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# Unexploded Ordnance: A Reference Guide for the Citizen

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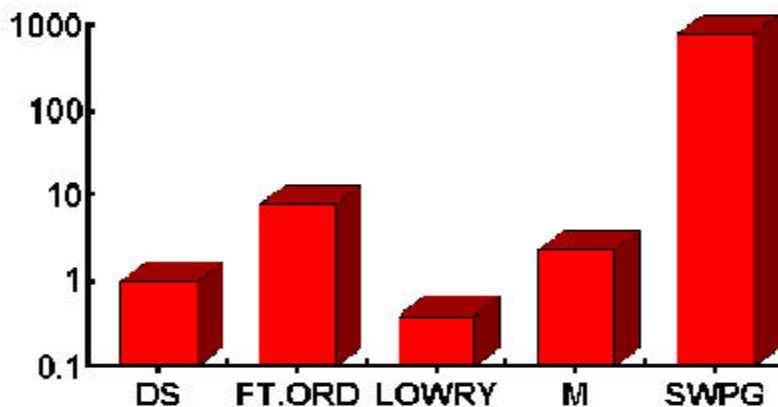
**T**he Technical Outreach Services for Communities (TOSC) program of the Great Plains/Rocky Mountain Hazardous Substance Research Center (HSRC) acts as a source of technical expertise for citizens at formerly used defense sites undergoing environmental cleanup. Many communities across the United States are near former military bases that have environmental problems. A complication in the cleanup of these sites is the potential presence of UXO (unexploded ordnance). TOSC presents this reference about UXO to help provide the general public with a greater understanding of the cleanup process in these areas.

## INTRODUCTION

Today, the United States military has a heightened environmental awareness, even to the point of developing "green" rifle ammunition that does not

contain lead, which might contaminate firing ranges on military bases. However, many "formerly used defense sites" (known as FUDS in military parlance) have been left with unexploded ordnance that present a special kind of hazard to those workers involved with cleaning up the site, and for any future use of the area.

Types of former military installations where UXO may be encountered during environmental cleanup typically include depots where ordnance may have been stored and decommissioned, as well as bombing, artillery, and gunnery ranges used for firing practice. Figure 1 shows the estimated number of UXO at five former defense sites, with the estimates ranging from 0.4 UXO/acre at the former Lowry Bombing Range in Colorado, to 800 UXO/acre at the former Southwestern Proving Ground in Arkansas. The number of estimated UXO per site varies because



**Figure 1.** Estimates of the maximum number of UXO per acre at five former defense sites in the United States. DS = Dolly Sods National Wilderness, West Virginia (site of a World War II Army training ground); FT. ORD = Former Ft. Ord Artillery and Gunnery Range, California; LOWRY = Former Lowry Bombing and Gunnery Range, Colorado; M = Former Motlow Artillery and Gunnery Range, Tennessee, and SWPG = Former Southwestern Proving Ground, Arkansas.

of the different sizes of the sites, different intensities of use, and different lengths of use as military bases. It should be noted, however, that more recent estimates of UXO density at Lowry, based on actual excavation, are as high as 38 UXO/acre. The TOSC program of the Great Plains/Rocky Mountain HSRC (and its companion program, the Technical Outreach Services for Native American Communities, or TOSNAC) has assisted citizens at several formerly used defense sites, among them the former Badlands Bombing Range (BBR) in South Dakota. Figure 2 shows a typical UXO warning sign posted at the Former BBR to warn of the possible presence of unexploded ordnance. An item of UXO recovered from the former BBR is seen in Figure 3, and Figure 4 shows UXO being detonated as part of the cleanup of this site.

Under the Defense Environmental Restoration Program (for) Formerly Used Defense Sites (DERP-FUDS), the U.S. Department of Defense has given the Army the responsibility for environmental restoration (i.e., cleanup) of former defense sites, regardless of which branch of the service was originally responsible for operating the site. In turn, the Army has designated the U.S. Army Corps of Engineers as the agency in charge of conducting the cleanup. As of 1999, 2,657 former defense properties were identified as requiring environmental response actions. FUDS environmental restoration funding for fiscal year 2000 was \$238 million.

## GLOSSARY OF UXO-RELATED TERMS AND ACRONYMS

**Accident:** An injury or death caused by the explosion of UXO.

**Anomaly:** Unusual buried feature in a geophysical (seismic) or magnetic survey that may be a UXO.

**Antimaterial:** Designed to deteriorate or damage material.

**Antipersonnel:** Designed to kill or wound.

**Blasting cap:** This word means the same thing as “detonator” (see below).

**Bomblet:** Any munition that performs its task by separating from a parent munition. “Bomblet” means the same thing as “submunition.”

**BRAC:** Base Realignment and Closure. The process by which the Department of Defense decided which military bases would be proposed to the United States Congress for closure.

**Caliber:** The diameter (in millimeters or inches) of a projectile, gun, or launching tube.

**CERCLA:** The Comprehensive Environmental Response, Compensation and Liability Act of 1980. A United States law that, among other things, allowed the President to delegate the cleanup of hazardous substances at both active and former defense sites.

**Clearance:** The clearing of an area of all UXO, at least to a specified standard.

**Cluster bomb:** A bomb containing and dispensing bomblets or submunitions.

**DERP:** Defense Environmental Restoration Program. The program under which cleanup of formerly used defense sites is conducted.

**Detonator:** An explosive activated by electrical or other means, used to initiate the main charge.

**DoD:** Department of Defense. Established in 1947, it is the successor to the Department of War. This is the civilian agency with oversight over America's armed forces.

**EE/CA:** Engineering Evaluation/Cost Analysis. Prepared for all non-time critical OE removal actions. Determines the extent of a hazard, identifies objectives of the removal action, and analyzes various alternatives that may satisfy the cost, effectiveness, and practicality goals of the removal action.



Figure 2. UXO warning sign posted at the Former Badlands Bombing Range in South Dakota. Photo by Brenda Brandon, GP/RM HSRC.

**EOD:** Explosive Ordnance Disposal. The detection, identification, field evaluation, making safe, recovery, and final disposal of UXO.

**Exclusion zone:** A safety zone established around a UXO cleanup work area.

**Explosive:** A substance or mixture that undergoes a rapid chemical change, generating large quantities of energy usually accompanied by hot gases.

**Exposure:** Defined as someone coming near a UXO, but not necessarily resulting in injury from the UXO.

**Fragmentation:** Ordnance intended to fragment in operation.

**Frost heave:** In areas where the soil freezes during winter, repeated freeze-thaw cycles may force UXO to the surface, presenting a danger to human health and the environment.

**FUDS:** Formerly Used Defense Sites. These are United States military bases that are no longer in operation.

**Fuse:** A device that initiates an explosion in ordnance; also spelled “fuze.”

**Geophysical techniques:** Seismic techniques used to determine the presence of buried UXO.

**GPS:** Global Positioning System. A system of American satellites in Earth orbit that enable military or civilian personnel, equipped with the proper radio receiver, to determine their position with high accuracy. Used in UXO investigations to mark locations of anomalies that may be UXO.

**Great Plains/Rocky Mountain Hazardous Substance Research Center (HSRC):** The Great Plains/Rocky Mountain Hazardous Substance Research Center is one of five regional centers in the United States funded by the United States Environmental Protection Agency. The center was established in 1989 to conduct research pertaining to hazardous substances produced through agriculture, forestry, mining, mineral processing, and other activities. Operating in EPA Regions 7 and 8, it also runs the TOSC program in this area.

**Ground-penetrating radar:** Radio wave system that penetrates the ground to reveal the presence of metallic objects that may be UXO.

**HQUSACE:** Headquarters, United States Army Corps of Engineers.

**Illumination:** Ordnance intended to produce high intensity light, such as a flare. May be suspended from a parachute.

**Incendiary:** Chemicals such as white phosphorus that burn at very high temperatures when ignited. Used as filler in ordnance intended to destroy a target by fire.

**Inert:** Made from the same parts as a real munition, except that it has no explosive content. Inert ordnance is used in training.

**Institutional control:** Policy on land use meant to minimize exposure to UXO.

**Intentional detonation:** A deliberate, planned detonation of UXO as part of a cleanup program.

**Intrusive activity:** Investigative or removal action that involves actual penetration of the ground surface in an area known or suspected to contain UXO.

**Land mine:** This word means the same thing as “mine” (see below).

**Long-term monitoring:** Observation of an area at a former defense site over a period of time, (usually years) in order to monitor the area for any danger to human health and the environment.

**Magnetometer:** An instrument used for detecting the strength and direction of magnetic fields. Used for locating the metal cases of UXO.

**Military range:** A designated land and/or water area used to research, develop, test, and evaluate military munitions and explosives, as well as other ordnance or weapon systems.

**Mine:** A munition designed to be hidden, and then exploded, by presence or

proximity with the target, or by contact with the target. “Mine” means the same thing as “land mine”.

**MPE:** Most Probable Event. The most likely event that could result from an accidental, unplanned, or unintended detonation of UXO, possibly during a cleanup activity.

**Munition:** A device charged with explosives or other material for use in military operations. “Munition” means the same things as “ordnance.”

**NCP:** National Oil and Hazardous Substance Pollution Contingency Plan. Revised in 1990, the NCP provides the regulatory framework for action under CERCLA. The NCP gives the Department of Defense authority for removal of ordnance and explosive hazards.

**NFA:** No Further Action. The recommendation of a cleanup program when it is determined there is no danger to human health or the environment at an area under investigation.

**NTCRA:** Non-Time Critical Removal Action. Removal cleanup action in re-



Figure 3. An actual item of UXO (in this case, a bomb) found on the Former Badlands Bombing Range. Photo by the U.S. Army Corps of Engineers.



Figure 4. UXO being detonated at the Former Badlands Bombing Range during cleanup of the site. Photo by the U.S. Army Corps of Engineers.

sponse to a threat to human health or the environment that may be safely delayed for six months or more.

**OE:** Ordnance and explosives. OE includes explosive devices such as bombs and explosive substances such as TNT. “Ordnance” means the same thing as “munition.”

**OECert:** Ordnance and Explosives Cost Estimating Risk Tool, developed by QuantiTech, Inc., for the United States Army Corps of Engineers. OECert is a mathematical model that calculates both individual and public risk from exposure to UXO. Individual risk is defined as the probability of a person being exposed to ordnance during a given activity on a FUDS. Public risk is defined as the sum of all individual risks and applies to the entire population surrounding a FUDS.

**OERIA:** Ordnance and Explosives Risk Impact Assessment. A qualitative method for evaluating UXO remediation alternatives. Possible response actions are said to have “No Impact” (that is, no effect in removing

the UXO risk) or are assigned a letter grade of “A” (the response alternative with the greatest effect in removing the UXO risk) to “D” (the response alternative with the least effect when there are four remediation alternatives). A grade of “E” would be given to the response alternative with the least effect when there are five alternatives, and so on.

**Primer:** A self-contained munition fitted into a cartridge case or firing mechanism, providing the means of igniting a propellant charge.

**Projectile:** An object such as a bomb, bullet, grenade, or shell that applies force through its own movement or inertia.

**Propellant:** A chemical material or materials that produce a large amount of gas or heat upon ignition; used to put an item of ordnance in motion.

**RAB:** Restoration Advisory Board. Composed primarily of local citizens, RABs are formed at DERP-FUDS projects wherever there is sufficient interest. At the former defense sites

where it is active, TOSC helps the local RAB.

**RAC:** Risk Assessment Code. Used to indicate the risk associated with a hazard, on a scale from 1 to 5, with 1 being the greatest risk, and 5 the lowest. The RAC is used to prioritize response actions.

**Range:** See “military range.”

**Range Rule:** A proposed regulation being developed by the Department of Defense in order to determine the response to risks from military munitions and other associated materials on closed, transferred, and transferring military ranges.

**Removal action:** The cleanup or removal of UXO from the environment, including its disposal.

**Response action:** Action taken in addition or instead of a removal action of UXO so that it does not cause harm to human health or the environment.

**SARA:** Superfund Amendment and Reauthorization Act of 1986. A United States law that, among other things, authorized the Secretary of Defense to carry out the Defense Environmental Restoration Program.

**Smoke:** Filler for ordnance intended to produce smoke for camouflage or crowd control.

**Stakeholder:** Anyone having a personal interest or involvement, or commercial or monetary involvement, in the real property that is to undergo a UXO response action.

**Submunition:** This word has the same meaning as “bomblet.”

**TOSC:** Technical Outreach Services for Communities. This program provides technical expertise for citizens at former defense sites (and civilian sites) with environmental cleanup problems.

**TOSNAC:** Technical Outreach Services for Native American Communi-

ties. This program provides technical expertise for Native American communities near former defense sites (and civilian sites) with environmental cleanup problems.

**Unintentional detonation:** A detonation of UXO that was not planned in advance.

**USACE:** United States Army Corps of Engineers, charged with the responsibility of cleaning up formerly used defense sites in the United States. The Corps traces its history to an act of the Continental Congress in 1775 that authorized the first Chief Engineer to build fortifications near Boston at Bunker Hill.

**U.S. EPA:** United States Environmental Protection Agency. Established in 1970, this is the federal agency charged with protecting human health and safeguarding the environment.

**UXO:** Unexploded ordnance. It may be any kind of bomb, bullet cartridge, mine, grenade, or shell. By definition, UXO have been primed, fused, armed, or otherwise prepared for action so as to constitute a hazard. UXO remain unexploded either by malfunction, design, or any other cause.

**UXO Calculator:** A statistical tool used to estimate UXO density at a former defense site. Density numbers from the UXO Calculator can be used with either the OECert or OERIA tools.

**Warhead:** The part of a munition that contains the explosive or other material intended to inflict damage.

## USEFUL WEB SITES RELATED TO THIS TOPIC

The Department of Defense UXO Center of Excellence Web site, with information about unexploded ordnance and its cleanup:

**[www.uxocoe.brtrc.com/index.htm](http://www.uxocoe.brtrc.com/index.htm)**

The Federal Remediation Technologies Roundtable (FRTR) EOD-UXO links Web site is sponsored by several federal departments and agencies, in-

cluding the Department of Defense; Department of Energy; Department of the Interior; the Departments of the Army, Air Force, and Navy; and the United States Environmental Protection Agency. It has comprehensive links to UXO-related Web sites in all of these agencies, as well as links to the UXO Countermine Forum. It also has downloadable documents, such as one from the Department of Defense about the Range Rule for closed, transferred, and transferring military ranges.

**[www.frtr.gov/topical/uxo/index.html](http://www.frtr.gov/topical/uxo/index.html)**

The Great Plains/Rocky Mountain HSRC TOSC Web site (location of the TOSC Citizen's Briefs under the category "Useful Publications") with information about the sites served by our center through both the TOSC and TOSNAC programs:

**[www.engg.ksu.edu/HSRC/Tosc/toschome.html](http://www.engg.ksu.edu/HSRC/Tosc/toschome.html)**

The TOSC program national Web site, with information on TOSC activities across the United States:

**[www.toscprogram.org](http://www.toscprogram.org)**

The United States Army Corps of Engineers Web site, with information about Corps cleanup projects and other activities:

**[www.usace.army.mil](http://www.usace.army.mil)**

The United States Environmental Protection Agency, charged with protecting human health and safeguarding the environment, has its Web site at:

**[www.epa.gov](http://www.epa.gov)**

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