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Ordnance Explosives

environment

News From the Ordnance Center of Expertise and Design Center

October—December1998 Vol. 5, No. 4

The good, the bad, the administrative record

by Margaret Simmons, Huntsville Center Office of Counsel

What do you mean, good or bad? Most of you are familiar by now with environmental projects. You're also painfully aware of regulatory requirements as well as some of our self-imposed programmatic requirements. Over the past couple of years you should have heard of the administrative (admin) record requirement.

What is it and why do it? The admin record is the body of documents that supports our decision-making process throughout an environmental project. It is required by law, specifically section 113(k) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or Superfund Law. But best of all, it can actually streamline litigation at a site if we've done our job in establishing and maintaining this record. "How is that possible?" you ask. Lawyers never streamline anything! Luckily, the law provides that if the government is sued over an environmental cleanup, the evidence in the lawsuit will be limited to the documents contained in the admin record. Trust me, that is streamlining!

Engineering Technical Letter (ETL) 1110-1-168, *Procedures for Establishing and Maintaining An Administrative Record*, 30OCT97, addresses setting up the admin record for both ordnance and explosives (OE) and hazardous, toxic, and radioactive waste (HTRW) projects. You can access that ETL through Huntsville Center's website page, www.hnd.usace.army.mil/oew/index.htm.

Establishing and maintaining an admin record is not a choice. You may believe that you should only do this if you "think" there could be litigation. Not true. You must do this, period.

There is another important purpose served by the admin record. It is a vehicle for public

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Faster, easier predictions with UXO Calculator

by Arkie Fanning, Huntsville Center, Systems Engineering Division

Developed by Huntsville Center, UXO Calculator is now used to support site characterization work at ordnance sites during engineering evaluations/cost analyses (EE/CA's). A user-friendly software package, the new statistical tool provides two basic types of information:

- Before sampling, Calculator helps determine how much sampling will be needed to meet goals.
- After sampling, Calculator helps determine confidence levels in ordnance contamination predictions.

To make predictions, UXO Calculator assumes a negative binomial distribution for unexploded ordnance (UXO). That means, yes or no, there is or is not UXO in a given area or at a given anomaly. From that assumption, the mathematics of the tool calculates the number of UXO items remaining in a homogenous area or the probability that there is no more UXO in a given area.

Even further, Calculator can determine the probability that there is no UXO in areas where no UXO has been found. The question often asked is if we are not finding UXO, does that mean there is none to be found, or does it mean that we are not taking enough samples to determine if there is any? UXO Calculator can help answer that question. Using this tool, we can make predictions such as the following: We are 90% confident that there is no UXO in this sector because we found no UXO in 20 acres

Calculator continued on page 7

Avoiding the big bang

by P.J. Spaul, Little Rock District

World War II wasn't fought in Arkansas, but you wouldn't know it judging by all the explosives used there. During the war, the Army used the munitions testing site near Hope to test machine-gun ammunition, artillery rounds, grenades, bombs, mortar shells, and rockets.

When the war ended, ordnance was scattered throughout the 50,000-acre site. The Army removed surface munitions, and the property was turned over to state and private owners. But large areas of the site still contain heavy concentrations of rusting munitions. Some lie beneath the ground. Others have been forced to the surface by erosion, cultivation, and other activities.

To make the former proving ground safer, two arms of the U.S. Army Corps of Engineers have teamed up under the Defense Environmental Restoration Program. USACE's Little Rock District and the U.S. Army Engineering and Support Center in Huntsville, Ala., are working together to minimize dangers from the old ordnance.

Little Rock's project manager, Margaret Morehead, said the first phase started in January and includes removing ordnance from former target ranges and the vicinity of a few residences where ordnance is known or suspected to remain.

"Efforts also include educational programs and public-information displays to encourage safe behavior," she said.

In some areas workers have encountered more ordnance than they had planned for. To control costs, the cleanup depths were decreased in some cases, depending on the land use and the circumstances under which people would be exposed, Morehead said.

Ordnance workers at Southwest Proving Ground (SWPG) attach "shape charges" to aging artillery rounds placed in a trench. The rounds will be covered with earth and sandbags, and the charges will be detonated. The remaining scrap metal will be recycled.

Ordnance-removal workers usually clear to a depth of four feet below the ground. Workers didn't clear as deep in areas that are little used and which, therefore, pose little threat. In more heavily used areas, the workers have been clearing to the full four-foot depth.

"Participation in the ordnance removal program is voluntary. The government will not remove ordnance against landowners' wishes, but most of them have been willing to cooperate," Morehead said.

Chason Smith, a project manager from the Huntsville Center, said that not all the ordnance tested at Hope was live. Color-coded, inert rounds, which contained no explosives, were used when only propellants were being tested.

"The problem is that, after more than 50 years, all the paint has rusted off. The inert rounds are indistinguishable from the live rounds," Smith said. Therefore, every round has to be treated as if it were high explosive.

"When cleaning up ordnance, workers render it safe by using a small explosive referred to as a shaped charge," he said. "Inert ordnance is left with a small hole through it. Ordnance that contains explosives detonates."

During the controlled detonations, workers make a special effort to keep the noise and explosive force under control and prevent property damage. After the ordnance is rendered safe, the scrap metal is recycled, Smith said.

"Since January we have recovered about 3,000 items," Smith said. "About one third of those were live rounds."

Ordnance encountered includes 37-mm and 40-mm gun rounds, mortar shells, 20-pound fragmentation bombs, 5-inch high-velocity aircraft rockets, and assorted artillery munitions up to 155 mm, Smith said.

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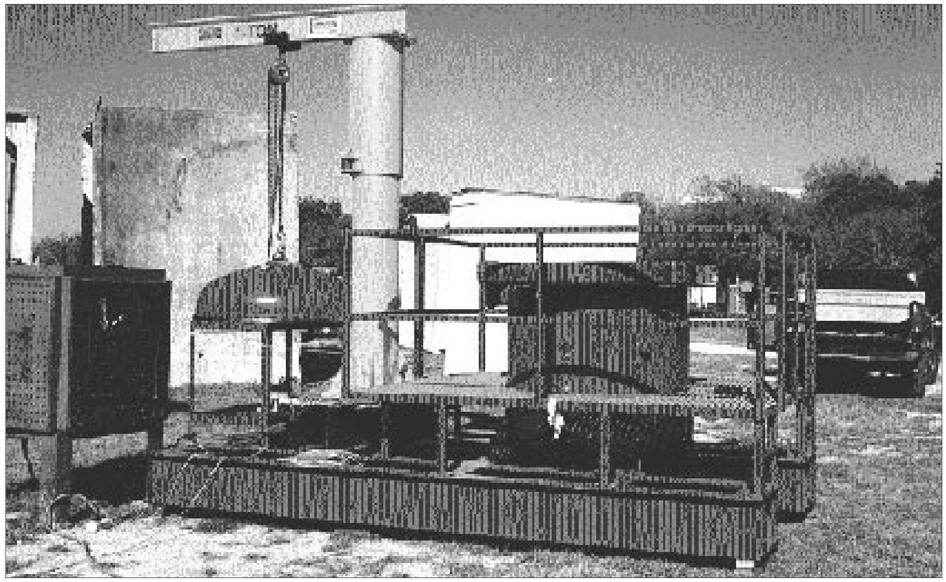
On-site ordnance demolition container approved for use

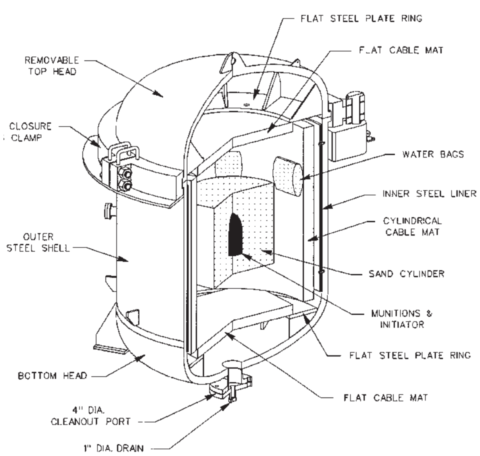
by Joe Serena, Huntsville Center, Civil-Structures Division

Huntsville Center's On-site Ordnance Demolition Container (ODC) has been approved by the Department of Defense Explosives Safety Board (DDESB) for intentional detonation and destruction of ordnance items. The ODC is designed to contain all significant blast pressures for a total net explosive weight of up to six pounds of TNT or the equivalent. It is also designed to capture 100 percent of the fragments from detonation of cased munitions with fragmenting characteristics not exceeding an 81-mm M374 mortar.

The container is a steel cylinder, 3 feet 6 inches in diameter and 6 feet tall, with elliptical top and bottom caps. The top cap is removable and is held in place by a hinged steel ring. The bottom cap is permanently welded to the cylinder, but it features a 4-inch diameter drain port and several 1-inch diameter vent holes. The entire container is mounted on a steel frame skid, which includes a working platform made of fiberglass grating and a hoist for removing the top cap. All steel parts are cabled together to be electrically continuous and are grounded.



Complete On-Site Demolition Container with working platform and skid. The top cap has been removed using the chain hoist and is on the support frame at left.



Details of the On-Site Demolition Container

The on-site container uses an innovative, yet simple, multi-layer fragment capture system to prevent any fragments from escaping. The system starts with a plastic or cardboard cylinder filled with sand in which the ordnance and initiating charge are placed. That sand layer initially slows the fragments. Just outside the sand layer, plastic bags filled with water absorb much of the heat of the explosion and reduce blast pressures. Next is a set of woven steel cable mats, similar to blasting mats used on construction sites. One mat, formed in the shape of the cylinder, protects the sides of the ODC. Flat cable mats are used to protect the ends of the container. The mats intercept most of the fragments. Next is a steel liner located just inside the outer steel shell. That liner is made in easily removable segments and is thick enough to stop any fragments that pass through the cable mat. The configuration provides complete capture of the fragments and ensures a virtually unlimited life of the outer container with no fragment penetration.

All layers of the fragment capture system can be easily replaced. The sand and water bags are replaced after each detonation. The cable mats are expected to last up to 10 shots, and the liner plates may survive as many as 100 shots or more. Preparation time between detonations is expected to be 30 to 45 minutes.

Procedures in the ODC safety submission, including fragmentation limits for ordnance detonated in the ODC and operational procedures, must be followed. The maximum permitted explosive weight, including any initiating charge, is six pounds TNT equivalent. The minimum withdrawal distance for related personnel is 75 feet during a detonation. Site specific explosives safety site plans at sites where the ODC will be used must still be approved by DDESB.

Currently, one ODC has been constructed and is available for use. Additional units can be constructed from the design drawings at a cost of less than $50K per unit. Detailed design drawings for the ODC and the technical report, CEHNC-ED-CS-S-97-3, "Safety Submission for On-Site Demolition Container for Unexploded Ordnance," are maintained by Huntsville Center.

For more information on the ODC, see Huntsville Center's website at www.hnd.usace.army.mil or e-mail Joseph.M.Serena@hnd01.usace.army.mil.

Sandbags reduce exclusion zone by 90%

by Joe Serena, Huntsville Center, Civil-Structures Division

The figure above shows a typical sandbag enclosure for the intentional detonation of an 81-mm mortar. The outside dimensions are roughly 46 inches wide by 64 inches long by 30 inches tall. The table below shows specifications for sandbag enclosures.

Munition	Sandbag thickness To Capture All Fragments	Maximum Sandbag Throw Distance
155-mm M107	36 inches	220 feet
4.2-inch M329A2	24 inches	125 feet
105-mm M1	24 inches	35 feet
81-mm M374A2	20 inches	125 feet
60-mm M49A4	12 inches	25 feet

Through a series of explosive tests, Huntsville Center developed procedures for using sandbag enclosures to reduce blast pressures and capture fragments from intentional detonations of ordnance. Test data show that the procedures result in dramatically reduced exclusion zones for intentional detonations. For example, for an 81-mm mortar detonation without sandbags, the exclusion zone would be 1,233 feet. With sandbags, however, the zone is whittled to 125 feet, nearly a 90% reduction.

Although sandbags have been widely used for a long time in field fortifications and in expedient applications to reduce fragment and pressure hazards, there were no approved procedures that could be included in safety submissions or work plans. No specific test data defining the performance of sandbags in stopping the high-velocity fragments from cased weapons or reducing noise or blast pressures were available. Huntsville Center, therefore, designed a set of tests to determine the sandbag thickness needed to capture fragments and how far the sandbags would be thrown.

In 1997, five different munitions were tested, including the 60-mm M49A4 mortar, 81-mm M374A2 mortar, 105-mm M1 projectile, 4.2-inch M329A2 mortar, and the 155-mm M107 projectile. Several tests were run for each munition.

For each test, a rectangular enclosure of sandbags was constructed as shown in the figure above. The enclosure consisted of four sandbag walls stacked to a height of six inches above the round and a sandbag roof supported by a sheet of 3/4-inch thick plywood placed over the sandbag walls. To show how far fragments penetrated into the sand, thin aluminum witness panels were placed both inside the walls and roof and around the outside of the completed sandbag structure. Wall and roof thicknesses were varied between tests until the optimum thickness needed to capture all of the fragments within the sandbags was found. In the field, then, fragments will go no further than the sandbags, and the exclusion zone distance simply becomes the distance that the sandbags are thrown.

During testing, shaped charge penetrators were used to initiate each round. That type of charge matches typical field procedures and provides the minimum charge needed to initiate the round. The shaped charge was angled downward so that the jet penetrated through the round and into the ground, not through the sandbag walls. Test instrumentation included both pressure gauges and a sound level meter, which provided a measurement of the reduction in blast pressures and noise levels.

Sandbag locations were mapped after each test to record the distances that bags were thrown and to determine whether the wall or roof bags

The figure shows dispersion of sandbags after the detonation of an 81-mm mortar. Most of the bags travelled less than 20 feet, and the most distant bag is about 110 feet from ground zero.

traveled farther. Also, most of the fragments were recovered from the sandbags to ensure that the bags were capable of capturing large base plate and fin assembly fragments. Witness panels were recovered and inspected to identify fragment penetrations.

One critical feature of the tests and the final field procedures was maintaining an air gap between the sandbags and the rounds. The sandbags are not placed in contact with the round. Instead, the walls are stacked to leave a six-inch gap between the round and the bags and plywood roof. The air gap ensures that the fragments are ahead of the blast wave. Fragments then strike the sandbags before the blast wave moves or disturbs them, maximizing the effectiveness of the sand in stopping fragments.

The table shows sandbag thickness required to capture all fragments as well as sandbag throw distances. Sandbag throw distances include a 10-percent safety factor over and above the actual distance measured to the farthest sandbag.

Based on these results, Huntsville Center has developed complete guidelines for using sandbags to mitigate intentional detonations of individual ordnance items. The procedures cover almost any round up to a 155-mm projectile. Only detonations of individual rounds, one at a time, are included. The guidelines include how to build the sandbag enclosures, required wall and roof thicknesses, and the resulting sandbag throw distances and exclusion zones.

The sandbag guidelines have been submitted to the U.S. Army Technical Center for Explosives Safety and the Department of Defense Explosives Safety Board for safety approval. Once approved, the procedures will be available from Huntsville Center. For more information, contact Joe Serena at Joseph.M.Serena@HND01.usace.army.mil.

Joe Serena is a registered professional engineer in Huntsville Center's Civil-Structures Division. He provides support to the ordnance program in the area of blast effects.

Getting the lead out at small-arms ranges

by Barbara M. Nelson, Naval Facilities Engineering Service Center

The Naval Facilities Engineering Service Center (NFESC) and the Army Environmental Center have demonstrated removing metals from small-arms range soils by physical separation and acid leaching. The demonstration was conducted under the Environmental Security Technology Certification Program (ESTCP) at an Army installation. The technology produced a metal product suitable for recycling.

It is estimated that over 2,600 military bases have small-arms ranges. The soil in the impact berms usually have high levels of heavy metals, primarily lead, from the bullets used when training military personnel. When these ranges are closed, they must comply with environmental regulations often requiring soil cleanup.

The Physical Separation/Chemical Leaching (PS/CL) technology uses physical separation to remove particulate metals (bullets and large bullet fragments) and acid leaching to remove metal fines and molecular/ionic metal species. Physical separation involves separating soil particles from the heavy metals based on the differences in their physical properties, including density, size, and shape. This process, adapted from the mining industry, combines several techniques in series. The operational size of the process is determined during bench-scale tests. The type of soil, amount of weathering of the metals, age of the range, and climate all affect the form in which the metals are present and therefore the removal mechanism. Physical separation usually produces a metal stream that can be sent to an off-site smelter for recycling.

Acid leaching, also known as soil washing, solubilizes the metals that remain after physical separation by adding an acid that lowers the pH. Acid leaching usually involves mixing the acid and soil, separating the leached soil from the leachant, regenerating the spent leachant by precipitating the heavy metals out of solution, and recycling the sludge to an off-site smelter for its lead content.

The ESTCP field demonstration using PS/AL was conducted at an Army site in the fall of 1996. Two variations of the technology were shown using two different vendors. The first one performed physical separation with acetic acid leaching; the second vendor used physical separation with hydrochloric acid leaching. Both conducted bench-scale tests to determine the feasibility of the process and to aid in plant design. Results showed that both the acetic and hydrochloric processes could be effective on the Army installation's soil.

During the field tests, the acetic acid process removed 93% of the lead on the first day. The processed soil coming from the treatment system had less than 1,000 mg/kg total lead and less than 5 mg/l Toxicity Characteristic Leaching Procedure (TCLP), thus meeting demonstration criteria. Process control difficulties gradually build up lead in the regenerated leachant; this results in a progressive decline in heavy metal removal. Because of the buildup, final processed soil started to fail demonstration criteria.

The hydrochloric acid process consistently produced a soil that had less than 250 mg/kg total lead and less than 5 mg/l TCLP lead. The vendor's ability to adjust his system was a key factor in the demonstration's success. On average, the process removed 96% of the lead, 97% of the copper, 89% of the zinc, and 60% of the antimony.

A full–scale soil processing project is ongoing at Marine Corps Air Ground Combat Center (MCAGCC), Twenty-Nine Palms, CA. MCAGCC is redesigning their small-arms ranges. In the redesign, impact berm soils will be processed to reduce the lead concentrations below a health risk level that was determined using the Lead-Spread model. Soil processing will only involve the physical separation aspect of the technology. About 7,956 cubic yards of soil will be processed.

Small-arms range maintenance using physical separation/chemical leaching (PS/CL) to remove lead from berms.

Costs associated with PS/AL vary from $70.00 to $1,250 a ton with the amount of soil needing to be processed. PS/AL is comparable with both landfilling and stabilization once the amount of soil needing treatment reaches 2,000 tons. Small sites can be combined at a central location and processed together to lower costs.

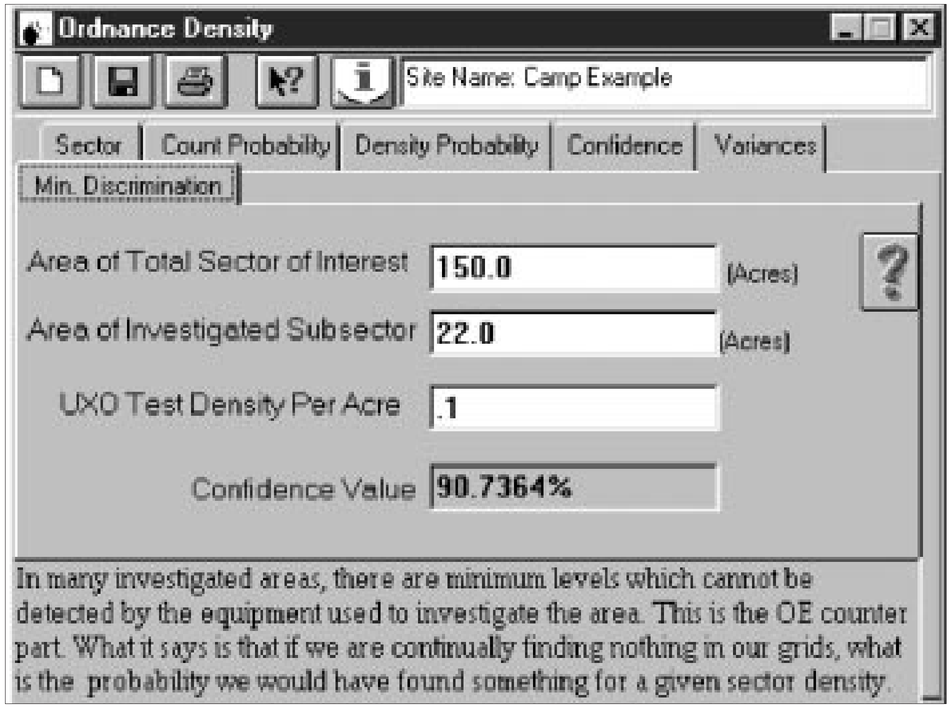
Off-site landfilling and on-site stabilization are the two technologies most commonly considered to address high metal levels in active and inactive small-arms ranges. From a short-term perspective, both reduce the hazard associated with metals. Landfilling removes the metal-bearing soil from the site and stabilization immobilizes the metal in the soil. In the long term, however, the heavy metals stay with the soil and the potential for liability remains. With physical separation/acid leaching, heavy metals are removed from the soil and recycled in an off-site smelter. From a long-term perspective, PS/AL is the preferred option.

Barbara M. Nelson is an environmental engineer in the Restoration Development Branch, NFESC. Phone 805-982-1668; e-mail bnelson@nfesc.navy.mil. □

Calculator *continued from page 1*
of sampling based upon a test density of one in ten acres.

UXO Calculator can also be used to determine UXO density in a given sector. Although SiteStats/GridStats is still appropriate for “mag and flag” sites, UXO Calculator is the statistical tool of choice where geophysical mapping is used to select anomalies of interest. UXO Calculator offers flexibility and speed. It enables investigators to play “what if” games to develop statistics for various data discriminators. SiteStats/GridStats, on the other hand, was designed to produce statistics for only site homogeneity and the amount of sampling needed based on a set data discriminator of five.

UXO Calculator has six modules enabling OE teams to determine statistical characteristics of UXO at a site. Those modules provide ordnance teams with details on factors such as expected density, number of ordnance items in a sector, and the probability of no UXO. Such information contributes to the decision-making process.



Through user friendly screens, UXO Calculator helps decision makers determine confidence levels quickly. Calculator also helps determine how much sampling will be needed to meet goals.

For technical information on UXO Calculator, call Arkie Fanning at 256-895-1762 or e-mail arkie.d.fanning@hnd01.usace.army.mil. UXO Calculator software is available free of charge through 1-800-632-7306 or hsv.oerisk@hnd01.usace.army.mil. ☐

Admin Record *continued from page 1*
participation. You must notify the public when you first establish the record and let the public know it is available to them. Documents are placed there for both information and for review and comment. Not every document placed in the record goes out for comment, but every document does give information.

Just wanted to make sure this information gets out to as many people working environmental projects as possible. There will be groans and grunts, and already there has been resistance. Good or bad, there it is. I personally see many benefits in properly establishing and maintaining the admin record. Believe it or not, I enjoy seeing the judicial process streamlined whenever possible.

Check the web. This is fairly new for most of us, so don’t hesitate to call with questions. Also, I’ve never seen a process yet that couldn’t be improved; so let us know if you’ve got suggestions.

Margaret Simmons has been providing legal counsel to the Huntsville Center Ordnance Team and other Huntsville programs since 1991. For questions on the administrative record, call 256-895-1104 or e-mail margaret.p.simmons@hnd01.usace.army.mil. ☐

Bang *continued ffrom page 2*
Morehead explained that the project would continue in phases as funds become available over several years. If fully funded and implemented, the cleanup will cost about $42 million.

The prioritized cleanup plan was developed as the most economically efficient way to reduce risk. It involves removing ordnance from the areas with the highest concentrations or areas where people have the most exposure, Morehead said.

Ordnance will be removed wherever it is practical to do so, but the cost of removing all ordnance at SWPG is considered to be impractical. Estimates indicate it would cost at least $230 million to clean up the entire former proving ground, an amount that is unlikely to be funded under current budgetary constraints.

P.J. Spaul is a staff writer for the U.S. Army Corps of Engineers Little Rock District publication, LR Dispatch. ☐

Institutional controls: OE vs. HTW sites

by Rob Wilcox, Huntsville Center

As safeguards against injuries or fatalities, institutional controls are more effective on sites contaminated with ordnance and explosives (OE) than on sites contaminated with hazardous and toxic wastes (HTW).

Institutional controls are safeguards in the regulatory environment designed to limit access to a contaminated site or to modify people's behavior at a contaminated site. Such controls work only in a limited area under the jurisdiction of a state or local government or private entity cooperating with a response authority to enforce the controls. The response authority is the Environmental Protection Agency (EPA) for HTW sites and the Department of Defense (DOD) for OE sites. There are several reasons why institutional controls are more effective when applied to OE sites:

- *Nature of an Event:* HTW affects individuals through multiple exposures, is highly dependent on concentration of contaminant, and may be dependent on the exposed individual's susceptibility to cancer or other personal attributes. Because an HTW event involves many parameters, control is also multifaceted. On the other hand, an ordnance event requires one exposure combined with one instance of unfortunate behavior. It is an event that is not dependent on the victim's health or any other preexisting conditions. It is deadly, but simple, and, therefore, more controllable.
- *Nature of Access:* HTW contact does not necessarily require access at the site. HTW moves through environmental media, which are subject to the most dynamic forces of nature, i.e., groundwater, air, surface water, dermal contact, etc. When the contaminated environmental media migrate off-site through natural processes, the contamination comes with it. Ordnance, however, is relatively non-mobile without human intervention. Ordnance tends to stay onsite or at least follow the natural drift of environmental forces in a somewhat predictable manner. For example, if ordnance were shot into a mountainside, it might migrate to the foot of the mountain through erosion. With ordnance, there is little intricacy to confound efforts to protect people.
- *Effect of Behavior:* Behavior is not an issue for an HTW contaminated site. HTW effects the basic life requirements of the human organism (i.e., breathing, drinking, eating, washing, etc.). There is little room for managing such issues in any meaningful way without destroying the usefulness of the site. On the other hand, if reasonable rules are established on an OE site, reasonable behavior can be expected: Stay on the path, don't touch, and so forth. The behavior changes necessary are usually small and lend themselves to simple controls.

Many people paint institutional controls for OE sites with the same broad brush they use for institutional controls on HTW sites. For the reasons stated, institutional controls are logically more effective on OE sites than on HTW sites. The bigger question may be whether state or local government or individuals with authority will accept the responsibility of enforcement. If they will not accept the responsibility, then any plan relying on institutional controls is truly infeasible no matter what contamination is present.

Furthermore, since current technology does not remove all OE, institutional controls provide the only solution to residual risk on an OE site. Therefore, responsible management and reasonable behavior on the part of the state and local agencies, landowners, the public, and the Federal government are necessary to protect all stakeholders.

Rob Wilcox has worked on explosives cleanup since 1982 and wrote the first management plan for the Defense Environmental Restoration Program (DERP). For questions on institutional controls, call 256-895-1508 or e-mail robert.g.wilcox@hnd01.usace.army.mil. ☐

Distributed quarterly by the Ordnance and Explosives Center of Expertise and Design Center, *Ordnance and Explosives Environment* is an unofficial newsletter published under the authority of AR 25-30. The purpose of this newsletter is to provide information about DOD ordnance response actions, issues, policy, and technology. Address comments to Commander, U.S. Army Engineering and Support Center, Huntsville, ATTN: CEHNC-OE-MC, P.O. Box 1600, Huntsville, AL, 35807-4301.

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