due to nest parasitism by the brown-headed cowbird, which removes black-capped vireo eggs and lays their own to be hatched and raised by the vireos (Drake 2000). The brown-headed cowbird eggs hatch earlier than the black-capped vireo eggs, giving them an advantage (Guilfoyle 2002).

**Foraging.** The black-capped vireo primarily eats insects such as caterpillars and beetles. Young supplement their diet with spiders, while adults supplement with fruits and berries (Guilfoyle 2002). Individuals hang upside down from branches while foraging among deciduous and broad-leaved trees and shrubs (Drake 2000).

**Predation.** Predators include jays, squirrels, skunks, raccoons, rat snakes, and fire ants.

### ***Golden-cheeked Warbler***

#### **Taxonomy**

Class: Aves  
Order: Passeriformes  
Family: Parulidae  
Genus: Dendroica  
Species: chrysoparia

#### **Description**

Physical characteristics of the golden-cheeked warbler are provided in Table 18.

### **Status**

The U.S. Fish and Wildlife Service listed the golden-cheeked warbler as endangered in 1990.

### **Range**

Figure 19 shows the range of the golden-cheeked warbler.

### **Life History and Ecology**

**Habitat.** The golden-cheeked warbler migrates between breeding grounds located exclusively in central Texas to wintering grounds in the highlands of central Mexico and south thru Nicaragua (Damude 2003). Breeding grounds are restricted to mature Ashe juniper stands mixed with other deciduous trees, oak in particular (Guilfoyle 2002). Water must be located close to the nests for drinking and bathing (Damude 2003).

**Migration.** Golden-cheeked warblers arrive at breeding grounds from mid March and depart toward wintering areas in mid-July (Guilfoyle 2002).

**Reproduction.** Monogamous mating pairs are formed shortly after arrival at breeding grounds. Females build the nests in branch forks approximately 15 ft above ground in 4 to 6 days (Guilfoyle 2002). Bark from 20-to 30-yr old juniper trees is needed for nest construction (Damude 2003). Females lay clutches of 3 to 4 eggs and are solely responsible for incubation (Guilfoyle 2002). Males will feed the females during the 12-day incubation period (Guilfoyle 2002). Both males and females will feed the hatchlings. Fledging occurs 9 to 12 days after hatching, and fledglings will rely on adults to feed them for at least 4 weeks after leaving the nest (Guilfoyle, 2002). Golden-cheeked warbler nests are targeted by the parasitic nestling brown-headed cowbird, which removes warbler eggs and lays their own to be hatched and raised by the warblers. The brown-headed cowbird eggs hatch earlier than the golden-cheeked warbler eggs, giving them an advantage (Guilfoyle 2002).

**Foraging.** Golden-cheeked warblers are entirely insectivorous, foraging on caterpillars, flies, and spiders among the foliage of Ashe junipers and a variety of oaks (Stout 1999).

**Predation.** Predators of the golden-cheeked warbler include rat snakes and coach whips, and opportunistic opossum, squirrel, and cats (Guilfoyle, 2002).

## Conceptual Model

Each installation has essentially the same conceptual model of exposure for each of the selected threatened and endangered species. These are shown in Figure 20 for S&Os and Figure 21 for the MUCs.

S&Os are typically and most commonly released during fog oil training exercises or maneuvers. They may be administered via vehicle-equipped generators or from handheld devices. S&O usage results in a cloud comprised of vapor and particulate that may undergo subsequent dry and wet deposition onto soil, plant surfaces, other prey items, and water surfaces. Munition usage, by contrast, is from direct-fired artillery and handheld devices (i.e., rifles, pistols, etc.) When munitions fire correctly, there is very little chemical residue remaining in the environment. However, particularly for the larger and or “self-contained” munition types (e.g., grenades, mortars, artillery, and other munitions with high explosive and other projectile internal contents), there is a known “dud” rate or misfire rate. This results in the potential for chemicals to enter the environment into the soil where the projectile has landed. Once in the soil, the MUCs may undergo subsequent chemical transformation, subsurface transport to groundwater, or can be taken up by plants and other organisms depending on the chemical and physical properties of each individual constituent.

Depending on the prey items favored by each of the threatened and endangered species, they may be exposed to S&Os and MUCs via ingestion of different prey items. The exposure pathways (described in Figures 20 and 21) for this screening level assessment are considered as follows:

### ***Smoke and obscurant exposure pathways***

Air → deposition onto plants and leaves → leaf and plant ingestion by terrestrial insects, caterpillars, etc. → ingestion of prey items by higher vertebrates (e.g., birds and bats).

Air → deposition onto plants → leaf ingestion by tortoise, and other herbivores.

Air → deposition onto water → settling of particulate to sediment → sediment ingestion by emergent aquatic insects → ingestion of aquatic insects by higher vertebrates (e.g., birds and bats).

***Munitions related chemical exposure pathways***

Soil → uptake into trees and tree foliage → leaf ingestion by terrestrial insects, caterpillars, etc. → ingestion of prey items by higher vertebrates (e.g., birds and bats).

Soil → uptake into plants → plant and incidental soil ingestion by tortoise.

A complete exposure pathway that may be important given the specific physical and chemical properties of the individual munitions is:

Soil → runoff into surface water → settling of particulates to sediment → ingestion by emergent aquatic insects → ingest of aquatic insects by bats and birds.

However, this path could not be quantified even at a screening level due to the complexity of the modeling (e.g., universal soil loss equation, which requires detailed information on topography, soil type, vegetation type, etc.) and the number of assumptions required. This screening level assessment assumes that all of the constituents in the munitions are available for uptake by plants and the potential runoff to water and aquatic life forms is not quantified.

Table 18. Exposure parameters for the TES of concern.

| Species                                                    | Life Span         |      |                    | Body Weight                          |                           |                      | Body Length           |                  |                            | Wingspread   |         |                    |
|------------------------------------------------------------|-------------------|------|--------------------|--------------------------------------|---------------------------|----------------------|-----------------------|------------------|----------------------------|--------------|---------|--------------------|
|                                                            | Range             | Mean | Source             | Range                                | Mean                      | Source               | Range                 | Mean             | Source                     | Range        | Mean    | Source             |
| Indiana Bat<br>( <i>Myotis sodalis</i> )                   | 13 - 20<br>years  |      | Evans et al., 1998 | 7 - 9 g                              | 8 g                       | Evans et al., 1998   | 7.5 - 10 cm           | 8.75 cm          | Evans et al., 1998         | 24 - 27 cm   | 25.5 cm | Evans et al., 1998 |
| Gray Bat<br>( <i>Myotis grisescens</i> )                   | up to 17<br>years |      | Mitchell, 1998     | 8 - 16 g                             | 10.5 g                    | Mitchell, 1998       |                       | 8.7 cm           | Mitchell, 1998             | 27.5 - 30 cm | 28.8 cm | Mitchell, 1998     |
| Gopher Tortoise<br>( <i>Gopherus polyphemus</i> )          | 40 - 60<br>years  |      | Germano, 1992      | 2064 - 4911 g (adults ages 15 - 31+) | 3500 g                    | Landers et al., 1982 | 15 - 37 cm (carapace) | 25 cm (carapace) | Wilson and Mushinsky, 1997 | NA           | NA      |                    |
| Desert Tortoise<br>( <i>Gopherus agassizii</i> )           | 32 - 52<br>years  |      | Germano, 1992      | 1030 - 3021 g                        | 1995 g                    | Cal/ECOTOX           | 23 - 38 cm (carapace) |                  | Burg and Roy, 2003         | NA           | NA      |                    |
| Red-Cockaded Woodpecker<br>( <i>Picoides borealis</i> )    | up to 16<br>years |      | USFWS, 2003        | 40 - 55 g                            | 47.5 g                    | USFWS, 2003          | 20 - 23 cm            |                  | USFWS, 2003                | 35 - 38 cm   |         | NatureServe, 2003  |
| Black-Capped Vireo ( <i>Vireo atricapillus</i> )           | 5 - 6<br>years    |      | USFWS, 1991        | 9 - 10 g                             | 10 g                      | USFWS, 1991          | 11 - 12 cm            |                  | Damude, 2003               |              | 16.5 cm | Drake, 2003        |
| Golden-Cheeked Warbler<br>( <i>Dendroica chrysoparia</i> ) |                   |      |                    |                                      | 9.4 (male), 10.2 (female) | USFWS, 1992          | 11 - 13 cm            |                  | Damude, 2003               |              | 20.3 cm | Damude, 2003       |

Table 18 Continued.

| Species                                                                                                                                                                                                                                                                                                                                                                                                                         | Inhalation Rate                |                     | Surface Area         |           | Ingestion Rate             |                                    |           |           |             |                                       |                                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|---------------------|----------------------|-----------|----------------------------|------------------------------------|-----------|-----------|-------------|---------------------------------------|----------------------------------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                 | Mean                           | Source              | Mean                 | Source    | Range                      | Mean                               | g dw /day | Food Type | Source      | Mean (g Wet Weight/day <sup>4</sup> ) | Mean (kg Wet Weight/day <sup>4</sup> ) |
| Indiana Bat<br>( <i>Myotis sodalis</i> )                                                                                                                                                                                                                                                                                                                                                                                        | 0.00034<br>m <sup>3</sup> /day | BHE, 2001           | 0.022 m <sup>2</sup> | BHE, 2001 |                            | 0.0025 kg/day                      | 2.5       | Insect    | BHE, 2001   | 4.25                                  | 0.00425                                |
| Gray Bat<br>( <i>Myotis grisescens</i> )                                                                                                                                                                                                                                                                                                                                                                                        | 0.00034<br>m <sup>3</sup> /day | BHE, 2001           | 0.026 m <sup>2</sup> | BHE, 2001 |                            | 0.0025 Kg/day                      | 2.5       | Insect    | BHE, 2001   | 4.25                                  | 0.00425                                |
| Gopher Tortoise<br>( <i>Gopherus polyphemus</i> )                                                                                                                                                                                                                                                                                                                                                                               |                                |                     |                      |           |                            | 11.6 g dry matter/day              | 11.6      | Plant     | Nagy, 2001  | 20.90                                 | 0.02090                                |
| Desert Tortoise<br>( <i>Gopherus agassizii</i> )                                                                                                                                                                                                                                                                                                                                                                                |                                |                     |                      |           | 0 - 15.6 g dry matter/Kg/d | 4.52 g dry matter/Kg/d             | 4.52      | Plant     | Cal/ECOTOX  | 8.14                                  | 0.00814                                |
| Red-Cockaded Woodpecker<br>( <i>Picoides borealis</i> )                                                                                                                                                                                                                                                                                                                                                                         | 0.045<br>L/min <sup>1</sup>    | Driver et al., 2002 |                      |           |                            | 9.00 g dry matter/day <sup>3</sup> | 9         | Insect    | USEPA, 1993 | 15.30                                 | 0.01530                                |
| Black-Capped Vireo ( <i>Vireo atricapillus</i> )                                                                                                                                                                                                                                                                                                                                                                                |                                |                     |                      |           |                            | 2.82 g dry matter/day <sup>2</sup> | 2.82      | Insect    | USEPA, 1993 | 4.79                                  | 0.00479                                |
| Golden-Cheeked Warbler ( <i>Dendroica chrysoparia</i> )                                                                                                                                                                                                                                                                                                                                                                         |                                |                     |                      |           |                            | 2.82 g dry matter/day <sup>2</sup> | 2.82      | Insect    | USEPA, 1993 | 4.79                                  | 0.00479                                |
| Notes: 1 Calculated using Red-winged Blackbird as surrogate species.<br>2 Calculated using equation 3-4 IN USEPA Wildlife Exposure Factors Handbook. Vol. I. December 1993. EPA 600/R-93/187a.<br>3 Calculated using equation 3-3 IN USEPA Wildlife Exposure Factors Handbook. Vol. I. December 1993. EPA 600/R-93/187a.<br>4 Wet weight ingestion rate calculated assuming 70% water for insect prey and 80% water for plants. |                                |                     |                      |           |                            |                                    |           |           |             |                                       |                                        |

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Table 19. Detailed dietary composition for the TES of concern.

| Golden-Cheeked Warbler        |                     |                                  |           |                 |
|-------------------------------|---------------------|----------------------------------|-----------|-----------------|
| Source                        | Diet Component      | Common Name                      | Food Type | Percent of Diet |
| Pulich, 1976 IN: USFWS, 1992  | Beetles             |                                  | Insect    | 32              |
|                               | Caterpillars        |                                  | Insect    | 17              |
|                               | Homoptera           | Winged insects                   | Insect    | 17              |
|                               | Hemiptera           | Winged insects                   | Insect    | 13              |
|                               | Spiders             | Spiders                          | Insect    | 11              |
| Kroll, 1980 IN: USFWS, 1992   | Lepidopteran larvae | Moths                            | Insect    | 54              |
|                               | Orthoptera          | Grasshoppers, crickets           | Insect    | 13              |
| Black-Capped Vireo            |                     |                                  |           |                 |
| Source                        | Diet Component      | Common Name                      | Food Type | Percent of Diet |
| Graber, 1961                  | Wintering Months    |                                  |           |                 |
|                               | Vegetable Matter    |                                  | Plant     | 38              |
|                               | Spiders             |                                  | Insect    | 2               |
|                               | Odonata             | Dragonflies, damselflies         | Insect    | 3               |
|                               | Hemiptera           | Winged insects                   | Insect    | 7               |
|                               | Coleoptera          | Beetles                          | Insect    | 5               |
|                               | Lepidoptera         | Moth                             | Insect    | 43              |
|                               | Diptera             | True flies                       | Insect    | 2               |
|                               |                     |                                  |           |                 |
|                               | Nesting Months      |                                  |           |                 |
|                               | Vegetable Matter    |                                  | Plant     | 1               |
|                               | Spiders             |                                  | Insect    | 4               |
|                               | Centipedes          |                                  | Insect    | 6               |
|                               | Orthoptera          | Grasshoppers, crickets           | Insect    | 3               |
|                               | Hemiptera           | Winged insects                   | Insect    | 1               |
|                               | Homoptera           | Winged insects                   | Insect    | 3               |
|                               | Coleoptera          | Beetles                          | Insect    | 28              |
|                               | Lepidoptera         | Moth                             | Insect    | 53              |
|                               | Diptera             | True flies                       | Insect    | 1               |
|                               |                     |                                  |           |                 |
| Gopher Tortoise               |                     |                                  |           |                 |
| Source                        | Diet Component      | Common Name                      | Food Type | Percent of Diet |
| Macdonald and Mushinsky, 1988 | Plant Family        |                                  |           |                 |
|                               | Asteraceae          | Daisies, dandelion, thistles     | Plant     | 8               |
|                               | Bromeliaceae        | Bromeliads                       | Plant     | 5.1             |
|                               | Cyperaceae          | Sedges                           | Plant     | 3               |
|                               | Ericaceae           | Rhododendron, heather, blueberry | Plant     | 1.8             |
|                               | Euphorbiaceae       | Shrubs                           | Plant     | 5.5             |
|                               | Fabaceae            | Herbs                            | Plant     | 7.3             |
|                               | Fagaceae            | Chestnut, oak                    | Plant     | 9.1             |

|                                   |                         |                          |       |      |
|-----------------------------------|-------------------------|--------------------------|-------|------|
|                                   | Iridaceae               | Iris                     | Plant | 1.1  |
|                                   | Pinaceae                | Fir, cedar, spruce, pine | Plant | 9.7  |
|                                   | Poaceae                 | Grasses                  | Plant | 31.3 |
|                                   | Polygonaceae            | Herbs and shrubs         | Plant | 3.9  |
|                                   | Rosaceae                | Berries, wild rose       | Plant | 1.5  |
|                                   | Rubiaceae               | Small trees, shrubs      | Plant | 4.8  |
|                                   | Scrophulariaceae        | Flowering herbs          | Plant | 1.5  |
| Garner<br>and<br>Landers,<br>1981 | April - mid May         |                          |       |      |
|                                   | Broad-Leaved<br>Grasses |                          | Plant | 90   |
|                                   | Legumes                 |                          | Plant | 5    |
|                                   | Minor Plants            |                          | Plant | 3    |
|                                   | Dead Pine Leaves        |                          | Plant | 1    |
|                                   | mid May - June          |                          |       |      |
|                                   | Broad-Leaved<br>Grasses |                          | Plant | 48   |
|                                   | Wiregrass               |                          | Plant | 1    |
|                                   | Legumes                 |                          | Plant | 14   |
|                                   | Morning Glory           | Shrub                    | Plant | 16   |
|                                   | Dyschoriste             | Flowering herb           | Plant | 6    |
|                                   | Poor Joe                | Shrub                    | Plant | 3    |
|                                   | Fleshy Fruit            |                          | Plant | 1    |
|                                   | Minor Plants            |                          | Plant | 8    |
|                                   | Dead Pine Leaves        |                          | Plant | 3    |
|                                   |                         |                          |       |      |
|                                   | July - Sep              |                          |       |      |
|                                   | Broad-Leaved<br>Grasses |                          | Plant | 66   |
|                                   | Wiregrass               |                          | Plant | 1    |
|                                   | Legumes                 |                          | Plant | 5    |
|                                   | Morning Glory           | Shrub                    | Plant | 1    |
|                                   | Dyschoriste             | Flowering herb           | Plant | 5    |
|                                   | Poor Joe                | Shrub                    | Plant | 3    |
|                                   | Fleshy Fruit            |                          | Plant | 5    |
|                                   | Florida Pussley         | Shrub                    | Plant | 7    |
|                                   | Minor Plants            |                          | Plant | 4    |
|                                   | Dead Pine Leaves        |                          | Plant | 1    |
|                                   | Oct - Dec               |                          |       |      |
|                                   | Broad-Leaved<br>Grasses |                          | Plant | 86   |
|                                   | Wiregrass               |                          | Plant | 1    |
|                                   | Poor Joe                | Shrub                    | Plant | 9    |
|                                   | Pawpaw                  | Fruiting tree            | Plant | 1    |
|                                   | Dead Pine Leaves        |                          | Plant | 1    |

| Indiana Bat           |                               |                   |           |                 |
|-----------------------|-------------------------------|-------------------|-----------|-----------------|
| Source                | Diet Component                | Common Name       | Food Type | Percent of Diet |
| Brack and LaVal, 1985 | Lepidoptera                   | Moth              | Insect    | 83              |
|                       | Coleoptera                    | Beetles           | Insect    | 8               |
|                       | Diptera                       | True flies        | Insect    | 1               |
|                       | Trichoptera                   | Caddisflies       | Insect    | 4               |
|                       | Plecoptera                    | Stoneflies        | Insect    | 1               |
|                       | Homoptera                     | Winged insects    | Insect    | 2               |
|                       | Other                         |                   | Insect    | 1               |
| Whitaker, 1972        | Hymenoptera                   | Ants, wasps, bees | Insect    | 50              |
|                       | Homoptera                     | Winged insects    | Insect    | 19              |
|                       | Coleoptera                    | Beetles           | Insect    | 24              |
| Desert Tortoise       |                               |                   |           |                 |
| Source                | Diet Component                | Common Name       |           | Percent of Diet |
| Nagy and Medica, 1986 | <i>Langloisia setosissima</i> | Flowering herb    | Plant     | 39.5            |
|                       | <i>Camissonia munzii</i>      | Flowering herb    | Plant     | 34              |
|                       | <i>Oryzopsis hymenoides</i>   | Ricegrass         | Plant     | 14.5            |
|                       | <i>Bromus rubens</i>          | Grass             | Plant     | 11.5            |
|                       | Other                         |                   | Plant     | 0.5             |
| Hansen et al., 1976   | Threeawn                      | Grass             | Plant     | 13              |
|                       | Globemallow                   | Flowering shrub   | Plant     | 9               |
|                       | Slim tridens                  | Grass             | Plant     | 23              |
|                       | Foxtail brome                 | Grass             | Plant     | 28              |
|                       | Red grama                     | Grass             | Plant     | 2               |
|                       | Sedge                         | Grass             | Plant     | 1               |
|                       | Bush muhly                    | Grass             | Plant     | 6               |
|                       | Slender janusia               | Shrub             | Plant     | 4               |
|                       | Redstem filaree               | Herb              | Plant     | 8               |
|                       | Common winterfat              | Sage              | Plant     | 2               |
|                       | Vetch                         | Flowering herb    | Plant     | 1               |
|                       | Other                         |                   | Plant     | 2               |
| Gray Bat              |                               |                   |           |                 |
| Source                | Diet Component                | Common Name       | Food Type | Percent of Diet |
| Best et al., 1997     | Lepidoptera                   | Moths             | Insect    | 36              |
|                       | Diptera                       | True flies        | Insect    | 26              |
|                       | Coleoptera                    | Beetles           | Insect    | 11              |
|                       | Insecta                       | Insects           | Insect    | 8               |
|                       | Unknown                       |                   | Insect    | 7               |
|                       | Trichoptera                   | Caddisflies       | Insect    | 5               |
|                       | Hemiptera                     | Winged insects    | Insect    | 2               |
|                       | Homoptera                     | Winged insects    | Insect    | 2               |
|                       | Hymenoptera                   | Ants, wasps, bees | Insect    | 2               |

| Indiana Bat               |                              |                |           |                 |
|---------------------------|------------------------------|----------------|-----------|-----------------|
| Source                    | Diet Component               | Common Name    | Food Type | Percent of Diet |
|                           | Ephemeroptera                | Mayflies       | Insect    | 1               |
|                           | Araneae                      | Spiders        | Insect    | 1               |
|                           | Other                        |                | Insect    | 1               |
| Red-Cockaded Woodpecker   |                              |                |           |                 |
| Source                    | Diet Component               | Common Name    | Food Type | Percent of Diet |
| Hanula and Franzreb, 1995 | Diet fed to nestlings        |                |           |                 |
|                           | Wood Roach                   |                | Insect    | 69              |
|                           | Wood Borer Beetle larva      |                | Insect    | 5               |
|                           | Moth larva                   |                | Insect    | 5               |
|                           | Spider                       |                | Insect    | 4               |
|                           | Ant                          |                | Insect    | 3               |
|                           | Longhorned grasshopper       |                | Insect    | 3               |
|                           | Centipede                    |                | Insect    | 3               |
|                           | Insect larva                 |                | Insect    | 5               |
|                           | Beetle larva                 |                | Insect    | 1               |
|                           | Moth or butterfly larva      |                | Insect    | 1               |
| Hess and James, 1998      | Adults                       |                |           |                 |
|                           | Ants (larvae, pupae, adults) |                | Insect    | 58              |
|                           | Beetles (larvae, adults)     |                | Insect    | 7               |
|                           | Unidentified larvae          |                | Insect    | 3               |
|                           | Hemiptera                    | Winged insects | Insect    | 2               |
|                           | Spiders                      |                | Insect    | 2               |
|                           | Centipedes                   |                | Insect    | 1               |
|                           | Carpenter bees               |                | Insect    | 0               |
|                           | Roaches                      |                | Insect    | 1               |
|                           | Lepidoptera                  | Moth           | Insect    | 0               |
|                           | Tabanid flies                |                | Insect    | 0               |
|                           | Miscellaneous                |                | Insect    | 1               |
|                           | Unknown                      |                | Insect    | 2               |
|                           | Fruit and seeds              |                | Plant     | 16              |
|                           | Wood                         |                | Plant     | 9               |
|                           | Nestlings                    |                |           |                 |
|                           | Ants (larvae, pupae, adults) |                | Insect    | 15              |
|                           | Beetles (larvae, adults)     |                | Insect    | 14              |
|                           | Unidentified larvae          |                | Insect    | 3               |
|                           | Hemiptera                    | Winged insects | Insect    | 2               |
|                           | Spiders                      |                | Insect    | 15              |
|                           | Centipedes                   |                | Insect    | 12              |
|                           | Carpenter bees               |                | Insect    | 5               |
|                           | Roaches                      |                | Insect    | 3               |
|                           | Lepidoptera                  | Moth           | Insect    | 2               |
|                           | Tabanid flies                |                | Insect    | 2               |

| Indiana Bat         |                                |                   |           |                 |
|---------------------|--------------------------------|-------------------|-----------|-----------------|
| Source              | Diet Component                 | Common Name       | Food Type | Percent of Diet |
|                     | Miscellaneous                  |                   | Insect    | 3               |
|                     | Unknown                        |                   | Insect    | 5               |
|                     | Fruit and seeds                |                   | Plant     | 1               |
|                     | Wood                           |                   | Plant     | 18              |
|                     |                                |                   |           |                 |
| Hanula et al., 2000 | Diet fed to nestlings          |                   |           |                 |
|                     | Wood Roach                     |                   | Insect    | 51              |
|                     | Caterpillar                    |                   | Insect    | 8               |
|                     | Spider                         |                   | Insect    | 7               |
|                     | Wood Borer larvae              |                   | Insect    | 4               |
|                     | Beetle (larvae, pupae, adults) |                   | Insect    | 5               |
|                     | Ant (larvae, adults)           |                   | Insect    | 4               |
|                     | Blueberry                      |                   | Plant     | 4               |
|                     | Centipede                      |                   | Insect    | 4               |
|                     | Insect (larvae, adults)        |                   | Insect    | 9               |
|                     | Hymenoptera (larvae, adults)   | Ants, wasps, bees | Insect    | 2               |
|                     | Lepidoptera pupae              | Moth              | Insect    | 1               |
|                     | Sawfly larvae                  |                   | Insect    | 1               |
|                     | Other                          |                   | Insect    | 1               |

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Figure 13. Species distribution of the Indiana bat.

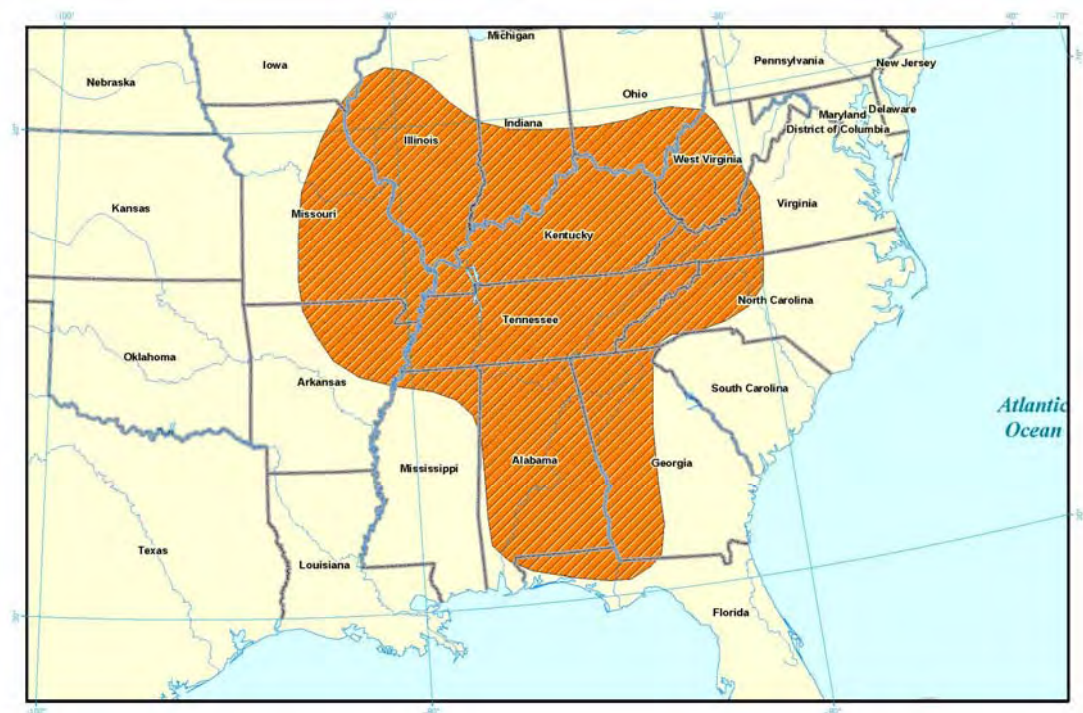


Figure 14. Species distribution of the gray bat.



Figure 15. Approximate species distribution of the gopher tortoise.

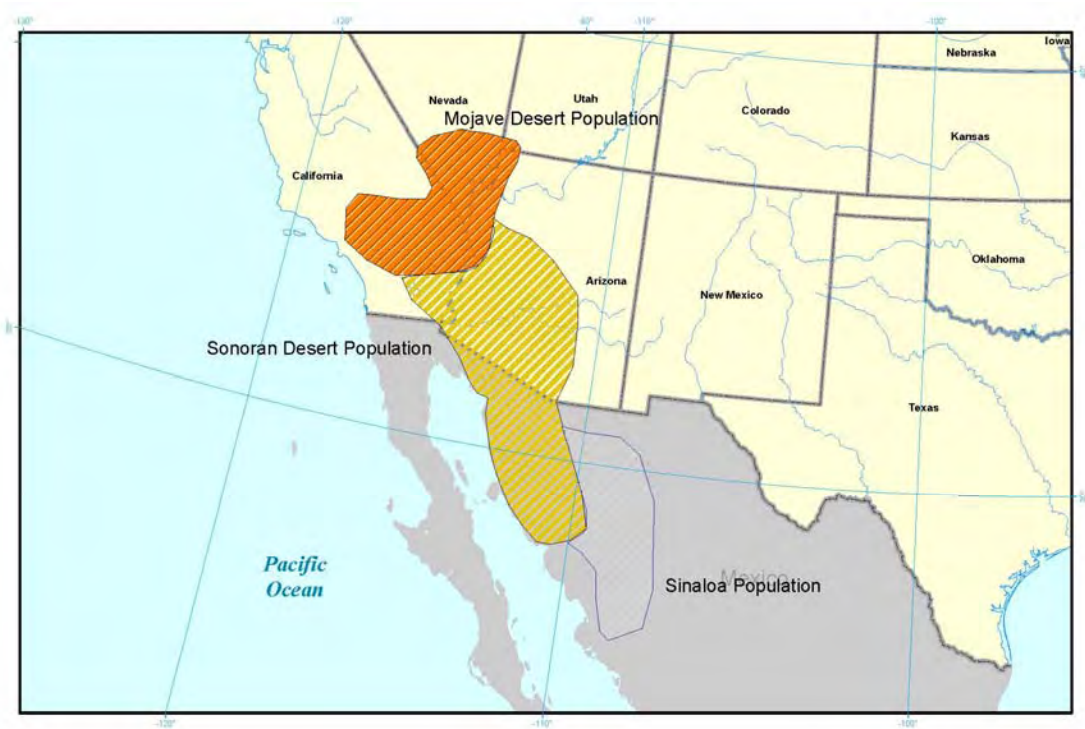


Figure 16. Approximate species distribution of the desert tortoise.

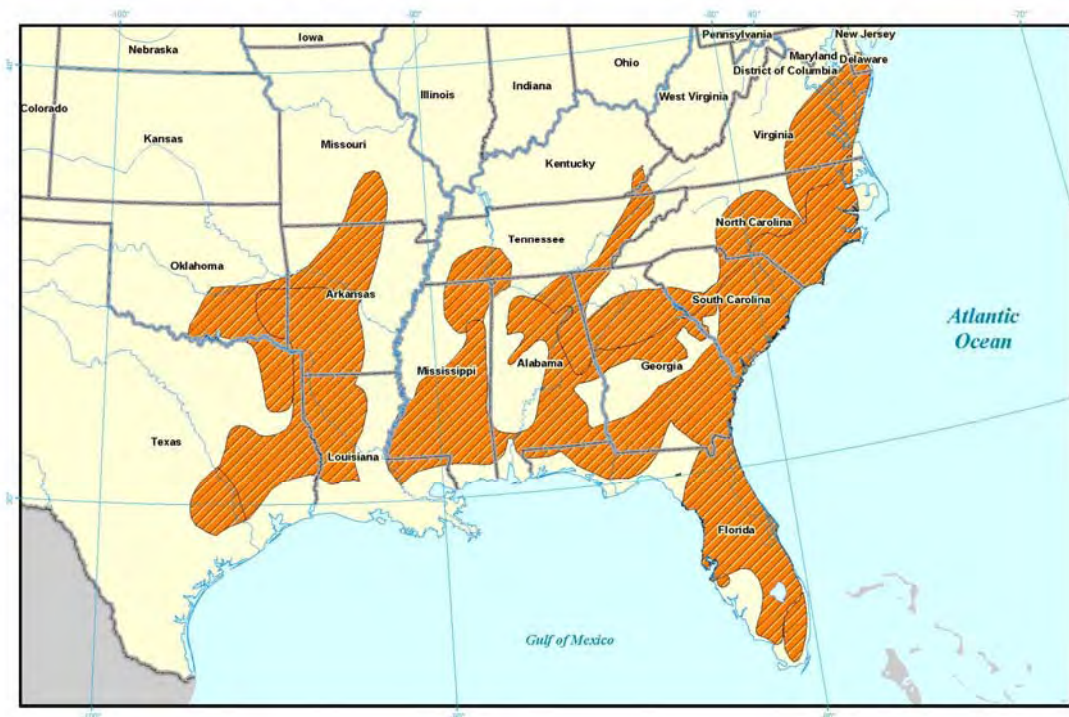


Figure 17. Species distribution of the red-cockaded woodpecker.



Figure 18. Species distribution of the black-capped vireo.

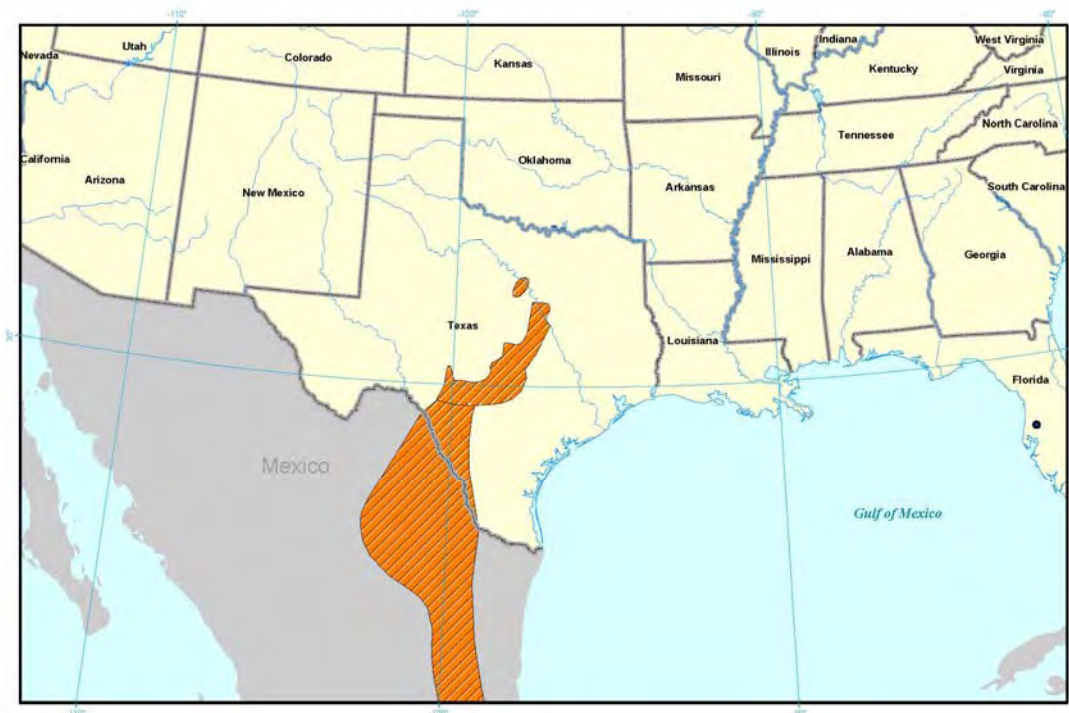


Figure 19. Species distribution of the golden-cheeked warbler.

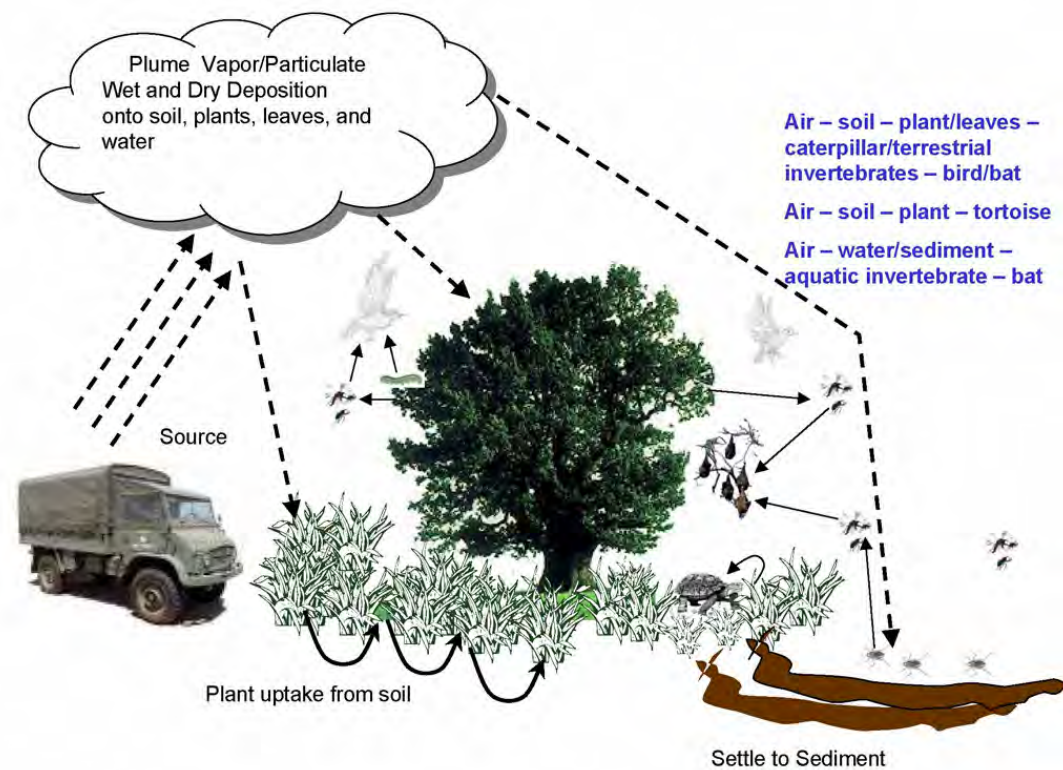


Figure 20. Exposure pathways for smokes and obscurants.

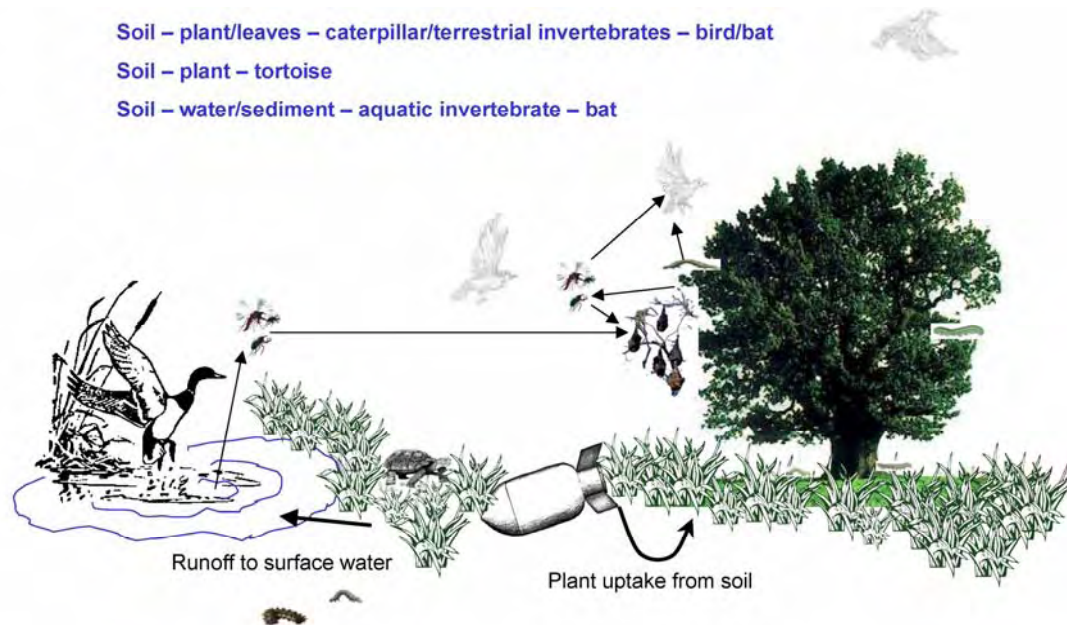


Figure 21. Exposure pathways for munitions.

## 4 Exposure Assessment

An exposure assessment quantifies the concentrations of contaminants that the receptors of concern are exposed to in the environment. The following procedure was used to estimate doses to receptors of concern at each installation:

1. Determine munition and smoke and obscurant usage at each installation based on data presented in Chapter 2 (page 6).
2. Determine chemical composition of each munition and smoke and obscurant as presented in General Munitions Database)(page 118);
3. Determine the dud and low order firing rate for the munitions as presented in General Munitions Database (page 118);
4. Use maximum estimates from the literature of smoke and obscurant deposition as presented in Expected Soil Concentrations (page 121);
5. Combine the usage statistics with steps 3 and 4 to predict expected soil concentrations;
6. Model uptake into food items (e.g., plants, soil fauna, terrestrial insects, etc.) as presented in Modeling Contaminant Migration (page 122); and
7. Estimate doses to receptors of concern as presented in Profiles for Receptors of Concern (page 89) based on the exposure parameters developed and presented in Predicted Doses to Receptors of Concern (page 125).

Each of these steps will be discussed in the following sections.

### Step 1: Determine Constituent Use at Each Installation

Tables 1 through 5 and 7 through 17 provide summaries of ammunition usage at each installation. These are used together with the chemical profiles, as presented in the following section, to obtain the mass of chemical (in grams) found at each installation during 2002.

### Step 2: Determine Chemical Profiles of Smokes and Obscurants and Munitions

This section summarizes the chemical properties and constituents of each of the S&Os and MUCs being evaluated. S&Os and MUCs differ in the ways in which they are used and dispersed in the environment and require different ways of esti-

minating potential exposures. S&Os are used to generate cover to hide movement or otherwise distort visual and non-visual wavelengths. Heavy artillery is fired in specifically identified impact areas in order to avoid human contact. Hand-held artillery (e.g., small arms) can be used anywhere on the installation at identified training areas.

### **General Munitions Database**

Each munition is identified by a Department of Defense Identification Code (DoDIC) and is further identified by a National Stock Number (NSN), which is a code given to any piece of equipment used or purchased by the U.S. government. Therefore, each munition type is associated with its own DoDIC/NSN combination, although these may not be unique. In this project, researchers developed a database for each DoDIC identified at each installation that details relevant constituents by percent weight. They used the Defense Ammunition Center (DAC) website ([www.dac.army.mil](http://www.dac.army.mil)) to access the Munitions Items Disposition Action System (MIDAS), which provides details on munition composition. The TRI Data Delivery System (TRI-DDS) supports munitions demilitarization through open burning (OB) and open detonation (OD) as well as munitions activities on ranges. TRI-DDS provides information on munitions statistics and usage under a self-reporting system. The following data elements are the basic inputs to TRI-DDS as obtained from treatment logs, range usage or scheduling logs and data systems, emergency response and training logs, or other data collection mechanisms:

- DODIC, NSN, drawing number (for components), or common name.
- Description of item (helps with nomenclature search, selecting substitutes for items not in TRI-DDS, and common name pick list selection).
- Quantity used.
- Unit of use.
- Fuels, initiators, and donor charges (if applicable).

However, there are TRI-DDS reporting thresholds so the usage statistics as provided by the installations was used directly. Researchers consulted TRI-DDS to determine the specific munition name for the DoDIC/NSN combination provided by the installations. They developed the following procedure to quantify chemicals based on installation munition usage:

1. Search TRI-DDS by DODIC for the “preferred” NSN.
2. Search MIDAS Database by DoDIC.
  - If TRI-DDS indicates a preferred NSN, use datasheet for that NSN.
  - If TRI-DDS does not indicate a preferred NSN:
    - If only one NSN is in MIDAS, use that entry’s datasheet.
    - If multiple NSNs are in the MIDAS database:

- Since drawing numbers correspond to engineering revisions,\* find an NSN with the highest (latest) drawing number.
- If there are still multiple NSNs with the same drawing number, use the highest NSN by default. Since different NSNs for the same DoDIC refer only to differences in packaging,\* the compositions will not differ.
- 3. Within a datasheet, there may be alternate components or parts, designated by “(ALT)”. These alternate parts are used to make munitions only when the manufacturer runs out of the primary parts, so it is safe to assume that the majority of munitions are made of the primary parts.\* Only enter COCs from the primary structure of the munition.
- There will be some cases in which a COC is contained in the alternate composition of a part, but not in the primary. Even in this case, use the primary structure components since that composition represents the majority of the munitions produced.
- 4. Since most tracers are identical to ball projectiles in composition, aside from the added ignition/illuminatory compounds,\* munitions having a ball/tracer format will be entered using the composition of the ball.
- 5. Some DoDICs are “PROPRIETARY,” in which case the composition is not available in MIDAS.

The database provides a detailed accounting of the constituents contained in each munition, which provides the mass of each chemical associated with each individual DoDIC. However, that is not the amount of material that is deposited in the environment. When the munitions fire properly, they typically burn “clean” and do not leave any residual contamination in the environment. However, munitions occasionally fire incorrectly and end up in the environment where the munition constituents may become available to threatened and endangered and other species that come into contact with them. This is referred to as a “dud” or low order detonation. A dud is a round that is fired, but fails to function and ultimately either penetrates the ground or comes to rest on the surface without firing (Dauphin and Doyle 2000). A low order detonation occurs when a high explosive round is fired, but functions only partially at the target such that part of the filler detonates and part of it does not. A misfire occurs when and an attempt is made to fire (e.g., pulling a trigger or dropping a mortar round down the tube) and nothing happens. In this case, nothing leaves the weapon and is not considered in estimates of the dud and low order detonation rates.

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\* Personal communication, U.S. Army Defense Ammunition Center – MIDAS database administrator, February 2004.

Dauphin and Doyle (2000, 2001) conducted a study of ammunition and dud and low order detonation rates for a number of ammunition types. Researchers in this study evaluated these reports to determine the dud rate percentage applicable to each munition type. Dauphin and Doyle (2000, 2001) did not evaluate small arms munitions (.50-caliber and below) as these items have non-explosive projectiles or only small tracer elements or incendiary charges and are therefore not assumed to contribute appreciably to environmental concentrations of chemicals.

The average dud rate for typical munitions is approximately 3 percent. The highest reported dud rate for any munition is approximately 18 percent for colored smoke grenades. However, this screening level assessment assumes that 100 percent of the colored smoke found in a grenade has the potential to disperse in the environment (that is, this report assumes there is no dud rate for colored smokes). In addition, this screening level assessment assumes two different dud rates across all munition types (with the exception of the colored smoke grenades):

- 10 percent (higher than the average dud rate given in Dauphin and Doyle [2000] and is considered a conservative estimate); and,
- 100 percent (assumes the entire mass of contaminant in the munitions is available for uptake into the food web).

A number of grenade types or formulations are used to administer various S&Os, particularly the colored smokes. The mass of dye in each of these is evaluated in its entirety, rather than applying the dud rate, since one expects the cloud to deposit each time. Since the exact location for use of these grenades is unknown, researchers assume that the entire mass of material contained in the colored smoke grenades will land on the same area as the munitions (e.g., the impact area). As these clouds are typically low to the ground and do not drift appreciably, researchers did not incorporate deposition estimates but rather conservatively worked with the entire mass of material being taken up in plants.

The list of constituent concentrations obtained via this method include:

|                                |                                   |
|--------------------------------|-----------------------------------|
| 2,4-Dinitrotoluene             | (o-chlorobenzol)-malonitrile (CS) |
| Dinitrotoluene (mixed isomers) | CI Basic Yellow 2                 |
| HMX                            | CI Disperse Yellow 11             |
| Dinitrobenzene                 | Dibenz(b,f)-1,4-oxazepine (CR)    |
| Nitroglycerin                  | Disperse Red 9                    |
| PETN                           | Dye Solvent Green 3               |
| RDX                            | Dye Solvent Yellow 33             |
| Tetryl                         | Dye Yellow 4                      |
| TNT                            | Dye Yellow Smoke 6                |
| Hexchloroethane (HC)           | Red Phosphorus                    |
| Terephthalic acid              | Titanium Dioxide                  |
| White Phosphorus               |                                   |

Several of the COCs are breakdown products from TNT, RDX, and HMX. These include 1,3,5-trinitrobenzene, 1,4-dinitrobenzene, dinitrophenol, nitrobenzene, and nitrophenol isomers. There are no data in MIDAS for these constituents as they are not directly part of any munitions. Talmage et al. (1999) suggests that 1,4-dinitrobenzene is typically less than 1 percent of the TNT concentration found, and that 1,3,5-trinitrobenzene is very similar to 1,4-dinitrobenzene. For this analysis, researchers assumed that 1,3,5-trinitrobenzene and 1,4-dinitrobenzene are present at 10 percent of the TNT value. They were unable to quantify the remaining compounds. Monitoring data from an installation could be evaluated to determine the relative proportion of these constituents as compared to TNT, RDX, and/or HMX. This ratio could then be applied across all installations in the absence of site-specific data.

### ***Smokes and obscurants***

S&Os differ from munitions in that the conceptual model involves the settling of residual smoke vapor and particles onto soil, leaves, and prey items for the selected threatened and endangered species. Although it is theoretically possible for S&O constituents deposited onto soils to be subsequently taken up by plants, there is virtually no data available to quantify this process. This analysis assumes that the entire quantity of S&O used in a given year at an installation deposits onto plants and is available for uptake by prey items. This is a conservative assumption given that it is likely there will be loss processes including precipitation, losses due to wind, and other local climactic influences.

The TRI-DDS/MIDAS procedure described above was used for hexachloroethane, white phosphorus, red phosphorus, colored smoke, and terephthalic acid. Researchers relied on the installations to provide details on graphite flakes, fog oil, and brass flakes. Researchers did obtain usage statistics for fog oil, but none of the installations provided quantitative information on graphite and brass flake usage.

## **Expected Soil Concentrations**

This section summarizes calculations of expected soil concentrations for all the COCs except fog oil, and including colored smokes (which are usually used as part of different grenade types). Fog oil and fog oil additives are deposited directly onto tree foliage and plants; therefore expected concentrations of these COCs in the environment are estimated for tree foliage and plants and not in soil.

The predicted concentration in soil is given as:

$$C_{soil} = \frac{C \times COC_{mass}}{A \times D \times Dens} \quad [\text{Equation 1}]$$

where:

- $C_{soil}$  = concentration in soil (mg/kg).
- $COC_{mass}$  = mass of munition/colored smoke from database (total amount used \* 10% dud rate; grams).
- $A$  = site-specific area over which munitions end up (typically the impact area; square miles).
- $D$  = dry depth of soil (cm).
- $Dens$  = dry soil bulk density (2.65 g/cm<sup>3</sup>).
- $C$  = conversion factor (3.86x10<sup>-11</sup>mi<sup>2</sup>/cm<sup>2</sup>\*10<sup>-6</sup>mg/kg).

## Modeling Contaminant Migration

This section summarizes calculations of COC concentrations in food items of threatened and endangered species of concern. COC concentrations in tree foliage and plants, terrestrial insects, and aquatic insects are calculated using modeling of chemical migration.

### ***Predicted concentrations in tree foliage and herbaceous plants***

Above-ground herbaceous plants and tree leaves are consumed by a number of threatened and endangered species or are consumed by other food (i.e., prey items) of those species (e.g., caterpillars and beetles). Chemicals can reach tree foliage and herbaceous plants by:

- Direct wet and dry deposition of S&O clouds following training exercises;
- Root uptake of both S&Os and MUCs from soil; and,
- Soil-to-plant “splash” transfer of both S&Os and MUCs to low-lying herbaceous plants.

This analysis quantifies the deposition of S&O clouds and root uptake from soil for MUCs. One expects the soil-to-plant “splash” transfer to be low compared to direct deposition, particularly considering that most, if not all, soils are covered by plants (ranging from grasses to trees) and so very little of the S&O actually reaches the soil. For the munitions, which are deposited directly on the ground, this is not the case, and one assumes that all material is available for uptake by plants.

## Fog Oil

Fog oil is potentially deposited onto plants and tree foliage via both wet and dry deposition of particulate matter found in the smoke cloud. This analysis relies on fog oil modeling results presented in Getz et al. (1996) based on Driver et al. (1993), which provides estimated environmental concentrations of fog oil following a 2-hr smoking exercise. This “worst-case” scenario (Getz et al. 1996) incorporates the following assumptions:

- The smoking exercise is 2 hours in length (most smoke training exercises last 30 to 90 min);
- The release rate is 80 gal (302 liters) per hour per generator with a total release of 160 gal per generator; and
- An area 1 km by 1 km is smoked (the cloud can be wider but less material would be deposited).

The following equation is used to estimate the concentration of fog oil and fog oil additives on plants and tree foliage:

$$C_{plant} = \frac{V_{fogoil} \times Dens_{fogoil}}{A \times P} \quad \text{[Equation 2]}$$

where:

- $C_{plant}$  = concentration on plants (mg/kg ww).  
 $V_{fogoil}$  = amount of fog oil deposited (gals).  
 $Dens_{fogoil}$  = density of fog oil (0.92 g/cm<sup>3</sup>).  
 $A$  = area over which fog oil is used (assumed to be 1 km by 1 km square or 0.39 mi<sup>2</sup>).  
 $P$  = plant yield (plants grass – 1 kg ww/m<sup>2</sup> and tree leaves = 1.5 kg ww/m<sup>2</sup>).  
 $C$  = conversion factor (3785 cm<sup>3</sup>/gallons\*1000mg/g\*3.86x10<sup>-8</sup>mi<sup>2</sup>/m<sup>2</sup>).

## Munitions and Colored Smokes

In this screening level assessment, root uptake is considered the dominant pathway by which munitions and colored smokes reach plants and tree foliage. The equation is given as:

$$C_{plant} = 7.7 \times K_{ow}^{-0.58} \times C_{soil} \quad \text{[Equation 3]}$$

where:

$C_{\text{plant}}$  = concentration in leaves and tree foliage via root uptake (mg/kg ww).

$K_{\text{ow}}$  = octanol-water partitioning coefficient.

$C_{\text{soil}}$  = concentration in soil (mg/kg dw).

### ***Predicted concentrations in terrestrial insects***

Several of the selected threatened and endangered species are known to consume a wide variety of arthropods, in particular terrestrial insects that are found in and among trees and other habitats. Many of these insects primarily consume leaves (i.e., tree leaves, grass leaves, etc.). For this analysis, assume that the insects are in equilibrium with predicted chemical concentrations in the tree leaves (as derived in the previous section). The equilibrium calculation is given as:

$$C_{\text{terr insect}} = \frac{C_{\text{leaf}} \times L_{\text{insect}} \times C}{L_{\text{leaf}}} \quad [\text{Equation 4}]$$

where:

$C_{\text{terr insect}}$  = concentration in terrestrial insects (mg/kg ww).

$C_{\text{leaf}}$  = concentration in the leaf (mg/kg ww).

$L_{\text{insect}}$  = lipid content of insects (10.5% dry weight).

$L_{\text{leaf}}$  = lipid content of tree leaves (0.5% wet weight).

$C$  = 0.29 dry weight insects / wet weight insects.

The lipid content of tree leaves was obtained from Nutrition Analysis Tool and System version 1.1 at <http://www.ag.uiuc.edu/~food-lab/nat/mainnat.html>. The value is for an average lipid content of green leaf lettuce, Romaine lettuce, kale, collards, and chard. Although these are leafy vegetables (which does correspond to the yield estimates from Baes et al. 1984), the leaf structure and composition is similar as for herbaceous plants as well as leafy green trees. The lipid content of insects typically ranges from 1 to 10 percent with a wet to dry conversion factor of 0.29 obtained from U.S. Department of Energy (1998).

### ***Predicted concentrations in aquatic insects***

Chemicals found in S&Os can land directly on water bodies within the deposition area of the cloud. Some of the material will volatilize from the water, but some of it will “partition” onto particles in the water column and eventually settle into the sediments. Once in the sediment, emergent aquatic insects can be exposed to chemicals in the sediment while in their larval stage. Typically, these insects will then travel through the water column and emerge from the water where they may

become prey items for the identified bats and birds in general. Predicted concentrations in sediment are given as:

$$C_{sed} = \frac{V_{fogoil} \times Dens_{fogoil} \times C}{A \times Dens_{sed} \times D} \quad [\text{Equation 5}]$$

where:

- $C_{sed}$  = concentration in sediment (mg/kg dw).
- $V_{fogoil}$  = volume of fog oil deposited onto water body (gallons).
- $Dens_{fogoil}$  = density of fog oil (0.92 g/cm<sup>3</sup>).
- $A$  = area over which fog oil is deposited (1 km by 1 km or 0.39 mi<sup>2</sup>).
- $Dens_{sed}$  = density of dry sediment (2.65 g/cm<sup>3</sup>).
- $D$  = depth of dry sediment (1 cm).
- $C$  = conversion factor (3785 cm<sup>3</sup>/gallons\*3.86x10<sup>-11</sup>mi<sup>2</sup>/cm<sup>2</sup>\*10<sup>-6</sup>mg/kg).

The concentration in benthic invertebrates (i.e., aquatic insects) is given as:

$$C_{benth} = \frac{C_{sed} \times L_{benth} \times C}{TOC} \quad [\text{Equation 6}]$$

where:

- $C_{benth}$  = predicted concentration in benthic invertebrates (mg/kg ww).
- $C_{sed}$  = concentration in sediment (mg/kg dw).
- $L_{benth}$  = lipid content of benthic invertebrates (10.5% dry weight).
- $TOC$  = total organic carbon of sediment (1.5%).
- $C$  = 0.29 dry weight insects / wet weight invertebrates.

Chemicals found in S&Os and munitions can runoff from soils into water and settle to the sediments. Similarly, aquatic insects in their larval stage can be exposed to these chemicals in the water column prior to larval emergence from the water. This exposure pathway is not quantified in this screening level assessment.

## Predicted Doses to Receptors of Concern

Table 18 provides a summary of exposure parameters for the threatened and endangered species of concern based on information from Profiles for Receptors of Concern (page 89). The general equation for predicting doses to the threatened and endangered species of concern is given as:

$$Dose_{tes} = \frac{\Sigma C_{preyitem} \times IR_{preyitem}}{BW} \quad [\text{Equation 7}]$$

where:

Dose<sub>TES</sub> = dose to receptor (mg/kg bw-day).

C<sub>preyitem</sub> = concentration in plants, terrestrial insects, aquatic insects.

IR<sub>preyitem</sub> = ingestion rate for the specific prey item.

BW = receptor body weight (kg).

The exposure summaries are provided as part of the Risk Characterization and in Tables 26 through 40. (These tables are at the end of Chapter 6, beginning on page 160.)

## 5 Effects Assessment

This chapter provides toxicity profiles for the S&Os and MUCs being evaluated and develops TRVs for comparison of predicted doses to the selected threatened and endangered species to ascertain the potential for adverse effects as a result of expected exposures.

The general approach was to:

- Conduct a literature review;
- Characterize the types of studies for developing the TRV;
- Specify a method for deriving TRVs; and
- Select the TRVs for receptors of concern.

### Literature Review

A search of the primary literature was conducted through the following sources: Cambridge Scientific Abstracts, National Library of Medicine (NLM) TOXNET, which includes Hazardous Substances Data Base (HSDB), Integrated Risk Information System (IRIS), GENE-TOX, Chemical Carcinogenesis Research Information System, TOXLINE, Developmental and Reproductive Toxicology and Environmental Teratology Information Center, Toxics Release Inventory (TRI), USEPA's ECOTOX, and references contained in retrieved articles (e.g., Von Stackelberg et al. 2004, 2005).

### Characterize the Types of Studies for Developing the TRV

Results of studies identified in the literature review were characterized according to the following criteria:

*A. Use population-level endpoints.* Where possible, researchers used reproductive endpoints. Toxicity endpoints that are related to adverse impacts on survival, growth, or reproduction are thought to have greater potential for adverse effects on populations of organisms than endpoints that are related to other effects. For example, changes in behavior, disease, cell structure, immunological responses, and hormonal or biochemical changes may affect individual organisms, but may not result in adverse effects at the population level. Therefore, researchers may discuss

studies that examine the effects of COCs on other sublethal endpoints but not use them to select TRVs. In general, researchers assumed that effects on reproduction represent a more sensitive endpoint than growth or mortality of adult organisms. This may not always be the case.

*B. Use chronic studies.* Researchers preferentially used studies of chronic exposure to select TRVs. In cases where exposures are expected to be long-term, data from studies of chronic exposure are preferable to data from medium-term (subchronic), short-term (acute), or single-exposure studies (USEPA 1997).

*C. Use dose response studies.* Where possible, researchers used studies that exhibited a dose response and could provide doses from above and below the threshold level examined in the study. Such dose-response studies compare the response of organisms exposed to a range of doses to that of a control group. The toxicity metrics derived from dose-response (and other) studies include:

- NOAEL (No Observed Adverse Effect Level) or NOEC (No Observed Effect Concentration). The NOAEL or NOEC is the highest exposure level shown to be without adverse effect in organisms exposed to a range of doses. NOAELs may be expressed as dietary doses (e.g., mg COC consumed/kg body weight/day) or as a concentration in food. In some cases for the COC/COPC for this study where the transport is to soil or foliar surfaces, the NOEC was expressed as concentration per area ( $\mu\text{g}/\text{cm}^2$ );
- LOAEL (Lowest Observed Adverse Effect Level) or LOEC (Lowest Observed Effect Concentration). The LOAEL or LOEC is the lowest exposure level shown to produce an adverse effect in organisms exposed to a range of doses. LOAELs may be expressed as dietary doses (e.g., mg COC consumed/kg body weight/day). The LOAEL represents a concentration at which the particular effect has been observed and the occurrence of the effect is statistically significantly different from the control organisms. In some cases for the COPCs for this study where the transport is to soil or foliar surfaces, the NOEC was expressed as concentration per area ( $\mu\text{g}/\text{cm}^2$ );
- LD<sub>50</sub>. The LD<sub>50</sub> is the Lethal Dose that results in death of 50 percent of the exposed organisms. The LD<sub>50</sub> is expressed in units of dose (e.g., mg COC administered/kg body weight of test organism);
- LC<sub>50</sub>. The LC<sub>50</sub> is the Lethal Concentration in some external media (e.g., food, water, or sediment) that results in death of 50 percent of the exposed organisms. The LC<sub>50</sub> is expressed in units of concentration (e.g., mg COC/kg wet weight food);
- ED<sub>50</sub>. The ED<sub>50</sub> is the Effective Dose that results in a sublethal effect in 50 percent of the exposed organisms (mg/kg/day);

- **EC<sub>50</sub>.** EC<sub>50</sub> is the Effective Concentration in some external media that results in a sublethal effect in 50 percent of the exposed organisms (mg/kg) or as a concentration in tissues (e.g., mg COC/kg tissue);
- **EL-effect.** EL-effect is the effect level that results in an adverse effect in organisms exposed to a single dose, rather than a range of doses [expressed in units of dose (mg/kg/day) or concentration (mg/kg)] or as a concentration in tissues (e.g., mg COC/kg tissue);
- **EL-no effect.** EL-no effect is the effect level that does not result in an adverse effect in organisms exposed to a single dose, rather than a range of doses [expressed in units of dose (mg/kg/d) or concentration (mg/kg)] or as a concentration in tissues (e.g., mg COC/kg tissue).

*D. Use NOAELs and LOAELs.* Most USEPA risk assessments typically estimate risk by comparing the exposure of receptors of concern to TRVs derived from NOAELs. The TRVs for this assessment are derived from NOAELs and LOAELs to provide perspective on the range of potential effects relative to measured or modeled exposures.

*E. Select TRVs on the basis of the most likely route of exposure.* Differences in feeding behaviors among organisms determine the type of toxicity endpoints that are most easily measured and most useful in assessing risk. In some studies, doses are administered via gavage, intraperitoneal injection into an adult, or injection into a fish or bird egg. TRVs for the present risk assessment are selected on the basis of the most likely route of exposure, as described below:

- TRVs for soil invertebrates are expressed as concentrations in external media (e.g., mg/kg soil) and as a mass of contaminant deposited per unit area of soil (ug/cm<sup>2</sup>).
- TRVs for plants are expressed as concentrations in external media (e.g., mg/kg soil or foliage) and as a mass of contaminant deposited per unit area of soil or foliage (ug/cm<sup>2</sup>).
- TRVs for reptiles, birds, and mammals are expressed as daily dietary doses (e.g., mg/kg whole body wt/day).

Use TRVs that bracket the range of risks to address uncertainty.

*F. Consider the use of appropriate field studies to derive TRVs, where available.* The literature on toxic effects includes laboratory and field studies. Each type of study has advantages and disadvantages for deriving TRVs. Laboratory studies can control for co-occurring contaminants, thus providing greater confidence in the conclusion that observed effects are related to exposure to the test compound. Field studies have the advantage that organisms may be exposed to a more realistic mixture of COCs than are organisms that are exposed to technical grades in the laboratory. Field studies have the disadvantage that organisms are often exposed to other

contaminants and observed effects may not be attributable solely to exposure to a given COC.

Laboratory studies often use species that are easily maintained in the laboratory, rather than wildlife species that may be more closely related to a particular receptor of concern. Field studies may be used most successfully to establish concentrations of COCs at which adverse effects are not observed (e.g., a NOAEL).

If appropriate field studies are available, those field studies may be used to derive NOAEL TRVs for receptors of concern. Appropriateness of a field study depends on whether:

- the study examines sensitive endpoints, such as reproductive effects, in a species that is closely related (e.g., within the same taxonomic family) to the receptor of concern;
- measured exposure concentrations of COCs are reported for dietary doses or whole organisms;
- the study establishes a dose-response relationship between exposure concentrations of COCs and observed effects; and
- contributions of co-occurring chemicals are reported and considered to be negligible in comparison to the contribution of COCs.

Use laboratory studies if appropriate field studies are not available for a test species in the same taxonomic family as the receptor species.

## Methodology to Derive TRVs

This section describes the general methodology to derive TRVs from appropriate studies for receptors of concern. When appropriate chronic-exposure toxicity studies on the effects of COCs on lethality, growth, or reproduction were not available for a selected threatened and endangered species, researchers extrapolated from other studies to estimate appropriate TRVs. This method follows the general protocols employed elsewhere (e.g., Sample et al. 1996, California EPA 1996, USEPA 1996). The general methodology to develop LOAEL and NOAEL TRVs followed several steps.

1. If an appropriate NOAEL and LOAEL was unavailable for the species of concern or for a phylogenetically similar species (e.g., within the same taxonomic family), the assessment developed TRV values from studies conducted on other species, and used the highest appropriate NOAEL whenever several studies were available.
2. In the absence of an appropriate NOAEL and if an LOAEL was available for a phylogenetically similar species, researchers divided by an uncertainty factor of

- 10 to account for an LOAEL-to-NOAEL conversion, except where noted. The LOAEL-to-NOAEL conversion is similar to USEPA's derivation of a human health Reference Dose (RfD).
3. When calculating chronic dietary dose-based TRVs (e.g., mg/kg-day) from data for sub-chronic tests, the sub-chronic LOAEL or NOAEL values were divided by an uncertainty factor of 10 to estimate chronic TRVs. The use of an uncertainty factor of 10 is consistent with the methodology used to derive human health RfDs. These factors are applied to account for uncertainty in using an external dose (mg/kg/day in diet) as a surrogate for the dose at the site of toxic action (e.g., mg/kg in tissue). Since organisms may attain a toxic dose at the site of toxic action (e.g., in tissues or organs) via a large dose administered over a short period, or via a smaller dose administered over a longer period, uncertainty factors are used to estimate the smallest dose that, if administered chronically, would result in a toxic dose at the site of action. USEPA has not established a definitive line between sub-chronic and chronic exposures for ecological receptors. The present risk assessment follows recently developed guidance (Sample et al. 1996), which considers 10 weeks to be the minimum time for chronic exposure of birds and 1 year for chronic exposure of mammals.
  4. In cases where NOAELs are available as a dietary concentration (e.g., mg contaminant per kg food), a daily dose for birds or mammals is calculated on the basis of standard estimates of food intake rates and body weights (e.g., USEPA 1993 and Sample et al. 1996).

Tables 20 through 22 provide the selected TRVs for plants, birds, and mammals for the S&Os, respectively, and Tables 23 through 25 show the selected TRVs for plants, birds, and mammals for the MUCs, respectively.

### ***Amphibians and reptiles***

In general, there are very few studies available for any contaminant conducted specifically for reptiles and/or amphibians. For the present study, researchers conducted an extensive literature review, and found no toxicity information for tortoises for the MUCs. Sources of information reviewed included standard journal search engines such as Cambridge Scientific Abstracts (CSA), and compilations of toxicity information such as the USEPA's ECOTOX online database, the Society for Environmental Toxicology and Chemistry compilation (Jarvinen and Ankley 1999) and the Army Corps of Engineers online Environmental Effects Database. As summarized by Sparling et al. (2000), little toxicity information is available for reptiles, and what little that exists is a statement of this fact. Since there are virtually no toxicity data for reptiles, the adjusted benchmark for the tortoise was calculated by dividing the test mammal NOAEL or LOAEL by an uncertainty factor of 10 to extrapolate from the test species to a target species. The interclass uncertainty fac-

tor of 10 is in accordance with existing procedural protocol (California EPA 1996). Thus, TRVs for the reptiles and amphibians are the mammalian TRVs divided by a factor of 10.

### **TRVs for individual COCs**

#### **Fog Oil**

Fog oil has characteristics that make it similar to No. 1 and No. 2 fuel oils and lubricating oils. Analyses of fog oil show a variety of individual constituents, including aliphatics, substituted indanes, naphthalenes, tetrahydronaphthalenes, biphenyls, and multialkyl polycyclic aromatic hydrocarbons. The exact composition of fog oil differs from batch to batch and also depends on the combustion characteristics.

Much of the toxicity data for fog oil has been developed using materials other than the type of fog oil currently in use in the military, SFG-2. Some of these materials are substantially similar to fog oil (i.e., white mineral oil, 10-W and 10-W-30 lubricating oils, etc.) while others (i.e., diesel fuel) contain higher concentrations of toxic compounds such as polycyclic aromatic hydrocarbons. Therefore, in developing TRVs for fog oil, researchers limited their review to the materials with a greater similarity to the type of fog oil that is in current use.

Schaeffer et al. (1986) concluded that plants and animals exposed to smokes at Fort Irwin, CA, are at a toxicologically higher risk for several types of damage than control organisms, although the study was unable to discern the ecological significance of the observed effects. However, the data suggest there is the potential for adverse effects resulting from chronic exposure to fog oil use.

Cataldo et al. (1989a) studied effects of SFG-2 fog oil on plants and invertebrates through deposition on soil or deposition on foliage. For invertebrates, they reported a “no effects” concentration in soil of 160 mg/kg and the lowest concentration at which effects were observed of 285 mg/kg. Therefore, for the current study, researchers selected these values as the NOEC and LOEC, respectively. The plants studied by Cataldo et al. (1989a) included ponderosa pine (*Pinus ponderosa*), short needle pine (*Pinus* sp.), sagebrush (*Artemisia* sp.), and tall fescue (*Festuca arundinaceae*) (a grass). The lowest concentration to produce an effect on plants was 69 µg/cm<sup>2</sup> of leaf surface. This value was selected as the LOEC. The highest concentration associated with no effects, but below this value, was 55 µg/cm<sup>2</sup> on the leaf surface, and it was selected as the NOEC. In addition, Cataldo et al. (1989a) reported a NOEC in soil of 330 µg/cm<sup>2</sup> for tall fescue. They did not report a level at which effects were observed.

There was little information available for the toxicity of fog oil to birds. Hartung and Hunt (1966) reported single doses of lubricating oils up to 17,000 mg/kg produced no adverse effect on ducks. They also reported no renal or hepatic effect on ducks given single doses of 1,700 mg/kg lubricating oil. This information is insufficient to develop an LOAEL or NOAEL for fog oil for birds.

The information for mammals is similarly as sparse. Smith et al. (1995) reported that a concentration of 1,500 mg/kg of white mineral oil in food did not produce an effect over 90 days when fed to rats. Since an LD<sup>50</sup> of 5,000 mg/kg is available for fog oil for rats (Mayhew et al. 1986), these two values can be used to estimate an NOAEL and LOAEL of 12 and 50 mg/kg/day, respectively. The resulting calculated NOAEL and LOAEL for reptiles are 1.2 and 5 mg/kg/day, respectively.

### **Graphite Flakes**

Relatively little toxicity data was available for graphite flakes. Bowser et al. (1990) reported a soil concentration of 10,000 mg/kg that did not cause adverse effects to earthworms. However, since they did not report any concentrations that did cause adverse effects, researchers were unable to calculate a NOEC or LOEC from this value.

No effects on growth were reported for plants (corn and cucumbers) due to graphite flakes at concentrations up to 50 mg/kg (Phillips and Wentzel 1990). Phillips and Wentzel did not provide a concentration at which adverse effects were observed. Therefore, researchers are unable to derive a NOEC or LOEC for graphite flakes for plants.

No toxicity information was available on the effects of graphite flakes in the diet on birds.

No reports of toxicity to mammals were identified in the literature. Manthei et al. (1980) studied acute toxicity of graphite flakes. Their highest single dose via gavage of 5,000 mg/kg body weight did not produce adverse effects in a rat. Because no effects data were available, researchers are unable to calculate a NOAEL or LOAEL from these data.

### **Brass Flakes**

Brass flakes, an alloy typically composed of approximately 70 percent copper and 30 percent zinc, are used to block detection by infrared waves. Also, trace amounts of aluminum (0.2 percent), antimony (0.1 percent), and lead (0.1 percent) have been detected, and there may be other inorganic contaminants at concentrations close to

or below typical detection limits (National Research Council [NRC] 1999). The predicted fate and effects of brass flakes depends not only on the composition of the alloy, but also on the size of the individual particles, which is variable, and on whether or not specific coatings have been used. Typical coatings include palmitic and/or stearic acid, which make the powder float on water surfaces.

Many studies have documented that elevated concentrations of copper and or zinc, in and of themselves, can have detrimental impacts on biological communities (Hodson and Sprague 1975, Horne and Dunson 1995). Environmental fate, and toxicity, of brass flakes is regulated by the speciation of zinc and copper in the environment.

### Hexachloroethane Smoke

Hexachloroethane smokes are generated from a pyrotechnic mixture containing aluminum, zinc oxide, and hexachloroethane. Combustion of this mixture produces predominantly zinc chloride, which rapidly absorbs moisture from the surrounding air to form a grayish-white smoke. Other constituents that are formed include aluminum oxide, carbon tetrachloride, tetrachloroethane, hexachlorobenzene, unreacted hexachloroethane and possibly phosgene (Cataldo et al. 1989a, Sadusky et al. 1993, Karlsson et al. 1986, Katz et al. 1980). Zinc chloride is corrosive and a known epithelial tissue irritant, and has been found to be primarily responsible for adverse effects associated with exposures to hexachloroethane smoke (Karlsson et al. 1986, Sadusky et al. 1993).

Sadusky et al. (1993) used open-top chambers to determine the relationships between hexachloroethane smoke, zinc deposition, and foliar injury of tree species indigenous to military training facilities. Exposures were characterized as:

| Dose Level | Zinc Deposition |                           |
|------------|-----------------|---------------------------|
|            | (mg Zn/plot)    | ( $\mu\text{g Zn/cm}^2$ ) |
| 0X         | 22              | 0.3                       |
| 1X         | 452             | 6.4                       |
| 2X         | 513             | 7.3                       |

Plot diameter was 3 meters and the area of the plot =  $3.14 (150 \text{ cm})^2 = 70,700 \text{ cm}^2$

A study by the Health Effects Research Division of the U.S. Army Biomedical Research and Development Laboratory (Cataldo et al. 1989a) observed symptoms of necrotic leaf spot, chlorotic mottle, marginal leaf necrosis, and defoliation in black locust and black cherry trees 7 days following exposures.

TRVs estimated from this study, based on effects to black locust (*Robina pseudoacacia*) and black cherry (*Prunus serotina*) trees are:

LOAEL = 6.4  $\mu\text{g Zn/cm}^2$ .

NOAEL = 0.3  $\mu\text{g Zn/cm}^2$ .

Tall fescue and bushbean were most susceptible, with significant foliar damage (based on Daubenmire damage rating of 2.0 or greater) evident at approximately foliar mass loadings of 5  $\mu\text{g Zn/cm}^2$ . Other species (ponderosa pine and sagebrush) exhibited detectable damage at approximately 20  $\mu\text{g Zn/cm}^2$ . Damage symptoms included chlorosis, necrotic spotting, tip or leaf burn, and in extreme cases, leaf drop.

TRVs based on effects observed in tall fescues are:

LOAEL = 5  $\mu\text{g Zn/cm}^2$ .

NOAEL = 3  $\mu\text{g Zn/cm}^2$ .

Sample et al. (1996) developed TRVs for zinc for mammals based on a study in which rats were exposed through the diet during days 1 through 16 of gestation. This is considered equivalent to a chronic exposure because it occurs during gestation, which is considered to be a critical lifestage. The study found increased rates of fetal resorption and reduced fetal growth rates. TRVs based on effects in rats are:

Chronic LOAEL = 320 mg/kg/d.

Chronic NOAEL = 160 mg/kg/d.

Sample et al. (1996) also provides TRVs for zinc for avian effects based on a study on white leghorn hens exposed in diet for 44 weeks (> 10 weeks and during critical life stage is considered a chronic study). The study found reduced egg hatchability (< 20 percent of controls). The TRVs based on effects in chickens are:

Chronic LOAEL = 131 mg/kg/d.

Chronic NOAEL = 14.5 mg/kg/d.

### **White Phosphorus**

During the 1980s and 1990s, waterfowl mortalities were observed in Eagle River Flats, a site associated with Fort Richardson near Anchorage, Alaska. Those mortalities were attributed to waterfowl ingestion of white phosphorus ( $\text{P}_4$ ) particles (Racine et al. 1992). As a result, the effects of  $\text{P}_4$  on waterfowl have been examined. Ducks are very susceptible to  $\text{P}_4$  intoxication and have been the focus of many laboratory studies with  $\text{P}_4$  (Steele et al. 1997, Sparling et al. 1998, Roebuck et al. 1998, Vann et al. 2000). Studies show that the physiological tolerance to  $\text{P}_4$  among five species of ducks was very similar (Steele et al. 1997) and  $\text{P}_4$  particle size does not

influence P<sub>4</sub> toxicity (Roebuck et al. 1998) to dabbling ducks. A dose of 12 mg P<sub>4</sub>/kg body weight results in death of farm-raised mallards (*Anas platyrhynchos*) (Roebuck et al. 1998). Reproductive effects in the mallard (e.g., teratogenic defects and impacts on egg laying) resulted at a dose of 0.5 mg/kg/day given over 7 days (Vann et al. 2000). This same dose and exposure duration also resulted in renal and hepatic impairment as indicated by blood tests (Sparling et al. 1998).

In addition, the potential for secondary poisoning of avian predators [e.g., eagles, herring gulls (*Larus argentatus*) and ravens (*Corvus corax*) are known to consume sick/poisoned waterfowl] has been investigated (Nam et al. 1994, Sparling and Federoff 1997). P<sub>4</sub> can biotransfer from prey to predator (Nam et al. 1994) and, at 0.62 mg/kg/d in prey, cause P<sub>4</sub> intoxication (Sparling and Federoff 1997).

The sublethal studies with mallards conducted by Vann et al. (2000) and Sparling et al. (1998) were used to develop chronic dietary TRVs for birds. Both studies selected sensitive, ecologically-relevant endpoints with species sensitive to P<sub>4</sub> toxicity. Both the studies by Vann et al. (2000) and Sparling et al. (1998) were conducted over 7 days, which is not considered to be a chronic exposure period. Therefore, the effective dose (0.5 mg/kg/day) was divided by a subchronic to chronic factor of 10 resulting in a LOAEL TRV of 0.05 mg/kg/day. The NOAEL was derived from the LOAEL by dividing by a LOAEL-to-NOAEL factor of 10 resulting in a NOAEL of 0.005 mg/kg/day. These TRVs should also be protective of avian predators, which may consume P<sub>4</sub>-intoxicated ducks. Based on these studies:

The P<sub>4</sub> NOAEL TRV for birds is 0.005 mg/kg/day.

The P<sub>4</sub> LOAEL TRV for birds is 0.05 mg/kg/day.

The effects of P<sub>4</sub> to mammals are summarized in the Agency for Toxic Substances and Disease Registry (ATSDR) toxicological profile for white phosphorus (ATSDR 1997). In developing TRVs, preference was given to chronic oral studies. When administered orally to rats, a dose of 0.075 mg/kg/day over 1 generation resulted in an increased number of stillborn pups. A dose of 0.015 mg/kg/day in that study did not result in significant reproductive effects. Based on that study:

The P<sub>4</sub> NOAEL TRV for mammals is 0.015 mg/kg/day and

The P<sub>4</sub> LOAEL TRV for mammals is 0.075 mg/kg/day.

No appropriate studies on the effects of P<sub>4</sub> to soil invertebrates or terrestrial plants were found.

### Colored Smokes

Colored smoke grenades contain a combination of colored smoke mixtures and pyrotechnic mixtures. The dye components of the colored smoke grenades (approx-

mately 42 percent) represent the bulk of the chemicals in the mixture (NRC 1999). Most of the dyes contain anthraquinone and/or one of its derivatives. It is soluble in alcohol, ether, and acetone, and insoluble in water.

There are several inhalation studies of colored smokes, but the literature survey identified only one study that evaluated the potential for oral toxicity. Smith et al. (1986) evaluated six test articles to establish their eye and skin irritation potential and their oral and dermal toxicity. The test articles evaluated included:

- Disperse Red 11 - Lot 1;
- Disperse Red 11 - Lot 2;
- Disperse Blue 3 - Lot 3;
- Violet Mixture - 35 parts Disperse Red 11 - Lot 1:5 parts Disperse Blue 3;
- Solvent Red 1; and
- Red Mixture - 33.4 parts Solvent Red 1:6.6 parts Disperse Red 11 - Lot 1.

Oral studies were conducted using the Fischer-344 albino rat as the test system; all other studies used the New Zealand White Albino Rabbit as the test system. Results were as follows:

- Disperse Red 11: Lot 1 was found to be a moderate skin irritant; tested negative for eye irritation, had a dermal LD<sub>50</sub> greater than 2 g/kg. The authors were unable to calculate an oral LD<sub>50</sub> for males but estimate that it is between 708 and 891 mg/kg. The oral LD<sub>50</sub> for females is at least 5 g/kg.
- Disperse Red 11: Lot 2 was found to be a mild skin irritant; tested negative for eye irritation, had a dermal LD<sub>50</sub> greater than 2 g/kg; and oral LD<sub>50</sub> of 1042.7 mg/kg in males, and greater than 5 g/kg in females.
- Disperse Blue 3: Lot 3 was found to be practically non-irritating to the skin; tested negative for eye irritation; had a dermal LD<sub>50</sub> greater than 2 g/kg; and an oral LD<sub>50</sub> greater than 5 g/kg.
- Violet Mixture: 35 parts Lot 1 Disperse Red 11 to 5 parts Disperse Blue 3 was found to be a mild skin irritant; tested negative for eye irritation; had a dermal LD<sub>50</sub> greater than 2 g/kg; and an oral LD<sub>50</sub> of between 794 and 1000 mg/kg for males, between 1,413 and 1,778 mg/kg for females, and 1052 mg/kg for combined sexes.
- Solvent Red 1: This was found to be non-irritating to the skin; tested positive for eye irritation; had a dermal LD<sub>50</sub> greater than 2 g/kg; and an oral LD<sub>50</sub> greater than 5 g/kg.
- Red Mixture: 33.4 parts Solvent Red 1 to 6.6 parts Lot 1 Disperse Red 11 was found to be nonirritating to the skin; tested positive for eye irritation; had a dermal LD<sub>50</sub> greater than 2 g/kg; and an oral LD<sub>50</sub> greater than 5 g/kg.

For this analysis, only data for solvent yellow was deemed adequate for deriving TRVs. The TRVs for mammals are:

Solvent yellow chronic NOAEL = 1.36 mg/kg/day.

Solvent yellow chronic LOAEL = 13.6 mg/kg/day.

Data are insufficient for deriving TRVs for soil invertebrates, plants, birds, and reptiles and amphibians.

#### **Terephthalic Acid**

Terephthalic acid (TA), a smoke obscurant, is not particularly toxic to rodents via inhalation (Muse et al. 1997). Few studies have examined the effects of TA when administered orally to rodents. Moffitt et al. (1975) dosed adult male rats with TA by gavage. No effects were observed at the highest, single oral dose tested (80 mg TA). The body weight adjusted TRV was calculated as follows:

Given a body weight of 225 g,

Acute Dose = 80 mg/0.225 kg/day = 356 mg/kg/day,

Chronic Dose = 356 mg/kg/day divided by 100 = 35.6 mg/kg/day.

Based on this study:

The TA NOAEL TRV for mammals is 3.56 mg/kg/day.

The TA LOAEL TRV for mammals is unavailable.

Kim et al. (2001) demonstrated that TA is toxic to terrestrial plants. A reduction of radish seed germination by 30 percent occurred at a TA concentration of 1 percent in deionized water. A TRV based on solution concentration could be developed from this study. However, a soil-based TRV is desired and such a value cannot be estimated from this study.

No appropriate studies on the effects of terephthalic acid to soil invertebrates, birds, or terrestrial plants were found.

#### **Graphite Flakes**

Data are insufficient for deriving TRVs for any of the receptors.

#### **Titanium Dioxide**

Data are insufficient for deriving TRVs for any of the receptors.

**Polyethylene Glycol**

Data are insufficient for deriving TRVs for any of the receptors.

**(o-Chlorbenzol)malononitrile (CS)**

Data are insufficient for deriving TRVs for any of the receptors.

**Dibenz(bf)-14-oxazepine (CR)**

Researchers found two studies that evaluated the oral toxicity of dibenzo(b,f)-1,4-oxazepine to rodents: Ballantyne (1977) and Upshall (1974). Ballantyne (1977) fed mice, rats, guinea pigs, and rabbits CR via oral gavage for 5 days. No acute effects were observed in any of the test species. The highest oral dose tested in adult male guinea pigs was (63 mg CR/mg/day). The exposure period (5 days) used in this study is not considered to be a chronic exposure period. Therefore, the no-effect dose (63 mg/kg/day) was divided by a subchronic to chronic factor of 10 resulting in a NOAEL TRV of 6.3 mg/kg/day. Upshall (1974) administered CR to adult female rats via oral gavage during 1 day of pregnancy. No reproductive effects (e.g., teratogenic and embryo-lethal effects) were observed at the highest dose tested (400 mg/kg/day). No subchronic to chronic factor is applied because the dose was administered during a sensitive life stage. Based on these studies:

The CR NOAEL TRV for mammals is 400 mg/kg/day.

The CR LOAEL TRV for mammals is unavailable.

No appropriate studies on the effects of CR to soil invertebrates, birds, or terrestrial plants were found.

**1,3,5-Trinitrobenzene (1,3,5-TNB)**

1,3,5-trinitrobenzene is formed as a by-product during the manufacture of TNT. It is present in the final TNT product at concentrations ranging from 0.1 to 0.7 percent (Talmage et al. 1999) and is also formed in the environment via photolysis of TNT.

Little toxicological information was found for TNB. Quantitative Structure-Activity Relationship (QSAR) studies have found that the toxicity of nitroaromatic compounds is related to the number of constituents and their relative positions, indicating that TNB will be more toxic than other nitroaromatics (Deneer et al. 1989, Gough et al. 1994, Schmitt et al. 2000). Indigenous soil microbial communities exhibited negative correlations of basal respiration rates and phospholipid fatty acid production when exposed to TNB (Fuller and Manning 1998). TNB was found to be

mutagenic using the Salmonella fluctuation test (FT) and the V79 Chinese hamster lung cell mutagenicity assay (Lachance et al. 1999).

The U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) (2001a) developed a wildlife toxicity assessment to determine the adequacy of data for deriving toxicity reference values for wildlife receptors. That report identified no data for avian, reptile, and amphibian receptors. There are apparently few studies for mammals. File data from a study in which male and female rats in the high-dose group showed decreased body weights which in turn were associated with decreased food consumption, changes in relative organ weights, adverse hematological findings, and testicular effects. TRVs based on effects to mammals are:

Chronic NOAEL = 2.64 mg/kg-day.

Chronic LOAEL = 13.44 mg/kg-day.

### **1,3-Dinitrobenzene (1,3-DNB)**

1,3-dinitrobenzene is used in the manufacture of explosives and is found as an impurity in the final product. It is formed in the environment by photolysis of 2,4-dinitrotoluene, itself a by-product of the manufacture of TNT.

Little data was found for the toxicity of DNB. QSAR studies have found that the toxicity of nitroaromatic compounds is related to the number of constituents and their relative positions, indicating that DNB will be more toxic than other mononitroaromatics (Deneer et al. 1989, Gough et al. 1994, Schmitt et al. 2000).

DNB is a known Sertoli cell toxicant (Allenby et al. 1990, Cave and Foster 1990). Cave and Foster (1990) concluded that DNB requires metabolic activation before it can exert its toxicity to Sertoli cells.

USACHPPM (2001b) developed a wildlife toxicity assessment to determine the adequacy of data for deriving toxicity reference values for wildlife receptors. That report identified no data for avian, reptile, and amphibian receptors. There are three subchronic studies available lasting 84 to 112 days. Testicular degeneration, an endpoint relevant to the survival of the population, was found to be the relevant endpoint (Talmage et al. 1999). TRVs for mammals are:

Chronic NOAEL = 0.113 mg/kg-day.

Chronic LOAEL = 0.264 mg/kg-day.

### **2,4-Dinitrophenol (2,4-DNP)**

2,4-dinitrophenol is found in explosives as an impurity and can be formed in the environment.

No studies were found evaluating the effects of 2,4-dinitrophenol in plants, soil invertebrates, birds, or reptiles and amphibians.

Haghighi et al. (1995) examined the toxic effects of nitrophenols on acetate enrichment, methanogenic systems and determined that toxicity decreases in the following order: 2,4-dinitrophenol > 4-nitrophenol > 2-nitrophenol > 3-nitrophenol. Uberoi and Bhattacharya (1997) confirmed these findings when examining the toxic effects and degradability of nitrophenols in anaerobic acetate and propionate enrichment systems. The toxicity to both systems decreased in the following order: 2,4-dinitrophenol > 4-nitrophenol > 2-nitrophenol. Furthermore, Uberoi and Bhattacharya (1997) found that under anaerobic conditions 2,4-dinitrophenol was transformed both abiotically and biotically to 2-amino, 4-nitrophenol.

LD<sub>50</sub> values for animals treated once with 2,4-dinitrophenol by gavage were 30 mg/kg for white rats, 71 mg/kg for weanling male rats, and 72 mg/kg for weanling male CFL mice. In a fairly reliable study on mature rats of each sex treated once by gavage, a dose-related increase in mortality was observed, with no mortality at doses of 10 to 27 mg/kg, 37 percent mortality at 30 mg/kg, and 100 percent mortality at 100 mg/kg. A 100 percent survival dose of 20 mg/kg and a 100 percent lethal dose of 60 mg/kg were reported for white rats treated once by gavage. A 100 percent survival dose of 20 mg/kg and a 100 percent lethal dose of 30 mg/kg were reported in dogs treated once by gavage.

These data are inadequate for developing TRVs for any receptor.

### **Dinitrotoluene isomers**

2,4-DNT and 2,6-DNT are pale yellow solids with a slight odor and are two of the six forms of the chemical called dinitrotoluene (DNT). The other four forms (2,3-DNT, 2,5-DNT, 3,4-DNT, and 3,5-DNT) only make up about 5 percent of the technical grade DNT. DNT is not a natural substance but rather is usually made by reacting toluene (a solvent) with mixed nitric and sulfuric acids, which are strong acids. DNT is used to produce ammunition and explosives and to make dyes.

No studies were found for soil invertebrates, plants, birds, or reptiles and amphibians.

Several chronic feeding studies with rats have found effects ranging from testicular atrophy for 2,4-DNT and reduced weight gain (ATSDR 1998). TRVs for mammals for 2,4-DNT are:

Chronic NOAEL = 0.06 mg/kg/d.

Chronic LOAEL = 0.6 mg/kg/d.

TRVs for mammals for the remaining dinitrotoluene isomers (treated as 2,6-DNT) are:

Chronic NOAEL = 0.7 mg/kg/d.

Chronic LOAEL = 7 mg/kg-d.

#### **Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)**

Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) is formed by the nitration of hexamine with ammonium nitrate and nitric acid in an acetic acid/acetic anhydride solvent at 44° C (ATSDR 1997). HMX is used as a component in plastic-bonded explosives, a solid fuel rocket propellant, and a burster charge for military munitions (ATSDR 1997). HMX is used to implode fissionable material in nuclear devices to achieve critical mass (ATSDR 1997).

Data are insufficient to derive TRVs for soil invertebrates, plants, birds, or reptiles and amphibians.

Everett and Maddock (1985) conducted an ingestion study in B6C3F1 mice and found significant mortality in all dose groups. However, no clinical signs of toxicity and no significant changes in body weight or clinical chemistry were noted. Based on this study, TRVs for the mammals are:

Chronic NOAEL = 3 mg/kg-day.

Chronic LOAEL = 7.5 mg/kg-day.

#### **Nitrobenzene (NB)**

Nitrobenzene is found in explosives as an impurity and can be formed in the environment.

No studies were found evaluating the effects of nitrobenzene in plants, soil invertebrates, birds, or reptiles and amphibians.

A chronic feeding study in rats found significant testicular atrophy (Bond et al. 1981). The TRVs for mammals are:

Chronic NOAEL = 1.16 mg/kg-day.

Chronic LOAEL = 5.8 mg/kg-day.

### Nitroglycerin (NG)

Nitroglycerin is produced as a propellant for explosives.

Chronic exposure of laboratory animals to high NG concentrations resulted in adverse hematological and liver changes, and decreased body weight gain. Hepatocellular carcinomas as neoplastic nodules, and interstitial cell tumors of the testes were frequently observed in the high-dose group rats after 2-year exposures to NG (Ellis et al. 1978 and Ellis et al. 1984 in: USACHPPM 2001c). Four groups of 38 male and 38 female Charles River CD albino rats were fed diets containing 0, 0.01, 0.1 or 1 percent (average intakes of 0, 3.04 and 3.99, 31.5 and 38.1; 363 and 436 mg/kg/day in males and females, respectively) NG in their diet for 2 years (Ellis et al. 1978 and Ellis et al. 1984 in: USACHPPM, 2001c). No adverse effects were observed in any of the low dose rats. Mid-dose rats exhibited decreased weight gain in later months; males and females were about 60 and 30 g lighter than controls, respectively. Some rats fed 0.1 percent NG (31.0 [males] or 38.1 [females] mg/kg/day) had mild hepatic lesions (areas or foci of hepatocellular alteration that can develop into hepatocellular carcinomas). High-dose rats had decreased food consumption and weight gain, behavioral effects (decreased activity and failure to groom) compensated anemia with reticulocytosis, elevated serum transaminases, and methemoglobinemia, with some excessive pigmentation, in the spleens and renal epithelium. After 1 year, 8 high-dose rats had cholangiofibrosis and some had neoplastic foci in the liver. At 2 years, all 13 surviving high-dose rats and 6 out of 16 middle-dose rats had enlarged and grossly abnormal livers with severe cholangiofibrosis and hepatocellular carcinomas, some of which had metastasized to the lung. Interstitial tumors of the testes were observed in one-half the high-dose males, in some leading to aspermatogenesis. A decrease in the naturally occurring pituitary chromophobe adenoma and mammary tumors increased the life-span, especially in the females (Dacre et al. 1980 and Ellis et al. 1978 and Ellis et al. 1984, in: USACHPPM 2000c). The identified NOAEL for this study was 3.04 and 3.99 mg/kg/day and the LOAEL was 31.5 and 38.1 mg/kg/day for decreased weight gain and enlarged, abnormal livers with cholangiofibrosis and hepatocellular carcinomas in males and females, respectively.

TRVs for mammals are:

Chronic NOAEL = 3 mg/kg/d.

Chronic LOAEL = 31.5 mg/kg/d.

No studies were found for soil invertebrates, plants, birds, or reptiles and amphibians.

### Nitrophenol isomers

2-Nitrophenol is produced by the catalytic hydrolysis of 2-nitrochlorobenzene with NaOH. Alternatively, 2-nitrophenol can be produced by the action of dilute HNO<sub>3</sub> on phenol with subsequent steam distillation for separation from 4-nitrophenol. 4-Nitrophenol can also be produced in one of two ways. Like 2-nitrophenol, it can be produced by the catalytic hydrolysis of 4-nitrochlorobenzene or, alternatively, by the reaction of dilute HNO<sub>3</sub> on phenol and subsequent steam distillation to separate the 4- from the 2- isomer.

Nitrophenols may be released into the environment during their use as intermediates and indicators. 2-Nitrophenol is used as an intermediate for the production of dyestuffs, pigments, rubber chemicals, and fungicides. It is used in small amounts as an acid-base indicator and as a reagent for glucose. 4-Nitrophenol is used for the production of marathion, methyl parathion, and N-acetyl-p-aminophenol. 4-Nitrophenol is also used in the parathion-containing insecticide, Thiophos, and in fungicide for military footwear. Also, both 2- and 4- isomers may be released in vehicular exhaust from both gasoline and diesel engines.

There are no chronic toxicity tests available for mammals (ATSDR 1992) but there are subchronic oral studies in laboratory rats and mice. The literature summary did not identify any toxicity information for avian receptors, reptiles and amphibians, or higher order mammalian receptors. Therefore, the database is inadequate for developing toxicity reference values for ecological receptors.

### Pentaerythritol Tetranitrate (PETN)

Pentaerythritol tetranitrate (PETN) is an explosive chemical that is currently used as the primary ingredient in detonating fuses and as a component (mixed with hexahydro-1,2,5-trinitro-1,3,4 triazine) in “plastic” explosives such as Semtex. Structurally, PETN resembles nitroglycerin, a compound whose pharmacological as well as explosive properties it shares.

The suite of studies reported by NTP (1989) as cited in USACHPPM (2001d) appears comprehensive. The NTP (1989) report contains subacute, subchronic, and chronic study information for mice and rats. In these studies extremely high doses were generally used. However, no corroborative effects were observed in either target or magnitude of effect. For example, kidney and brain weights were increased in the high dose for female rats only in the 14-week study, yet there was no other information that suggested that adverse effects were observed relative to the kidney and brain function (i.e., histopathology results revealed no effect), nor did the chronic study show the same effects. Male rats in the high dose group in the 104-

week study showed a 2 to 9 percent lower body mass than controls, yet these effects were not seen in females or either sex in the 14-week study.

TRVs for mammals are:

Chronic NOAEL = 170 mg/kg-day.

Chronic LOAEL = 1700 mg/kg-day.

#### **Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)**

RDX is a crystalline high explosive used extensively by the military in shells, bombs, and demolition charges. It is persistent in the environment and is found in soil, surface water, sediments, and groundwater (Talmage et al. 1999).

Simini et al. (1995) performed soil toxicity testing using the cucumber at RDX concentrations of 0, 50, 100, or 200 mg/kg of soil. Biomass of plants exposed at 100 and 200 mg/kg was significantly reduced. TRVs for plants are:

Chronic NOAEL = data not available.

Chronic LOAEL = 100 mg/kg in soil.

A study involving bobwhite (Gogal et al. 2003) found decreased survival across all dose groups. The TRVs for birds are:

Chronic NOAEL = 0.223 mg/kg-day.

Chronic LOAEL = 0.263 mg/kg-day.

There are at least three chronic toxicity studies and a two-generation reproduction study on the oral toxicity of RDX in laboratory animals available. Lish et al. (1984) conducted a chronic study in mice that found reproductive effects (testicular degeneration) from which to derive a NOAEL and LOAEL. The TRVs for mammals are:

Chronic NOAEL = 7 mg/kg-day.

Chronic LOAEL = 35 mg/kg-day.

#### **Trinitrophenylmethylnitramine (Tetryl)**

Tetryl is used as a propellant or detonator charge in military explosives. Since 1973 it has been largely replaced by RDX but is still present in the environment.

Data are insufficient for deriving TRVs for soil invertebrates, birds, or reptiles and amphibians.

Fellows et al. (1992) conducted a 70-day growth study using 3 species of plants. The TRVs for plants are:

Chronic NOEC = data are insufficient.

Chronic LOEC = 25 mg/kg in soil.

Reddy et al. (1994) conducted a subchronic study using Fischer-344 laboratory rats. The endpoint was testicular effects, relevant for survivability of the population (Talmage et al. 1999). The TRVs for mammals are:

Chronic NOAEL = 1.4 mg/kg-day.

Chronic LOAEL = 6.9 mg/kg-day.

### **2,4,6-Trinitrotoluene (TNT)**

TNT is manufactured by a continuous process in which nitric acid and oleum are used to nitrate toluene in six to eight stages. TNT is produced at munitions production sites and is used extensively in explosives.

Cataldo et al. (1989b) grew bean, wheat, and blando broom in pots with TNT at concentrations of 10, 30, or 60 mg/kg dry weight using two different soils. Plant height was reduced by greater than 50 percent in all species in both soils at 60 mg/kg; a reduction of approximately 25 percent occurred in the wheat and grass at 30 mg/kg. The TRVs for plants are:

Chronic NOEC = data insufficient.

Chronic LOEC = 30 mg/kg in soil.

Testicular atrophy was found in Sprague-Dawley rats administered TNT in the diet at doses of 0, 1, 4, 6.97, 34.7, or 160 mg/kg-day for 13 weeks. Signs of anemia and some organ weight changes occurred at the intermediate dose levels, and testicular atrophy was observed at the highest dose of 160 mg/kg-day. Since the study was subchronic, an uncertainty factor of 10 is applied to account for chronic to subchronic extrapolation. The TRVs for mammals are:

Chronic NOAEL = 1.6 mg/kg-day.

Chronic LOAEL = 16 mg/kg-day.

Table 20. Selected plant TRV values for smokes and obscurants.

| Species                                                                 | Exposure Media             | Exposure Duration | Effect Level                | Contaminant       | Effective Concentration | Units                                    | Effect Endpoint                                                        | Reference                             |
|-------------------------------------------------------------------------|----------------------------|-------------------|-----------------------------|-------------------|-------------------------|------------------------------------------|------------------------------------------------------------------------|---------------------------------------|
| Ponderosa Pine, shortneedle pine, sagebrush, tall fescue                | deposition on leaf surface | 21 days           | NOEC                        | SGF-2 fog oil     | 55                      | ug/cm <sup>2</sup>                       | none                                                                   | Cataldo et al, 1989 - see table 3.13  |
| Ponderosa Pine, shortneedle pine, sagebrush, tall fescue                | deposition on leaf surface | 21 days           | LOEC                        | SGF-2 fog oil     | 69                      | ug/cm <sup>2</sup>                       | 5-25% necrotic spotting, chlorosis, and old growth affected in 21 days | Cataldo et al., 1989 - see Table 3.13 |
| Tall Fescue (grass)                                                     | deposition on soil         | 100 days          | no effect                   | SGF-2 fog oil     | up to 330               | ug/cm <sup>2</sup> of soil               | no effect on dry matter production in first harvest                    | Cataldo et al., 1989 - Table 3.22     |
| Corn, cucumber                                                          | spiked soil                | 14 days           | no adverse effect observed  | graphite flakes   | 50                      | mg/kg                                    | growth                                                                 | Phillips and Wentzel (1990)           |
| Radish                                                                  | deionized water            | 6 days            | LOEC                        | terephthalic acid | 1                       | %                                        | seed germination                                                       | Kim et al., 2001                      |
| Black locust, black cherry                                              | airborne foliar deposition | 7 days            | no adverse effect observed  | HC (zinc)         | 0.3                     | ug/cm <sup>2</sup>                       | none                                                                   | Sadusky et al., 1993                  |
| Black locust, black cherry                                              | airborne foliar deposition | 7 days            | leaf spot, chlorotic mottle | HC (zinc)         | 6.4                     | ug/cm <sup>2</sup>                       | defoliation                                                            | Sadusky et al., 1993                  |
| Tall fescue, bush bean                                                  | airborne foliar deposition | 7 days            | no adverse effect observed  | HC (zinc)         | 3                       | ug/cm <sup>2</sup>                       | chlorosis, leaf burn                                                   | Battelle, 1989                        |
| Tall fescue, bush bean                                                  | airborne foliar deposition | 7 days            | leaf spot, chlorotic mottle | HC (zinc)         | 5                       | ug/cm <sup>2</sup>                       | chlorosis, leaf burn, leaf drop                                        | Battelle, 1989                        |
| Ponderosa Pine, bush bean, big sagebrush, shortneedle pine, tall fescue | airborne foliar deposition | 30 days           | NOEC                        | brass flakes      | 237.01                  | ug/cm <sup>2</sup> (foliar mass loading) | effects on old and new growth                                          | Cataldo et al. (1990)                 |
| Ponderosa Pine, bush bean, big sagebrush, shortneedle pine, tall fescue | airborne foliar deposition | 60 days           | LOEC                        | brass flakes      | 238.68                  | ug/cm <sup>2</sup> (foliar mass loading) | significant reduction in dry matter production                         | Cataldo et al. (1990)                 |

| Species                                                                                  | Exposure Media                                                                 | Exposure Duration | Effect Level               | Contaminant         | Effective Concentration | Units                        | Effect Endpoint                                                                                                                                               | Reference             |
|------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|-------------------|----------------------------|---------------------|-------------------------|------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Bush bean ( <i>Phaseolus vulgaris</i> ), alfalfa, Tall Fescue ( <i>Festuca elatior</i> ) | four soil types at various stages of weathering (up to 450 days of weathering) | 2 weeks           | no adverse effect observed | brass flake         | 2500                    | mg/kg                        | seed germination                                                                                                                                              | Cataldo et al. (1990) |
| Tall fescue, bush bean                                                                   | spiked soil                                                                    | 60 days           | no adverse effect observed | brass flakes        | 100                     | ug/g                         | less than 25% chlorosis and necrotic spotting                                                                                                                 | Cataldo et al. (1990) |
| Tall Fescue, bush bean                                                                   | spiked soil                                                                    | 60 days           | effect observed            | brass flakes        | 100                     | ug/g                         | greater than 30-40%% chlorosis, necrotic spotting, tip burn; significant difference in dry production                                                         | Cataldo et al. (1990) |
| Bush Bean, big sagebrush, Ponderosa pine, shortneedle pine, tall fescue                  | airborne foliar deposition                                                     | 30 days           | no adverse effect observed | brass flake/fog oil | 148.68                  | ug/cm2 (foliar mass loading) | growth, leaf burn, leaf drop, necrotic spotting, leaf abscission or needle drop, chlorosis, dieback, leaf curl, wilting, survival. Floral/seed/fruit abortion | Cataldo et al. (1990) |
| Bush Bean, big sagebrush, Ponderosa pine, shortneedle pine, tall fescue                  | airborne foliar deposition                                                     | 30 days           | effect observed            | brass flake/fog oil | 376.65                  | ug/cm2 (foliar mass loading) | new growth, wilting, leaf curl, necrotic spotting                                                                                                             | Cataldo et al. (1990) |

Table 21. Selected avian TRV values for smokes and obscurants.

| Compound                                                                                                      | Chemical Form                     | Test Species     | Exposure Route      | Exposure Duration (Days) | Effect                                                    | NOAEL (mg/kg/d)                                     | LOAEL (mg/kg/d) | Source                      | Note                                                                                                                            |
|---------------------------------------------------------------------------------------------------------------|-----------------------------------|------------------|---------------------|--------------------------|-----------------------------------------------------------|-----------------------------------------------------|-----------------|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------|
| Fog Oil                                                                                                       | 10-W and 10-W-30 lubricating oils | Duck             | stomach tube        | 1 dose                   | No lethality observed in unstressed ducks                 | No effect observed at highest dose of 17,000 mg/kg. | No data         | Hartung and Hunt, 1966.     | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                      |
| Hexachloroethane smoke (zinc)                                                                                 | zinc                              | White leg-horn   | diet                | 44 weeks                 | Reduced egg hatchability                                  | 14.5                                                | 131             | Sample et al., 1996         |                                                                                                                                 |
| White phosphorus                                                                                              | P4                                | Domestic chicken | gavage in water     | 5                        | Reproduction (egg laying frequency)                       | 0.01                                                | 0.1             | Nam et al., 1996            | LOAEL based on an effect dose of 1 mg/kg/day over 5 days divided by 10 to adjust subchronic to chronic dose. LOAEL/10 = NOAEL   |
| White phosphorus                                                                                              | P4                                | American kestrel | prey (dosed chicks) | 1                        | Mortality and weight loss                                 | 0.0062                                              | 0.062           | Sparling and Federoff, 1997 | LOAEL based on an effect dose of 0.62 mg/kg/day over 1 day divided by 10 to adjust subchronic to chronic dose. LOAEL/10 = NOAEL |
| White phosphorus                                                                                              | P4                                | Mallard          | gavage in oil       | 7                        | Renal and hepatic impairment as indicated by blood tests. | 0.005                                               | 0.05            | Sparling et al., 1998.      | LOAEL based on an effect dose of 0.5 mg/kg/day over 7 days divided by 10 to adjust subchronic to chronic dose. LOAEL/10 = NOAEL |
| Notes: No toxicity data available for birds for graphite flakes, brass flakes, or colored smoke constituents. |                                   |                  |                     |                          |                                                           |                                                     |                 |                             |                                                                                                                                 |

Table 22. Selected mammalian TRV values for smokes and obscurants.

| Compound                      | Chemical Form     | Test Species   | Exposure Route           | Exposure Duration (Days) | Effect                                                                                 | NOAEL (mg/kg/d)                           | LOAEL (mg/kg/d)     | Source                                      | Note                                                                                                                                                                                                       |
|-------------------------------|-------------------|----------------|--------------------------|--------------------------|----------------------------------------------------------------------------------------|-------------------------------------------|---------------------|---------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Fog Oil                       | Fog oil           | Rat            | Exposure route not given | Duration not given.      | Mortality                                                                              | No data.                                  | 50                  | Mayhew et al., 1986 in Driver et al., 1993. | LD50 of 5000 mg/kg used as an upper bound since a no effect level was available. LD50/100 to adjust acute to chronic dose. Note that there is great uncertainty in this value.                             |
| Fog Oil                       | White mineral oil | Long-Evans rat | Food                     | 90                       | general health, food consumption, body weight, hematology, serum chemistry, urinalysis | 12                                        | No data.            | Smith et al., 1995                          | No effect at highest concentration tested of 1500 mg/kg food. Used because an LD50 value was available as an upper bound. Converted to daily dose. Adjusted by 1/10 to convert subchronic to chronic dose. |
| Graphite Flakes               | Graphite          | Rat            | gavage in corn oil       | Duration not given.      | Acute toxicity                                                                         | No effect observed at dose of 5000 mg/kg. | No data.            | Manthei et al., 1980 cited in NRC, 1999     | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                                                                                                 |
| Brass Flakes                  | Brass flakes      | Rat            | gavage in corn oil       | 1 dose.                  | Lethality                                                                              | No data.                                  | LD50 of 2,780 mg/kg | Manthei et al., 1983 cited in NRC, 1999.    | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                                                                                                 |
| Hexachloroethane smoke (zinc) | zinc              | Rat            | diet                     | 16 d (during gestation)  | fetal resorption, reduced fetal growth rate                                            | 160                                       | 320                 | Sample et al., 1996                         |                                                                                                                                                                                                            |

| Compound                | Chemical Form                               | Test Species                                     | Exposure Route           | Exposure Duration (Days) | Effect                                                        | NOAEL (mg/kg/d)          | LOAEL (mg/kg/d)    | Source                                                  | Note                                                                                                                                                                                       |
|-------------------------|---------------------------------------------|--------------------------------------------------|--------------------------|--------------------------|---------------------------------------------------------------|--------------------------|--------------------|---------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Solvent yellow 33       | (2-quinolyl)-1,3-indandione or QID          | F344/N rats                                      | Food                     | 14 to 91                 | body weight gain; increased liver weight; other liver effects | 1.36                     | 13.6               | Eastin et al., 1996 cited in NRC, 1999                  | LOAEL based on an effect concentration 1700 mg/kg converted to a dose of 136 mg/kg/day divided by 10 to convert subchronic dose to chronic. LOAEL/10 = NOAEL                               |
| Solvent green 3         | 1,4-di-p-toluidino-9,10-anthraquinone (PTA) | Rat                                              | Not reported             | 1 dose.                  | Lethality                                                     | No data.                 | LD50 of 3000 mg/kg | Dacre et al, 1979 in NRC, 1999                          | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                                                                                 |
| Solvent red 1           | alpha-methoxybenzenazo-beta-naphthol (MBN)  | Two species of rats                              | Oral, but method unknown | 1 dose.                  | Lethality                                                     | No effect at 5000 mg/kg. | No data.           | Manthei et al, 1983 and Smith et al., 1986 in NRC, 1999 | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                                                                                 |
| Disperse red 11         | 1,4-diamino-2-methoxyanthraquinone (DMA)    | Fischer 344 rat (male)* no effect on female rats | Oral, but method unknown | 1 dose.                  | Lethality                                                     | No data.                 | LD50 of 1000 mg/kg | Smith et al., 1986 in NRC, 1999                         | Not enough data available to develop NOAEL and LOAEL; use for qualitative assessment only.                                                                                                 |
| Terephthalic acid       | TA                                          | Adult male Charles River rats                    | Oral gavage              | single dose              | Mortality                                                     | 3.56                     | NA                 | Moffitt et al., 1975                                    | No effects were observed at the highest oral dose tested (80 mg TA) for single dose. BW = 225 g, dose = 80 mg/0.225 kg/1 day = 356 mg/kg/d divided by 100 to adjust acute to chronic dose. |
| Benz(b,f)-1,4-oxazepine | CR                                          | Adult male guinea pigs                           | Oral gavage              | 5                        | Mortality and growth                                          | 6.3                      | NA                 | Ballantyne, 1977                                        | No effects were observed at the highest oral dose tested (63 mg CR/kg/day) over 5 days divided by 10 to adjust subchronic to chronic dose.                                                 |

| Compound                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Chemical Form    | Test Species               | Exposure Route                     | Exposure Duration (Days)          | Effect                                                | NOAEL (mg/kg/d) | LOAEL (mg/kg/d) | Source                                            | Note                                                                                                                                       |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------|----------------------------|------------------------------------|-----------------------------------|-------------------------------------------------------|-----------------|-----------------|---------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Benz(b,f)-1,4-oxazepine                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | CR               | Adult female rats          | Oral - intragastric administration | Single dose on Day 7 of pregnancy | Reproduction - teratogenic and embryolethal effects   | 400             | NA              | Upshall, 1974                                     | No effects were observed at the highest oral dose tested (400 mg CR/kg/day) with a single dose during sensitive lifestage (no ACR needed). |
| White phosphorus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | P4               | Charles River COBS CD rats | Oral gavage                        | 1 generation                      | reproduction - increased the number of stillborn pups | 0.015           | 0.0175          | IRDC, 1985 unpublished study cited in ATSDR, 1989 | Data developed from generational study; does not require uncertainty factors.                                                              |
| White phosphorus                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | White phosphorus | Charles River COBS CD rats | Oral gavage                        | 1 generation                      | reproduction - increased the number of stillborn pups | 0.015           | 0.0175          | IRDC, 1985 unpublished study cited in ATSDR, 1989 | Data developed from generational study; does not require uncertainty factors.                                                              |
| Notes:<br>Solvent yellow 33 makes up 42 % of new yellow smoke formulation and 12.6% of new green smoke formulation (NRC, 1999).<br>It is 71.3% of fallout from yellow smoke grenade detonation and 27.3% of fallout from green smoke grenade detonation (Buchanan and Ma, 1988).<br>Solvent green 3 makes up 29.4% of new green smoke formulation (NRC, 1999) and 58% of green smoke grenade detonation fallout (Buchanan and Ma, 1988).<br>Solvent red 1 makes up 34.2% of new red smoke formulation (NRC, 1999) and 35% of red smoke grenade detonation fallout (Buchanan and Ma, 1988).<br>Disperse red 11 makes up 6.8% of new red smoke formulation (NRC, 1999) and 15% of fallout from red smoke grenade detonation (Buchanan and Ma, 1988). |                  |                            |                                    |                                   |                                                       |                 |                 |                                                   |                                                                                                                                            |

**Table 23. Selected plant TRV values for MUCs.**

| Compound                                         | Accronym | NOAEL<br>(mg/kg)  | LOAEL<br>(mg/kg)     | Reference               | As cited in             |
|--------------------------------------------------|----------|-------------------|----------------------|-------------------------|-------------------------|
| 2,4,6-Trinitrotoluene                            | TNT      |                   | 30                   | Cataldo<br>et al., 1989 | Talmage<br>et al., 1999 |
| 1,3,5-Trinitrobenzene                            | TNB      | Insufficient data |                      |                         | Talmage<br>et al., 1999 |
| 1,3-Dinitrobenzene                               | DNB      | Insufficient data |                      |                         | Talmage<br>et al., 1999 |
| 3,5-dinitronaline                                | DNA      |                   | Insufficient<br>data |                         | Talmage<br>et al., 1999 |
| 2-amino-4,6-dinitrotoluene                       | 2-DANT   | 80                |                      | Pennington<br>1988a,b   | Talmage<br>et al., 1999 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine          | RDX      |                   | 100                  | Simini<br>et al., 1992  | Talmage<br>et al., 1999 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX      | Insufficient data |                      |                         | Talmage<br>et al., 1999 |
| N-methyl-N,2,4,6-tetranitroaniline               | Tetryl   |                   | 25                   | Fellows<br>et al., 1992 | Talmage<br>et al., 1999 |

**Table 24. Selected avian TRV values for MUCs.**

| Compound                                         | Acronym | NOAEL             | LOAEL | Test Or-<br>ganism   | Effect/<br>Endpoint | Reference             | As cited in             |
|--------------------------------------------------|---------|-------------------|-------|----------------------|---------------------|-----------------------|-------------------------|
|                                                  |         | (mg/kg/day)       |       |                      |                     |                       |                         |
| 2,4,6-Trinitrotoluene                            | TNT     | 0.7               | 17.8  | northern<br>bobwhite | survival            | Gogal<br>et al., 2002 |                         |
| 1,3,5-Trinotrobenzene                            | TNB     | Insufficient data |       |                      |                     |                       | Talmage<br>et al., 1999 |
| 1,3-Dinitrobenzene                               | DNB     | Insufficient data |       |                      |                     |                       | Talmage<br>et al., 1999 |
| 3,5-Dinitroanaline                               | DNA     | Insufficient data |       |                      |                     |                       | Talmage<br>et al., 1999 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine          | RDX     | 2.23              | 2.63  | northern<br>bobwhite | survival            | Gogal<br>et al., 2003 |                         |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX     | Insufficient data |       |                      |                     |                       |                         |
| N-methyl-N,2,4,6-tetranitroaniline               | Tetryl  | Insufficient data |       |                      |                     |                       |                         |

Note: TRVs for TNT and RDX based on subchronic studies. Reported NOAEL and LOAEL divided by 10 to estimate chronic TRV.

Table 25. Selected mammalian TRV values for MUCs.

| Compound                                         | Acronym | NOAEL       | LOAEL | Test Or-<br>ganism | Body<br>Weight<br>(kg) | Effect/<br>Endpoint           | Reference                                  | As cited in          |
|--------------------------------------------------|---------|-------------|-------|--------------------|------------------------|-------------------------------|--------------------------------------------|----------------------|
|                                                  |         | (mg/kg/day) |       |                    |                        |                               |                                            |                      |
| 2,4,6-Trinitrotoluene                            | TNT     | 1.6         | 16    | rat                | 0.289                  | Testicular atrophy            | Dilley et al., 1982                        | Talmage et al., 1999 |
| 1,3,5-Trinotrobenzene                            | TNB     |             | 13.44 | rat                | 0.35                   | Decreased body weight         | Reddy et al., 1996                         | Talmage et al., 1999 |
| 1,3-Dinitrobenzene                               | DNB     | 0.113       | 0.264 | rat                | 0.35                   | Testicular degeneration       | Cody et al., 1981                          | Talmage et al., 1999 |
| Hexahydro-1,3,5-trinitro-1,3,5-triazine          | RDX     | 7           | 35    | mouse              | 0.0359                 | Testicular degeneration       | Lish et al., 1984                          | Talmage et al., 1999 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine | HMX     | 3           | 7.5   | mouse              | 0.025                  | Mortality                     | Everett and Mad-dock, 1985                 | Talmage et al., 1999 |
| N-methyl-N,2,4,6-tetranitroaniline               | tetryl  | 1.4         | 6.9   | rat                | 0.258 (males)          | Reduced body weight (females) | Reddy et al., 1994c                        | Talmage et al., 1999 |
| Pentaerythritol Tetranitrate                     | PETN    | 170         | 1700  | rat                | 0.35 (es-timate)       | Reduced body weight           | Bucher et al., 1990                        | USCHPPM, 2001        |
| 2,4-Dinitrotoluene                               | 2,4-DNT | 0.06        | 0.6   | rat                | 0.35 (es-timate)       | Testicular atrophy            | Lee et al., 1978, 1985, Ellis et al., 1979 | ATSDR, Dec 1998      |
| 2,6-Dinitrotoluene                               | 2,6-DNT | 0.7         | 7     | rat                | 0.35 (es-timate)       | Reduced body weight (males)   | Leonard et al., 1987                       | ATSDR, Dec 1998      |
| Nitroglycerin                                    | NG      | 3           | 32    | rat                | 0.35 (es-timate)       | Reduced body weight           | Ellis et al., 1978                         | USA CHPPM, 2001      |
| Nitrobenzene                                     | NB      | 1.16        | 5.8   | rat                | 0.58                   | Testicular atrophy            | Cattley et al., 1994                       |                      |

## 6 Risk Characterization

The risk characterization provides exposure and toxicity quotient estimates for each installation. Exposure estimates are derived following the methodology described in Chapter 4. Exposure or dose estimates are divided by applicable TRVs discussed in Chapter 5 and presented in Tables 20 through 25 to obtain toxicity quotients. The equation is given as:

$$TQ = \frac{Dose_{receptor}}{TRV} \quad \text{[Equation 8]}$$

where:

TQ = Toxicity Quotient  
 Dose<sub>receptor</sub> = Predicted dose to the receptor (mg/kg/day)  
 TRV = toxicity reference value (mg/kg/day).

In general, estimated TQs greater than one are considered indicative of potential adverse effects to threatened and endangered species of concern. TQs are estimated using TRVs derived from both NOAELs and LOAELs, where available. A potential for risk is interpreted as high, moderate, or low, depending on whether the TRVs exceeded a NOAEL and/or a LOAEL, and depending on the assumed dud rate, as follows:

| Exceeds the | Compared to 10% dud rate | Compared to 100% dud rate |
|-------------|--------------------------|---------------------------|
| NOAEL       | moderate                 | low                       |
| LOAEL       | high                     | moderate                  |

The NOAEL is the dose or concentration at which no effect is observed, while the LOAEL is the lowest dose or concentration at which an effect is observed. The true effect level is unknown but lies somewhere between the NOAEL and LOAEL. Therefore, both comparisons are relevant to a determination of potential risk.

Tables 26 through 40 present results of exposure and risk estimates for each installation and TES of concern. These results are discussed in the following paragraphs.

## **Fort Rucker, Alabama**

Table 26 provides the exposure and toxicity quotient estimates for Fort Rucker. There are no exceedances of any TRVs for Fort Rucker, and predicted toxicity quotients are below 1. Therefore, potential risk to TES of concern from exposure to COCs for which toxicity data are available is low. This screening level assessment assumes that the entire mass of COCs found in munitions is deposited over the impact area (22 mi<sup>2</sup>).

## **Yuma Proving Ground, Arizona**

There are no data for Yuma Proving Ground.

## **Fort Irwin, California**

Table 27 provides the exposure and toxicity quotient estimates for Fort Irwin. There are no exceedances of any TRVs. Potential risk to threatened and endangered species of concern from exposure to COCs for which toxicity data are available is low. This assessment assumes that the entire mass of COCs found in munitions is deposited over the impact area (159 mi<sup>2</sup>).

## **Fort Benning, Georgia**

Table 28 provides the exposure and toxicity quotient estimates for Fort Benning. Predicted toxicity quotients for the red-cockaded woodpecker exceed 1 for white phosphorus on an NOAEL basis but not for the LOAEL. Both the NOAELs and LOAELs are exceeded for potential effects on vegetation from fog oil. Assuming a 10 percent dud rate for the munitions results in no exceedances. However, assuming that the entire mass of COCs in munitions is deposited over the impact area (25 mi<sup>2</sup>), results in a NOAEL-based TQ greater than 1 for exposure to TNT and RDX, and an LOAEL-based TQ greater than 1 for exposure to RDX. There is the moderate potential for risk to the red-cockaded woodpecker from exposure to white phosphorus and RDX and a high potential for risk to vegetation from exposure to fog oil. There is a low potential for risk to the red-cockaded woodpecker from exposure to RDX.

## **Fort Gordon, Georgia**

Table 29 provides the exposure and toxicity quotient estimates for Fort Gordon. There are no exceedances of any TRVs. Potential risk to threatened and endangered species of concern from exposure to COCs for which toxicity data are available is low. This analysis assumes that the entire mass of COCs found in munitions is deposited over the impact area (19 mi<sup>2</sup>).

## **Fort Stewart, Georgia**

Table 30 provides the exposure and toxicity quotient estimates for Fort Stewart. There is potential for adverse effects to red-cockaded woodpecker from exposure to white phosphorus smoke. Assuming a 10 percent dud rate for munitions results in potential adverse effects to the red-cockaded woodpecker from exposure to TNT on a NOAEL basis. Assuming the entire mass of COCs in munitions is deposited over the impact area (30 mi<sup>2</sup>) results in potential adverse effects to the red-cockaded woodpecker from exposure to RDX and TNT. There is a high potential for risk to the red-cockaded woodpecker from exposure to white phosphorus. There is a moderate potential for risk to the red-cockaded woodpecker from exposure to RDX and TNT.

## **Fort Campbell, Kentucky**

Table 31 provides the exposure and toxicity quotient estimates for Fort Campbell. There is potential for adverse effects to the Indiana bat and gray bat from exposure to white phosphorus smoke. Assuming that the entire mass of COCs in the munitions (100 percent dud rate) is deposited over the impact area (39 mi<sup>2</sup>) results in potential adverse effects to the Indiana and gray bats from exposure to RDX, TNT, nitroglycerin, and 1,3-dinitrobenzene on an NOAEL basis and 1,3-dinitrobenzene on an LOAEL basis. Therefore, there is a moderate potential for risk for these chemicals and a high potential for risk from white phosphorus.

## **Fort Knox, Kentucky**

Table 32 provides the exposure and toxicity quotient estimates for Fort Knox. There is a low potential for adverse effects to Indiana bat and gray bat from exposure to fog oil smoke based on an exceedance of the NOAEL but not the LOAEL. All other TQ estimates are below 1. This analysis assumes that the entire mass of COCs found in munitions is deposited over the impact area (158 mi<sup>2</sup>).

## **Fort Polk, Louisiana**

Table 33 provides the exposure and toxicity quotient estimates for Fort Polk. There is a high potential for adverse effects to the red-cockaded woodpecker from exposure to white phosphorus smoke. Assuming either a 10 percent or 100 percent dud rate results in potential adverse effects to the red-cockaded woodpecker from exposure to TNT and RDX.

## **Camp Shelby, Mississippi**

Table 33 provides the exposure and toxicity quotient estimates for Camp Shelby. There is potential for adverse effects to the red-cockaded woodpecker from exposure to white phosphorus smoke based on exceedances of both the NOAEL and LOAEL, and from fog oil to vegetation. The dose of fog oil estimated for the gopher tortoise exceeds the NOAEL, but not the LOAEL, suggesting a moderate potential for adverse effects. Assuming a 10 percent dud munitions rate shows there is potential for adverse effects to the red-cockaded woodpecker from exposure to TNT on a NOAEL basis. Assuming the entire mass of COCs is deposited over the impact area (12 mi<sup>2</sup>) increases potential risk from TNT and RDX. (The potential risks to the red-cockaded woodpecker assumes that the species is present on Camp Shelby).

## **Fort Leonard Wood, Missouri**

Table 35 provides the exposure and toxicity quotient estimates for Fort Leonard Wood. For the Indiana and gray bat, NOAEL-based TQs exceed 1 from exposure to 1,3-trinitrobenzene and LOAEL- and NOAEL-based TQs exceed 1 from exposure to 1,3-dinitrobenzene, RDX, and TNT. This suggests a potential risk to the bats if only 10 percent of munitions are distributed throughout the impact area (0.79 mi<sup>2</sup>). Assuming deposition of 100 percent of the munitions increases the potential risk from terephthalic acid, PETN, and nitroglycerin on a NOAEL basis. For vegetation, there are no exceedances assuming a 10 percent dud rate but there are exceedances for RDX and TNT assuming a 100 percent dud rate. There is also a high potential for risk to both the Indiana and gray bats as well as vegetation from exposure to fog oil.

## **Fort Bragg, North Carolina**

Table 36 provides the exposure and toxicity quotient estimates for Fort Bragg. There is potential for adverse effects to red-cockaded woodpecker from exposure to

white phosphorus smoke. Assuming a 10 percent dud rate for munitions results in potential adverse effects to red-cockaded woodpecker from exposure to RDX and TNT, suggesting potential risk to the woodpecker from exposure to RDX and possibly TNT. Assuming the entire mass of COCs in munitions is deposited over the impact area (51 mi<sup>2</sup>) further increases potential risk for those two chemicals.

### **Fort Sill, Oklahoma**

Table 37 provides the exposure and toxicity quotient estimates for Fort Sill. Assuming 100 percent of the COCs in munitions are deposited over the impact area (73 mi<sup>2</sup>) results in no exceedances of any TRVs.

### **Fort Jackson, South Carolina**

Table 38 provides the exposure and toxicity quotient estimates for Fort Jackson. Assuming 10 percent of COCs in munitions are deposited over the impact area (17 mi<sup>2</sup>) results in no exceedances of TRVs. Assuming 100 percent of COCs in munitions are deposited over the impact area results in an exceedance of the NOAEL-based TQ above 1 from exposure to TNT and RDX and an exceedance of the LOAEL for RDX. This suggests a moderate potential risk to the red-cockaded woodpecker from exposure to munitions. There is a high potential for risk to the red-cockaded woodpecker from exposure to white phosphorus and to vegetation from exposure to fog oil.

### **Camp Bullis, Texas**

Table 39 provides the exposure and toxicity quotient estimates for Camp Bullis. Assuming 100 percent of COCs in munitions are deposited over the impact area (43 mi<sup>2</sup>) results in no exceedances.

### **Fort Hood, Texas**

Table 40 provides the exposure and toxicity quotient estimates for Fort Hood. Assuming 10 percent of COCs in munitions are deposited over the impact area (34 mi<sup>2</sup>) results in an exceedance of NOAEL-based TQs above 1 for both the black-capped vireo and the golden-cheeked warbler from exposure to TNT. Potential risk is further increased assuming 100 percent of COCs in munitions are deposited over the impact area for both TNT and RDX. There is a high potential for risk to the birds from exposure to white phosphorus and to vegetation from exposure to fog oil.

Table 26. Exposure and risk estimates for Fort Rucker, Alabama.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww |
|-----------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                             |                                            |                                                      |
| Fog Oil Smoke                     |         |                                             |                                            |                                                      |
| Hexachloroethane (HC) Smoke       | 3.74    |                                             |                                            |                                                      |
| White Phosphorous (WP) Smoke      | 3.08    |                                             |                                            |                                                      |
| Brass Flakes                      | -0.52   |                                             |                                            |                                                      |
| Graphite Flakes                   |         |                                             |                                            |                                                      |
| Titanium Dioxide                  | 2.23    |                                             |                                            |                                                      |
| Polyethylene Glycol (PEG)         | -1.2    |                                             |                                            |                                                      |
| Terephthalic Acid                 | 2       | 1421.81                                     | 1.88E-04                                   | 1.00E-04                                             |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    | 17.63                                       | 2.34E-06                                   | 4.51E-07                                             |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                             |                                            |                                                      |
| <b>Colored Smokes</b>             |         |                                             |                                            |                                                      |
| CI Basic Yellow 2                 | 3.54    |                                             |                                            |                                                      |
| Disperse Yellow 11                | 4.54    | 149.05                                      | 1.97E-05                                   | 3.54E-07                                             |
| Disperse Red 9                    | 4.045   | 51328.05                                    | 6.80E-03                                   | 2.36E-04                                             |
| Solvent Green 3                   | 8.995   | 49816.06                                    | 6.60E-03                                   | 3.08E-07                                             |
| Solvent Yellow 33                 | 4.1     | 49928.20                                    | 6.61E-03                                   | 2.13E-04                                             |
| Yellow Smoke 6                    | 6.28    |                                             |                                            |                                                      |
| Dye Yellow 4 (Benzanthrone)       | 4.81    |                                             |                                            |                                                      |
| <b>Military Unique Compounds</b>  |         |                                             |                                            |                                                      |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 25722.11                                    | 3.41E+00                                   | 6.04E+00                                             |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 25722.11                                    | 3.41E+00                                   | 3.59E+00                                             |
| 2,4 - Dinitrophenol (2,4-DNP)     | 1.67    |                                             |                                            |                                                      |
| Dinitrotoluene isomers            | 2.14    | 49250.52                                    | 6.52E-03                                   | 2.88E-03                                             |
| 2,4-Dinitrotoluene                | 1.98    |                                             |                                            |                                                      |

| Compound                                                    | log Kow | Sum of COC Weight (g)<br>Adjusted for Dud Rate | Soil Concentration (top<br>5 cm dry) mg/kg dw | Concentration in Vegetation via<br>Root Uptake mg/kg ww |
|-------------------------------------------------------------|---------|------------------------------------------------|-----------------------------------------------|---------------------------------------------------------|
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    | 2617.10                                        | 3.47E-04                                      | 2.16E-03                                                |
| Nitrobenzene (NB)                                           | 1.85    |                                                |                                               |                                                         |
| Nitroglycerin (NG)                                          | 1.62    | 56836138.54                                    | 7.53E+00                                      | 6.66E+00                                                |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                                |                                               |                                                         |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 1006.98                                        | 1.33E-04                                      | 1.20E-04                                                |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 435989.39                                      | 5.78E-02                                      | 1.39E-01                                                |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     | 27913.15                                       | 3.70E-03                                      | 1.15E-03                                                |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 257221.11                                      | 3.41E-02                                      | 3.10E-02                                                |

Table 26 Continued.

| Compound                          | Mass of smokes Fog<br>Oil and additives into<br>air gallons | Concentration in sedi-<br>ment - deposition (top 1<br>cm dry) mg/kg dw | Concentration on<br>Plants from Direct<br>Deposition mg/kg ww | Concentration on<br>Tree Leaves from<br>Direct Deposition<br>mg/kg ww |
|-----------------------------------|-------------------------------------------------------------|------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |                                                             |                                                                        |                                                               |                                                                       |
| Fog Oil Smoke                     | NA                                                          |                                                                        |                                                               |                                                                       |
| Hexachloroethane (HC) Smoke       | NA                                                          |                                                                        |                                                               |                                                                       |
| White Phosphorous (WP) Smoke      | NA                                                          |                                                                        |                                                               |                                                                       |
| Brass Flakes                      | NA                                                          |                                                                        |                                                               |                                                                       |
| Graphite Flakes                   | NA                                                          |                                                                        |                                                               |                                                                       |
| Titanium Dioxide                  |                                                             |                                                                        |                                                               |                                                                       |
| Polyethylene Glycol (PEG)         |                                                             |                                                                        |                                                               |                                                                       |
| Terephthalic Acid                 |                                                             |                                                                        |                                                               |                                                                       |
| (o-Chlorbenzol)malononitrile (CS) |                                                             |                                                                        |                                                               |                                                                       |
| Dibenz(bf)-14-oxazepine (CR)      |                                                             |                                                                        |                                                               |                                                                       |

| Compound                                                    | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww |
|-------------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|
| <b>Colored Smokes</b>                                       |                                                       |                                                                |                                                         |                                                              |
| CI Basic Yellow 2                                           |                                                       |                                                                |                                                         |                                                              |
| Disperse Yellow 11                                          |                                                       |                                                                |                                                         |                                                              |
| Disperse Red 9                                              |                                                       |                                                                |                                                         |                                                              |
| Solvent Green 3                                             |                                                       |                                                                |                                                         |                                                              |
| Solvent Yellow 33                                           |                                                       |                                                                |                                                         |                                                              |
| Yellow Smoke 6                                              |                                                       |                                                                |                                                         |                                                              |
| Dye Yellow 4 (Benzanthrone)                                 |                                                       |                                                                |                                                         |                                                              |
| <b>Military Unique Compounds</b>                            |                                                       |                                                                |                                                         |                                                              |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           |                                                       |                                                                |                                                         |                                                              |
| 1,3-Dinitrobenzene (1,3-DNB)                                |                                                       |                                                                |                                                         |                                                              |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                                                       |                                                                |                                                         |                                                              |
| Dinitrotoluene isomers                                      |                                                       |                                                                |                                                         |                                                              |
| 2,4-Dinitrotoluene                                          |                                                       |                                                                |                                                         |                                                              |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      |                                                       |                                                                |                                                         |                                                              |
| Nitrobenzene (NB)                                           |                                                       |                                                                |                                                         |                                                              |
| Nitroglycerin (NG)                                          |                                                       |                                                                |                                                         |                                                              |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                                                       |                                                                |                                                         |                                                              |
| Pentaerythritol Tetranitrate (PETN)                         |                                                       |                                                                |                                                         |                                                              |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               |                                                       |                                                                |                                                         |                                                              |
| Trinitrophenylmethylnitramine (Tetryl)                      |                                                       |                                                                |                                                         |                                                              |
| 2,4,6-Trinitrotoluene (TNT)                                 |                                                       |                                                                |                                                         |                                                              |

Table 26 Continued

| Compound                          | Concentration<br>in Aquatic<br>Insects <sup>1</sup><br>mg/kg bw | Concentration<br>in Terrestrial<br>Insects <sup>2</sup><br>mg/kg bw | Dose to Go-<br>pher Tortoise<br>mg/kg-day | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-<br>based TQ<br>for Tor-<br>toise | LOAEL-<br>based TQ<br>for Tor-<br>toise |
|-----------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------|----------------------------------------------------|-----------------------------------------|-----------------------------------------|
| <b>Smokes and Obscurants</b>      |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Fog Oil Smoke                     |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Hexachloroethane (HC) Smoke       |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| White Phosphorous (WP) Smoke      |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Brass Flakes                      |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Graphite Flakes                   |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Titanium Dioxide                  |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Polyethylene Glycol (PEG)         |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Terephthalic Acid                 |                                                                 | 6.11E-04                                                            | 5.99E-07                                  |                                                    |                                         |                                         |
| (o-Chlorbenzol)malononitrile (CS) |                                                                 | 2.75E-06                                                            | 2.69E-09                                  |                                                    |                                         |                                         |
| Dibenz(bf)-14-oxazepine (CR)      |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| <b>Colored Smokes</b>             |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| CI Basic Yellow 2                 |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Disperse Yellow 11                |                                                                 | 2.15E-06                                                            | 2.11E-09                                  |                                                    |                                         |                                         |
| Disperse Red 9                    |                                                                 | 1.44E-03                                                            | 1.41E-06                                  |                                                    |                                         |                                         |
| Solvent Green 3                   |                                                                 | 1.88E-06                                                            | 1.84E-09                                  |                                                    |                                         |                                         |
| Solvent Yellow 33                 |                                                                 | 1.30E-03                                                            | 1.27E-06                                  |                                                    | 9.36E-06                                | 9.36E-07                                |
| Yellow Smoke 6                    |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Dye Yellow 4 (Benzanthrone)       |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| <b>Military Unique Compounds</b>  |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| 1,3-Dinitrobenzene (1,3-DNB)      |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| 2,4 - Dinitrophenol (2,4-DNP)     |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |

| Compound                                                                                                                                                                                      | Concentration<br>in Aquatic<br>Insects <sup>1</sup><br>mg/kg bw | Concentration<br>in Terrestrial<br>Insects <sup>2</sup><br>mg/kg bw | Dose to Go-<br>pher Tortoise<br>mg/kg-day | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-<br>based TQ<br>for Tor-<br>toise | LOAEL-<br>based TQ<br>for Tor-<br>toise |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|-------------------------------------------|----------------------------------------------------|-----------------------------------------|-----------------------------------------|
| Dinitrotoluene isomers                                                                                                                                                                        |                                                                 | 1.76E-02                                                            | 1.72E-05                                  |                                                    |                                         |                                         |
| 2,4-Dinitrotoluene                                                                                                                                                                            |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                                                                        |                                                                 | 1.31E-02                                                            | 1.29E-05                                  |                                                    | 4.29E-05                                | 1.72E-05                                |
| Nitrobenzene (NB)                                                                                                                                                                             |                                                                 |                                                                     | 0.00E+00                                  |                                                    |                                         |                                         |
| Nitroglycerin (NG)                                                                                                                                                                            |                                                                 | 4.06E+01                                                            | 3.98E-02                                  |                                                    |                                         |                                         |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                                                   |                                                                 |                                                                     | 0.00E+00                                  |                                                    |                                         |                                         |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                                           |                                                                 | 7.28E-04                                                            | 7.14E-07                                  |                                                    | 4.20E-08                                | 4.20E-09                                |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                                                 |                                                                 | 8.47E-01                                                            | 8.31E-04                                  | 1.39E-03                                           | 1.19E-03                                | 2.37E-04                                |
| Trinitrophenylmethylamine (Tetryl)                                                                                                                                                            |                                                                 | 7.03E-03                                                            | 6.89E-06                                  | 4.62E-05                                           |                                         |                                         |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                                   |                                                                 | 1.89E-01                                                            | 1.85E-04                                  | 1.03E-03                                           | 1.16E-03                                | 1.16E-04                                |
| 1. Concentration in aquatic insects estimated via equilibrium partitioning with sediment.<br>2. Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                                 |                                                                     |                                           |                                                    |                                         |                                         |

Table 27. Exposure and risk estimates for Fort Irwin, California.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|-----------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Fog Oil Smoke                     |         |                                             |                                            |                                                      | 5.50E+01                                              | 7.23E+00                                                       | 1.92E+01                                                |
| Hexachloroethane (HC) Smoke       | 3.74    | 6558519.06                                  | 1.20E-01                                   | 6.27E-03                                             |                                                       |                                                                |                                                         |
| White Phosphorous (WP) Smoke      | 3.08    | 11415028.93                                 | 2.09E-01                                   | 2.63E-02                                             |                                                       |                                                                |                                                         |
| Brass Flakes                      | -0.52   |                                             |                                            |                                                      | NA                                                    |                                                                |                                                         |
| Graphite Flakes                   |         |                                             |                                            |                                                      | NA                                                    |                                                                |                                                         |
| Titanium Dioxide                  | 2.23    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Polyethylene Glycol (PEG)         | -1.2    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Terephthalic Acid                 | 2       | 1196451.42                                  | 2.19E-02                                   | 1.17E-02                                             |                                                       |                                                                |                                                         |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    | 35662.62                                    | 6.54E-04                                   | 1.26E-04                                             |                                                       |                                                                |                                                         |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| <b>Colored Smokes</b>             |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| CI Basic Yellow 2                 | 3.54    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Disperse Yellow 11                | 4.54    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Disperse Red 9                    | 4.045   | 169869.79                                   | 3.11E-03                                   | 1.08E-04                                             |                                                       |                                                                |                                                         |
| Solvent Green 3                   | 8.995   | 208208.05                                   | 3.82E-03                                   | 1.78E-07                                             |                                                       |                                                                |                                                         |
| Solvent Yellow 33                 | 4.1     | 155922.87                                   | 2.86E-03                                   | 9.22E-05                                             |                                                       |                                                                |                                                         |
| Yellow Smoke 6                    | 6.28    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| <b>Military Unique Compounds</b>  |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |

| Compound                                                    | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|-------------------------------------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| 2,4 - Dinitrophenol (2,4-DNP)                               | 1.67    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Dinitrotoluene isomers                                      | 2.14    | 15054908.03                                 | 2.76E-01                                   | 1.22E-01                                             |                                                       |                                                                |                                                         |
| 2,4-Dinitrotoluene                                          | 1.98    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    | 16985.25                                    | 3.11E-04                                   | 1.94E-03                                             |                                                       |                                                                |                                                         |
| Nitrobenzene (NB)                                           | 1.85    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Nitroglycerin (NG)                                          | 1.62    | 2899893.79                                  | 5.31E-02                                   | 4.70E-02                                             |                                                       |                                                                |                                                         |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 1216037.57                                  | 2.23E-02                                   | 2.00E-02                                             |                                                       |                                                                |                                                         |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 38977386.84                                 | 7.14E-01                                   | 1.72E+00                                             |                                                       |                                                                |                                                         |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     | 40760.92                                    | 7.47E-04                                   | 2.33E-04                                             |                                                       |                                                                |                                                         |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 128834262.56                                | 2.36E+00                                   | 2.15E+00                                             |                                                       |                                                                |                                                         |

Table 27 Continued.

| Compound                     | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves ug/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Desert Tortoise mg/kg-day |
|------------------------------|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|-----------------------------------|
| <b>Smokes and Obscurants</b> |                                                              |                                                    |                                                        |                                                            |                                   |
| Fog Oil Smoke                | 1.28E+01                                                     | 1.92E+01                                           | 1.47E+01                                               | 7.78E+01                                                   | 7.81E-02                          |
| Hexachloroethane (HC) Smoke  |                                                              |                                                    |                                                        | 3.82E-02                                                   | 2.56E-05                          |
| White Phosphorous (WP) Smoke |                                                              |                                                    |                                                        | 1.60E-01                                                   | 1.07E-04                          |
| Brass Flakes                 |                                                              |                                                    |                                                        |                                                            |                                   |

| Compound                                                    | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves ug/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Desert Tortoise mg/kg-day |
|-------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|-----------------------------------|
| Graphite Flakes                                             |                                                              |                                                    |                                                        |                                                            |                                   |
| Titanium Dioxide                                            |                                                              |                                                    |                                                        |                                                            |                                   |
| Polyethylene Glycol (PEG)                                   |                                                              |                                                    |                                                        |                                                            |                                   |
| Terephthalic Acid                                           |                                                              |                                                    |                                                        | 7.11E-02                                                   | 4.77E-05                          |
| (o-Chlorbenzol)malononitrile (CS)                           |                                                              |                                                    |                                                        | 7.68E-04                                                   | 5.15E-07                          |
| Dibenz(bf)-14-oxazepine (CR)                                |                                                              |                                                    |                                                        |                                                            |                                   |
| <b>Colored Smokes</b>                                       |                                                              |                                                    |                                                        |                                                            |                                   |
| CI Basic Yellow 2                                           |                                                              |                                                    |                                                        |                                                            |                                   |
| Disperse Yellow 11                                          |                                                              |                                                    |                                                        |                                                            |                                   |
| Disperse Red 9                                              |                                                              |                                                    |                                                        | 6.58E-04                                                   | 4.41E-07                          |
| Solvent Green 3                                             |                                                              |                                                    |                                                        | 1.09E-06                                                   | 7.27E-10                          |
| Solvent Yellow 33                                           |                                                              |                                                    |                                                        | 5.61E-04                                                   | 3.76E-07                          |
| Yellow Smoke 6                                              |                                                              |                                                    |                                                        |                                                            |                                   |
| <b>Military Unique Compounds</b>                            |                                                              |                                                    |                                                        |                                                            |                                   |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           |                                                              |                                                    |                                                        |                                                            |                                   |
| 1,3-Dinitrobenzene (1,3-DNB)                                |                                                              |                                                    |                                                        |                                                            |                                   |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                                                              |                                                    |                                                        |                                                            |                                   |
| Dinitrotoluene isomers                                      |                                                              |                                                    |                                                        | 7.43E-01                                                   | 4.97E-04                          |
| 2,4-Dinitrotoluene                                          |                                                              |                                                    |                                                        |                                                            |                                   |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      |                                                              |                                                    |                                                        | 1.18E-02                                                   | 7.90E-06                          |
| Nitrobenzene (NB)                                           |                                                              |                                                    |                                                        |                                                            |                                   |
| Nitroglycerin (NG)                                          |                                                              |                                                    |                                                        | 2.86E-01                                                   | 1.92E-04                          |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                                                              |                                                    |                                                        |                                                            |                                   |

| Compound                                                                                                                                                                                      | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves ug/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Desert Tortoise mg/kg-day |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|-----------------------------------|
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                                           |                                                              |                                                    |                                                        | 1.22E-01                                                   | 8.16E-05                          |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                                                 |                                                              |                                                    |                                                        | 1.05E+01                                                   | 7.02E-03                          |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                                                                        |                                                              |                                                    |                                                        | 1.42E-03                                                   | 9.52E-07                          |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                                   |                                                              |                                                    |                                                        | 1.31E+01                                                   | 8.76E-03                          |
| 1. Concentration in aquatic insects estimated via equilibrium partitioning with sediment.<br>2. Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                              |                                                    |                                                        |                                                            |                                   |

Table 27 Continued

| Compound                          | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Desert Tortoise | LOAEL-based TQ for Desert Tortoise |
|-----------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|------------------------------------|------------------------------------|
| <b>Smokes and Obscurants</b>      |                           |                           |                                |                                |                                    |                                    |
| Fog Oil Smoke                     | 3.5E-01                   | 2.8E-01                   | 3.5E-01                        | 2.8E-01                        | 6.5E-02                            | 1.6E-02                            |
| Hexachloroethane (HC) Smoke       |                           |                           |                                |                                |                                    |                                    |
| White Phosphorous (WP) Smoke      |                           |                           |                                |                                | 7.2E-02                            | 6.1E-02                            |
| Brass Flakes                      |                           |                           |                                |                                |                                    |                                    |
| Graphite Flakes                   |                           |                           |                                |                                |                                    |                                    |
| Titanium Dioxide                  |                           |                           |                                |                                |                                    |                                    |
| Polyethylene Glycol (PEG)         |                           |                           |                                |                                |                                    |                                    |
| Terephthalic Acid                 |                           |                           |                                |                                | 1.3E-04                            |                                    |
| (o-Chlorbenzol)malononitrile (CS) |                           |                           |                                |                                |                                    |                                    |
| Dibenz(bf)-14-oxazepine (CR)      |                           |                           |                                |                                |                                    |                                    |

| Compound                                                    | NOAEL-based<br>TQ for Plants | LOAEL-based<br>TQ for Plants | NOAEL-based<br>TQ for Tree<br>Leaves | LOAEL-based<br>TQ for Tree<br>Leaves | NOAEL-based<br>TQ for Desert<br>Tortoise | LOAEL-based<br>TQ for Desert<br>Tortoise |
|-------------------------------------------------------------|------------------------------|------------------------------|--------------------------------------|--------------------------------------|------------------------------------------|------------------------------------------|
| <b>Colored Smokes</b>                                       |                              |                              |                                      |                                      |                                          |                                          |
| CI Basic Yellow 2                                           |                              |                              |                                      |                                      |                                          |                                          |
| Disperse Yellow 11                                          |                              |                              |                                      |                                      |                                          |                                          |
| Disperse Red 9                                              |                              |                              |                                      |                                      |                                          |                                          |
| Solvent Green 3                                             |                              |                              |                                      |                                      |                                          |                                          |
| Solvent Yellow 33                                           |                              |                              |                                      |                                      | 2.8-06                                   | 2.8-07                                   |
| Yellow Smoke 6                                              |                              |                              |                                      |                                      |                                          |                                          |
| <b>Military Unique Compounds</b>                            |                              |                              |                                      |                                      |                                          |                                          |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           |                              |                              |                                      |                                      | 6.5E-03                                  | 1.3E-03                                  |
| 1,3-Dinitrobenzene (1,3-DNB)                                |                              |                              |                                      |                                      | 9.0E-02                                  | 3.8E-02                                  |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                              |                              |                                      |                                      |                                          |                                          |
| Dinitrotoluene isomers                                      |                              |                              |                                      |                                      |                                          |                                          |
| 2,4-Dinitrotoluene                                          |                              |                              |                                      |                                      |                                          |                                          |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      |                              |                              |                                      |                                      | 2.6E-05                                  | 1.1E05                                   |
| Nitrobenzene (NB)                                           |                              |                              |                                      |                                      |                                          |                                          |
| Nitroglycerin (NG)                                          |                              |                              |                                      |                                      | 6.4E-04                                  | 6.0E-05                                  |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                              |                              |                                      |                                      |                                          |                                          |
| Pentaerythritol Tetranitrate (PETN)                         |                              |                              |                                      |                                      | 4.8E-06                                  | 4.8E-07                                  |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               |                              | 1.7E-02                      |                                      | 1.7E-02                              | 1.0E-02                                  | 2.0E-03                                  |
| Trinitrophenylmethyl nitramine (Tetryl)                     |                              | 9.3E-06                      |                                      | 9.3E-06                              |                                          |                                          |
| 2,4,6-Trinitrotoluene (TNT)                                 |                              | 7.2E-02                      |                                      | 7.2E-02                              | 5.5E02                                   | 5.5E03                                   |

Table 28. Exposure and risk estimates for Fort Benning, Georgia.

| Compound                                               | log Kow | Sum of COC Weight (g) Adjusted for Duder Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons |
|--------------------------------------------------------|---------|-----------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|
| <b>Smokes and Obscurants</b>                           |         |                                               |                                            |                                                      |                                                                    |
| Fog Oil Smoke                                          |         |                                               |                                            |                                                      | 5.00E+02                                                           |
| Hexachloroethane (HC) Smoke                            | 3.74    | 63009.35                                      | 7.34E-03                                   | 3.83E-04                                             |                                                                    |
| White Phosphorous (WP) Smoke                           | 3.08    | 288846.00                                     | 3.37E-02                                   | 4.24E-03                                             |                                                                    |
| Brass Flakes                                           | -0.52   |                                               |                                            |                                                      | NI                                                                 |
| Graphite Flakes                                        |         |                                               |                                            |                                                      | NI                                                                 |
| Titanium Dioxide                                       | 2.23    |                                               |                                            |                                                      |                                                                    |
| Polyethylene Glycol (PEG)                              | -1.2    |                                               |                                            |                                                      |                                                                    |
| Terephthalic Acid                                      | 2       | 710.90                                        | 8.29E-05                                   | 4.41E-05                                             |                                                                    |
| (o-Chlorbenzol)malononitrile (CS)                      | 2.76    | 3.28                                          | 3.82E-08                                   | 7.38E-09                                             |                                                                    |
| Dibenz(bf)-14-oxazepine (CR)                           | 3.49    |                                               |                                            |                                                      |                                                                    |
| <b>Colored Smokes</b>                                  |         |                                               |                                            |                                                      |                                                                    |
| CI Basic Yellow 2                                      | 3.54    | 21.79                                         | 2.54E-06                                   | 1.73E-07                                             |                                                                    |
| Disperse Yellow 11                                     | 4.54    | 28414.64                                      | 3.31E-03                                   | 5.93E-05                                             |                                                                    |
| Disperse Red 9                                         | 4.045   | 8420.58                                       | 9.82E-04                                   | 3.41E-05                                             |                                                                    |
| Solvent Green 3                                        | 8.995   | 533.44                                        | 6.22E-05                                   | 2.90E-09                                             |                                                                    |
| Solvent Yellow 33                                      | 4.1     | 2922.59                                       | 3.41E-04                                   | 1.10E-05                                             |                                                                    |
| Yellow Smoke 6                                         | 6.28    | 1012.37                                       | 1.18E-04                                   | 2.07E-07                                             |                                                                    |
| <b>Military Unique Compounds</b>                       |         |                                               |                                            |                                                      |                                                                    |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                      | 1.1     | 137943.08                                     | 1.61E-02                                   | 2.85E-02                                             |                                                                    |
| 1,3-Dinitrobenzene (1,3-DNB)                           | 1.49    | 13794.31                                      | 1.61E-03                                   | 1.69E-03                                             |                                                                    |
| 2,4 - Dinitrophenol (2,4-DNP)                          | 1.67    |                                               |                                            |                                                      |                                                                    |
| Dinitrotoluene isomers                                 | 2.14    | 26259.99                                      | 3.06E-03                                   | 1.35E-03                                             |                                                                    |
| 2,4-Dinitrotoluene                                     | 1.98    | 1.09                                          | 1.27E-07                                   | 6.94E-08                                             |                                                                    |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 0.16    | 84989.90                                      | 9.91E-03                                   | 6.16E-02                                             |                                                                    |

| Compound                                                                                               | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons |
|--------------------------------------------------------------------------------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|
| Nitrobenzene (NB)                                                                                      | 1.85    | 243269.14                                   | 2.84E-02                                   | 2.51E-02                                             |                                                                    |
| Nitroglycerin (NG)                                                                                     | 1.62    |                                             |                                            |                                                      |                                                                    |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                            | 1.9     |                                             |                                            |                                                      |                                                                    |
| Pentaerythritol Tetranitrate (PETN)                                                                    | 1.61    | 70099.09                                    | 8.17E-03                                   | 7.33E-03                                             |                                                                    |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                          | 0.87    | 940614.64                                   | 1.10E-01                                   | 2.64E-01                                             |                                                                    |
| Trinitrophenylmethylnitramine (Tetryl)                                                                 | 2.4     | 4231.81                                     | 4.93E-04                                   | 1.54E-04                                             |                                                                    |
| 2,4,6-Trinitrotoluene (TNT)                                                                            | 1.6     | 1379430.85                                  | 1.61E-01                                   | 1.46E-01                                             |                                                                    |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available |         |                                             |                                            |                                                      |                                                                    |

Table 28 Continued.

| Compound                          | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves ug/cm <sup>2</sup> | Concentration in aquatic insects <sup>2</sup> mg/kg bw |
|-----------------------------------|----------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |                                                                |                                                         |                                                              |                                                    |                                                        |
| Fog Oil Smoke                     | 6.57E+01                                                       | 1.74E+02                                                | 1.16E+02                                                     | 1.74E+02                                           | 1.33E+02                                               |
| Hexachloroethane (HC) Smoke       |                                                                |                                                         |                                                              |                                                    |                                                        |
| White Phosphorous (WP) Smoke      |                                                                |                                                         |                                                              |                                                    |                                                        |
| Brass Flakes                      |                                                                |                                                         |                                                              |                                                    |                                                        |
| Graphite Flakes                   |                                                                |                                                         |                                                              |                                                    |                                                        |
| Titanium Dioxide                  |                                                                |                                                         |                                                              |                                                    |                                                        |
| Polyethylene Glycol (PEG)         |                                                                |                                                         |                                                              |                                                    |                                                        |
| Terephthalic Acid                 |                                                                |                                                         |                                                              |                                                    |                                                        |
| (o-Chlorbenzol)malononitrile (CS) |                                                                |                                                         |                                                              |                                                    |                                                        |

| Compound                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves ug/cm <sup>2</sup> | Concentration in aquatic insects <sup>2</sup> mg/kg bw |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|----------------------------------------------------|--------------------------------------------------------|
| Dibenz(bf)-14-oxazepine (CR)                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                |                                                         |                                                              |                                                    |                                                        |
| <b>Colored Smokes</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                |                                                         |                                                              |                                                    |                                                        |
| CI Basic Yellow 2<br>Disperse Yellow 11<br>Disperse Red 9<br>Solvent Green 3<br>Solvent Yellow 33<br>Yellow Smoke 6                                                                                                                                                                                                                                                                                                                                                                     |                                                                |                                                         |                                                              |                                                    |                                                        |
| <b>Military Unique Compounds</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                |                                                         |                                                              |                                                    |                                                        |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)<br>1,3-Dinitrobenzene (1,3-DNB)<br>2,4 – Dinitrophenol (2,4-DNP)<br>Dinitrotoluene isomers<br>2,4-Dinitrotoluene<br>Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)<br>Nitrobenzene (NB)<br>Nitroglycerin (NG)<br>Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol)<br>Pentaerythritol Tetranitrate (PETN)<br>Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)<br>Trinitrophenylmethylnitramine (Tetryl)<br>2,4,6-Trinitrotoluene (TNT) |                                                                |                                                         |                                                              |                                                    |                                                        |
| 2 Concentration in aquatic insects estimated via equilibrium partitioning with sediment.                                                                                                                                                                                                                                                                                                                                                                                                |                                                                |                                                         |                                                              |                                                    |                                                        |

Table 28 Continued.

| Compound                          | Concentration in Terrestrial Insects <sup>3</sup><br>mg/kg bw | Dose to Gopher Tortoise<br>mg/kg-day | Dose to Woodpecker<br>mg/kg-day | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves |
|-----------------------------------|---------------------------------------------------------------|--------------------------------------|---------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|
| <b>Smokes and Obscurants</b>      |                                                               |                                      |                                 |                           |                           |                                |                                |
| Fog Oil Smoke                     | 7.07E+02                                                      | 1.04E+00                             | 2.28E+02                        | 3.2E+00                   | 2.5E+00                   | 3.2E+00                        | 2.5E+00                        |
| Hexachloroethane (HC) Smoke       | 2.33E-03                                                      | 2.29E-06                             | 7.51E-04                        |                           |                           |                                |                                |
| White Phosphorous (WP) Smoke      | 2.58E-02                                                      | 2.53E-05                             | 8.32E-03                        |                           |                           |                                |                                |
| Brass Flakes                      |                                                               |                                      |                                 |                           |                           |                                |                                |
| Graphite Flakes                   |                                                               |                                      |                                 |                           |                           |                                |                                |
| Titanium Dioxide                  |                                                               |                                      |                                 |                           |                           |                                |                                |
| Polyethylene Glycol (PEG)         |                                                               |                                      |                                 |                           |                           |                                |                                |
| Terephthalic Acid                 | 2.69E-04                                                      | 2.64E-07                             | 8.66E-05                        |                           |                           |                                |                                |
| (o-Chlorbenzol)malononitrile (CS) | 4.50E-08                                                      | 4.41E-11                             | 1.45E-08                        |                           |                           |                                |                                |
| Dibenz(bf)-14-oxazepine (CR)      |                                                               |                                      |                                 |                           |                           |                                |                                |
| <b>Colored Smokes</b>             |                                                               |                                      |                                 |                           |                           |                                |                                |
| CI Basic Yellow 2                 | 1.05E-06                                                      | 1.03E-09                             | 3.39E-07                        |                           |                           |                                |                                |
| Disperse Yellow 11                | 3.61E-04                                                      | 3.54E-07                             | 1.16E-04                        |                           |                           |                                |                                |
| Disperse Red 9                    | 2.07E-04                                                      | 2.03E-07                             | 6.68E-05                        |                           |                           |                                |                                |
| Solvent Green 3                   | 1.77E-08                                                      | 1.73E-11                             | 5.70E-09                        |                           |                           |                                |                                |
| Solvent Yellow 33                 | 6.69E-05                                                      | 6.56E-08                             | 2.15E-05                        |                           |                           |                                |                                |
| Yellow Smoke 6                    | 1.26E-06                                                      | 1.24E-09                             | 4.06E-07                        |                           |                           |                                |                                |
| <b>Military Unique Compounds</b>  |                                                               |                                      |                                 |                           |                           |                                |                                |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.74E-01                                                      | 1.70E-04                             | 5.59E-02                        |                           |                           |                                |                                |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.03E-02                                                      | 1.01E-05                             | 3.32E-03                        |                           |                           |                                |                                |
| 2,4 - Dinitrophenol (2,4-DNP)     |                                                               |                                      |                                 |                           |                           |                                |                                |
| Dinitrotoluene isomers            | 8.24E-03                                                      | 8.08E-06                             | 2.65E-03                        |                           |                           |                                |                                |
| 2,4-Dinitrotoluene                | 4.23E-07                                                      | 4.14E-10                             | 1.36E-07                        |                           |                           |                                |                                |

| Compound                                                        | Concentration in Terrestrial Insects <sup>a</sup><br>mg/kg bw | Dose to Gopher Tortoise<br>mg/kg-day | Dose to Woodpecker<br>mg/kg-day | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves |
|-----------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------|---------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)          | 3.75E-01                                                      | 3.68E-04                             | 1.21E-01                        |                           |                           |                                |                                |
| Nitrobenzene (NB)                                               |                                                               |                                      |                                 |                           |                           |                                |                                |
| Nitroglycerin (NG)                                              | 1.53E-01                                                      | 1.50E-04                             | 4.92E-02                        |                           |                           |                                |                                |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)     |                                                               |                                      |                                 |                           |                           |                                |                                |
| Pentaerythritol Tetranitrate (PETN)                             | 4.46E-02                                                      | 4.38E-05                             | 1.44E-02                        |                           |                           |                                |                                |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 1.61E+00                                                      | 1.58E-03                             | 5.18E-01                        |                           | 2.6E-03                   |                                | 2.6E-03                        |
| Trinitrophenylmethylnitramine (Tetryl)                          | 9.38E-04                                                      | 9.20E-07                             | 3.02E-04                        |                           | 6.2E-06                   |                                | 6.2E-06                        |
| 2,4,6-Trinitrotoluene (TNT)                                     | 8.90E-01                                                      | 8.73E-04                             | 2.87E-01                        |                           | 4.9E-03                   |                                | 4.9E-03                        |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                                                               |                                      |                                 |                           |                           |                                |                                |

Table 28 Continued.

| Compound                          | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker | NOAEL-based TQ for Tortoise | LOAEL-based TQ for Tortoise |
|-----------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|
| <b>Smokes and Obscurants</b>      |                               |                               |                             |                             |
| Fog Oil Smoke                     |                               |                               | 8.7E-01                     | 2.1E-01                     |
| Hexachloroethane (HC) Smoke       | 5.2E-05                       | 5.7E-06                       | 1.4E-07                     | 7.1E-08                     |
| White Phosphorous (WP) Smoke      | <b>1.7E+00</b>                | 1.7E-01                       | 1.7E-02                     | 1.4E-02                     |
| Brass Flakes                      |                               |                               |                             |                             |
| Graphite Flakes                   |                               |                               |                             |                             |
| Titanium Dioxide                  |                               |                               |                             |                             |
| Polyethylene Glycol (PEG)         |                               |                               | 7.4E-06                     |                             |
| Terephthalic Acid                 |                               |                               |                             |                             |
| (o-Chlorbenzol)malononitrile (CS) |                               |                               |                             |                             |
| Dibenz(bf)-14-oxazepine (CR)      |                               |                               |                             |                             |

| Compound                                                        | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker | NOAEL-based TQ for Tortoise | LOAEL-based TQ for Tortoise |
|-----------------------------------------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|
| <b>Colored Smokes</b>                                           |                               |                               |                             |                             |
| CI Basic Yellow 2                                               |                               |                               |                             |                             |
| Disperse Yellow 11                                              |                               |                               |                             |                             |
| Disperse Red 9                                                  |                               |                               |                             |                             |
| Solvent Green 3                                                 |                               |                               |                             |                             |
| Solvent Yellow 33                                               |                               |                               | 4.8E-07                     | 4.8E-08                     |
| Yellow Smoke 6                                                  |                               |                               |                             |                             |
| <b>Military Unique Compounds</b>                                |                               |                               |                             |                             |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                               |                               |                               | 6.4E-04                     | 1.3E-04                     |
| 1,3-Dinitrobenzene (1,3-DNB)                                    |                               |                               | 8.9E-04                     | 3.8E-04                     |
| 2,4 - Dinitrophenol (2,4-DNP)                                   |                               |                               |                             |                             |
| Dinitrotoluene isomers                                          |                               |                               | 1.2E-04                     | 1.2E-05                     |
| 2,4-Dinitrotoluene                                              |                               |                               | 6.9E-08                     | 6.9E-09                     |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)          |                               |                               | 1.2E-03                     | 4.9E-04                     |
| Nitrobenzene (NB)                                               |                               |                               |                             |                             |
| Nitroglycerin (NG)                                              |                               |                               | 5.0E-04                     | 4.7E-05                     |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)     |                               |                               |                             |                             |
| Pentaerythritol Tetranitrate (PETN)                             |                               |                               | 2.6E-06                     | 2.6E-07                     |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 2.3E-01                       | 2.0E-01                       | 2.3E-03                     | 4.5E-04                     |
| Trinitrophenylmethylnitramine (Tetryl)                          |                               |                               | 6.6E-06                     | 1.3E-06                     |
| 2,4,6-Trinitrotoluene (TNT)                                     | 4.1E-01                       | 1.6E-02                       | 5.5E-03                     | 5.5E-04                     |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                               |                               |                             |                             |

Table 29. Exposure and risk estimates for Fort Gordon, Georgia.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Duder Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw |
|-----------------------------------|---------|-----------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                               |                                            |                                                      |                                                                    |                                                                |
| Fog Oil Smoke                     |         |                                               |                                            |                                                      | NI                                                                 |                                                                |
| Hexachloroethane (HC) Smoke       | 3.74    | 2584.64                                       | 3.96E-04                                   | 2.07E-05                                             |                                                                    |                                                                |
| White Phosphorous (WP) Smoke      | 3.08    |                                               |                                            |                                                      |                                                                    |                                                                |
| Brass Flakes                      | -0.52   |                                               |                                            |                                                      | NI                                                                 |                                                                |
| Graphite Flakes                   |         |                                               |                                            |                                                      | NI                                                                 |                                                                |
| Titanium Dioxide                  | 2.23    |                                               |                                            |                                                      |                                                                    |                                                                |
| Polyethylene Glycol (PEG)         | -1.2    |                                               |                                            |                                                      |                                                                    |                                                                |
| Terephthalic Acid                 | 2       | 568.72                                        | 8.72E-05                                   | 4.65E-05                                             |                                                                    |                                                                |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    | 412.92                                        | 6.33E-05                                   | 1.22E-05                                             |                                                                    |                                                                |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                               |                                            |                                                      |                                                                    |                                                                |
| <b>Colored Smokes</b>             |         |                                               |                                            |                                                      |                                                                    |                                                                |
| CI Basic Yellow 2                 | 3.54    |                                               |                                            |                                                      |                                                                    |                                                                |
| Disperse Yellow 11                | 4.54    | 272.97                                        | 4.19E-05                                   | 7.50E-07                                             |                                                                    |                                                                |
| Disperse Red 9                    | 4.045   | 3566.77                                       | 5.47E-04                                   | 1.90E-05                                             |                                                                    |                                                                |
| Solvent Green 3                   | 8.995   | 12021.25                                      | 1.84E-03                                   | 8.61E-08                                             |                                                                    |                                                                |
| Solvent Yellow 33                 | 4.1     | 24261.57                                      | 3.72E-03                                   | 1.20E-04                                             |                                                                    |                                                                |
| Yellow Smoke 6                    | 6.28    |                                               |                                            |                                                      |                                                                    |                                                                |
| Dye Yellow 4 (Benzanthrone)       | 4.81    |                                               |                                            |                                                      |                                                                    |                                                                |
| <b>Military Unique Compounds</b>  |         |                                               |                                            |                                                      |                                                                    |                                                                |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 406.36                                        | 6.23E-05                                   | 1.10E-04                                             |                                                                    |                                                                |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 406.36                                        | 6.23E-05                                   | 6.56E-05                                             |                                                                    |                                                                |
| 2,4 - Dinitrophenol (2,4-DNP)     | 1.67    |                                               |                                            |                                                      |                                                                    |                                                                |

| Compound                                                                                               | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw |
|--------------------------------------------------------------------------------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------|
| Dinitrotoluene isomers                                                                                 | 2.14    |                                             |                                            |                                                      |                                                                    |                                                                |
| 2,4-Dinitrotoluene                                                                                     | 1.98    |                                             |                                            |                                                      |                                                                    |                                                                |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                 | 0.16    |                                             |                                            |                                                      |                                                                    |                                                                |
| Nitrobenzene (NB)                                                                                      | 1.85    |                                             |                                            |                                                      |                                                                    |                                                                |
| Nitroglycerin (NG)                                                                                     | 1.62    | 270.64                                      | 4.15E-05                                   | 3.67E-05                                             |                                                                    |                                                                |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                            | 1.9     |                                             |                                            |                                                      |                                                                    |                                                                |
| Pentaerythritol Tetranitrate (PETN)                                                                    | 1.61    | 1.84                                        | 2.83E-07                                   | 2.54E-07                                             |                                                                    |                                                                |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                          | 0.87    |                                             |                                            |                                                      |                                                                    |                                                                |
| Trinitrophenylmethylnitramine (Tetryl)                                                                 | 2.4     | 370.50                                      | 5.68E-05                                   | 1.77E-05                                             |                                                                    |                                                                |
| 2,4,6-Trinitrotoluene (TNT)                                                                            | 1.6     | 40.64                                       | 6.23E-06                                   | 5.66E-06                                             |                                                                    |                                                                |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available |         |                                             |                                            |                                                      |                                                                    |                                                                |

Table 29 Continued.

| Compound                     | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Gopher Tortoise mg/kg-day | Dose to Woodpecker mg/kg-day |
|------------------------------|--------------------------------------------------------|------------------------------------------------------------|-----------------------------------|------------------------------|
| <b>Smokes and Obscurants</b> |                                                        |                                                            |                                   |                              |
| Fog Oil Smoke                |                                                        |                                                            |                                   |                              |
| Hexachloroethane (HC) Smoke  |                                                        | 1.26E-04                                                   | 1.23E-07                          | 4.06E-05                     |
| White Phosphorous (WP) Smoke |                                                        |                                                            |                                   |                              |
| Brass Flakes                 |                                                        |                                                            |                                   |                              |
| Graphite Flakes              |                                                        |                                                            |                                   |                              |
| Titanium Dioxide             |                                                        |                                                            |                                   |                              |
| Polyethylene Glycol (PEG)    |                                                        |                                                            |                                   |                              |
| Terephthalic Acid            |                                                        | 2.83E-04                                                   | 2.77E-07                          | 9.12E-05                     |

| Compound                                                                                               | Concentration<br>in Aquatic<br>Insects <sup>1</sup><br>mg/kg bw | Concentration<br>in Terrestrial<br>Insects <sup>2</sup><br>mg/kg bw | Dose to<br>Gopher<br>Tortoise<br>mg/kg-day | Dose to Wood-<br>pecker mg/kg-<br>day |
|--------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---------------------------------------------------------------------|--------------------------------------------|---------------------------------------|
| (o-Chlorbenzol)malononitrile (CS)<br>Dibenz(bf)-14-oxazepine (CR)                                      |                                                                 | 7.45E-05                                                            | 7.30E-08                                   | 2.40E-05                              |
| <b>Colored Smokes</b>                                                                                  |                                                                 |                                                                     |                                            |                                       |
| CI Basic Yellow 2                                                                                      |                                                                 |                                                                     |                                            |                                       |
| Disperse Yellow 11                                                                                     |                                                                 | 4.57E-06                                                            | 4.48E-09                                   | 1.47E-06                              |
| Disperse Red 9                                                                                         |                                                                 | 1.16E-04                                                            | 1.13E-07                                   | 3.72E-05                              |
| Solvent Green 3                                                                                        |                                                                 | 5.24E-07                                                            | 5.14E-10                                   | 1.69E-07                              |
| Solvent Yellow 33                                                                                      |                                                                 | 7.31E-04                                                            | 7.16E-07                                   | 2.35E-04                              |
| Yellow Smoke 6                                                                                         |                                                                 |                                                                     |                                            |                                       |
| Dye Yellow 4 (Benzanthrone)                                                                            |                                                                 |                                                                     |                                            |                                       |
| <b>Military Unique Compounds</b>                                                                       |                                                                 |                                                                     |                                            |                                       |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                      |                                                                 | 6.73E-04                                                            | 6.59E-07                                   | 2.17E-04                              |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                           |                                                                 | 4.00E-04                                                            | 3.92E-07                                   | 1.29E-04                              |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                          |                                                                 |                                                                     |                                            |                                       |
| Dinitrotoluene isomers                                                                                 |                                                                 |                                                                     |                                            |                                       |
| 2,4-Dinitrotoluene                                                                                     |                                                                 |                                                                     |                                            |                                       |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                 |                                                                 |                                                                     |                                            |                                       |
| Nitrobenzene (NB)                                                                                      |                                                                 |                                                                     |                                            |                                       |
| Nitroglycerin (NG)                                                                                     |                                                                 | 2.24E-04                                                            | 2.19E-07                                   | 7.21E-05                              |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                            |                                                                 |                                                                     |                                            |                                       |
| Pentaerythritol Tetranitrate (PETN)                                                                    |                                                                 | 1.55E-06                                                            | 1.52E-09                                   | 4.98E-07                              |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                          |                                                                 |                                                                     |                                            |                                       |
| Trinitrophenylmethylnitramine (Tetryl)                                                                 |                                                                 | 1.08E-04                                                            | 1.06E-07                                   | 3.48E-05                              |
| 2,4,6-Trinitrotoluene (TNT)                                                                            |                                                                 | 3.45E-05                                                            | 3.38E-08                                   | 1.11E-05                              |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available |                                                                 |                                                                     |                                            |                                       |

Table 29 Continued.

| Compound                                                                                                                                                                                                                                                   | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-based<br>TQ for Wood-<br>pecker | LOAEL-based<br>TQ for Wood-<br>pecker | NOAEL-based<br>TQ for Tor-<br>toise | LOAEL-based<br>TQ for Tor-<br>toise |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| <b>Smokes and Obscurants</b>                                                                                                                                                                                                                               |                                                    |                                       |                                       |                                     |                                     |
| Fog Oil Smoke<br>Hexachloroethane (HC) Smoke<br>White Phosphorous (WP) Smoke<br>Brass Flakes<br>Graphite Flakes<br>Titanium Dioxide<br>Polyethylene Glycol (PEG)<br>Terephthalic Acid<br>(o-Chlorbenzol)malononitrile (CS)<br>Dibenz(bf)-14-oxazepine (CR) |                                                    |                                       |                                       |                                     |                                     |
| <b>Colored Smokes</b>                                                                                                                                                                                                                                      |                                                    |                                       |                                       |                                     |                                     |
| CI Basic Yellow 2<br>Disperse Yellow 11<br>Disperse Red 9<br>Solvent Green 3<br>Solvent Yellow 33<br>Yellow Smoke 6<br>Dye Yellow 4 (Benzanthrone)                                                                                                         |                                                    |                                       |                                       | 5.27E-06                            | 5.27E-07                            |
| <b>Military Unique Compounds</b>                                                                                                                                                                                                                           |                                                    |                                       |                                       |                                     |                                     |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)<br>1,3-Dinitrobenzene (1,3-DNB)<br>2,4 - Dinitrophenol (2,4-DNP)<br>Dinitrotoluene isomers                                                                                                                               |                                                    |                                       |                                       |                                     |                                     |

| Compound                                                                                               | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-based<br>TQ for Wood-<br>pecker | LOAEL-based<br>TQ for Wood-<br>pecker | NOAEL-based<br>TQ for Tor-<br>toise | LOAEL-based<br>TQ for Tor-<br>toise |
|--------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| 2,4-Dinitrotoluene                                                                                     |                                                    |                                       |                                       |                                     |                                     |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                 |                                                    |                                       |                                       |                                     |                                     |
| Nitrobenzene (NB)                                                                                      |                                                    |                                       |                                       |                                     |                                     |
| Nitroglycerin (NG)                                                                                     |                                                    |                                       |                                       |                                     |                                     |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                            |                                                    |                                       |                                       |                                     |                                     |
| Pentaerythritol Tetranitrate (PETN)                                                                    |                                                    |                                       |                                       | 8.91E-11                            | 8.91E-12                            |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                          |                                                    |                                       |                                       |                                     |                                     |
| Trinitrophenylmethylnitramine (Tetryl)                                                                 | 7.10E-07                                           |                                       |                                       |                                     |                                     |
| 2,4,6-Trinitrotoluene (TNT)                                                                            | 1.89E-07                                           | 1.59E-05                              | 6.24E-07                              | 2.11E-07                            | 2.11E-08                            |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available |                                                    |                                       |                                       |                                     |                                     |

Table 30. Exposure and risk estimates for Fort Stewart, Georgia.

| Compound                     | log Kow | Sum of COC<br>Weight (g)<br>Adjusted for<br>Dud Rate | Soil Concen-<br>tration (top 5<br>cm dry)<br>mg/kg dw | Concentration<br>in Vegetation<br>via Root Up-<br>take mg/kg ww | Mass of<br>smokes Fog<br>Oil and addi-<br>tives into air <sup>2</sup><br>gallons | Concentration<br>in Terrestrial<br>Insects <sup>3</sup><br>g/kg bw |
|------------------------------|---------|------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------------|----------------------------------------------------------------------------------|--------------------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                                      |                                                       |                                                                 |                                                                                  |                                                                    |
| Fog Oil Smoke                |         |                                                      |                                                       |                                                                 | NI                                                                               |                                                                    |
| Hexachloroethane (HC) Smoke  | 3.74    | 42416.50                                             | 3.99E-03                                              | 2.08E-04                                                        |                                                                                  | 1.27E-03                                                           |
| White Phosphorous (WP) Smoke | 3.08    | 2304193.95                                           | 2.17E-01                                              | 2.73E-02                                                        |                                                                                  | 1.66E-01                                                           |
| Brass Flakes                 | -0.52   |                                                      |                                                       |                                                                 | NI                                                                               |                                                                    |
| Graphite Flakes              |         |                                                      |                                                       |                                                                 | NI                                                                               |                                                                    |
| Titanium Dioxide             | 2.23    |                                                      |                                                       |                                                                 |                                                                                  |                                                                    |

|                                                                                                                                                                                                            |       |            |          |          |  |          |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|------------|----------|----------|--|----------|
| Polyethylene Glycol (PEG)                                                                                                                                                                                  | -1.2  |            |          |          |  |          |
| Terephthalic Acid                                                                                                                                                                                          | 2     | 5687.23    | 5.35E-04 | 2.85E-04 |  | 1.73E-03 |
| (o-Chlorbenzol)malononitrile (CS)                                                                                                                                                                          | 2.76  | 147963.56  | 1.39E-02 | 2.69E-03 |  | 1.64E-02 |
| Dibenz(bf)-14-oxazepine (CR)                                                                                                                                                                               | 3.49  |            |          |          |  |          |
| <b>Colored Smokes</b>                                                                                                                                                                                      |       |            |          |          |  |          |
| CI Basic Yellow 2                                                                                                                                                                                          | 3.54  |            |          |          |  |          |
| Disperse Yellow 11                                                                                                                                                                                         | 4.54  | 6336.57    | 5.96E-04 | 1.07E-05 |  | 6.50E-05 |
| Disperse Red 9                                                                                                                                                                                             | 4.045 |            |          |          |  |          |
| Solvent Green 3                                                                                                                                                                                            | 8.995 |            |          |          |  |          |
| Solvent Yellow 33                                                                                                                                                                                          | 4.1   | 1631.30    | 1.53E-04 | 4.95E-06 |  | 3.01E-05 |
| Yellow Smoke 6                                                                                                                                                                                             | 6.28  |            |          |          |  |          |
| Dye Yellow 4 (Benzanthrone)                                                                                                                                                                                | 4.81  |            |          |          |  |          |
| <b>Military Unique Compounds</b>                                                                                                                                                                           |       |            |          |          |  |          |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                                                                                                                          | 1.1   | 476640.82  | 4.48E-02 | 7.94E-02 |  | 4.84E-01 |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                                                                                                                               | 1.49  | 476640.82  | 4.48E-02 | 4.72E-02 |  | 2.87E-01 |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                                                                                                                              | 1.67  |            |          | 0. +00   |  |          |
| Dinitrotoluene isomers                                                                                                                                                                                     | 2.14  | 300492.42  | 2.82E-02 | 1.25E-02 |  | 7.60E-02 |
| 2,4-Dinitrotoluene                                                                                                                                                                                         | 1.98  |            |          |          |  |          |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                                                                                     | 0.16  | 82573.82   | 7.76E-03 | 4.83E-02 |  | 2.94E-01 |
| Nitrobenzene (NB)                                                                                                                                                                                          | 1.85  |            |          |          |  |          |
| Nitroglycerin (NG)                                                                                                                                                                                         | 1.62  | 510340.63  | 4.80E-02 | 4.25E-02 |  | 2.59E-01 |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                                                                | 1.9   |            |          |          |  |          |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                                                        | 1.61  | 12680.30   | 1.19E-03 | 1.07E-03 |  | 6.51E-03 |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                                                              | 0.87  | 1339375.31 | 1.26E-01 | 3.03E-01 |  | 1.85E+00 |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                                                                                     | 2.4   | 19.50      | 1.83E-06 | 5.72E-07 |  | 3.48E-06 |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                                                | 1.6   | 4766408.21 | 4.48E-01 | 4.07E-01 |  | 2.48E+00 |
| 1. NI indicates installation reports using fog oil or additives, but the amount used is not available.<br>2. Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |       |            |          |          |  |          |

Table 30 Continued.

| Compound                          | Dose to Gopher<br>Tortoise<br>mg/kg-day | Dose to<br>Woodpecker<br>mg/kg-day | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-based<br>TQ for Wood-<br>pecker | LOAEL-based<br>TQ for Wood-<br>pecker | NOAEL-based<br>TQ for Tor-<br>toise | LOAEL-based<br>TQ for Tor-<br>toise |
|-----------------------------------|-----------------------------------------|------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| <b>Smokes and Obscurants</b>      |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Fog Oil Smoke                     |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Hexachloroethane (HC) Smoke       | 1.24E-06                                | 4.08E-04                           |                                                    | 2.8E-05                               | 1.3E-05                               | 7.8E-08                             | 3.9E-08                             |
| White Phosphorous (WP) Smoke      | 1.63E-04                                | 5.35E-02                           |                                                    | <b>1.1E+01</b>                        | <b>1.1E+00</b>                        | 1.1E-01                             | 9.3E-02                             |
| Brass Flakes                      |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Graphite Flakes                   |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Titanium Dioxide                  |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Polyethylene Glycol (PEG)         |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Terephthalic Acid                 | 1.70E-06                                | 5.59E-04                           |                                                    |                                       |                                       |                                     |                                     |
| (o-Chlorbenzol)malononitrile (CS) | 1.60E-05                                | 5.27E-03                           |                                                    |                                       |                                       |                                     |                                     |
| Dibenz(bf)-14-oxazepine (CR)      |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| <b>Colored Smokes</b>             |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| CI Basic Yellow 2                 |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Disperse Yellow 11                | 6.37E-08                                | 2.09E-05                           |                                                    |                                       |                                       |                                     |                                     |
| Disperse Red 9                    |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Solvent Green 3                   |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Solvent Yellow 33                 | 2.95E-08                                | 9.70E-06                           |                                                    |                                       |                                       | 2.2E-07                             | 2.2E-08                             |
| Yellow Smoke 6                    |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Dye Yellow 4 (Benzanthrone)       |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| <b>Military Unique Compounds</b>  |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 4.74E-04                                | 1.56E-01                           |                                                    |                                       |                                       | 1.8E-03                             | 3.5E-04                             |
| 1,3-Dinitrobenzene (1,3-DNB)      | 2.82E-04                                | 9.25E-02                           |                                                    |                                       |                                       | 2.5E-02                             | 1.1E-02                             |
| 2,4 - Dinitrophenol (2,4-DNP)     |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Dinitrotoluene isomers            | 7.45E-05                                | 2.45E-02                           |                                                    |                                       |                                       | 1.1E-03                             | 1.1E-04                             |

| Compound                                                        | Dose to Gopher<br>Tortoise<br>mg/kg-day | Dose to<br>Woodpecker<br>mg/kg-day | LOAEL-based<br>TQ for Plants<br>and Tree<br>Leaves | NOAEL-based<br>TQ for Wood-<br>pecker | LOAEL-based<br>TQ for Wood-<br>pecker | NOAEL-based<br>TQ for Tor-<br>toise | LOAEL-based<br>TQ for Tor-<br>toise |
|-----------------------------------------------------------------|-----------------------------------------|------------------------------------|----------------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------|-------------------------------------|
| 2,4-Dinitrotoluene                                              | 2.88E-04                                | 9.47E-02                           |                                                    |                                       |                                       | 9.6E-04                             | 3.8E-04                             |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)          |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Nitrobenzene (NB)                                               |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Nitroglycerin (NG)                                              | 2.53E-04                                | 8.33E-02                           |                                                    |                                       |                                       | 8.4E-04                             | 7.9E-05                             |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)     |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |
| Pentaerythritol Tetranitrate (PETN)                             | 6.38E-06                                | 2.10E-03                           |                                                    |                                       |                                       | 3.8E-07                             | 3.8E-08                             |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 1.81E-03                                | 5.95E-01                           | 3.0E-03                                            | 2.7E+00                               | 2.3E+00                               | 2.6E-03                             | 5.2E-04                             |
| Trinitrophenylmethylnitramine (Tetryl)                          | 3.42E-09                                | 1.12E-06                           | 2.3E-08                                            |                                       |                                       | 2.4E-08                             | 5.0E-09                             |
| 2,4,6-Trinitrotoluene (TNT)                                     | 2.43E-03                                | 7.99E-01                           | 1.4E-02                                            | <b>1.1E+00</b>                        | 4.5E-02                               | 1.5E-02                             | 1.5E-03                             |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                                         |                                    |                                                    |                                       |                                       |                                     |                                     |

Table 31. Exposure and risk estimates for Fort Campbell, Kentucky.

| Compound                     | log Kow | Sum of COC<br>Weight (g) Ad-<br>justed for Dud<br>Rate | Soil Concen-<br>tration (top 5<br>cm dry)<br>mg/kg dw | Concentration<br>in Vegetation<br>via Root Up-<br>take<br>mg/kg ww | Mass of<br>smokes Fog<br>Oil and addi-<br>tives into air <sup>1</sup><br>gallons | Concentration<br>in Terrestrial<br>Insects <sup>2</sup><br>mg/kg bw |
|------------------------------|---------|--------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------------------|----------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                                        |                                                       |                                                                    |                                                                                  |                                                                     |
| Fog Oil Smoke                |         |                                                        |                                                       |                                                                    | NI                                                                               |                                                                     |
| Hexachloroethane (HC) Smoke  | 3.74    | 244893.70                                              | 1.83E-02                                              | 9.54E-04                                                           |                                                                                  | 5.81E-03                                                            |
| White Phosphorous (WP) Smoke | 3.08    | 861538.01                                              | 6.44E-02                                              | 8.11E-03                                                           |                                                                                  | 4.94E-02                                                            |
| Brass Flakes                 | -0.52   |                                                        |                                                       |                                                                    | NI                                                                               |                                                                     |



Table 31 Continued.

| Compound                          | Dose to<br>Indiana Bat<br>mg/kg-day | Dose to<br>Gray Bat<br>mg/kg-day | NOAEL-<br>based TQ<br>for Indiana<br>Bat | LOAEL-<br>based TQ<br>for Indiana<br>Bat | NOAEL-<br>based TQ<br>for Gray Bat | LOAEL-<br>based TQ<br>for Gray Bat |
|-----------------------------------|-------------------------------------|----------------------------------|------------------------------------------|------------------------------------------|------------------------------------|------------------------------------|
| <b>Smokes and Obscurants</b>      |                                     |                                  |                                          |                                          |                                    |                                    |
| Fog Oil Smoke                     |                                     |                                  |                                          |                                          |                                    |                                    |
| Hexachloroethane (HC) Smoke       | 3.09E-03                            | 2.35E-03                         | 1.9E-05                                  | 9.6E-06                                  | 1.5E-05                            | 7.4E-06                            |
| White Phosphorous (WP) Smoke      | 2.62E-02                            | 2.00E-02                         | <b>1.7E+00</b>                           | <b>1.5E+00</b>                           | <b>1.3E+00</b>                     | <b>1.1E+00</b>                     |
| Brass Flakes                      |                                     |                                  |                                          |                                          |                                    |                                    |
| Graphite Flakes                   |                                     |                                  |                                          |                                          |                                    |                                    |
| Titanium Dioxide                  |                                     |                                  |                                          |                                          |                                    |                                    |
| Polyethylene Glycol (PEG)         |                                     |                                  |                                          |                                          |                                    |                                    |
| Terephthalic Acid                 | 2.29E-05                            | 1.74E-05                         | 6.4E-06                                  |                                          | 4.9E-06                            |                                    |
| (o-Chlorbenzol)malononitrile (CS) | 3.59E-02                            | 2.74E-02                         |                                          |                                          |                                    |                                    |
| Dibenz(bf)-14-oxazepine (CR)      |                                     |                                  |                                          |                                          |                                    |                                    |
| <b>Colored Smokes</b>             |                                     |                                  |                                          |                                          |                                    |                                    |
| CI Basic Yellow 2                 |                                     |                                  |                                          |                                          |                                    |                                    |
| Disperse Yellow 11                | 6.11E-05                            | 4.66E-05                         |                                          |                                          |                                    |                                    |
| Disperse Red 9                    | 1.95E-06                            | 1.49E-06                         |                                          |                                          |                                    |                                    |
| Solvent Green 3                   | 3.74E-08                            | 2.85E-08                         |                                          |                                          |                                    |                                    |
| Solvent Yellow 33                 | 1.92E-05                            | 1.46E-05                         | 1.4E-05                                  | 1.4E-06                                  | 1.1E05                             | 1.1E-06                            |
| Yellow Smoke 6                    | 1.60E-07                            | 1.22E-07                         |                                          |                                          |                                    |                                    |
| <b>Military Unique Compounds</b>  |                                     |                                  |                                          |                                          |                                    |                                    |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.78E+00                            | 1.36E+00                         | 6.7E-01                                  | 1.3E-01                                  | 5.1E-01                            | 1.0E-01                            |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.06E+00                            | 8.05E-01                         | <b>9.4E+00</b>                           | <b>4.0E+00</b>                           | <b>7.1E+00</b>                     | <b>3.1E+00</b>                     |
| 2,4 - Dinitrophenol (2,4-DNP)     |                                     |                                  |                                          |                                          |                                    |                                    |
| Dinitrotoluene isomers            | 1.68E-02                            | 1.2E-01                          | 2.4E-01                                  | 2.4E-02                                  | 1.8E-01                            | 1.8E-02                            |
| 2,4-Dinitrotoluene                |                                     |                                  |                                          |                                          |                                    |                                    |

| Compound                                                        | Dose to Indiana Bat<br>mg/kg-day | Dose to Gray Bat<br>mg/kg-day | NOAEL-based TQ<br>for Indiana Bat | LOAEL-based TQ<br>for Indiana Bat | NOAEL-based TQ<br>for Gray Bat | LOAEL-based TQ<br>for Gray Bat |
|-----------------------------------------------------------------|----------------------------------|-------------------------------|-----------------------------------|-----------------------------------|--------------------------------|--------------------------------|
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)          | 9.93E-01                         | 7.57E-01                      | 3.3E-01                           | 1.3E-01                           | 2.5E-01                        | 1.0E-01                        |
| Nitrobenzene (NB)                                               |                                  |                               |                                   |                                   |                                |                                |
| Nitroglycerin (NG)                                              | 4.55E+00                         | 3.47E+00                      | <b>1.5E+00</b>                    | 1.4E-01                           | <b>1.2E+00</b>                 | 1.1E-01                        |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)     |                                  |                               |                                   |                                   |                                |                                |
| Pentaerythritol Tetranitrate (PETN)                             | 1.79E-01                         | 1.37E-01                      | 1.1E-03                           | 1.1E-04                           | 8.0E-04                        | 8.0E-05                        |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 2.21E+01                         | 1.69E+01                      | <b>3.2E+00</b>                    | 6.3E-01                           | <b>2.4E+00</b>                 | 4.8E-01                        |
| Trinitrophenylmethylnitramine (Tetryl)                          | 8.40E-03                         | 6.40E-03                      | 6.0E-03                           | 1.2E-03                           | 4.6E-03                        | 9.3E-04                        |
| 2,4,6-Trinitrotoluene (TNT)                                     | 9.13E+00                         | 6.95E+00                      | <b>5.7E+00</b>                    | 5.7E-01                           | <b>4.3E+00</b>                 | 4.3E-01                        |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                                  |                               |                                   |                                   |                                |                                |

Table 32. Exposure and risk estimates for Fort Knox, Kentucky.

| Compound                     | log Kow | Sum Of COC Weight (g)<br>(100% of material) | Soil Concentration (top 5 cm dry)<br>mg/kg dw | Concentration in Vegetation via Root Uptake<br>mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry)<br>mg/kg dw | Concentration on Plants from Direct Deposition<br>mg/kg ww |
|------------------------------|---------|---------------------------------------------|-----------------------------------------------|---------------------------------------------------------|-------------------------------------------------------|-------------------------------------------------------------------|------------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                             |                                               |                                                         |                                                       |                                                                   |                                                            |
| Fog Oil Smoke                |         |                                             |                                               |                                                         | 5.50E+01                                              | 7.23E+00                                                          | 1.92E+01                                                   |
| Hexachloroethane (HC) Smoke  | 3.74    |                                             |                                               |                                                         |                                                       |                                                                   |                                                            |
| White Phosphorous (WP) Smoke | 3.08    | 21092.40                                    | 3.89E-04                                      | 4.90E-05                                                |                                                       |                                                                   |                                                            |
| Brass Flakes                 | -0.52   |                                             |                                               |                                                         | NI                                                    |                                                                   |                                                            |

| Compound                                               | log Kow | Sum Of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|--------------------------------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| Graphite Flakes                                        |         |                                          |                                            |                                                      | NI                                                    |                                                                |                                                         |
| Titanium Dioxide                                       | 2.23    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Polyethylene Glycol (PEG)                              | -1.2    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Terephthalic Acid                                      | 2       | 29680.24                                 | 5.47E-04                                   | 2.92E-04                                             |                                                       |                                                                |                                                         |
| (o-Chlorbenzol)malononitrile (CS)                      | 2.76    | 2971.55                                  | 5.48E-05                                   | 1.06E-05                                             |                                                       |                                                                |                                                         |
| Dibenz(bf)-14-oxazepine (CR)                           | 3.49    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Colored Smokes                                         |         |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| CI Basic Yellow 2                                      | 3.54    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Disperse Yellow 11                                     | 4.54    | 4059.25                                  | 7.49E-05                                   | 1.34E-06                                             |                                                       |                                                                |                                                         |
| Disperse Red 9                                         | 4.045   | 6264.09                                  | 1.16E-04                                   | 4.01E-06                                             |                                                       |                                                                |                                                         |
| Solvent Green 3                                        | 8.995   | 23080.80                                 | 4.26E-04                                   | 1.99E-08                                             |                                                       |                                                                |                                                         |
| Solvent Yellow 33                                      | 4.1     | 37376.23                                 | 6.89E-04                                   | 2.22E-05                                             |                                                       |                                                                |                                                         |
| Yellow Smoke 6                                         | 6.28    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Military Unique Compounds                              |         |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                      | 1.1     | 161664.43                                | 2.98E-03                                   | 5.28E-03                                             |                                                       |                                                                |                                                         |
| 1,3-Dinitrobenzene (1,3-DNB)                           | 1.49    | 161664.43                                | 2.98E-03                                   | 3.14E-03                                             |                                                       |                                                                |                                                         |
| 2,4 - Dinitrophenol (2,4-DNP)                          | 1.67    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Dinitrotoluene isomers                                 | 2.14    | 1958963.96                               | 3.61E-02                                   | 1.60E-02                                             |                                                       |                                                                |                                                         |
| 2,4-Dinitrotoluene                                     | 1.98    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 0.16    | 123968.16                                | 2.29E-03                                   | 1.42E-02                                             |                                                       |                                                                |                                                         |
| Nitrobenzene (NB)                                      | 1.85    |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Nitroglycerin (NG)                                     | 1.62    | 1102247.48                               | 2.03E-02                                   | 1.80E-02                                             |                                                       |                                                                |                                                         |

| Compound                                                    | log Kow | Sum Of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|-------------------------------------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                          |                                            |                                                      |                                                       |                                                                |                                                         |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 64939.29                                 | 1.20E-03                                   | 1.07E-03                                             |                                                       |                                                                |                                                         |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 2973173.61                               | 5.48E-02                                   | 1.32E-01                                             |                                                       |                                                                |                                                         |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     | 11943.66                                 | 2.20E-04                                   | 6.88E-05                                             |                                                       |                                                                |                                                         |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 1616644.33                               | 2.98E-02                                   | 2.71E-02                                             |                                                       |                                                                |                                                         |
| NI = no information available.                              |         |                                          |                                            |                                                      |                                                       |                                                                |                                                         |

Table 32 Continued.

| Compound                          | Concentration on Tree Leaves from Direct Deposition<br>mg/kg ww | Total Deposition on Tree Leaves<br>µg/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup><br>mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup><br>mg/kg bw | Dose to Indiana Bat<br>mg/kg-day | Dose to Gray Bat<br>mg/kg-day |
|-----------------------------------|-----------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|----------------------------------|-------------------------------|
| <b>Smokes and Obscurants</b>      |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Fog Oil Smoke                     | 1.28E+01                                                        | 1.92E+01                                              | 1.47E+01                                                  | 7.78E+01                                                      | 3.46E+01                         | 1.10E+01                      |
| Hexachloroethane (HC) Smoke       |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| White Phosphorous (WP) Smoke      |                                                                 | 7.35E-05                                              |                                                           | 2.98E-04                                                      | 1.27E-04                         | 2.41E-05                      |
| Brass Flakes                      |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Graphite Flakes                   |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Titanium Dioxide                  |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Polyethylene Glycol (PEG)         |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Terephthalic Acid                 |                                                                 | 4.37E-04                                              |                                                           | 1.78E-03                                                      | 7.55E-04                         | 1.44E-04                      |
| (o-Chlorbenzol)malononitrile (CS) |                                                                 | 1.59E-05                                              |                                                           | 6.44E-05                                                      | 2.74E-05                         | 5.22E-06                      |
| Dibenz(bf)-14-oxazepine (CR)      |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| <b>Colored Smokes</b>             |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| CI Basic Yellow 2                 |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Disperse Yellow 11                |                                                                 | 2.01E-06                                              |                                                           | 8.17E-06                                                      | 3.47E-06                         | 6.61E-07                      |
| Disperse Red 9                    |                                                                 | 6.01E-06                                              |                                                           | 2.44E-05                                                      | 1.04E-05                         | 1.98E-06                      |
| Solvent Green 3                   |                                                                 | 2.98E-08                                              |                                                           | 1.21E-07                                                      | 5.15E-08                         | 9.80E-09                      |
| Solvent Yellow 33                 |                                                                 | 3.33E-05                                              |                                                           | 1.35E-04                                                      | 5.75E-05                         | 1.10E-05                      |
| Yellow Smoke 6                    |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Dye Yellow 4 (Benzanthrone)       |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| <b>Military Unique Compounds</b>  |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) |                                                                 |                                                       |                                                           | 3.22E-02                                                      | 1.71E-02                         | 1.30E-02                      |
| 1,3-Dinitrobenzene (1,3-DNB)      |                                                                 |                                                       |                                                           | 1.9.E-02                                                      | 1.02E-02                         | 7.74E-03                      |

| Compound                                                                                          | Concentration on Tree Leaves from Direct Deposition<br>mg/kg ww | Total Deposition on Tree Leaves<br>µg/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup><br>mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup><br>mg/kg bw | Dose to Indiana Bat<br>mg/kg-day | Dose to Gray Bat<br>mg/kg-day |
|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|----------------------------------|-------------------------------|
| 2,4 - Dinitrophenol (2,4-DNP)                                                                     |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Dinitrotoluene isomers                                                                            |                                                                 |                                                       |                                                           | 9.72E-02                                                      | 5.17E-02                         | 3.94E-02                      |
| 2,4-Dinitrotoluene                                                                                |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                            |                                                                 |                                                       |                                                           | 8.66E-02                                                      | 4.60E-02                         | 3.50E-02                      |
| Nitrobenzene (NB)                                                                                 |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Nitroglycerin (NG)                                                                                |                                                                 |                                                       |                                                           | 1.10E-01                                                      | 5.82E-02                         | 4.43E-02                      |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                       |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| Pentaerythritol Tetranitrate (PETN)                                                               |                                                                 |                                                       |                                                           | 6.54E-03                                                      | 3.48E-03                         | 2.65E-03                      |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                     |                                                                 |                                                       |                                                           | 8.05E-01                                                      | 4.27E-01                         | 3.26E-01                      |
| Trinitrophenylmethylnitramine (Tetryl)                                                            |                                                                 |                                                       |                                                           | 4.19E-04                                                      | 2.23E-04                         | 1.70E-04                      |
| 2,4,6-Trinitrotoluene (TNT)                                                                       |                                                                 |                                                       |                                                           | 1.65E-01                                                      | 8.77E-02                         | 6.68E-02                      |
| 1 - Concentration in aquatic insects estimated via equilibrium partitioning with sediment.        |                                                                 |                                                       |                                                           |                                                               |                                  |                               |
| 2 - Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                                 |                                                       |                                                           |                                                               |                                  |                               |

Table 32 Continued.

| Compound                          | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Indiana Bat | LOAEL-based TQ for Indiana Bat | NOAEL-based TQ for Gray Bat | LOAEL-based TQ for Gray Bat |
|-----------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| <b>Smokes and Obscurants</b>      |                           |                           |                                |                                |                                |                                |                             |                             |
| Fog Oil Smoke                     | 3.5E-01                   | 2.8E-01                   | 3.5E-01                        | 2.8E-01                        | <b>2.9E+00</b>                 | 6.9E-01                        | 9.2E-01                     | 2.2E-01                     |
| Hexachloroethane (HC) Smoke       |                           |                           |                                |                                | 8.5E-03                        | 7.2E-03                        | 1.6E-03                     | 1.4E-03                     |
| White Phosphorous (WP) Smoke      |                           |                           |                                |                                |                                |                                |                             |                             |
| Brass Flakes                      |                           |                           |                                |                                |                                |                                |                             |                             |
| Graphite Flakes                   |                           |                           |                                |                                |                                |                                |                             |                             |
| Titanium Dioxide                  |                           |                           |                                |                                |                                |                                |                             |                             |
| Polyethylene Glycol (PEG)         |                           |                           |                                |                                |                                |                                |                             |                             |
| Terephthalic Acid                 |                           |                           |                                |                                | 2.1E-04                        |                                | 4.0E-05                     |                             |
| (o-Chlorbenzol)malononitrile (CS) |                           |                           |                                |                                |                                |                                |                             |                             |
| Dibenz(bf)-14-oxazepine (CR)      |                           |                           |                                |                                |                                |                                |                             |                             |
| <b>Colored Smokes</b>             |                           |                           |                                |                                |                                |                                |                             |                             |
| CI Basic Yellow 2                 |                           |                           |                                |                                |                                |                                |                             |                             |
| Disperse Yellow 11                |                           |                           |                                |                                |                                |                                |                             |                             |
| Disperse Red 9                    |                           |                           |                                |                                |                                |                                |                             |                             |
| Solvent Green 3                   |                           |                           |                                |                                |                                |                                |                             |                             |
| Solvent Yellow 33                 |                           |                           |                                |                                | 4.2E-05                        | 4.2E-06                        | 8.1E-06                     | 8.1E-07                     |
| Yellow Smoke 6                    |                           |                           |                                |                                |                                |                                |                             |                             |
| Dye Yellow 4 (Benzanthrone)       |                           |                           |                                |                                |                                |                                |                             |                             |
| <b>Military Unique Compounds</b>  |                           |                           |                                |                                |                                |                                |                             |                             |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) |                           |                           |                                |                                | 6.5E-02                        | 1.3E-02                        | 4.9E-02                     | 9.7E-03                     |
| 1,3-Dinitrobenzene (1,3-DNB)      |                           |                           |                                |                                | 9.1E-01                        | 3.8E-01                        | 6.8E-01                     | 2.9E-01                     |
| 2,4 - Dinitrophenol (2,4-DNP)     |                           |                           |                                |                                |                                |                                |                             |                             |

| Compound                                                        | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Indiana Bat | LOAEL-based TQ for Indiana Bat | NOAEL-based TQ for Gray Bat | LOAEL-based TQ for Gray Bat |
|-----------------------------------------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| Dinitrotoluene isomers                                          |                           |                           |                                |                                | 7.4E-02                        | 7.4E-02                        | 5.6E-02                     | 5.6E-03                     |
| 2,4-Dinitrotoluene                                              |                           |                           |                                |                                |                                |                                |                             |                             |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)          |                           |                           |                                |                                | 1.5E-02                        | 6.1E-03                        | 1.2E-02                     | 4.7E-03                     |
| Nitrobenzene (NB)                                               |                           |                           |                                |                                |                                |                                |                             |                             |
| Nitroglycerin (NG)                                              |                           |                           |                                |                                | 1.9E-02                        | 1.8E-03                        | 1.5E-02                     | 1.4E-03                     |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)     |                           |                           |                                |                                |                                |                                |                             |                             |
| Pentaerythritol Tetranitrate (PETN)                             |                           |                           |                                |                                | 2.0E-05                        | 2.0E-06                        | 1.6E-05                     | 1.6E-06                     |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 1.3E-03                   |                           |                                | 1.3E-03                        | 6.1E-04                        | 1.2E-02                        | 4.7E-02                     | 9.3E-03                     |
| Trinitrophenylmethylnitramine (Tetryl)                          | 2.8E-06                   |                           |                                | 2.8E-06                        | 1.6E-04                        | 3.2E-05                        | 1.2E-042                    | 2.5E-05                     |
| 2,4,6-Trinitrotoluene (TNT)                                     | 9.0E-04                   |                           |                                | 9.0E-04                        | 5.5E-02                        | 5.5E-02                        | 4.2E-02                     | 4.2E-03                     |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                           |                           |                                |                                |                                |                                |                             |                             |

Table 33. Exposure and risk estimates for Fort Polk, Louisiana.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw |
|-----------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                             |                                            |                                                      |                                                                    |                                                            |
| Fog Oil Smoke                     |         |                                             |                                            |                                                      | NI                                                                 |                                                            |
| Hexachloroethane (HC) Smoke       | 3.74    | 138185.58                                   | 3.10E-02                                   | 1.62E-03                                             |                                                                    | 9.84E-03                                                   |
| White Phosphorous (WP) Smoke      | 3.08    | 2212022.67                                  | 4.96E-01                                   | 6.24E-02                                             |                                                                    | 3.80E-01                                                   |
| Brass Flakes                      | -0.52   |                                             |                                            |                                                      | NA                                                                 |                                                            |
| Graphite Flakes                   |         |                                             |                                            |                                                      | NA                                                                 |                                                            |
| Titanium Dioxide                  | 2.23    |                                             |                                            |                                                      |                                                                    |                                                            |
| Polyethylene Glycol (PEG)         | -1.2    |                                             |                                            |                                                      |                                                                    |                                                            |
| Terephthalic Acid                 | 2       | 129029.07                                   | 2.89E-02                                   | 1.54E-02                                             |                                                                    | 9.38E-02                                                   |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    | 231802.88                                   | 5.20E-02                                   | 1.00E-02                                             |                                                                    | 6.11E-02                                                   |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    | 489.88                                      | 1.10E-04                                   | 8.00E-06                                             |                                                                    | 4.87E-05                                                   |
| <b>Colored Smokes</b>             |         |                                             |                                            |                                                      |                                                                    |                                                            |
| CI Basic Yellow 2                 | 3.54    | 1350.74                                     | 3.03E-04                                   | 2.06E-05                                             |                                                                    | 1.26E-04                                                   |
| Disperse Yellow 11                | 4.54    | 3934.38                                     | 8.82E-04                                   | 1.58E-05                                             |                                                                    | 9.62E-05                                                   |
| Disperse Red 9                    | 4.045   | 17966.75                                    | 4.03E-03                                   | 1.40E-04                                             |                                                                    | 8.51E-04                                                   |
| Solvent Green 3                   | 8.995   | 52140.53                                    | 1.17E-02                                   | 5.46E-07                                             |                                                                    | 3.32E-06                                                   |
| Solvent Yellow 33                 | 4.1     | 66705.79                                    | 1.50E-02                                   | 4.82E-04                                             |                                                                    | 2.94E-03                                                   |
| Yellow Smoke 6                    | 6.28    | 858.06                                      | 1.92E-04                                   | 3.37E-07                                             |                                                                    | 2.05E-06                                                   |
| Dye Yellow 4 (Benzanthrone)       | 4.81    | 7251.69                                     |                                            |                                                      |                                                                    |                                                            |
| <b>Military Unique Compounds</b>  |         |                                             |                                            |                                                      |                                                                    |                                                            |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 484999.93                                   | 1.09E-01                                   | 1.93E-01                                             |                                                                    | 1.17E+00                                                   |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 48499.99                                    | 1.09E-02                                   | 1.14E-02                                             |                                                                    | 6.97E-02                                                   |
| 2,4 – Dinitrophenol (2,4-DNP)     | 1.67    |                                             |                                            |                                                      |                                                                    |                                                            |

| Compound                                                                                                                                        | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw |
|-------------------------------------------------------------------------------------------------------------------------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|------------------------------------------------------------|
| Dinitrotoluene isomers                                                                                                                          | 2.14    | 72466.06                                    | 1.62E-02                                   | 7.18E-03                                             |                                                                    | 4.37E-02                                                   |
| 2,4-Dinitrotoluene                                                                                                                              | 1.98    |                                             |                                            |                                                      |                                                                    |                                                            |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                          | 0.16    | 52617.75                                    | 1.18E-02                                   | 7.33E-02                                             |                                                                    | 4.47E-01                                                   |
| Nitrobenzene (NB)                                                                                                                               | 1.85    |                                             |                                            |                                                      |                                                                    |                                                            |
| Nitroglycerin (NG)                                                                                                                              | 1.62    | 279307.25                                   | 6.26E-02                                   | 5.54E-02                                             |                                                                    | 3.37E-01                                                   |
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol)                                                                                     | 1.9     |                                             |                                            |                                                      |                                                                    |                                                            |
| Pentaerythritol Tetranitrate (PETN)                                                                                                             | 1.61    | 3472966.54                                  | 7.79E-01                                   | 6.98E-01                                             |                                                                    | 4.25E+00                                                   |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                   | 0.87    | 1039753.88                                  | 2.33E-01                                   | 5.62E-01                                             |                                                                    | 3.42E+00                                                   |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                          | 2.4     | 634.04                                      | 1.42E-04                                   | 4.44E-05                                             |                                                                    | 2.70E-04                                                   |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                     | 1.6     | 4849999.29                                  | 1.09E+00                                   | 9.88E-01                                             |                                                                    | 6.02E+00                                                   |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available. NA indicates not applicable (not used). |         |                                             |                                            |                                                      |                                                                    |                                                            |
| 2 - Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves.                                               |         |                                             |                                            |                                                      |                                                                    |                                                            |

Table 33 Continued.

| Compound                     | Dose to Woodpecker mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker |
|------------------------------|------------------------------|-------------------------------------------|-------------------------------|-------------------------------|
| <b>Smokes and Obscurants</b> |                              |                                           |                               |                               |
| Fog Oil Smoke                |                              |                                           |                               |                               |
| Hexachloroethane (HC) Smoke  | 3.17E-03                     |                                           |                               |                               |
| White Phosphorous (WP) Smoke | 1.22E-01                     |                                           | 2.45E+01                      | 2.45E+00                      |

| Compound                                                    | Dose to Woodpecker<br>mg/kg-day | LOAEL-based<br>TQ for Plants<br>and Tree Leaves | NOAEL-based TQ<br>for Woodpecker | LOAEL-based TQ for<br>Woodpecker |
|-------------------------------------------------------------|---------------------------------|-------------------------------------------------|----------------------------------|----------------------------------|
| Brass Flakes                                                |                                 |                                                 |                                  |                                  |
| Graphite Flakes                                             |                                 |                                                 |                                  |                                  |
| Titanium Dioxide                                            |                                 |                                                 |                                  |                                  |
| Polyethylene Glycol (PEG)                                   |                                 |                                                 |                                  |                                  |
| Terephthalic Acid                                           | 3.02E-02                        |                                                 |                                  |                                  |
| (o-Chlorbenzol)malononitrile (CS)                           | 1.97E-02                        |                                                 |                                  |                                  |
| Dibenz(bf)-14-oxazepine (CR)                                | 1.57E-05                        |                                                 |                                  |                                  |
| <b>Colored Smokes</b>                                       |                                 |                                                 |                                  |                                  |
| CI Basic Yellow 2                                           | 4.05E-05                        |                                                 |                                  |                                  |
| Disperse Yellow 11                                          | 3.10E-05                        |                                                 |                                  |                                  |
| Disperse Red 9                                              | 2.74E-04                        |                                                 |                                  |                                  |
| Solvent Green 3                                             | 1.07E-06                        |                                                 |                                  |                                  |
| Solvent Yellow 33                                           | 9.46E-04                        |                                                 |                                  |                                  |
| Yellow Smoke 6                                              | 6.62E-07                        |                                                 |                                  |                                  |
| Dye Yellow 4 (Benzanthrone)                                 |                                 |                                                 |                                  |                                  |
| <b>Military Unique Compounds</b>                            |                                 |                                                 |                                  |                                  |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           |                                 |                                                 |                                  |                                  |
| 1,3-Dinitrobenzene (1,3-DNB)                                | 2.24E-02                        |                                                 |                                  |                                  |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                                 |                                                 |                                  |                                  |
| Dinitrotoluene isomers                                      | 1.41E-02                        |                                                 |                                  |                                  |
| 2,4-Dinitrotoluene                                          |                                 |                                                 |                                  |                                  |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 1.44E-01                        |                                                 |                                  |                                  |
| Nitrobenzene (NB)                                           |                                 |                                                 |                                  |                                  |
| Nitroglycerin (NG)                                          | 1.09E-01                        |                                                 |                                  |                                  |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                                 |                                                 |                                  |                                  |
| Pentaerythritol Tetranitrate (PETN)                         | 1.37E+00                        |                                                 |                                  |                                  |

| Compound                                                        | Dose to Woodpecker<br>mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker |
|-----------------------------------------------------------------|---------------------------------|-------------------------------------------|-------------------------------|-------------------------------|
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                   | 1.10E+00                        | 5.62E-03                                  | <b>4.9E+00</b>                | <b>4.2E+00</b>                |
| Trinitrophenylmethylnitramine (Tetryl)                          | 8.71E-05                        | 1.78E-06                                  |                               |                               |
| 2,4,6-Trinitrotoluene (TNT)                                     | 1.94E+00                        | 3.29E-02                                  | <b>2.8E+00</b>                | 1.09E-01                      |
| <b>Bold</b> values indicate exceedance of regulatory threshold. |                                 |                                           |                               |                               |

Table 34. Exposure and risk estimates for Camp Shelby, Mississippi.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration on Plants from Direct Deposition mg/kg ww |
|-----------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|---------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                             |                                            |                                                      |                                                       |                                                         |
| Fog Oil Smoke                     |         |                                             |                                            |                                                      | 8.00E+02                                              | 2.79E+02                                                |
| Hexachloroethane (HC) Smoke       | 3.74    | 2450549.85                                  | 5.95E-01                                   | 7.49E-02                                             | NA<br>NA                                              |                                                         |
| White Phosphorous (WP) Smoke      | 3.08    |                                             |                                            |                                                      |                                                       |                                                         |
| Brass Flakes                      | -0.52   |                                             |                                            |                                                      |                                                       |                                                         |
| Graphite Flakes                   |         |                                             |                                            |                                                      |                                                       |                                                         |
| Titanium Dioxide                  | 2.23    |                                             |                                            |                                                      |                                                       |                                                         |
| Polyethylene Glycol (PEG)         | -1.2    |                                             |                                            |                                                      |                                                       |                                                         |
| Terephthalic Acid                 | 2       |                                             |                                            |                                                      |                                                       |                                                         |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    |                                             |                                            |                                                      |                                                       |                                                         |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                             |                                            |                                                      |                                                       |                                                         |

| <b>Colored Smokes</b>                                       |       |            |          |          |  |  |
|-------------------------------------------------------------|-------|------------|----------|----------|--|--|
| CI Basic Yellow 2                                           | 3.54  |            |          |          |  |  |
| Disperse Yellow 11                                          | 4.54  | 1101.43    | 2.67E-04 | 4.79E-06 |  |  |
| Disperse Red 9                                              | 4.045 | 1314.43    | 3.19E-04 | 1.11E-05 |  |  |
| Solvent Green 3                                             | 8.995 | 3077.44    | 7.47E-04 | 3.49E-08 |  |  |
| Solvent Yellow 33                                           | 4.1   | 1304.00    | 3.17E-04 | 1.02E-05 |  |  |
| Yellow Smoke 6                                              | 6.28  |            |          |          |  |  |
| Dye Yellow 4 (Benzanthrone)                                 | 4.81  |            |          |          |  |  |
| <b>Military Unique Compounds</b>                            |       |            |          |          |  |  |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           | 1.1   |            |          |          |  |  |
| 1,3-Dinitrobenzene (1,3-DNB)                                | 1.49  | 42510.69   | 1.03E-02 | 1.09E-02 |  |  |
| 2,4 – Dinitrophenol (2,4-DNP)                               | 1.67  |            |          |          |  |  |
| Dinitrotoluene isomers                                      | 2.14  | 19838.64   | 4.82E-03 | 2.13E-03 |  |  |
| 2,4-Dinitrotoluene                                          | 1.98  |            |          |          |  |  |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16  | 24503.76   | 5.95E-03 | 3.70E-02 |  |  |
| Nitrobenzene (NB)                                           | 1.85  |            |          |          |  |  |
| Nitroglycerin (NG)                                          | 1.62  | 34125.74   | 8.29E-03 | 7.33E-03 |  |  |
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol) | 1.9   |            |          |          |  |  |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61  | 10798.13   | 2.62E-03 | 2.35E-03 |  |  |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87  | 298265.05  | 7.24E-02 | 1.75E-01 |  |  |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4   |            |          |          |  |  |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6   | 4251069.12 | 1.03E+00 | 9.38E-01 |  |  |
| NA = not applicable (not used).                             |       |            |          |          |  |  |

Table 34 Continued.

| Compound                          | Concentration on Tree Leaves from Direct Deposition<br>mg/kg ww | Total Deposition on Tree Leaves<br>$\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup><br>mg/kg bw | Concentration in Terrestrial Insects <sup>1</sup><br>mg/kg bw | Dose to Gopher Tortoise<br>mg/kg-day | Dose to Woodpecker<br>mg/kg-day |
|-----------------------------------|-----------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|--------------------------------------|---------------------------------|
| <b>Smokes and Obscurants</b>      |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Fog Oil Smoke                     | 1.86E+02                                                        | 2.79E+02                                                     | 2.13E+02                                                  | 1.13E+03                                                      | 1.66E+00                             | 3.64E+02                        |
| Hexachloroethane (HC) Smoke       |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| White Phosphorous (WP) Smoke      |                                                                 | 1.12E-01                                                     |                                                           | 4.56E-01                                                      | 4.47E-04                             | 1.47E-01                        |
| Brass Flakes                      |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Graphite Flakes                   |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Titanium Dioxide                  |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Polyethylene Glycol (PEG)         |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Terephthalic Acid                 |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| (o-Chlorbenzol)malononitrile (CS) |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Dibenz(bf)-14-oxazepine (CR)      |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| <b>Colored Smokes</b>             |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| CI Basic Yellow 2                 |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Disperse Yellow 11                |                                                                 | 7.19E-06                                                     |                                                           | 2.92E-05                                                      | 2.86E-08                             | 9.40E-06                        |
| Disperse Red 9                    |                                                                 | 1.66E-05                                                     |                                                           | 6.75E-05                                                      | 6.61E-08                             | 2.17E-05                        |
| Solvent Green 3                   |                                                                 | 5.24E-08                                                     |                                                           | 2.13E-07                                                      | 2.08E-10                             | 6.85E-08                        |
| Solvent Yellow 33                 |                                                                 | 1.53E-05                                                     |                                                           | 6.22E-05                                                      | 6.10E-08                             | 2.00E-05                        |
| Yellow Smoke 6                    |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| Dye Yellow 4 (Benzanthrone)       |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| <b>Military Unique Compounds</b>  |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) |                                                                 | 2.74E-01                                                     |                                                           | 1.11E+00                                                      | 1.09E-03                             | 3.59E-01                        |
| 1,3-Dinitrobenzene (1,3-DNB)      |                                                                 | 1.63E-02                                                     |                                                           | 6.62E-02                                                      | 6.49E-05                             | 2.13E-02                        |
| 2,4 – Dinitrophenol (2,4-DNP)     |                                                                 |                                                              |                                                           |                                                               |                                      |                                 |

| Compound                                                                                        | Concentration on Tree Leaves from Direct Deposition<br>mg/kg ww | Total Deposition on Tree Leaves<br>µg/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup><br>mg/kg bw | Concentration in Terrestrial Insects <sup>1</sup><br>mg/kg bw | Dose to Gopher Tortoise<br>mg/kg-day | Dose to Woodpecker<br>mg/kg-day |
|-------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------------|---------------------------------------------------------------|--------------------------------------|---------------------------------|
| Dinitrotoluene isomers                                                                          |                                                                 | 3.19E-03                                              |                                                           | 1.30E-02                                                      | 1.27E-05                             | 4.18E-03                        |
| 2,4-Dinitrotoluene                                                                              |                                                                 |                                                       |                                                           |                                                               |                                      |                                 |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                          |                                                                 | 5.55E-02                                              |                                                           | 2.25E-01                                                      | 2.21E-04                             | 7.26E-02                        |
| Nitrobenzene (NB)                                                                               |                                                                 |                                                       |                                                           |                                                               |                                      |                                 |
| Nitroglycerin (NG)                                                                              |                                                                 | 1.10E-02                                              |                                                           | 4.47E-02                                                      | 4.38E-05                             | 1.44E-02                        |
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol)                                     |                                                                 |                                                       |                                                           |                                                               |                                      |                                 |
| Pentaerythritol Tetranitrate (PETN)                                                             |                                                                 | 3.53E-03                                              |                                                           | 1.43E-02                                                      | 1.40E-05                             | 4.61E-03                        |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                   |                                                                 | 2.62E-01                                              |                                                           | 1.06E+00                                                      | 1.04E-03                             | 3.42E-01                        |
| Trinitrophenylmethylnitramine (Tetryl)                                                          |                                                                 |                                                       |                                                           |                                                               |                                      |                                 |
| 2,4,6-Trinitrotoluene (TNT)                                                                     |                                                                 | 1.41E+00                                              |                                                           | 5.71E+00                                                      | 5.60E-03                             | 1.84E+00                        |
| 1 Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                                 |                                                       |                                                           |                                                               |                                      |                                 |

Table 34 Continued.

| Compound                     | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker | NOAEL-based TQ for Tortoise | LOAEL-based TQ for Tortoise |
|------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|-------------------------------|-------------------------------|-----------------------------|-----------------------------|
| <b>Smokes and Obscurants</b> |                           |                           |                                |                                |                               |                               |                             |                             |
| Fog Oil Smoke                | 5.1E+00                   | 4.0E+00                   | 5.1E+00                        | 4.0E+00                        |                               |                               | 1.4E+00                     | 3.3E-01                     |
| Hexachloroethane (HC) Smoke  |                           |                           |                                |                                |                               |                               |                             |                             |

| Compound                                                                                                                                                                                                                          | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Wood-pecker | LOAEL-based TQ for Wood-pecker | NOAEL-based TQ for Tor-toise             | LOAEL-based TQ for Tor-toise             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------------------|------------------------------------------|
| White Phosphorous (WP) Smoke<br>Brass Flakes<br>Graphite Flakes<br>Titanium Dioxide<br>Polyethylene Glycol (PEG)<br>Terephthalic Acid<br>(o-Chlorbenzol)malononitrile (CS)<br>Dibenz(bf)-14-oxazepine (CR)                        |                           |                           |                                |                                | 2.9E+01                        | 2.9E+00                        | 3.0E-01                                  | 2.6E-01                                  |
| <b>Colored Smokes</b>                                                                                                                                                                                                             |                           |                           |                                |                                |                                |                                |                                          |                                          |
| CI Basic Yellow 2<br>Disperse Yellow 11<br>Disperse Red 9<br>Solvent Green 3<br>Solvent Yellow 33<br>Yellow Smoke 6<br>Dye Yellow 4 (Benzanthrone)                                                                                |                           |                           |                                |                                |                                |                                | 4.5E-07                                  | 4.5E-08                                  |
| <b>Military Unique Compounds</b>                                                                                                                                                                                                  |                           |                           |                                |                                |                                |                                |                                          |                                          |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)<br>1,3-Dinitrobenzene (1,3-DNB)<br>2,4 - Dinitrophenol (2,4-DNP)<br>Dinitrotoluene isomers<br>2,4-Dinitrotoluene<br>Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)<br>Nitrobenzene (NB) |                           |                           |                                |                                |                                |                                | 4.1E-03<br>5.7E-03<br>1.8E-04<br>7.4E-04 | 8.2E-04<br>2.5E-03<br>1.8E-05<br>2.9E-04 |

| Compound                                                                                                                                                                   | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Wood-pecker | LOAEL-based TQ for Wood-pecker | NOAEL-based TQ for Tor-toise | LOAEL-based TQ for Tor-toise |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|------------------------------|------------------------------|
| Nitroglycerin (NG)                                                                                                                                                         |                           |                           |                                |                                |                                |                                | 1.5E-04                      | 1.4E-05                      |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                                |                           |                           |                                |                                |                                |                                |                              |                              |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                        |                           |                           |                                |                                |                                |                                | 8.3E-07                      | 8.3E-08                      |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                              |                           |                           |                                | 1.7E-03                        | 1.5E-01                        | 1.30E+00                       | 1.5E-03                      | 3.0E-04                      |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                                                     |                           |                           |                                |                                |                                |                                |                              |                              |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                |                           |                           |                                | 3.1E-02                        | <b>2.6E+00</b>                 | 1.0E-01                        | 3.5E-02                      | 3.5E-03                      |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available.<br><b>Bold</b> values indicate exceedance of regulatory threshold. |                           |                           |                                |                                |                                |                                |                              |                              |

Table 35. Exposure and risk estimates for Fort Leonard Wood, Missouri.

| Compound                     | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gal-lons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw |
|------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                             |                                            |                                                      |                                                        |                                                                |
| Fog Oil Smoke                |         |                                             |                                            |                                                      | 3.65E+04                                               | 4.80E+03                                                       |
| Hexachloroethane (HC) Smoke  | 3.74    | 6412.32                                     | 2.37E-02                                   | 1.23E-03                                             |                                                        |                                                                |
| White Phosphorous (WP) Smoke | 3.08    |                                             |                                            |                                                      |                                                        |                                                                |
| Brass Flakes                 | -0.52   |                                             |                                            |                                                      | NA                                                     |                                                                |
| Graphite Flakes              |         |                                             |                                            |                                                      | NA                                                     |                                                                |
| Titanium Dioxide             | 2.23    | 209016.00                                   | 7.71E-01                                   | 3.02E-01                                             |                                                        |                                                                |

| Compound                                                    | log Kow | Sum of COC Weight (g) Adjusted for Duderstadt Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw |
|-------------------------------------------------------------|---------|----------------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|
| Polyethylene Glycol (PEG)                                   | -1.2    |                                                    |                                            |                                                      |                                                       |                                                                |
| Terephthalic Acid                                           | 2       | 303378.28                                          | 1.12E+00                                   | 5.96E-01                                             |                                                       |                                                                |
| (o-Chlorobenzol)malononitrile (CS)                          | 2.76    | 206764.18                                          | 7.63E-01                                   | 1.47E-01                                             |                                                       |                                                                |
| Dibenz(bf)-14-oxazepine (CR)                                | 3.49    |                                                    |                                            |                                                      |                                                       |                                                                |
| <b>Colored Smokes</b>                                       |         |                                                    |                                            |                                                      |                                                       |                                                                |
| CI Basic Yellow 2                                           | 3.54    |                                                    |                                            |                                                      |                                                       |                                                                |
| Disperse Yellow 11                                          | 4.54    | 22452.13                                           | 8.28E-02                                   | 1.48E-03                                             |                                                       |                                                                |
| Disperse Red 9                                              | 4.045   | 218657.21                                          | 8.07E-01                                   | 2.80E-02                                             |                                                       |                                                                |
| Solvent Green 3                                             | 8.995   | 242660.58                                          | 8.95E-01                                   | 4.18E-05                                             |                                                       |                                                                |
| Solvent Yellow 33                                           | 4.1     | 480500.01                                          | 1.77E+00                                   | 5.72E-02                                             |                                                       |                                                                |
| Yellow Smoke 6                                              | 6.28    |                                                    |                                            |                                                      |                                                       |                                                                |
| <b>Military Unique Compounds</b>                            |         |                                                    |                                            |                                                      |                                                       |                                                                |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           | 1.1     | 184845.77                                          | 6.82E-01                                   | 1.21E+00                                             |                                                       |                                                                |
| 1,3-Dinitrobenzene (1,3-DNB)                                | 1.49    | 184845.77                                          | 6.82E-01                                   | 7.18E-01                                             |                                                       |                                                                |
| 2,4 - Dinitrophenol (2,4-DNP)                               | 1.67    |                                                    |                                            |                                                      |                                                       |                                                                |
| Dinitrotoluene isomers                                      | 2.14    | 7.43                                               | 2.74E-05                                   | 1.21E-05                                             |                                                       |                                                                |
| 2,4-Dinitrotoluene                                          | 1.98    |                                                    |                                            |                                                      |                                                       |                                                                |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    | 2.00                                               | 7.37E-06                                   | 4.58E-05                                             |                                                       |                                                                |
| Nitrobenzene (NB)                                           | 1.85    |                                                    |                                            |                                                      |                                                       |                                                                |
| Nitroglycerin (NG)                                          | 1.62    | 32685.56                                           | 1.21E-01                                   | 1.07E-01                                             |                                                       |                                                                |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                                    |                                            |                                                      |                                                       |                                                                |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 6022317.08                                         | 2.22E+01                                   | 1.99E+01                                             |                                                       |                                                                |

| Compound                                      | log Kow | Sum of COC Weight (g) Adjusted for Duderstadt Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw |
|-----------------------------------------------|---------|----------------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX) | 0.87    | 3653834.18                                         | 1.35E+01                                   | 3.25E+01                                             |                                                       |                                                                |
| Trinitrophenylmethylnitramine (Tetryl)        | 2.4     | 1257.03                                            | 4.64E-03                                   | 1.45E-03                                             |                                                       |                                                                |
| 2,4,6-Trinitrotoluene (TNT)                   | 1.6     | 1848457.72                                         | 6.82E+00                                   | 6.20E+00                                             |                                                       |                                                                |

Table 35 Continued.

| Compound                          | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total concentration in Tree Leaves µg/cm <sup>2</sup> | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Indiana Bat mg/kg-day | Dose to Gray Bat mg/kg-day |
|-----------------------------------|---------------------------------------------------------|--------------------------------------------------------------|-------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|-------------------------------|----------------------------|
| <b>Smokes and Obscurants</b>      |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| Fog Oil Smoke                     | 1.27E+04                                                | 8.48E+03                                                     | 1.27E+04                                              | 9.74E+03                                               | 5.16E+04                                                   | 2.30E+04                      | 4.97E+03                   |
| Hexachloroethane (HC) Smoke       |                                                         |                                                              | 1.85E-03                                              |                                                        | 7.51E-03                                                   | 3.99E-03                      | 3.04E-03                   |
| White Phosphorous (WP) Smoke      |                                                         |                                                              | 0.00E+00                                              |                                                        |                                                            |                               |                            |
| Brass Flakes                      |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| Graphite Flakes                   |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| Titanium Dioxide                  |                                                         |                                                              | 4.53E-01                                              |                                                        | 1.84E+00                                                   | 9.77E-01                      | 7.45E-01                   |
| Polyethylene Glycol (PEG)         |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| Terephthalic Acid                 |                                                         |                                                              | 8.94E-01                                              |                                                        | 3.63E+00                                                   | 1.93E+01                      | 1.47E+00                   |
| (o-Chlorbenzol)malononitrile (CS) |                                                         |                                                              | 2.21E-01                                              |                                                        | 8.97E-01                                                   | 4.76E-01                      | 3.63E-01                   |
| Dibenz(bf)-14-oxazepine (CR)      |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| <b>Colored Smokes</b>             |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| CI Basic Yellow 2                 |                                                         |                                                              |                                                       |                                                        |                                                            |                               |                            |
| Disperse Yellow 11                |                                                         |                                                              | 2.23E-03                                              |                                                        | 9.04E-03                                                   | 4.80E-03                      | 3.66E-03                   |

| Compound                                                                                                                                                                                        | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total concentration in Tree Leaves $\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Indiana Bat mg/kg-day | Dose to Gray Bat mg/kg-day |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|-------------------------------|----------------------------|
| Disperse Red 9                                                                                                                                                                                  |                                                         |                                                              | 4.20E-02                                                     |                                                        | 1.70E-01                                                   | 9.06E-02                      | 6.90E-02                   |
| Solvent Green 3                                                                                                                                                                                 |                                                         |                                                              | 6.27E-05                                                     |                                                        | 2.55E-04                                                   | 1.35E-04                      | 1.03E-04                   |
| Solvent Yellow 33                                                                                                                                                                               |                                                         |                                                              | 8.57E-02                                                     |                                                        | 3.48E-01                                                   | 1.85E-01                      | 1.41E-01                   |
| Yellow Smoke 6                                                                                                                                                                                  |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| Dye Yellow 4 (Benzanthrone)                                                                                                                                                                     |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| <b>Military Unique Compounds</b>                                                                                                                                                                |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                                                                                                               |                                                         |                                                              |                                                              |                                                        | 7.36E+00                                                   | 3.91E+00                      | 2.98E+00                   |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                                                                                                                    |                                                         |                                                              |                                                              |                                                        | 4.37E+00                                                   | 2.32E+00                      | 1.77E+00                   |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                                                                                                                   |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| Dinitrotoluene isomers                                                                                                                                                                          |                                                         |                                                              |                                                              |                                                        | 7.37E-05                                                   | 3.92E-05                      | 2.98E-05                   |
| 2,4-Dinitrotoluene                                                                                                                                                                              |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                                                                          |                                                         |                                                              |                                                              |                                                        | 2.79E-04                                                   | 1.48E-04                      | 1.13E-04                   |
| Nitrobenzene (NB)                                                                                                                                                                               |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| Nitroglycerin (NG)                                                                                                                                                                              |                                                         |                                                              |                                                              |                                                        | 6.50E-01                                                   | 3.45E-01                      | 2.63E-01                   |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                                                     |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                                             |                                                         |                                                              |                                                              |                                                        | 1.21E+02                                                   | 6.45E+01                      | 4.91E+01                   |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                                                   |                                                         |                                                              |                                                              |                                                        | 1.98E+02                                                   | 1.05E+02                      | 8.00E+01                   |
| Trinitrophenylmethyl nitramine (Tetryl)                                                                                                                                                         |                                                         |                                                              |                                                              |                                                        | 8.82E-03                                                   | 4.68E-03                      | 3.57E-03                   |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                                     |                                                         |                                                              |                                                              |                                                        | 3.77E+01                                                   | 2.00E+01                      | 1.53E+01                   |
| 1 - Concentration in aquatic insects estimated via equilibrium partitioning with sediment.<br>2 - Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                         |                                                              |                                                              |                                                        |                                                            |                               |                            |

Table 35 Continued.

| Compound                          | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Indiana Bat | LOAEL-based TQ for Indiana Bat | NOAEL-based TQ for Gray Bat | LOAEL-based TQ for Gray Bat |
|-----------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| <b>Smokes and Obscurants</b>      |                           |                           |                                |                                |                                |                                |                             |                             |
| Fog Oil Smoke                     | 2.5E+02                   | 1.8E+02                   | 2.3E+02                        | 1.8E+02                        | 1.9E+03                        | 4.6E+02                        | 4.1E+02                     | 9.9E+01                     |
| Hexachloroethane (HC) Smoke       |                           |                           |                                |                                | 2.5E-05                        | 1.2E-05                        | 1.9E-05                     | 9.5E-06                     |
| White Phosphorous (WP) Smoke      |                           |                           |                                |                                |                                |                                |                             |                             |
| Brass Flakes                      |                           |                           |                                |                                |                                |                                |                             |                             |
| Graphite Flakes                   |                           |                           |                                |                                |                                |                                |                             |                             |
| Titanium Dioxide                  |                           |                           |                                |                                |                                |                                |                             |                             |
| Polyethylene Glycol (PEG)         |                           |                           |                                |                                |                                |                                |                             |                             |
| Terephthalic Acid                 |                           |                           |                                |                                | 5.4E-01                        |                                | 4.1E-01                     |                             |
| (o-Chlorbenzol)malononitrile (CS) |                           |                           |                                |                                |                                |                                |                             |                             |
| Dibenz(bf)-14-oxazepine (CR)      |                           |                           |                                |                                |                                |                                |                             |                             |
| <b>Colored Smokes</b>             |                           |                           |                                |                                |                                |                                |                             |                             |
| CI Basic Yellow 2                 |                           |                           |                                |                                |                                |                                |                             |                             |
| Disperse Yellow 11                |                           |                           |                                |                                |                                |                                |                             |                             |
| Disperse Red 9                    |                           |                           |                                |                                |                                |                                |                             |                             |
| Solvent Green 3                   |                           |                           |                                |                                |                                |                                |                             |                             |
| Solvent Yellow 33                 |                           |                           |                                |                                | 1.4E-01                        | 1.4E-02                        | 1.0E-01                     | 1.0E-02                     |
| Yellow Smoke 6                    |                           |                           |                                |                                |                                |                                |                             |                             |
| Dye Yellow 4 (Benzanthrone)       |                           |                           |                                |                                |                                |                                |                             |                             |
| <b>Military Unique Compounds</b>  |                           |                           |                                |                                |                                |                                |                             |                             |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) |                           |                           |                                |                                | 1.5E+00                        | 2.9E-01                        | 1.1E+00                     | 2.2E-01                     |
| 1,3-Dinitrobenzene (1,3-DNB)      |                           |                           |                                |                                | 2.1E+01                        | 8.80E-01                       | 1.6E+01                     | 6.70E+0                     |
| 2,4 - Dinitrophenol (2,4-DNP)     |                           |                           |                                |                                |                                |                                |                             |                             |
| Dinitrotoluene isomers            |                           |                           |                                |                                | 5.6E-05                        | 5.6E-06                        | 4.3E-05                     | 4.3E-06                     |

| Compound                                                                                                                                                                   | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Indiana Bat | LOAEL-based TQ for Indiana Bat | NOAEL-based TQ for Gray Bat | LOAEL-based TQ for Gray Bat |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|-----------------------------|-----------------------------|
| 2,4-Dinitrotoluene                                                                                                                                                         |                           |                           |                                |                                |                                |                                |                             |                             |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                                                     |                           |                           |                                |                                | 4.9E-05                        | 2.0E-05                        | 3.8E-05                     | 1.5E-05                     |
| Nitrobenzene (NB)                                                                                                                                                          |                           |                           |                                |                                |                                |                                |                             |                             |
| Nitroglycerin (NG)                                                                                                                                                         |                           |                           |                                |                                | 1.2E-01                        | 1.1E-02                        | 8.8E-02                     | 8.2E-03                     |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                                |                           |                           |                                |                                |                                |                                |                             |                             |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                        |                           |                           |                                |                                | 3.8E-01                        | 3.8E-02                        | 2.9E-01                     | 2.9E-02                     |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                              |                           | 3.2E-01                   |                                | 3.2E-01                        | <b>1.5E+01</b>                 | <b>3.0E+00</b>                 | <b>1.1E+01</b>              | <b>2.3E+00</b>              |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                                                     |                           | 5.8E-05                   |                                | 5.8E-05                        | 3.3E-03                        | 6.8E-04                        | 2.5E-03                     | 5.2E-04                     |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                                |                           | 2.1E-01                   |                                | 2.1E-01                        | <b>1.3E+01</b>                 | <b>1.3E+00</b>                 | <b>9.5E+00</b>              | 9.5E-01                     |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available.<br><b>Bold</b> values indicate exceedance of regulatory threshold. |                           |                           |                                |                                |                                |                                |                             |                             |

**Table 36. Exposure and risk estimates for Fort Bragg, North Carolina.**

| Compound                     | log Kow | Sum of COC Weight (g) Adjusted for 10% Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons |
|------------------------------|---------|-------------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                                 |                                            |                                                      |                                                                    |
| Fog Oil Smoke                |         |                                                 |                                            |                                                      | NI                                                                 |
| Hexachloroethane (HC) Smoke  | 3.74    | 576047.73                                       | 3.29E-02                                   | 1.72E-03                                             |                                                                    |
| White Phosphorous (WP) Smoke | 3.08    | 5982139.69                                      | 3.42E-01                                   | 4.30E-02                                             |                                                                    |
| Brass Flakes                 | -0.52   |                                                 |                                            |                                                      | NA                                                                 |
| Graphite Flakes              |         |                                                 |                                            |                                                      | NI                                                                 |
| Titanium Dioxide             | 2.23    |                                                 |                                            |                                                      |                                                                    |

| Compound                                                    | log Kow | Sum of COC Weight (g) Adjusted for 10% Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons |
|-------------------------------------------------------------|---------|-------------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|
| Polyethylene Glycol (PEG)                                   | -1.2    |                                                 |                                            |                                                      |                                                                    |
| Terephthalic Acid                                           | 2       | 449646.77                                       | 2.57E-02                                   | 1.37E-02                                             |                                                                    |
| (o-Chlorbenzol)malononitrile (CS)                           | 2.76    | 988.98                                          | 5.65E-05                                   | 1.09E-05                                             |                                                                    |
| Dibenz(bf)-14-oxazepine (CR)                                | 3.49    |                                                 |                                            |                                                      |                                                                    |
| <b>Colored Smokes</b>                                       |         |                                                 |                                            |                                                      |                                                                    |
| CI Basic Yellow 2                                           | 3.54    | 479.30                                          | 2.74E-05                                   | 1.87E-06                                             |                                                                    |
| Disperse Yellow 11                                          | 4.54    | 15255.54                                        | 8.72E-04                                   | 1.56E-05                                             |                                                                    |
| Disperse Red 9                                              | 4.045   | 57636.47                                        | 3.29E-03                                   | 1.14E-04                                             |                                                                    |
| Solvent Green 3                                             | 8.995   | 86896.20                                        | 4.97E-03                                   | 2.32E-07                                             |                                                                    |
| Solvent Yellow 33                                           | 4.1     | 74244.54                                        | 4.24E-03                                   | 1.37E-04                                             |                                                                    |
| Yellow Smoke 6                                              | 6.28    | 7583.00                                         | 4.33E-04                                   | 7.60E-07                                             |                                                                    |
| <b>Military Unique Compounds</b>                            |         |                                                 |                                            |                                                      |                                                                    |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           | 1.1     | 1655414.42                                      | 9.46E-02                                   | 1.68E-01                                             |                                                                    |
| 1,3-Dinitrobenzene (1,3-DNB)                                | 1.49    | 165541.44                                       | 9.46E-03                                   | 9.96E-03                                             |                                                                    |
| 2,4 - Dinitrophenol (2,4-DNP)                               | 1.67    |                                                 |                                            |                                                      |                                                                    |
| Dinitrotoluene isomers                                      | 2.14    | 402784.08                                       | 2.30E-02                                   | 1.02E-02                                             |                                                                    |
| 2,4-Dinitrotoluene                                          | 1.98    |                                                 |                                            |                                                      |                                                                    |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    | 25233.75                                        | 1.44E-03                                   | 8.97E-03                                             |                                                                    |
| Nitrobenzene (NB)                                           | 1.85    |                                                 |                                            |                                                      |                                                                    |
| Nitroglycerin (NG)                                          | 1.62    | 2362181.02                                      | 1.35E-01                                   | 1.19E-01                                             |                                                                    |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                                 |                                            |                                                      |                                                                    |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 2391680.50                                      | 1.37E-01                                   | 1.23E-01                                             |                                                                    |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 16308347.85                                     | 9.32E-01                                   | 2.25E+00                                             |                                                                    |

| Compound                                                                                                                                   | log Kow | Sum of COC Weight (g) Adjusted for 10% Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air <sup>1</sup> gallons |
|--------------------------------------------------------------------------------------------------------------------------------------------|---------|-------------------------------------------------|--------------------------------------------|------------------------------------------------------|--------------------------------------------------------------------|
| Trinitrophenylmethyl nitramine (Tetryl)                                                                                                    | 2.4     | 8268.25                                         | 4.72E-04                                   | 1.48E-04                                             |                                                                    |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                | 1.6     | 16554144.24                                     | 9.46E-01                                   | 8.60E-01                                             |                                                                    |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available.<br>NA – Not applicable (not used). |         |                                                 |                                            |                                                      |                                                                    |

Table 36 Continued.

| Compound                          | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Woodpecker mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker |
|-----------------------------------|------------------------------------------------------------|------------------------------|-------------------------------------------|-------------------------------|-------------------------------|
| <b>Smokes and Obscurants</b>      |                                                            |                              |                                           |                               |                               |
| Fog Oil Smoke                     |                                                            |                              |                                           |                               |                               |
| Hexachloroethane (HC) Smoke       | 1.05E-02                                                   | 3.37E-03                     |                                           | 2.32E-04                      | 2.57E-05                      |
| White Phosphorous (WP) Smoke      | 2.62E-01                                                   | 8.44E-02                     |                                           | <b>1.69E+01</b>               | <b>1.69E+00</b>               |
| Brass Flakes                      |                                                            |                              |                                           |                               |                               |
| Graphite Flakes                   |                                                            |                              |                                           |                               |                               |
| Titanium Dioxide                  |                                                            |                              |                                           |                               |                               |
| Polyethylene Glycol (PEG)         |                                                            |                              |                                           |                               |                               |
| Terephthalic Acid                 | 8.34E-02                                                   | 2.68E-02                     |                                           |                               |                               |
| (o-Chlorbenzol)malononitrile (CS) | 6.64E-05                                                   | 2.14E-05                     |                                           |                               |                               |
| Dibenz(bf)-14-oxazepine (CR)      |                                                            |                              |                                           |                               |                               |
| <b>Colored Smokes</b>             |                                                            |                              |                                           |                               |                               |
| CI Basic Yellow 2                 | 1.14E-05                                                   | 3.66E-06                     |                                           |                               |                               |
| Disperse Yellow 11                | 9.51E-05                                                   | 3.06E-05                     |                                           |                               |                               |
| Disperse Red 9                    | 6.96E-04                                                   | 2.24E-04                     |                                           |                               |                               |
| Solvent Green 3                   | 1.41E-06                                                   | 4.55E-07                     |                                           |                               |                               |
| Solvent Yellow 33                 | 8.33E-04                                                   | 2.68E-04                     |                                           |                               |                               |
| Yellow Smoke 6                    | 4.63E-06                                                   | 1.49E-06                     |                                           |                               |                               |

| Compound                                                                                                                                                            | Concentration in Terrestrial Insects <sup>2</sup><br>mg/kg bw | Dose to Woodpecker mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Woodpecker | LOAEL-based TQ for Woodpecker |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|------------------------------|-------------------------------------------|-------------------------------|-------------------------------|
| <b>Military Unique Compounds</b>                                                                                                                                    |                                                               |                              |                                           |                               |                               |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                                                                                   | 1.02E+00                                                      | 3.29E-01                     |                                           |                               |                               |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                                                                                        | 6.06E-02                                                      | 1.95E-02                     |                                           |                               |                               |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                                                                                       |                                                               |                              |                                           |                               |                               |
| Dinitrotoluene isomers                                                                                                                                              | 6.19E-02                                                      | 1.99E-02                     |                                           |                               |                               |
| 2,4-Dinitrotoluene                                                                                                                                                  |                                                               |                              |                                           |                               |                               |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                                                                              | 5.46E-02                                                      | 1.76E-02                     |                                           |                               |                               |
| Nitrobenzene (NB)                                                                                                                                                   |                                                               |                              |                                           |                               |                               |
| Nitroglycerin (NG)                                                                                                                                                  | 7.27E-01                                                      | 2.34E-01                     |                                           |                               |                               |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                                                                         |                                                               |                              |                                           |                               |                               |
| Pentaerythritol Tetranitrate (PETN)                                                                                                                                 | 7.46E-01                                                      | 2.40E-01                     |                                           |                               |                               |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                                                                       | 1.37E+01                                                      | 4.40E+00                     | 2.25E-02                                  | <b>1.97E+00</b>               | <b>1.67E+00</b>               |
| Trinitrophenylmethylnitramine (Tetryl)                                                                                                                              | 8.98E-04                                                      | 2.89E-04                     | 5.90E-06                                  |                               |                               |
| 2,4,6-Trinitrotoluene (TNT)                                                                                                                                         | 5.24E+00                                                      | 1.69E+00                     | 2.87E-02                                  | <b>2.41E+00</b>               | 9.47E-02                      |
| 1 - NI indicates installation reports using fog oil or additives, but the amount used is not available.<br>Bold values indicate exceedance of regulatory threshold. |                                                               |                              |                                           |                               |                               |

Table 37. Exposure and risk estimates for Fort Sill, Oklahoma.

| Compound                     | log Kow | Sum of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons |
|------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| <b>Smokes and Obscurants</b> |         |                                          |                                            |                                                      |                                                       |
| Fog Oil Smoke                |         |                                          |                                            |                                                      | NA                                                    |
| Hexachloroethane (HC) Smoke  | 3.74    | 1053240.82                               | 4.20E-03                                   | 2.19E-04                                             |                                                       |

| Compound                                               | log Kow | Sum of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons |
|--------------------------------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| White Phosphorous (WP) Smoke                           | 3.08    |                                          |                                            |                                                      |                                                       |
| Brass Flakes                                           | -0.52   |                                          |                                            |                                                      | NA                                                    |
| Graphite Flakes                                        |         |                                          |                                            |                                                      | NA                                                    |
| Titanium Dioxide                                       | 2.23    |                                          |                                            |                                                      |                                                       |
| Polyethylene Glycol (PEG)                              | -1.2    |                                          |                                            |                                                      |                                                       |
| Terephthalic Acid                                      | 2       | 209716.68                                | 8.37E-03                                   | 4.46E-03                                             |                                                       |
| (o-Chlorbenzol)malononitrile (CS)                      | 2.76    | 22559.42                                 | 9.01E-04                                   | 1.74E-04                                             |                                                       |
| Dibenz(bf)-14-oxazepine (CR)                           | 3.49    |                                          |                                            |                                                      |                                                       |
| <b>Colored Smokes</b>                                  |         |                                          |                                            |                                                      |                                                       |
| CI Basic Yellow 2                                      | 3.54    |                                          |                                            |                                                      |                                                       |
| Disperse Yellow 11                                     | 4.54    |                                          |                                            |                                                      |                                                       |
| Disperse Red 9                                         | 4.045   | 18847.04                                 | 7.52E-04                                   | 2.61E-05                                             |                                                       |
| Solvent Green 3                                        | 8.995   | 340249.45                                | 1.36E-02                                   | 6.34E-07                                             |                                                       |
| Solvent Yellow 33                                      | 4.1     | 179246.54                                | 7.16E-03                                   | 2.31E-04                                             |                                                       |
| Yellow Smoke 6                                         | 6.28    |                                          |                                            |                                                      |                                                       |
| <b>Military Unique Compounds</b>                       |         |                                          |                                            |                                                      |                                                       |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                      | 1.1     | 88026.22                                 | 3.51E-03                                   | 6.23E-03                                             |                                                       |
| 1,3-Dinitrobenzene (1,3-DNB)                           | 1.49    | 88026.22                                 | 3.51E-03                                   | 3.70E-03                                             |                                                       |
| 2,4 – Dinitrophenol (2,4-DNP)                          | 1.67    |                                          |                                            |                                                      |                                                       |
| Dinitrotoluene isomers                                 | 2.14    |                                          |                                            |                                                      |                                                       |
| 2,4-Dinitrotoluene                                     | 1.98    |                                          |                                            |                                                      |                                                       |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX) | 0.16    |                                          |                                            |                                                      |                                                       |
| Nitrobenzene (NB)                                      | 1.85    |                                          |                                            |                                                      |                                                       |
| Nitroglycerin (NG)                                     | 1.62    |                                          |                                            |                                                      |                                                       |

| Compound                                                    | log Kow | Sum of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons |
|-------------------------------------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol) | 1.9     |                                          |                                            |                                                      |                                                       |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    |                                          |                                            |                                                      |                                                       |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 1602454.32                               | 6.40E-02                                   | 1.54E-01                                             |                                                       |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     | 0.00                                     |                                            |                                                      |                                                       |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 880262.22                                | 3.51E-02                                   | 3.19E-02                                             |                                                       |

Table 37 Continued.

| Compound                          | Concentration in Terrestrial Insects <sup>1</sup> mg/kg bw | Dose to Black-Capped Vireo mg/kg-day | LOAEL-based TQ for Plants | NOAEL-based TQ for Black-Capped Vireo | LOAEL-based TQ for Black-Capped Vireo |
|-----------------------------------|------------------------------------------------------------|--------------------------------------|---------------------------|---------------------------------------|---------------------------------------|
| <b>Smokes and Obscurants</b>      |                                                            |                                      |                           |                                       |                                       |
| Fog Oil Smoke                     |                                                            |                                      |                           |                                       |                                       |
| Hexachloroethane (HC) Smoke       | 1.34E-03                                                   | 6.40E-04                             |                           | 4.4E-04                               | 2.0E-04                               |
| White Phosphorous (WP) Smoke      |                                                            |                                      |                           |                                       |                                       |
| Brass Flakes                      |                                                            |                                      |                           |                                       |                                       |
| Graphite Flakes                   |                                                            |                                      |                           |                                       |                                       |
| Titanium Dioxide                  |                                                            |                                      |                           |                                       |                                       |
| Polyethylene Glycol (PEG)         |                                                            |                                      |                           |                                       |                                       |
| Terephthalic Acid                 | 2.72E-02                                                   | 1.30E-02                             |                           |                                       |                                       |
| (o-Chlorbenzol)malononitrile (CS) | 1.06E-03                                                   | 5.07E-04                             |                           |                                       |                                       |
| Dibenz(bf)-14-oxazepine (CR)      |                                                            |                                      |                           |                                       |                                       |
| <b>Colored Smokes</b>             |                                                            |                                      |                           |                                       |                                       |
| CI Basic Yellow 2                 |                                                            |                                      |                           |                                       |                                       |
| Disperse Yellow 11                |                                                            |                                      |                           |                                       |                                       |
| Disperse Red 9                    | 1.59E-04                                                   | 7.62E-05                             |                           |                                       |                                       |

| Compound                                                                                          | Concentration in Terrestrial Insects <sup>1</sup><br>mg/kg bw | Dose to Black-Capped Vireo<br>mg/kg-day | LOAEL-based TQ for Plants | NOAEL-based TQ for Black-Capped Vireo | LOAEL-based TQ for Black-Capped Vireo |
|---------------------------------------------------------------------------------------------------|---------------------------------------------------------------|-----------------------------------------|---------------------------|---------------------------------------|---------------------------------------|
| Solvent Green 3                                                                                   | 3.86E-06                                                      | 1.85E-06                                |                           |                                       |                                       |
| Solvent Yellow 33                                                                                 | 1.41E-03                                                      | 6.73E-04                                |                           |                                       |                                       |
| Yellow Smoke 6                                                                                    |                                                               |                                         |                           |                                       |                                       |
| Dye Yellow 4 (Benzanthrone)                                                                       |                                                               |                                         |                           |                                       |                                       |
| <b>Military Unique Compounds</b>                                                                  |                                                               |                                         |                           |                                       |                                       |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                 | 3.79E-02                                                      | 1.82E-02                                |                           |                                       |                                       |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                      | 2.25E-02                                                      | 1.08E-02                                |                           |                                       |                                       |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                     |                                                               |                                         |                           |                                       |                                       |
| Dinitrotoluene isomers                                                                            |                                                               |                                         |                           |                                       |                                       |
| 2,4-Dinitrotoluene                                                                                |                                                               |                                         |                           |                                       |                                       |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                            |                                                               |                                         |                           |                                       |                                       |
| Nitrobenzene (NB)                                                                                 |                                                               |                                         |                           |                                       |                                       |
| Nitroglycerin (NG)                                                                                |                                                               |                                         |                           |                                       |                                       |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                       |                                                               |                                         |                           |                                       |                                       |
| Pentaerythritol Tetranitrate (PETN)                                                               |                                                               |                                         |                           |                                       |                                       |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                     | 9.39E-01                                                      | 4.50E-01                                | 1.5E-03                   | 2.0E-01                               | 1.7E-01                               |
| Trinitrophenylmethylnitramine (Tetryl)                                                            |                                                               |                                         |                           |                                       |                                       |
| 2,4,6-Trinitrotoluene (TNT)                                                                       | 1.94E-01                                                      | 9.32E-02                                | 1.1E-03                   | 1.3E-01                               | 5.2E-03                               |
| 1 – Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |                                                               |                                         |                           |                                       |                                       |

Table 38. Exposure and risk estimates for Fort Jackson, South Carolina.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for 10% Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww |
|-----------------------------------|---------|-------------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|
| Smokes and Obscurants             |         |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Fog Oil Smoke                     |         |                                                 |                                            |                                                      | 3.30E+02                                              | 4.34E+01                                                       | 1.15E+02                                                | 7.66E+01                                                     |
| Hexachloroethane (HC) Smoke       | 3.74    | 22058183.9                                      | 3.78E+00                                   | 4.76E-01                                             | NA<br>NA                                              |                                                                |                                                         |                                                              |
| White Phosphorous (WP) Smoke      | 3.08    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Brass Flakes                      | -0.52   |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Graphite Flakes                   |         |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Titanium Dioxide                  | 2.23    | 756224.12                                       | 1.30E-01                                   | 6.91E-02                                             |                                                       |                                                                |                                                         |                                                              |
| Polyethylene Glycol (PEG)         | -1.2    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Terephthalic Acid                 | 2       |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    | 5294.61                                         | 9.08E-04                                   | 1.75E-04                                             |                                                       |                                                                |                                                         |                                                              |
| Colored Smokes                    |         |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| CI Basic Yellow 2                 | 3.54    | 10957.20                                        | 1.88E-03                                   | 3.37E-05                                             |                                                       |                                                                |                                                         |                                                              |
| Disperse Yellow 11                | 4.54    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Disperse Red 9                    | 4.045   |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Solvent Green 3                   | 8.995   |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Solvent Yellow 33                 | 4.1     | 32620.21                                        | 5.59E-03                                   | 1.80E-04                                             |                                                       |                                                                |                                                         |                                                              |
| Yellow Smoke 6                    | 6.28    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Dye Yellow 4 (Benzanthrone)       | 4.81    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Military Unique Compounds         |         |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 91610.65                                        | 1.57E-02                                   | 2.78E-02                                             |                                                       |                                                                |                                                         |                                                              |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 91610.65                                        | 1.57E-02                                   | 1.65E-02                                             |                                                       |                                                                |                                                         |                                                              |
| 2,4 - Dinitrophenol (2,4-DNP)     | 1.67    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |

| Compound                                                    | log Kow | Sum of COC Weight (g) Adjusted for 10% Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww | Concentration on Tree Leaves from Direct Deposition mg/kg ww |
|-------------------------------------------------------------|---------|-------------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|--------------------------------------------------------------|
| Dinitrotoluene isomers                                      | 2.14    | 3475.80                                         | 5.96E-04                                   | 2.63E-04                                             |                                                       |                                                                |                                                         |                                                              |
| 2,4-Dinitrotoluene                                          | 1.98    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Nitrobenzene (NB)                                           | 1.85    |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Nitroglycerin (NG)                                          | 1.62    | 3802.81                                         | 6.52E-04                                   | 5.77E-04                                             |                                                       |                                                                |                                                         |                                                              |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) | 1.9     |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 9839.72                                         | 1.69E-03                                   | 1.51E-03                                             |                                                       |                                                                |                                                         |                                                              |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 662400.21                                       | 1.14E-01                                   | 2.74E-01                                             |                                                       |                                                                |                                                         |                                                              |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 916106.54                                       | 1.57E-01                                   | 1.43E-01                                             |                                                       |                                                                |                                                         |                                                              |
| NA – not applicable (not used)                              |         |                                                 |                                            |                                                      |                                                       |                                                                |                                                         |                                                              |

Table 38 Continued.

| Compound                     | Total Deposition on Tree Leaves $\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Woodpecker mg/kg-day |
|------------------------------|-----------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|------------------------------|
| <b>Smokes and Obscurants</b> |                                                           |                                                        |                                                            |                              |
| Fog Oil Smoke                | 1.15E+02                                                  | 8.80E+01                                               | 4.67E+02                                                   | 1.50E+02                     |
| Hexachloroethane (HC) Smoke  |                                                           |                                                        |                                                            |                              |
| White Phosphorous (WP) Smoke |                                                           |                                                        | 2.90E+00                                                   | 9.34E-01                     |
| Brass Flakes                 |                                                           |                                                        |                                                            |                              |

| Compound                                                    | Total Deposition on Tree Leaves $\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>2</sup> mg/kg bw | Dose to Woodpecker mg/kg-day |
|-------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|------------------------------|
| Graphite Flakes                                             |                                                           |                                                        |                                                            |                              |
| Titanium Dioxide                                            |                                                           |                                                        |                                                            |                              |
| Polyethylene Glycol (PEG)                                   |                                                           |                                                        |                                                            |                              |
| Terephthalic Acid                                           |                                                           |                                                        | 4.21E-01                                                   | 1.35E-01                     |
| (o-Chlorbenzol)malononitrile (CS)                           |                                                           |                                                        | 1.07E-03                                                   | 3.44E-04                     |
| Dibenz(bf)-14-oxazepine (CR)                                |                                                           |                                                        |                                                            |                              |
| <b>Colored Smokes</b>                                       |                                                           |                                                        |                                                            |                              |
| CI Basic Yellow 2                                           |                                                           |                                                        |                                                            |                              |
| Disperse Yellow 11                                          |                                                           |                                                        | 2.05E-04                                                   | 6.60E-05                     |
| Disperse Red 9                                              |                                                           |                                                        | 8.74E-04                                                   | 2.81E-04                     |
| Solvent Green 3                                             |                                                           |                                                        | 8.44E-07                                                   | 2.72E-07                     |
| Solvent Yellow 33                                           |                                                           |                                                        | 1.10E-03                                                   | 3.54E-04                     |
| Yellow Smoke 6                                              |                                                           |                                                        |                                                            |                              |
| Dye Yellow 4 (Benzanthrone)                                 |                                                           |                                                        |                                                            |                              |
| <b>Military Unique Compounds</b>                            |                                                           |                                                        |                                                            |                              |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           |                                                           |                                                        | 1.69E-01                                                   | 5.46E-02                     |
| 1,3-Dinitrobenzene (1,3-DNB)                                |                                                           |                                                        | 1.01E-01                                                   | 3.24E-02                     |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                                                           |                                                        |                                                            |                              |
| Dinitrotoluene isomers                                      |                                                           |                                                        | 1.60E-03                                                   | 5.16E-04                     |
| 2,4-Dinitrotoluene                                          |                                                           |                                                        |                                                            |                              |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      |                                                           |                                                        |                                                            |                              |
| Nitrobenzene (NB)                                           |                                                           |                                                        |                                                            |                              |
| Nitroglycerin (NG)                                          |                                                           |                                                        | 3.51E-03                                                   | 1.13E-03                     |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                                                           |                                                        |                                                            |                              |
| Pentaerythritol Tetranitrate (PETN)                         |                                                           |                                                        | 9.21E-03                                                   | 2.97E-03                     |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               |                                                           |                                                        | 1.67E+00                                                   | 5.37E-01                     |



| Compound                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | NOAEL-based<br>TQ for Plants | LOAEL-based<br>TQ for Plants                           | NOAEL-based<br>TQ for Tree<br>Leaves | LOAEL-<br>based TQ for<br>Tree Leaves                  | NOAEL-based<br>TQ for Wood-<br>pecker                    | LOAEL-based<br>TQ for Wood-<br>pecker                  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------|--------------------------------------------------------|--------------------------------------|--------------------------------------------------------|----------------------------------------------------------|--------------------------------------------------------|
| Solvent Yellow 33<br>Yellow Smoke 6<br>Dye Yellow 4 (Benzanthrone)                                                                                                                                                                                                                                                                                                                                                                                                                            |                              |                                                        |                                      |                                                        |                                                          |                                                        |
| <b>Military Unique Compounds</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                              |                                                        |                                      |                                                        |                                                          |                                                        |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)<br>1,3-Dinitrobenzene (1,3-DNB)<br>2,4 - Dinitrophenol (2,4-DNP)<br>Dinitrotoluene isomers<br>2,4-Dinitrotoluene<br>Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine<br>(HMX)<br>Nitrobenzene (NB)<br>Nitroglycerin (NG)<br>Nitrophenol isomers (e.g. 2 - Nitrophenol;<br>4 - Nitrophenol)<br>Pentaerythritol Tetranitrate (PETN)<br>Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)<br>Trinitrophenylmethylnitramine (Tetryl)<br>2,4,6-Trinitrotoluene (TNT) |                              | 2.7E-03<br><br><br><br><br><br><br><br><br><br>4.8E-03 |                                      | 2.7E=03<br><br><br><br><br><br><br><br><br><br>4.8E-03 | 2.41E+00<br><br><br><br><br><br><br><br><br><br>4.00E-01 | 2.0E-01<br><br><br><br><br><br><br><br><br><br>1.6E-02 |
| <b>Bold</b> values indicate exceedance of regulatory threshold.                                                                                                                                                                                                                                                                                                                                                                                                                               |                              |                                                        |                                      |                                                        |                                                          |                                                        |

Table 39. Exposure and risk tables for Camp Bullis, Texas.

| Compound                          | log Kow | Sum of COC Weight (g) (100% of material) | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in Terrestrial Insects <sup>1</sup> mg/kg bw |
|-----------------------------------|---------|------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|------------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                          |                                            |                                                      |                                                       |                                                            |
| Fog Oil Smoke                     |         |                                          |                                            |                                                      | NI                                                    |                                                            |
| Hexachloroethane (HC) Smoke       | 3.74    | 933486.76                                | 6.33E-02                                   | 3.30E-03                                             |                                                       | 2.01E-02                                                   |
| White Phosphorous (WP) Smoke      | 3.08    |                                          |                                            |                                                      |                                                       |                                                            |
| Brass Flakes                      | -0.52   |                                          |                                            |                                                      | NI                                                    |                                                            |
| Graphite Flakes                   |         |                                          |                                            |                                                      | NI                                                    |                                                            |
| Titanium Dioxide                  | 2.23    |                                          |                                            |                                                      |                                                       |                                                            |
| Polyethylene Glycol (PEG)         | -1.2    |                                          |                                            |                                                      |                                                       |                                                            |
| Terephthalic Acid                 | 2       |                                          |                                            |                                                      |                                                       |                                                            |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    |                                          |                                            |                                                      |                                                       |                                                            |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                          |                                            |                                                      |                                                       |                                                            |
| <b>Colored Smokes</b>             |         |                                          |                                            |                                                      |                                                       |                                                            |
| CI Basic Yellow 2                 | 3.54    |                                          |                                            |                                                      |                                                       |                                                            |
| Disperse Yellow 11                | 4.54    | 561.78                                   | 3.81E-05                                   | 6.82E-07                                             |                                                       | 4.15E-06                                                   |
| Disperse Red 9                    | 4.045   |                                          |                                            |                                                      |                                                       |                                                            |
| Solvent Green 3                   | 8.995   |                                          |                                            |                                                      |                                                       |                                                            |
| Solvent Yellow 33                 | 4.1     |                                          |                                            |                                                      |                                                       |                                                            |
| Yellow Smoke 6                    | 6.28    |                                          |                                            |                                                      |                                                       |                                                            |
| <b>Military Unique Compounds</b>  |         |                                          |                                            |                                                      |                                                       |                                                            |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 93348.68                                 | 6.33E-03                                   | 1.12E-02                                             |                                                       | 6.83E-02                                                   |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 9334.87                                  | 6.33E-04                                   | 6.66E-04                                             |                                                       | 4.06E-03                                                   |
| 2,4 – Dinitrophenol (2,4-DNP)     | 1.67    |                                          |                                            |                                                      |                                                       |                                                            |
| Dinitrotoluene isomers            | 2.14    |                                          |                                            |                                                      |                                                       |                                                            |
| 2,4-Dinitrotoluene                | 1.98    |                                          |                                            |                                                      |                                                       |                                                            |

|                                                                                                   |      |            |          |          |  |          |
|---------------------------------------------------------------------------------------------------|------|------------|----------|----------|--|----------|
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                            | 0.16 |            |          |          |  |          |
| Nitrobenzene (NB)                                                                                 | 1.85 |            |          |          |  |          |
| Nitroglycerin (NG)                                                                                | 1.62 | 2493.11    | 1.69E-04 | 1.50E-04 |  | 9.11E-04 |
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol)                                       | 1.9  |            |          |          |  |          |
| Pentaerythritol Tetranitrate (PETN)                                                               | 1.61 |            |          |          |  |          |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                     | 0.87 | 1818104.86 | 1.23E-01 | 2.97E-01 |  | 1.81E+00 |
| Trinitrophenylmethylnitramine (Tetryl)                                                            | 2.4  |            |          |          |  |          |
| 2,4,6-Trinitrotoluene (TNT)                                                                       | 1.6  | 933486.76  | 6.33E-02 | 5.75E-02 |  | 3.50E-01 |
| 1 – Concentration in terrestrial insects estimated via equilibrium partitioning with tree leaves. |      |            |          |          |  |          |
| NI – Installation reports using fog oil or additives, but the amount used is not available.       |      |            |          |          |  |          |

Table 39. Continued.

| Compound                          | Dose to Black-Capped Vireo mg/kg-day | Dose to Golden-Cheeked Warbler mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Black-Capped Vireo | LOAEL-based TQ for Black-Capped Vireo | NOAEL-based TQ for Golden-Cheeked Warbler | LOAEL-based TQ for Golden-Cheeked Warbler |
|-----------------------------------|--------------------------------------|------------------------------------------|-------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------|-------------------------------------------|
| <b>Smokes and Obscurants</b>      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Fog Oil Smoke                     |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Hexachloroethane (HC) Smoke       | 9.62E-03                             | 9.62E-03                                 |                                           | 6.6E-04                               | 7.3E-05                               | 6.6E-04                                   | 7.3E-05                                   |
| White Phosphorous (WP) Smoke      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Brass Flakes                      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Graphite Flakes                   |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Titanium Dioxide                  |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Polyethylene Glycol (PEG)         |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Terephthalic Acid                 |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| (o-Chlorbenzol)malononitrile (CS) |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Dibenz(bf)-14-oxazepine (CR)      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |

| Compound                                                    | Dose to Black-Capped Vireo mg/kg-day | Dose to Golden-Cheeked Warbler mg/kg-day | LOAEL-based TQ for Plants and Tree Leaves | NOAEL-based TQ for Black-Capped Vireo | LOAEL-based TQ for Black-Capped Vireo | NOAEL-based TQ for Golden-Cheeked Warbler | LOAEL-based TQ for Golden-Cheeked Warbler |
|-------------------------------------------------------------|--------------------------------------|------------------------------------------|-------------------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------|-------------------------------------------|
| <b>Colored Smokes</b>                                       |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| CI Basic Yellow 2                                           | 1.99E-06                             | 1.99E-06                                 |                                           |                                       |                                       |                                           |                                           |
| Disperse Yellow 11                                          |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Disperse Red 9                                              |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Solvent Green 3                                             |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Solvent Yellow 33                                           |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Yellow Smoke 6                                              |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Dye Yellow 4 (Benzanthrone)                                 |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| <b>Military Unique Compounds</b>                            |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                           | 3.27E-02                             | 3.27E-02                                 |                                           |                                       |                                       |                                           |                                           |
| 1,3-Dinitrobenzene (1,3-DNB)                                | 1.94E-03                             | 1.94E-03                                 |                                           |                                       |                                       |                                           |                                           |
| 2,4 - Dinitrophenol (2,4-DNP)                               |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Dinitrotoluene isomers                                      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| 2,4-Dinitrotoluene                                          |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Nitrobenzene (NB)                                           |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Nitroglycerin (NG)                                          | 4.36E-04                             | 4.36E-04                                 |                                           |                                       |                                       |                                           |                                           |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol) |                                      |                                          | 3.0E-03                                   | 3.9E-01                               | 3.3E-01                               | 3.9E-01                                   | 3.3E0-01                                  |
| Pentaerythritol Tetranitrate (PETN)                         | 8.66E-01                             | 8.66E-01                                 |                                           |                                       |                                       |                                           |                                           |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               |                                      |                                          |                                           |                                       |                                       |                                           |                                           |
| Trinitrophenylmethyl nitramine (Tetryl)                     | 1.68E-01                             | 1.68E-01                                 |                                           |                                       |                                       |                                           |                                           |
| 2,4,6-Trinitrotoluene (TNT)                                 |                                      |                                          | 1.9E-03                                   | 2.4E-01                               | 9.4E-03                               | 2.4E-01                                   | 9.4E-03                                   |

Table 40. Exposure and risk estimates for Fort Hood, Texas.

| Compound                          | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|-----------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| <b>Smokes and Obscurants</b>      |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Fog Oil Smoke                     |         |                                             |                                            |                                                      | 1.76E+03                                              | 2.31E+02                                                       | 6.13E+02                                                |
| Hexachloroethane (HC) Smoke       | 3.74    | 90666.63                                    | 7.77E-03                                   | 4.05E-04                                             |                                                       |                                                                |                                                         |
| White Phosphorous (WP) Smoke      | 3.08    | 4850364.48                                  | 4.16E-01                                   | 5.23E-02                                             |                                                       |                                                                |                                                         |
| Brass Flakes                      | -0.52   |                                             |                                            |                                                      | NI                                                    |                                                                |                                                         |
| Graphite Flakes                   |         |                                             |                                            |                                                      | NI                                                    |                                                                |                                                         |
| Titanium Dioxide                  | 2.23    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Polyethylene Glycol (PEG)         | -1.2    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Terephthalic Acid                 | 2       |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| (o-Chlorbenzol)malononitrile (CS) | 2.76    | 20764.16                                    | 1.78E-03                                   | 3.44E-04                                             |                                                       |                                                                |                                                         |
| Dibenz(bf)-14-oxazepine (CR)      | 3.49    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| <b>Colored Smokes</b>             |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| CI Basic Yellow 2                 | 3.54    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Disperse Yellow 11                | 4.54    | 5469.17                                     | 4.69E-04                                   | 8.40E-06                                             |                                                       |                                                                |                                                         |
| Disperse Red 9                    | 4.045   | 657.22                                      | 5.63E-05                                   | 1.95E-06                                             |                                                       |                                                                |                                                         |
| Solvent Green 3                   | 8.995   | 32.72                                       | 2.80E-06                                   | 1.31E-10                                             |                                                       |                                                                |                                                         |
| Solvent Yellow 33                 | 4.1     | 1102.24                                     | 9.45E-05                                   | 3.05E-06                                             |                                                       |                                                                |                                                         |
| Yellow Smoke 6                    | 6.28    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| <b>Military Unique Compounds</b>  |         |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| 1,3,5-Trinitrobenzene (1,3,5-TNB) | 1.1     | 589352.02                                   | 5.05E-02                                   | 8.95E-02                                             |                                                       |                                                                |                                                         |
| 1,3-Dinitrobenzene (1,3-DNB)      | 1.49    | 589352.02                                   | 5.05E-02                                   | 5.32E-02                                             |                                                       |                                                                |                                                         |
| 2,4 – Dinitrophenol (2,4-DNP)     | 1.67    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Dinitrotoluene isomers            | 2.14    | 354054.05                                   | 3.03E-02                                   | 1.34E-02                                             |                                                       |                                                                |                                                         |

| Compound                                                    | log Kow | Sum of COC Weight (g) Adjusted for Dud Rate | Soil Concentration (top 5 cm dry) mg/kg dw | Concentration in Vegetation via Root Uptake mg/kg ww | Mass of smokes Fog Oil and additives into air gallons | Concentration in sediment - deposition (top 1 cm dry) mg/kg dw | Concentration on Plants from Direct Deposition mg/kg ww |
|-------------------------------------------------------------|---------|---------------------------------------------|--------------------------------------------|------------------------------------------------------|-------------------------------------------------------|----------------------------------------------------------------|---------------------------------------------------------|
| 2,4-Dinitrotoluene                                          | 1.98    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)      | 0.16    | 6297.26                                     | 5.40E-04                                   | 3.36E-03                                             |                                                       |                                                                |                                                         |
| Nitrobenzene (NB)                                           | 1.85    |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Nitroglycerin (NG)                                          | 1.62    | 425323.03                                   | 3.65E-02                                   | 3.23E-02                                             |                                                       |                                                                |                                                         |
| Nitrophenol isomers (e.g. 2 – Nitrophenol; 4 – Nitrophenol) | 1.9     |                                             |                                            |                                                      |                                                       |                                                                |                                                         |
| Pentaerythritol Tetranitrate (PETN)                         | 1.61    | 955696.17                                   | 8.19E-02                                   | 7.35E-02                                             |                                                       |                                                                |                                                         |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)               | 0.87    | 855958.97                                   | 7.34E-02                                   | 1.77E-01                                             |                                                       |                                                                |                                                         |
| Trinitrophenylmethylnitramine (Tetryl)                      | 2.4     | 140.55                                      | 1.20E-05                                   | 3.76E-06                                             |                                                       |                                                                |                                                         |
| 2,4,6-Trinitrotoluene (TNT)                                 | 1.6     | 5893520.16                                  | 5.05E-01                                   | 4.59E-01                                             |                                                       |                                                                |                                                         |

Table 40 Continued.

| Compound                     | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves µg/cm² | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>1</sup> mg/kg bw | Dose to Black-Capped Vireo mg/kg-day | Dose to Golden-Cheeked Warbler mg/kg-day |
|------------------------------|--------------------------------------------------------------|----------------------------------------|--------------------------------------------------------|------------------------------------------------------------|--------------------------------------|------------------------------------------|
| <b>Smokes and Obscurants</b> |                                                              |                                        |                                                        |                                                            |                                      |                                          |
| Fog Oil Smoke                | 4.09E+02                                                     | 6.13E+02                               | 4.69E+02                                               | 2.49E+03                                                   | 1.19E+03                             | 1.19E+03                                 |
| Hexachloroethane (HC) Smoke  |                                                              | 6.08E-04                               |                                                        | 2.47E-03                                                   | 1.18E-03                             | 1.18E-03                                 |
| White Phosphorous (WP) Smoke |                                                              | 7.85E-02                               |                                                        | 3.19E-01                                                   | 1.53E-01                             | 1.53E-01                                 |
| Brass Flakes                 |                                                              |                                        |                                                        |                                                            |                                      |                                          |
| Graphite Flakes              |                                                              |                                        |                                                        |                                                            |                                      |                                          |
| Titanium Dioxide             |                                                              |                                        |                                                        |                                                            |                                      |                                          |

| Compound                                                                                                            | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves $\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>1</sup> mg/kg bw | Dose to Black-Capped Vireo mg/kg-day | Dose to Golden-Cheeked Warbler mg/kg-day |
|---------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|--------------------------------------|------------------------------------------|
| Polyethylene Glycol (PEG)<br>Terephthalic Acid<br>(o-Chlorbenzol)malononitrile (CS)<br>Dibenz(bf)-14-oxazepine (CR) |                                                              | 5.15E-04                                                  |                                                        | 2.09E-03                                                   | 1.00E-03                             | 1.00E-03                                 |
| <b>Colored Smokes</b>                                                                                               |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| CI Basic Yellow 2                                                                                                   |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| Disperse Yellow 11                                                                                                  |                                                              | 1.26E-05                                                  |                                                        | 5.12E-05                                                   | 2.45E-05                             | 2.45E-05                                 |
| Disperse Red 9                                                                                                      |                                                              | 2.93E-06                                                  |                                                        | 1.19E-05                                                   | 5.70E-06                             | 5.70E-06                                 |
| Solvent Green 3                                                                                                     |                                                              | 1.96E-10                                                  |                                                        | 7.98E-10                                                   | 3.82E-10                             | 3.82E-10                                 |
| Solvent Yellow 33                                                                                                   |                                                              | 4.57E-06                                                  |                                                        | 1.86E-05                                                   | 8.89E-06                             | 8.89E-06                                 |
| Yellow Smoke 6                                                                                                      |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| <b>Military Unique Compounds</b>                                                                                    |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                                   |                                                              | 1.34E-01                                                  |                                                        | 5.45E-01                                                   | 2.61E-01                             | 2.61E-01                                 |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                                        |                                                              | 7.98E-02                                                  |                                                        | 3.24E-01                                                   | 1.55E-01                             | 1.55E-02                                 |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                                       |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| Dinitrotoluene isomers                                                                                              |                                                              | 2.01E-02                                                  |                                                        | 8.17E-02                                                   | 3.91E-02                             | 3.91E-02                                 |
| 2,4-Dinitrotoluene                                                                                                  |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                              |                                                              | 5.03E-03                                                  |                                                        | 2.04E-02                                                   | 9.79E-03                             | 9.79E-03                                 |
| Nitrobenzene (NB)                                                                                                   |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| Nitroglycerin (NG)                                                                                                  |                                                              | 4.84E-02                                                  |                                                        | 1.96E-01                                                   | 9.41E-02                             | 9.41E-02                                 |
| Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)                                                         |                                                              |                                                           |                                                        |                                                            |                                      |                                          |
| Pentaerythritol Tetranitrate (PETN)                                                                                 |                                                              | 1.10E-01                                                  |                                                        | 4.47E-01                                                   | 2.14E-01                             | 2.14E-01                                 |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                                       |                                                              | 2.65E-01                                                  |                                                        | 1.08E+00                                                   | 5.16E-01                             | 5.16E-01                                 |

| Compound                                                                                   | Concentration on Tree Leaves from Direct Deposition mg/kg ww | Total Deposition on Tree Leaves $\mu\text{g}/\text{cm}^2$ | Concentration in Aquatic Insects <sup>1</sup> mg/kg bw | Concentration in Terrestrial Insects <sup>1</sup> mg/kg bw | Dose to Black-Capped Vireo mg/kg-day | Dose to Golden-Cheeked Warbler mg/kg-day |
|--------------------------------------------------------------------------------------------|--------------------------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------|------------------------------------------------------------|--------------------------------------|------------------------------------------|
| Trinitrophenylmethyl nitramine (Tetryl)                                                    |                                                              | 5.64E-06                                                  |                                                        | 2.29E-05                                                   | 1.10E-05                             | 1.10E-05                                 |
| 2,4,6-Trinitrotoluene (TNT)                                                                |                                                              | 6.89E-01                                                  |                                                        | 2.80E+00                                                   | 1.34E+00                             | 1.34E+00                                 |
| 1 – Concentration in aquatic insects estimated via equilibrium partitioning with sediment. |                                                              |                                                           |                                                        |                                                            |                                      |                                          |

Table 40 Continued.

| Compound                          | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves | NOAEL-based TQ for Black-Capped Vireo | LOAEL-based TQ for Black-Capped Vireo | NOAEL-based TQ for Golden-Cheeked Warbler | LOAEL-based TQ for Golden-Cheeked Warbler |
|-----------------------------------|---------------------------|---------------------------|--------------------------------|--------------------------------|---------------------------------------|---------------------------------------|-------------------------------------------|-------------------------------------------|
| <b>Smokes and Obscurants</b>      |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Fog Oil Smoke                     | 1.1E+01                   | 8.9E+00                   | 1.1E+01                        | 8.9E+00                        |                                       |                                       |                                           |                                           |
| Hexachloroethane (HC) Smoke       |                           |                           |                                |                                | 8.2E-05                               | 9.1E-06                               | 8.2E-05                                   | 9.0E-06                                   |
| White Phosphorous (WP) Smoke      |                           |                           |                                |                                | 3.1E+01                               | 3.1E+00                               | 3.1E+01                                   | 3.1E+00                                   |
| Brass Flakes                      |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Graphite Flakes                   |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Titanium Dioxide                  |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Polyethylene Glycol (PEG)         |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Terephthalic Acid                 |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| (o-Chlorbenzol)malononitrile (CS) |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Dibenz(bf)-14-oxazepine (CR)      |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| <b>Colored Smokes</b>             |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| CI Basic Yellow 2                 |                           |                           |                                |                                |                                       |                                       |                                           |                                           |
| Disperse Yellow 11                |                           |                           |                                |                                |                                       |                                       |                                           |                                           |

| Compound                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | NOAEL-based TQ for Plants | LOAEL-based TQ for Plants         | NOAEL-based TQ for Tree Leaves | LOAEL-based TQ for Tree Leaves    | NOAEL-based TQ for Black-Capped Vireo                     | LOAEL-based TQ for Black-Capped Vireo              | NOAEL-based TQ for Golden-Cheeked Warbler                 | LOAEL-based TQ for Golden-Cheeked Warbler          |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|-----------------------------------|--------------------------------|-----------------------------------|-----------------------------------------------------------|----------------------------------------------------|-----------------------------------------------------------|----------------------------------------------------|
| Disperse Red 9<br>Solvent Green 3<br>Solvent Yellow 33<br>Yellow Smoke 6<br>Dye Yellow 4 (Benzanthrone)                                                                                                                                                                                                                                                                                                                                                                                 |                           |                                   |                                |                                   |                                                           |                                                    |                                                           |                                                    |
| <b>Military Unique Compounds</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                           |                                   |                                |                                   |                                                           |                                                    |                                                           |                                                    |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)<br>1,3-Dinitrobenzene (1,3-DNB)<br>2,4 - Dinitrophenol (2,4-DNP)<br>Dinitrotoluene isomers<br>2,4-Dinitrotoluene<br>Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)<br>Nitrobenzene (NB)<br>Nitroglycerin (NG)<br>Nitrophenol isomers (e.g. 2 - Nitrophenol; 4 - Nitrophenol)<br>Pentaerythritol Tetranitrate (PETN)<br>Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)<br>Trinitrophenylmethylnitramine (Tetryl)<br>2,4,6-Trinitrotoluene (TNT) |                           | 1.8E-03<br><br>1.5E-07<br>1.5E-02 |                                | 1.8E-03<br><br>1.5E-07<br>1.5E-07 | 2.3E-01<br><br><br><br><br><br><br><br><br><b>1.9E+00</b> | 2.0E-01<br><br><br><br><br><br><br><br><br>7.5E-02 | 2.3E-01<br><br><br><br><br><br><br><br><br><b>1.9E+00</b> | 2.0E-01<br><br><br><br><br><br><br><br><br>7.5E-02 |
| <b>Bold</b> values indicate exceedance of regulatory threshold.                                                                                                                                                                                                                                                                                                                                                                                                                         |                           |                                   |                                |                                   |                                                           |                                                    |                                                           |                                                    |

## 7 Uncertainty Analysis

The analyses presented here relied on screening level approaches and calculations together with site-specific information on S&O and munition usage and impact area to predict the potential for adverse effects to the selected threatened and endangered species. In most cases, calculations were designed to represent reasonable upper-bound estimates of potential exposures. Sources of uncertainty, data limitations, and the potential relationship to drawing the conclusions are presented as follows.

*Installation-specific S&O and MUC usage:* Researchers relied on data obtained for fiscal year 2002 from each installation as to the quantity of each munition fired. The quantity and type of munitions used varies from year to year. For example, some installations reported no fog oil usage for 2002 but they have used it in the past and nothing is precluding them from using it in future. Similarly, the amount of any specific grenade type used varies from year to year. It is unknown whether this over- or underestimates potential risk. Obtaining data over many years (e.g., a 10-year time period) would allow a probabilistic approach to be used, in which usage data would be described by distributions rather than point estimates.

*COC buildup in the environment:* The analysis presented here is conducted on an annualized basis. This essentially assumes that the environment is in steady-state; that is, the amount of chemicals entering and leaving the system is roughly equivalent. However, firing grenades into an impact area over many years may result in higher environmental concentrations than predicted here, given the specific physical-chemical properties of each of the COCs. To address this potential source of uncertainty, this research assumed both a 10 percent dud rate (most realistic) and a 100 percent dud rate (that is, the entire amount of COCs contained in the munitions are deposited over the impact area). This is equivalent to the conservative assumption that this quantity of munitions would be used over a 10-year period with no loss of COCs.

*COC database from MIDAS/TRI-DDS:* Researchers estimated the quantity of each COC in each munition by DODIC using the procedure described previously, which relied on the TRI-DDS and MIDAS databases. In working with these databases, researchers noted discrepancies between the summary sheets and the individual DODIC reports, as well as multiple entries for any (in theory) unique DODIC-NSN combination. There were many instances in which a DODIC-NSN combination re-

sulted in several different constituent breakdowns, which were completely different (e.g., a different COC list between the two). The impact of these differences is unknown, but is presumed to be minimal.

*Degradation products:* TNT in particular, and to a lesser extent RDX and HMX, develop degradation products in the environment. Some of these are included on the COC list (e.g., 1,3,5-trinitrobenzene, 1,3-dinitrobenzene). Without having detailed site-specific environmental parameters, it is difficult to predict what the expected concentrations of these constituents are at any given installation or site. Moreover, there are additional breakdown products that were not included on the COC list that are potential contributors to risk, including 3,5-dinitroaniline and 2-amino-4,6-dinitrotoluene. The most efficient way to reduce this uncertainty is to develop site-specific sampling plans at each installation, which would provide actual concentration estimates in soil, vegetation, and other environmental media.

*Fate and transport estimates:*

*Dud rate:* This analysis assumed a 10 percent dud rate for the munitions. This is higher than the average dud rate across all DODICs. However, the actual dud rate could be greater, which would increase the risk estimates presented here. No dud rate was assumed for the colored smokes.

*Fog oil:* For fog oil, the screening-level analysis resulted in estimates of maximum deposition together with installation-specific values for actual fog oil use. More sophisticated modeling approaches, for example using the Hazard Production and Assessment Capability (HPAC) system models of release and transport of materials in the atmosphere, together with site-specific meteorology and knowledge of terrain, are possible but were beyond the scope of this analysis.

*Plant uptake:* This analysis used a regression equation developed for a large number of organic chemicals based on the Log  $K_{ow}$  to estimate potential uptake of munitions and smokes and obscurants into plants and trees. It is unknown whether this equation over- or under-estimates potential uptake for any given chemical due to unknown factors such as potential transformation processes (e.g., degradation, etc.) that the chemical may be subject to in the environment. This analysis assumed that all of the chemical mass was available for uptake into plants, which is conservative given that some of the COCs are known to degrade a certain amount relatively quickly in specific environments. In addition, the same equation was used for both plants and grasses as well as tree leaves, although the equation was not developed specifically for tree leaves. There are some data available for a few of the munitions (e.g., TNT, RDX) to develop empirical uptake factors and these could be used to compare to the predictions from the regression equation. Synoptic sampling of

soil, vegetation likely to serve as forage for the tortoises, and leaves from trees in which the avian threatened and endangered species are found would reduce this modeling uncertainty and provide a method for developing empirical relationships between soil and vegetation concentrations.

*Direct deposition on plants:* For fog oil, the analysis assumed vegetation yields for plants/grasses and tree leaves based on “generic” literature values designed to encompass a number of plant types rather than any specific vegetation, and further assumed no interception fraction (that is, the entire amount of fog oil available for deposition would fall onto plants and/or trees, even though this is almost certainly not really the case). Further, the analysis assumes no loss once the fog oil has landed on the foliage. Thus, these estimates are designed to overestimate potential concentrations. More sophisticated modeling could be used to refine these estimates (e.g., installation-specific fog oil deposition estimates using HPAC together with installation-specific knowledge of foliage and vegetation yield and interception fractions specific to the foliage type). A probabilistic analysis could incorporate the uncertainty in these parameters. An additional approach would be to measure fog oil concentrations at each installation at specified time intervals following a training exercise. Where this has been done at select installations, more site-specific modeling is a reasonable approach.

*Food/prey concentrations:* This screening level assessment assumes equilibrium partitioning for sediment to generic benthic invertebrates, and tree leaves to generic terrestrial insects that live in trees such as caterpillars, beetles, etc. Equilibrium partitioning is typically considered an upper-bound estimate in that it does not account for chemical decay, metabolism, and so on. However, if the exposure estimates in the sediment or tree leaves are underpredicted, then the resulting equilibrium concentrations in the organisms are likely underpredicted as well. It is unknown whether the estimates presented here are high or low and how high or low relative to actual concentrations. The gold standard would be to collect synoptic data on tree leaves and terrestrial insects to explore the relationship between the concentrations, and also to evaluate the absolute concentrations in the insects at any given installation.

*Biological parameters:* The screening level assessment relies on literature estimates for lipid content of plants and tree leaves, lipid content of benthic invertebrates and terrestrial insects, total organic carbon in sediment, vegetation yield, and soil/sediment bulk density. Collection of installation-specific biological parameters would reduce this source of uncertainty.

*Physical-chemical parameters:* A critical physical-chemical parameter in terms of modeling is the Log  $K_{ow}$  (octanol-water partition coefficient). This coefficient de-

scribes the affinity a chemical has for the lipid, or organic, fraction of any particular environmental medium (e.g., organic carbon, etc.). This assessment uses measured values where possible, and estimates values using an accepted QSAR program available from USEPA. The  $K_{ow}$  is a very sensitive parameter, indicating that small changes in the  $K_{ow}$  result in large effects to predicted environmental concentrations. A probabilistic model using a distribution of  $K_{ows}$  could be developed for each individual COC and the uncertainty surrounding the  $K_{ow}$  input on risk could be quantified.

*Exposure area:* Installations provided estimates of the area over which munitions are distributed (the impact area). The actual area may be larger or smaller than presented here. A smaller area would increase predicted environmental concentrations, while a larger area would decrease environmental concentrations. Changes in impact area could be quantitatively evaluated through a probabilistic framework. This assessment assumes a unit 1 km by 1 km deposition area for S&Os. Installation-specific modeling could be conducted to reduce this source of uncertainty.

*Exposure parameters:* This assessment relies on literature sources for exposure parameters, including body weight and ingestion rate for threatened and endangered species of concern. Uncertainty introduced as a result of these exposure parameters is likely to be moderate to low and could be quantitatively evaluated using a probabilistic framework. This assessment further assumes that the threatened and endangered species of concern would forage exclusively over the impact area, which is in all but one case 15 mi<sup>2</sup> or greater. However, threatened and endangered species of concern may forage over unimpacted areas as well. A site-use factor (defined as a point estimate or as a distribution or range) could be used in a model to evaluate the quantitative impact of this source of uncertainty.

*Exposure pathways:* This assessment focuses on long-term exposures via ingestion to residual COCs in the environment from training and maneuver activities. Many of these COCs have known adverse effects via inhalation, particularly in the short-term. Some of the COCs may also have potential effects via dermal absorption. Risk may be underestimated because these exposure routes are not quantitatively evaluated in this assessment.

*Toxicity Reference Values:* TRVs are selected or developed based on the best available information. In many cases, data are simply not available for developing TRVs. These data gaps could be addressed by conducting toxicity studies for COCs. There is always uncertainty in the application of TRVs, which can be quantitatively evaluated in a probabilistic framework for those COCs for which some data are available.

In general, a probabilistic framework allows for a quantitative evaluation of sources of uncertainty and the magnitude of each source on predicted risk. Additional data collection (e.g., concentrations in the environment, relationships between environmental components such as sediment and benthos, etc.) as well as more refined modeling using installation-specific meteorology, terrain, knowledge of vegetation and soil types, etc. would help to reduce sources of uncertainty and provide more refined risk estimates. A probabilistic framework in which distributions instead of point estimates are used for input parameters would provide a quantitative expression of the uncertainty (e.g., a distribution of predicted risks rather than a single number for each receptor-COC pathway combination). It would also provide a means for identifying predominant contributors to uncertainty (e.g., does the  $K_{ow}$  or the ingestion rate contribute more to the uncertainty in predicted risk estimates?).

## 8 Conclusions and Recommendations

Predicted toxicity quotients indicate potential adverse effects via food web exposures as a result of munition buildup in the environment. Specifically, potential adverse effects from exposure to munitions are indicated for the red-cockaded woodpecker, black-capped vireo, golden-cheeked warbler, gray bat, and the Indiana bat. There is no risk to tortoises from exposure to munitions. Potential adverse effects to all threatened and endangered species of concern are indicated from exposure to white phosphorus smoke. Table 41 provides a summary of exceedances assuming both 10 percent and 100 percent dud rates for munitions.

**Table 41. Summary of exceedances for predicted toxicity quotients for each installation.**

| Installation            | Impact Area (mi <sup>2</sup> ) | Dud Rate | Vegetation LOAEL | Avian NOAEL  | Avian LOAEL  | Tortoise NOAEL | Tortoise LOAEL | Mammal NOAEL              | Mammal LOAEL |
|-------------------------|--------------------------------|----------|------------------|--------------|--------------|----------------|----------------|---------------------------|--------------|
| Fort Rucker, AL         | 22                             | 100%     | None             | NA           | NA           | None           | None           | NA                        | NA           |
| Yuma Proving Ground, AZ | No Data                        | No Data  | No Data          | No Data      | No Data      | No Data        | No Data        | No Data                   | No Data      |
| Fort Irwin, CA          | 159                            | 100%     | None             | NA           | NA           | None           | None           | NA                        | NA           |
| Fort Benning, GA        | 25                             | 10%      | FO               | WP           | None         | None           | None           | NA                        | NA           |
|                         |                                | 100%     | FO               | WP, RDX, TNT | RDX          | None           | None           |                           |              |
| Fort Gordon, GA         | 19                             | 100%     | None             | None         | None         | None           | None           | NA                        | NA           |
| Fort Stewart, GA        | 30                             | 10%      | None             | WP, TNT      | WP           | None           | None           | NA                        | NA           |
|                         |                                | 100%     | None             | WP, RDX, TNT | WP, RDX      | None           | None           |                           |              |
| Fort Campbell, KY       | 39                             | 10%      | None             | NA           | NA           | NA             | NA             | WP                        | WP           |
|                         |                                | 100%     | None             |              |              |                |                | WP, RDX, TNT, NG, 1,3-DNB | WP, 1,3-DNB  |
| Fort Knox, KY           | 158                            | 10%      | None             | NA           | NA           | NA             | NA             | FO                        | None         |
|                         |                                | 100%     | None             |              |              |                |                | FO                        | None         |
| Fort Polk, LA           | 13                             | 10%      | None             | WP, RDX, TNT | WP, RDX      | NA             | NA             | NA                        | NA           |
|                         |                                | 100%     | None             | WP, RDX, TNT | WP, RDX, TNT |                |                |                           |              |
| Camp Shelby, MS         | 12                             | 10%      | FO               | WP, TNT      | WP           | FO             | None           | NA                        | NA           |
|                         |                                | 100%     | FO               | WP, RDX, TNT | WP, RDX, TNT | FO             | None           |                           |              |

| Installation                                                                                                                                                                                                                                                                                                                                                                                          | Impact Area (mi <sup>2</sup> ) | Dud Rate | Vegetatio n LOAEL | Avian NOAEL  | Avian LOAEL | Tortoise NOAEL | Tortoise LOAEL | Mammal NOAEL                                   | Mammal LOAEL                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|----------|-------------------|--------------|-------------|----------------|----------------|------------------------------------------------|----------------------------------|
| Fort Leonard Wood, MO                                                                                                                                                                                                                                                                                                                                                                                 | 0.79                           | 10%      | FO                | NA           | NA          | NA             | NA             | FO, 1,3,5-TNB, 1,3-DNB, RDX, TNT               | FO, 1,3-DNB, RDX, TNT            |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     | FO, RDX, TNT      |              |             |                |                | FO, TA, 1,3-DNB, RDX, TNT, PETN, NG, 1,3,5-TNB | FO, RDX, TNT, 1,3-DNB, 1,3,5-TNB |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                |          |                   |              |             |                |                |                                                |                                  |
| Fort Bragg, NC                                                                                                                                                                                                                                                                                                                                                                                        | 51                             | 10%      | None              | WP, RDX, TNT | WP, RDX     | NA             | NA             | NA                                             | NA                               |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     | None              | WP, RDX, TNT | WP, RDX     |                |                |                                                |                                  |
| Fort Sill, OK                                                                                                                                                                                                                                                                                                                                                                                         | 73                             | 10%      | None              | None         | None        | NA             | NA             | NA                                             | NA                               |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     |                   |              |             |                |                |                                                |                                  |
| Fort Jackson, SC                                                                                                                                                                                                                                                                                                                                                                                      | 17                             | 10%      | FO                | WP           | WP          | NA             | NA             | NA                                             | NA                               |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     | FO                | WP, RDX, TNT | WP, RDX     |                |                |                                                |                                  |
| Camp Bullis, TX                                                                                                                                                                                                                                                                                                                                                                                       | 43                             | 10%      | None              | None         | None        | NA             | NA             | NA                                             | NA                               |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     |                   |              |             |                |                |                                                |                                  |
| Fort Hood, TX                                                                                                                                                                                                                                                                                                                                                                                         | 34                             | 10%      | FO                | WP, TNT      | WP          | NA             | NA             | NA                                             | NA                               |
|                                                                                                                                                                                                                                                                                                                                                                                                       |                                | 100%     | FO                | WP, RDX, TNT | WP, RDX     |                |                |                                                |                                  |
| Notes:<br>None – no exceedances of TRVs.<br>NA – not applicable (receptor not evaluated for this Installation).<br>100% of fog oil, colored smokes, and smoke additives (e.g., white phosphorus, graphite flakes, brass flakes) are deposited over the impact area.<br>Munition dud rate is either 10% (realistic) or 100% (equivalent to 10 years of deposition at a 10% dud rate with no COC loss). |                                |          |                   |              |             |                |                |                                                |                                  |

This screening level assessment of potential chronic risk to threatened and endangered species of concern from exposure to S&Os and MUCs used at training and maneuver exercises at U.S. Army installations is installation-specific where possible, and could be further refined with additional installation-specific data to more precisely estimate potential risk. The following provides a list of limitations, uncertainties, and/or recommended analyses:

- This assessment relies on data and information obtained directly from contacts at each installation. Installation-specific data was not collected and visits were not made to any of the installations. Range characterization studies could be designed that specifically identify the nature and extent of surface

soil contamination in and around impact and training areas (see, for example, Pennington et al. 2001). More site-specific data and information could be included within a modeling framework (e.g., concentrations of COCs in the environment, biological surveys, site-specific knowledge of vegetation and foliage types to parameterize the model etc.).

- This assessment uses maximum predicted fog oil deposition rates from the literature (Driver 1993; Getz et al. 1996). Conducting site-specific dispersion modeling based on S&O usage and site-specific meteorology was beyond the scope of this effort. However, it is possible to develop site-specific dispersion models using the HPAC modeling system together with detailed information on meteorology, S&O usage, and terrain.
- An implicit assumption in this assessment is that receptors would forage 100 percent of the time over the impact area, when in fact they may spend only a portion of their time in this area.
- This analysis does not consider soil runoff into water due to the complexity of modeling and the lack of suitable data to constrain assumptions. This pathway could be evaluated using the Universal Soil Loss Equation together with site-specific information on soil type, slope, watershed area, and other parameters.
- The only receptors assumed to be consuming aquatic insects are the gray and Indiana bats. Given a consistent set of assumptions (e.g., fog oil is distributed over a 1-km by 1-km area to capture maximum deposition, etc.) the ratio of predicted aquatic invertebrate concentrations versus terrestrial insects is approximately 0.2:1. In other words, the aquatic invertebrate predicted concentration is approximately 20 percent of the terrestrial insect concentration. Therefore, TES of concern that consume primarily terrestrial insects receive a proportionally higher dose than TES that consume aquatic invertebrates. This is primarily relevant for the bats, which consume both aquatic and terrestrial insects.

There are a number of data gaps in terms of TRVs for the TES and receptor categories of concern. Literature reviews (Von Stackleberg et al. 2004, 2005) identified constituents for which data are inadequate or altogether unavailable for developing TRVs. These include:

| COC                                                                                                   | Invertebrates | Plants     | Birds      | Mammals    | Reptile |
|-------------------------------------------------------------------------------------------------------|---------------|------------|------------|------------|---------|
| Fog Oil Smoke                                                                                         | Adequate      | Adequate   | Inadequate | Adequate   | No Data |
| Hexachloroethane (HC) Smoke                                                                           | Inadequate    | Adequate   | Adequate   | Adequate   | No Data |
| White Phosphorous (WP) Smoke                                                                          | Adequate      | Inadequate | Adequate   | Adequate   | No Data |
| Colored Smokes                                                                                        | No Data       | No Data    | No Data    | *          | No Data |
| Brass Flakes                                                                                          | Adequate      | Adequate   | No Data    | Inadequate | No Data |
| Graphite Flakes                                                                                       | Inadequate    | No Data    | No Data    | Inadequate | No Data |
| Titanium Dioxide                                                                                      | No Data       | No Data    | No Data    | No Data    | No Data |
| Polyethylene Glycol (PEG)                                                                             | No Data       | No Data    | No Data    | No Data    | No Data |
| (o-Chlorbenzol)malononitrile (CS)                                                                     | No Data       | No Data    | No Data    | No Data    | No Data |
| Dibenz(bf)-14-oxazepine (CR)                                                                          | No Data       | No Data    | No Data    | Adequate   | No Data |
| Terephthalic Acid                                                                                     | No Data       | Inadequate | No Data    | Adequate   | No Data |
| 1,3,5-Trinitrobenzene (1,3,5-TNB)                                                                     | Adequate      | No Data    | No Data    | Adequate   | No Data |
| 1,3-Dinitrobenzene (1,3-DNB)                                                                          | Adequate      | No Data    | No Data    | Adequate   | No Data |
| 2,4 - Dinitrophenol (2,4-DNP)                                                                         | No Data       | No Data    | No Data    | Inadequate | No Data |
| Dinitrotoluene isomers                                                                                | Inadequate    | No Data    | No Data    | Adequate   | No Data |
| Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)                                                | Adequate      | Inadequate | No Data    | Adequate   | No Data |
| Nitrobenzene (NB)                                                                                     | Inadequate    | Inadequate | No Data    | Adequate   | No Data |
| Nitroglycerin (NG)                                                                                    | Inadequate    | Inadequate | No Data    | Inadequate | No Data |
| Nitrophenol isomers (e.g. 2-Nitrophenol; 4-Nitrophenol)                                               | Inadequate    | No Data    | No Data    | Inadequate | No Data |
| Pentaerythritol Tetranitrate (PETN)                                                                   | Inadequate    | No Data    | No Data    | Inadequate | No Data |
| Hexahydro-1,3,5-trinitro-1,2,5-triazine (RDX)                                                         | Inadequate    | Adequate   | No Data    | Adequate   | No Data |
| Trinitrophenylmethyl nitramine (Tetryl)                                                               | No Data       | Adequate   | No Data    | Adequate   | No Data |
| 2,4,6-Trinitrotoluene (TNT)                                                                           | Adequate      | Excellent  | Adequate   | Excellent  | **      |
| * – data adequate to develop a TRV for Solvent Yellow 33 only.                                        |               |            |            |            |         |
| ** – one study on dermal exposure to salamanders; not suitable for reptiles or the ingestion pathway. |               |            |            |            |         |

As described in the Chapter 7, Uncertainty Analysis, there are numerous uncertainties associated with each component of the modeling process. There are a number of significant data gaps that have been identified in assessing the potential for adverse effects, particularly in terms of appropriate toxicity reference values. Refining the screening level analysis to incorporate more sophisticated modeling approaches together with additional site-specific data could reduce many of the uncertainties associated with potential exposures. Specifically, the analyses could be refined by:

- Collecting installation-specific information on vegetation type and yield, soil type, and other site-specific parameters to more precisely define model parameters.

- Collecting additional installation-specific data on environmental concentrations of munitions and smoke and obscurant constituents following years of continuous use.
- Conducting installation-specific modeling of smoke and obscurant disposition in the environment using the HPAC modeling system together with site-specific meteorology, knowledge of terrain etc.
- Combining some or all of the above additional data into a probabilistic assessment to explicitly characterize uncertainty in the models and model parameters.

However, this assessment does indicate potential risk to threatened and endangered species of concern from exposure to RDX, TNT, 1,3,5-trinitrobenzene, 1,4-dinitrobenzene, white phosphorus, and fog oil as a result of their use during training and maneuver exercises at military installations.

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| 14. ABSTRACT<br><br>Preparation for anticipated, unknown, and invariably adverse battlefield conditions requires military training activities involving military smokes and obscurants (S&Os) and related chemical compounds, and can result in the release of other chemical agents and military unique compounds (MUCs) associated with munitions. This study evaluates the potential long-term impacts on selected threatened and endangered species resulting from dispersion and deposition of vapors and particles found in the fog oils, hexachloroethane smoke, colored smokes, white phosphorus, and obscurants such as brass flakes and graphite flakes used during training. Residue from these constituents can deposit directly on plants and prey species favored by higher vertebrates and other species or can be taken up by plants and prey species from the soil. From the literature and installation use reports, the authors develop estimates of toxicity and exposure to calculate installation-specific screening-level risk for selected threatened and endangered species. |                             |                              |                               |                                                              |                                                                          |
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