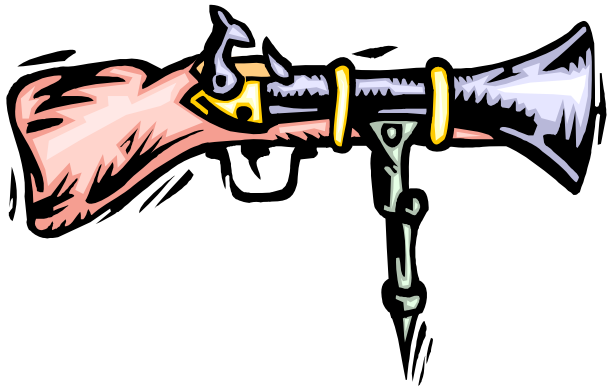


Shooting Ranges:

BMPs & Cleanup

SHOOTING RANGES: Why do we Care?

- The lead deposited on a range is not hazardous waste . . .

  . . . as long as it stays on the range or goes to recycling.

  So, BMPs to help keep the lead where it belongs.

BMPs: What they are

- Shooting range design considerations and operational procedures employed to better contain, concentrate and manage projectiles and other materials in a way that will minimize impacts to the environment;
- Strictly voluntary measures that can minimize range liability;
- Documented to be successful

BMPs: What they aren't

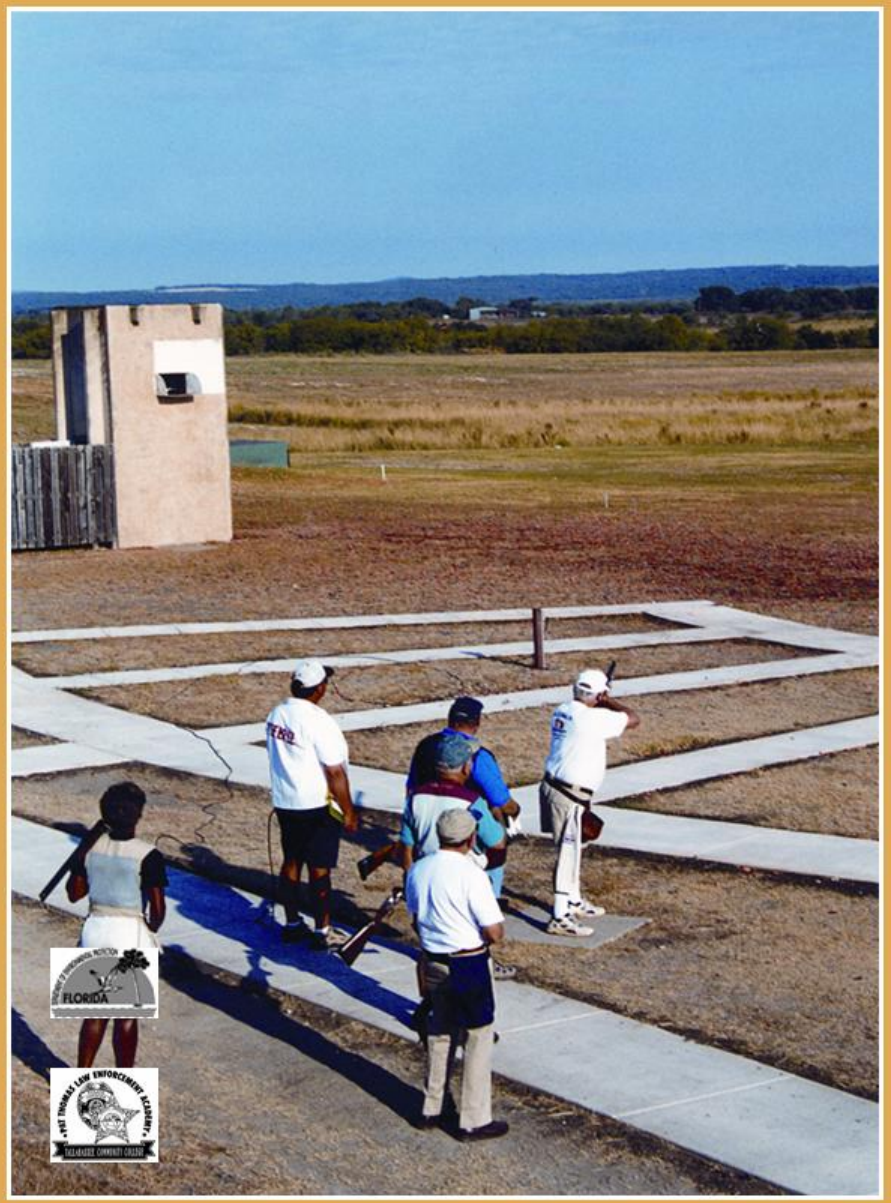
- Not a regulatory program requirement;
- Not a guarantee that a site can close without some measure of cleanup;
- Not a shield for third party legal action against the range operation;
- Not uniform in application, and must be tailored to site specific conditions.

BMPs: What is being managed?

- Primarily lead in metallic form of bullets and shotgun pellets;
- Secondary metals antimony, arsenic, copper and zinc;
- Broken skeet targets- Polycyclic Aromatic Hydrocarbons (PAHs);
- Containment features such as soil berms.

2004 EDITION

BEST MANAGEMENT PRACTICES FOR ENVIRONMENTAL STEWARDSHIP OF FLORIDA SHOOTING RANGES



Originally Published by FDEP Hazardous Waste Regulation Section

November 2002

Reprinted June 2003 and October 2004

United States
Environmental Protection
Agency

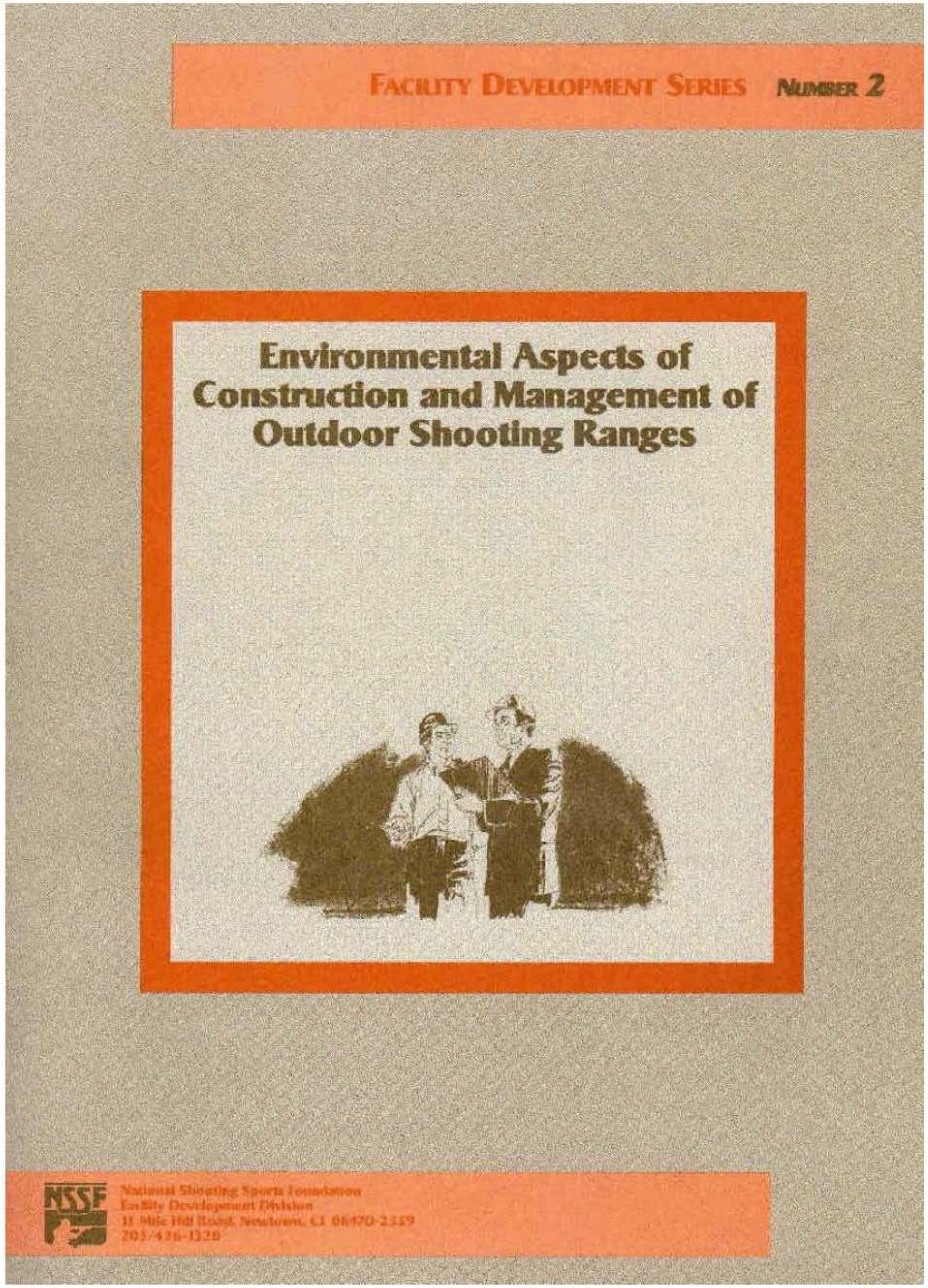
EPA-902-B-01-001
January 2001
Region 2

EPA

Best Management Practices for Lead at Outdoor Shooting Ranges

Source Documents included:

A Good Manual from EPA Region 2



Source Documents included:

NSSF Facility Development Series

Source Documents included:

Draft BMPs for Florida, Compiled by the U of F Florida Center for Solid and Hazardous Waste Management

Best Management Practices for Lead at Outdoor Shooting Ranges

Compiled by
The Florida Center for Solid and Hazardous Waste Management

Portions of this document have been extracted from the EPA-Region II Shooting Range BMP and the NSSF Management Guide.

Source Documents included:

And a lot of input from dedicated Stakeholders --

both government and private industry experts:

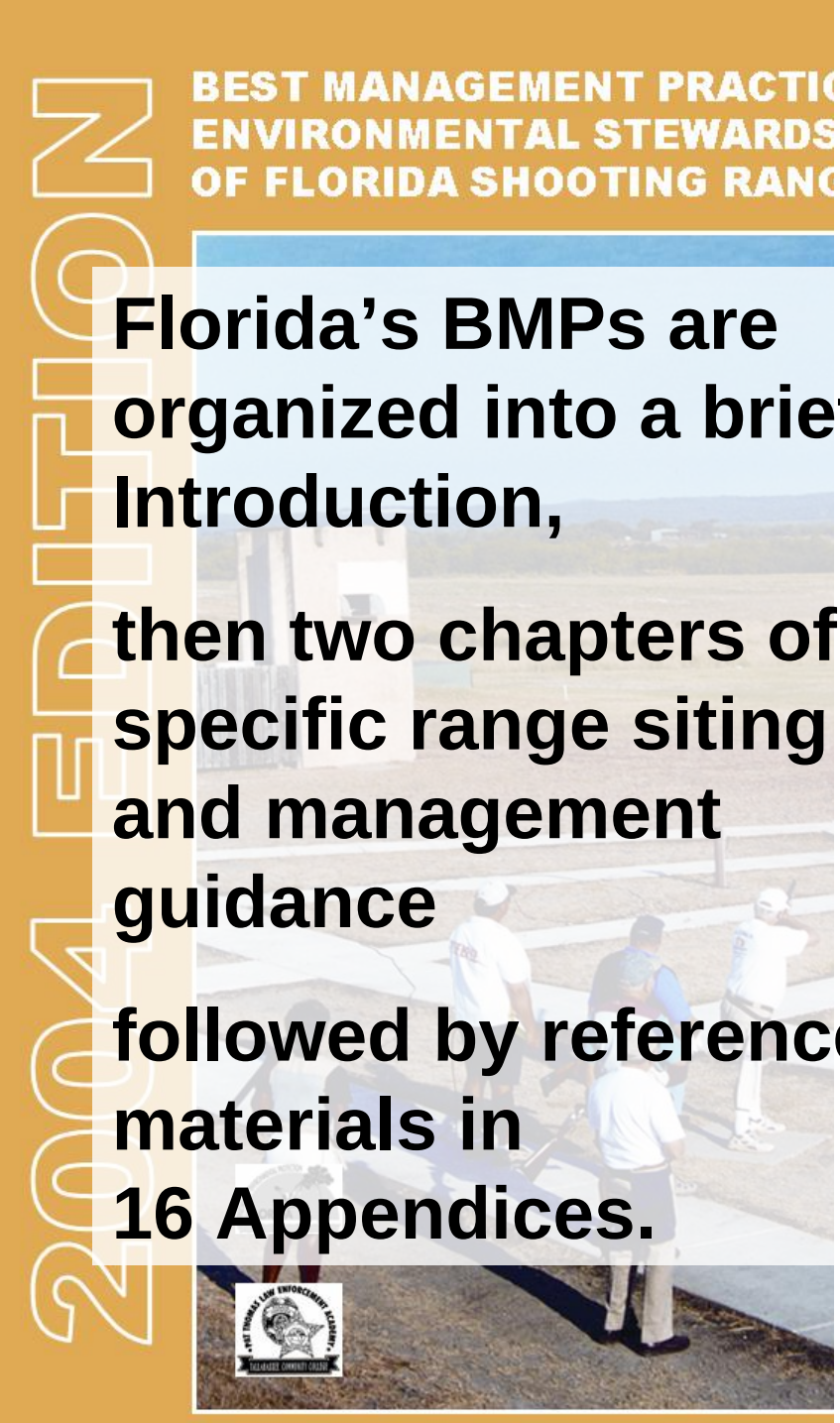
FSU/FAMU School of Engineering
Florida DEP
Tallahassee Community College
Santa Rosa Sheriff's Dept.
Wildlife Management Institute
Florida Fish and Wildlife Conservation Commission
Florida Department of Corrections
Sarasota County
George Stone Center
Orange County Sheriff's Dept.
Martin County Sheriff's Dept.

Source Documents included:

And a lot of input from dedicated Stakeholders --

both government and private industry experts:

Flagler Gun and Archery Club
Hopping, Green and Sams
George Stone Center
U.S. Air Force
Department of the Navy
Massachusetts DEP
National Sport Shooting Foundation
Escambia County
U.S. Environmental Protection Agency
Clark Vargas (range doc)
Florida Shooting Services, Inc.



Florida's BMPs are organized into a brief Introduction,

then two chapters of specific range siting and management guidance

followed by reference materials in 16 Appendices.

TABLE OF CONTENTS

CHAPTER 1: IN

Shooting sports have been popular for
has approximately 400 shooting clubs,
mately one million shooting sport enthu
ranges each year.

As a range owner/operator, you need to
environmental concerns associated wit
operating outdoor shooting ranges. **In**
manual focuses on lead, which compri
weight of most bullets and shot. Whil
element, it is rarely found in such a cor
in bullets and shot, and therefore is rar
at the high levels encountered in range
berms and [illegible] until [illegible]
sumed the lead from bullets and shot v
therefore did not consider it as a poten
contaminati[illegible]
range owner[illegible] operat[illegible]
potential environmental risks and unde
tance of managing facilities to minimize
Human exposure to lead has been iden
health concern. Soil and water can als
affected by uncontrolled dispersion of t
ated with shooting ranges. Under cond
many outdoor ranges, environmental is
generally be relatively minor, but birds,
fowl that may ingest shot are susceptib
effects of lead. To this end, the range
ideas presented in this manual are inte
minimize, or even eliminate, the amour
breaks down and poses a problem duri
of a range. Florida depends on ground
drinking water supply and on surface w
outdoor recreation industry. High rainf
conditions, typical in Florida, cause lea
mobile in the environment. **Therefore, p**
ment of outdoor shooting ranges is es
in the Sunshine State. See the Site Ch
(Chapter 2) section of this manual for m
on managing your shooting range site.

This manual provides owners and oper
rifle, pistol, skeet and sporting clay ra
mation on management of environmen

- Development of information on which to base prudent decision-making
- Planning and soliciting support for funding of range improvements
- Enhanced community relations
- Better range aesthetics
- Improved profitability through recovery and recycling lead
- Reduced public and regulatory scrutiny

and a five-step approach to lead management.

Stewardship options extend from easy, short term [illegible] tive actions for po[illegible]ntial con[illegible]ation; from designing new ranges to retrofitting existing ranges. **A variety of cost [illegible] techniques can be used to successfully manage the environmental issues at an outdoor shooting range**. Some BMPs can be implemented immediately; others require more long term planning.

Every owner/operator of a shooting range should begin an environmental stewardship program by documenting the physical and operational characteristics of your range. This will consist of a description of your facility, documentation of current and past operating practices, and an assessment of existing environmental conditions. Chapter 2 of this manual, “Site Characterization,” explains these procedures in detail. An example self-inspection checklist is found in Appendix C, and a template for an Environmental Stewardship Plan is provided in Appendix D.

Another essential element of environmental stewardship is documenting activities and keeping records. Typical records include:

- range inspections
- photographs of pre-existing and improved conditions (“before and after” photos)

Record keeping is discussed and some examples provided in Appendix E.

The “Management Techniques,”(Chapter 3) contains more information about documentation and record keeping, as well as selected BMP options. A properly maintained outdoor range is environmentally conscious, aesthetically pleasing to the surrounding community and protective of human health, the environment and wildlife. To operate an outdoor range that complies with these goals requires implementing an integrated lead management program, which incorporates a variety of appropriate BMPs. A five-step approach to lead management is outlined below:

Step 1
Evaluate existing environmental conditions

Step 2
Control and contain lead bullets and bullet fragments

Step 3
Prevent migration of lead to the subsurface groundwater and surrounding surface water bodies

Step 4
Periodically remove the lead from the range and recycle it

Step 5
Document activities and keep records

An effective lead management program requires implementing and evaluating BMPs from each of the five steps identified above. **Some combination of BMPs will be appropriate for your range.**

A glossary of terms is included as Appendix F, and a list of Frequently Asked Questions is Appendix G. A list of

Chapter 2 discusses concerns with lead in the environment

and details

Step 1 of the lead management approach, to: ***Evaluate existing environmental conditions***.

CHAPTER 2: SITE CHARACTERIZATION

2.0 BACKGROUND

Why lead is a concern for shooting ranges?

Lead is a naturally occurring element that can be found in many forms. In its metallic form, lead is inert. However, lead can also be found in the form of various lead compounds. The lead compounds that are water-soluble (like those formerly used in paint and gasoline) are readily absorbed by animals and humans.
Most of the lead used in ammunition is in the metallic form. A "white paper" accepted by California Department of Environmental Protection shows that a child who ingests a bullet would suffer no ill effects from the lead. In short, a large piece of metallic lead will pass through the system before it breaks down into lead compounds. A small amount of a sensitive lead compound (lead styphnate) is used in the primer. This compound is only slightly soluble in water.

How Can Lead Enter the Body?

Lead can enter the body by inhalation or ingestion. Lead can be inhaled when lead dust, mist, or fumes are in the air. Particles of lead can be swallowed if lead gets on a worker's hands, clothing, or face. Lead can also be swallowed if food, beverages, cigarettes, or tobacco products become contaminated with lead and then consumed. If contaminated cigarettes are smoked, lead can be both inhaled and swallowed. If the lead is absorbed into the bloodstream, it circulates throughout the body. Some of the lead that is absorbed is eliminated by the kidneys and is excreted from the body in urine. The lead that is not eliminated right away is stored in the organs and bones. Stored lead is released back into the bloodstream over time.

Refer to Figure 2-1: "Effects on the Human Body from Excessive Exposure to Lead" on next page.

(STEP 1)

Since each firing range site is unique, BMPs for lead must be selected to meet site-specific conditions in order to achieve maximum success. A range's physical characteristics will affect which BMPs may apply and how they will be implemented. Accordingly, whether designing a new outdoor range or operating an existing range, BMPs need to incorporate techniques appropriate for the range's individual characteristics. Section 2.1 of this chapter identifies the physical characteristics that must be considered when evaluating your range. Common physical characteristics at ranges include:

- Range size (primarily for shotgun ranges)
- Accessibility
- Soil characteristics
- Annual precipitation/seasonal flooding
- Topography/run-off direction
- Groundwater/surface water
- Vegetation/risk to wildlife
- Wetlands
- Proximity to neighbors

Appendix I provides detailed information on Florida soils.

Chapter 2 includes sub-chapters on:

2.1 PHYSICAL CHARACTERISTICS

Range Size/Activity Type

Shotgun, rifle and pistol range designs and types affect the ease of lead shot collection and management. Larger more heavily utilized ranges tend to disperse greater quantities of lead into the environment than smaller less frequently used facilities. Reducing the area of the shotfall zone will concentrate the lead within a smaller area allowing for easier reclamation and recycling. BMP techniques for reducing the shotfall zone at trap and skeet ranges, as well as sporting clays ranges, are discussed later in the manual.

This sporting clays course is arranged such that it shares a common shotfall zone with the trap and skeet ranges.

Chapter 2 includes sub-chapters on:

2.2 SOIL CHARACTERISTICS

Spent lead bullets and shot most often are deposited directly on and into soil during shooting. Lead may oxidize and form one of several soluble compounds. pH has the biggest impact on whether or not metallic lead breaks down into lead compounds. Knowing the soil characteristics of an existing range site is a key component to developing an effective lead management plan.

Figure 2-2: Soil pH

Chapter 2 includes sub-chapters on:

2.3 ANNUAL PRECIPITATION AND SOIL EROSION

In determining if, when, where and how soils at a shooting range will erode, the range manager must look at several factors including the amount and intensity of rainfall, soil texture, soil structure, slope of ground, vegetative cover, and amount of impervious area.

One of the most important factors that influences lead degradation (i.e., chemical reactions) and migration is precipitation. Water, most often in the form of rain, provides the means by which lead is transported. Generally, high precipitation rates result in heavy dew,

Chapter 2 includes sub-chapters on:

2.4 TOPOGRAPHY AND RUN-OFF DIRECTION

The topography of your range affects both the ease of lead reclamation and the mobility of the lead. Many lead reclamation companies use heavy machinery that cannot operate on steep slopes or hills. Also during and after periods of rain, stormwater run-off may wash lead particles or lead compounds off the range. Generally, the steeper the slope, the more difficult lead recovery is. Also, as stormwater run-off velocity increases, lead can remain consolidated, and potentially provide easier access for recovery equipment.

The direction in which your range slopes is another

Chapter 2 includes sub-chapters on:

2.5 GROUNDWATER AND SURFACE WATER

Groundwater depth should be considered when developing a Best Management Practices plan for your shooting range. The closer the groundwater is to the soil surface, the greater the potential for dissolved lead to cause groundwater contamination. The acidity of the water may also affect the solubility of lead. A good rule of thumb is that lead is likely to precipitate out of a solution when the pH is about 7.5, or slightly alkaline. (Refer to Section 2.2 on page 16 for further information on this). However, lead dissolved in groundwater may travel long distances. Groundwater contamination may, in turn, result in surface water contamination due to

Chapter 2 includes sub-chapters on:

2.6 VEGETATION

Lead and its components can be impacted by vegetated ground. Vegetation absorbs rainwater, thereby reducing the time that the lead is in contact with water. Vegetation also slows down surface water run-off, preventing the lead from migrating off-site. However, excessively wooded areas (such as those often used for sporting clay ranges) inhibit lead reclamation by preventing access of commonly used lead-removal machinery, which is typically large in size. **Understanding the type, concentration and variety of vegetation on your range is necessary for developing your lead management program and implementing BMPs at your range.** Grass and other vegetation reduce run-off velocity and act as a

Chapter 2 includes sub-chapters on:

2.7 POTENTIAL RISKS TO WILDLIFE

Direct ingestion of lead shot or lead bullet fragments is the most important exposure pathway for wildlife. Birds may consume lead shot as grit for the gizzard, or it may be mistaken for small seeds and eaten. This can occur whether birds are feeding on land or in the water. Waterfowl are particularly susceptible to lead poisoning, which resulted in the ban on lead shot for waterfowl hunting.

Lead shot and small bullet fragments may also be eaten with food by birds and animals feeding on earthworms, soil insects, fallen seeds, and other foods that are eaten at the surface of the soil. In addition, shooting

Chapter 2 includes sub-chapters on:

2.8 WILDLIFE HABITAT AND FEEDING

ISSUE

As described in Section 2.7 on page 20 spent lead may be available to wildlife, and if so, may result in detrimental effects. Under existing law (RCRA and CERCLA), suits and/or regulatory actions can be brought upon parties that are thought to be involved with damage to natural resources, including wildlife populations or their habitats. Ranges can take the steps discussed in Section 2.7 on page 20 to minimize potential lead

Chapter 2 includes sub-chapters on:

2.9 PROXIMITY TO NEIGHBORS

A large sound buffer area surrounding your range is preferred. Complaints about the sound of shooting can be difficult to resolve and often evolve into environmental complaints. Firing ranges have historically tended to be located in rural areas where land costs and sparse development was more suitable for this type of activity. However, the current rapid development of rural areas makes it inevitable those range owners and operators will have to address the impact that the development will have on the range. Whether operating an existing range or planning a new one, it is important that surrounding land uses and landowners are considered. A well

CHAPTER 3
MANAGEMENT TECHNIQUES

3.0 MANAGEMENT TECHNIQUES FOR OUTDOOR SHOOTING RANGES

To operate an outdoor range that is protective of human health, the environment and wildlife each range should have a site specific well designed BMP plan that includes a selection of management techniques. **The following are items that can be included in your range management plan:**

- Control and contain lead bullets and bullet fragments
- Prevent migration of lead to the subsurface and surrounding surface water bodies
- Remove the lead from the range and recycle
- Document activities and keep records

After (Step 1) evaluating existing environmental conditions (Chapter 2) an effective lead management program requires implementing and evaluating BMPs from each of the four steps identified above. The BMPs discussed in Sections 3.1 on page 25 and 3.2 on page 28 should not be considered alternatives to lead reclamation, but rather practices that should be followed between lead reclamation and recycling events.

3.1 BULLET AND SHOT CONTAINMENT TECHNIQUES
(STEP 2)

BULLET CONTAINMENT

Knowing where spent lead is deposited allows the appropriate BMP to be used. Another important BMP for managing lead in these areas is by bullet containment. The containment systems mentioned in this section are for reference only. Each containment design for a range is site specific. You must look at various factors in determining which containment system is best for your range. Some factors include: site conditions, design and operating procedures, overhead, costs of installations, maintenance. You should consult with several contractors/vendors to determine which containment system is best for your range. The State of Florida does not endorse any bullet containment design.This section discusses BMPs for controlling spent lead bullets and fragments in a "controlled" and well-defined area behind the target area.

A variety of containment device options exist to serve as BMPs to control lead. The principle behind all of them is trapping and containing the actual bullet. They include:

- Earthen Berms and Backstops
- Sand Traps
- Steel Traps
- Lamella or Rubber Granule Traps

For each type of trap, design variations have been developed to fit the specific needs of an individual range. Below are discussions of each general category of trap. This handbook identifies the possible advantages and disadvantages associated with each containment device in Appendix M. Information also is available at www.rangeinfo.org.

EARTHEN BERMS AND BACKSTOPS

Perhaps the most common bullet containment system at rifle and pistol ranges is the earthen backstop, located directly behind the targets. Range owners construct backstops and berms primarily to protect people from injury and property from damage. The backstops and berms also allow for manageable recovery of fired lead bullets.

The earthen backstop is generally between 15 and 20 feet high with a recommended slope as steep as possible. You should consider weather conditions, annual rainfall, erosion rate and future lead reclamation activities in determining the appropriate steepness of slope. In some instances, backstops may be naturally occurring hillsides. Other types of backstop and berm materials are:

- Earthen backstops constructed from clean fill
- Earthen backstops constructed from broken material and covered with clean dirt fill

Chapter 3 provides real range management guidance and techniques

and

the next 4 Steps in the lead management approach

Chapter 3 includes sub-chapters on:

3.1 BULLET AND SHOT CONTAINMENT TECHNIQUES

(STEP 2)

Step 2
Control and Contain the Lead

BULLET CONTAINMENT

Knowing where spent lead is deposited allows the appropriate BMP to be used. Another important BMP for managing lead in these areas is by bullet containment. The containment systems mentioned in this section are for reference only. Each containment design for a range is site specific. You must look at various factors in determining which containment system is best for your range. Some factors include: site conditions, design and

Utilizes ACTION Target Systems at two bullet trap ranges.

The two ranges cost about $300,000.

Hurlburt Air Force Base, Fort Walton Beach, FL

Vacuum with hepa-filter collects lead dust from the chambers.

The bullet is trapped by the steel plates in front, and channeled into a deceleration chamber, then into a bucket.

Chapter 3 includes sub-chapters on:

3.2 BMPS TO PREVENT LEAD MIGRATION (STEP 3)

Step 3
Prevent Lead Migration

This section discusses BMPs for preve
migration. These BMPs include:

- Immobilizing lead
- Monitoring and adjusting soil pH
- Controlling run-off

These BMPs are important for all outdoor ranges.

IMMOBILIZATION OF PB IN RANGE SOILS

One option to immobilize lead in range soils is by

Lead Mobility

Resources pote impacted:

- **Soil and se**
- **Surface w**
- **Groundwa**
- **Ingestion l**

Management techniques:

- **pH adjustment**
- **Erosion control**
- **Range orientation**
- **Projectile containment**
- **Alternative ammo**
- **Recovery/recycling**
- **Clay barrier**
- **Chemical stabilization**
- **Stormwater run-off management**
- **Vegetative controls with soil amendments**

Chapter 3 includes sub-chapters on:

3.3 LEAD REMOVAL AND RECYCLING (STEP 4)

Step 4
Periodically Remove the Lead

To successfully minimize lead migrati[illegible] **important BMP for lead management is lead reclamation.** Implementing a regular reclamation program will allow you to avoid expensive remediation and potential litigation costs. Ranges in regions with high precipitation and/or with acidic soil conditions may require more frequent lead recovery since the potential for lead migration is greater. In regions with little precipitation and/or where the soil is somewhat alkaline, spent bullets may be allowed to accumulate on the soil for a longer time between reclamation events. **It**

Chapter 3 includes sub-chapters on:

3.4 RECORD KEEPING

(STEP 5)

Step 5
Document Activities
and Keep Records

Keeping good records and documenting is of paramount importance for an effective lead management program at a range. You should document what type of BMPs were implemented to control lead migration, recycling of lead, the date of service, and who did the services. The records should be kept for the life of the range. These records will help you in determining how often pH stabilization should be done and how often lead reclamation activities should be conducted. Useful records may include:

1. Log of routine Range activities:

Chapter 3 includes sub-chapters on:

3.5 WILDLIFE MANAGEMENT TECHNIQUES

Landscaping/Plantings: The pattern and type of vegetation at a range influences the suitability of habitat and the types of wildlife that occur there. Any time there are vegetated areas present, there is the potential for wildlife to use the area. Most ranges are intentionally maintained in relatively open conditions to establish a clear field of view for shooting. These open often grass-covered areas are suitable habitat for deer, small mammals, and ground-foraging birds. Preferred wildlife food, such as plants that produce edible stems and seeds, should not be planted around active range areas. Other areas of shooting facilities (away from the firing ranges) may be managed to support wildlife. Issues

Chapter 3 includes sub-chapters on:

3.6 LEAD SHOT ALTERNATIVES

Another method of preventing lead contamination at pistol, rifle, trap, skeet, or sporting clays ranges is to use less toxic or non-lead ammunition.

Much progress has been made in the development of alternatives to lead shot for hunting uses. Information gathered since 1976 on lead poisoning of waterfowl due to lead ingestion, led the United States Fish and Wildlife Service (USFWS) to consider alternatives to eliminate lead poisoning among migratory waterfowl birds. A ban on lead shot for waterfowl hunting was phased-in beginning in the fall of 1986, and finalized in 1991. Lead shot is also now banned for shotgun hunting occurring

Lead vs. Steel Shot

- **Use required for waterfowl hunting over lakes, rivers and bays;**
- **Some research indicates that collocation with steel shot increases the corrosion rate lead shot thereby increasing lead mobility;**
- **Purely academic issue at present, but might be a concern for long term use of steel shot at ranges.**

Chapter 3 includes sub-chapters on:

3.7 HUMAN LEAD EXPOSURE STANDARD

The Occupational Safety and Health Administration (OSHA) is charged with protecting employee health and safety in the workplace. OSHA has a comprehensive lead regulation, 29 CFR 1910.1025. This standard defines your legal responsibilities to limit employee exposure to lead, provide protective equipment and hygiene facilities, maintain a clean workplace, and provide employees with safety training and medical care. The Lead Standard also establishes a limit on the amount of lead that can be in the air workers breathe. Failure to comply with the requirements of the Lead Standard could result in fines to your business. OSHA does not endorse any specific equipment. Their only function is to regulate the impact

Chapter 3 includes sub-chapters on:

3.8 REMEDIATION/CLOSURE/LAND USE CHANGE AT SHOOTING RANGES

Remediation is very different from the ongoing management of an active range. However, the range operator needs to be aware of this issue. Remediation is usually associated with range closure and a change in the land use. Implementating BMPs while the range is active will help reduce the scope and cost of future remediation. Some remediation activities may involve managing materials including soils and other environmental media that may be considered hazardous waste under federal, state, or local law. Such activities require considerable coordination and detailed planning.

Section 3.8 addresses lead removal and specific requirements for a Remediation/Closure Plan.

REMEDIATION/CLOSURE PLAN

Any range that is conducting remediation for closure involving soil, groundwater or surface water remediation must prepare a detailed closure plan. A DEP approved closure plan is also required if you plan to store or place contaminated soils or material in a non-contaminated area or in a different AOC. Such plan is also required if there is going to be a change in the land use.

Some of the major items for inclusion in the remediation or closure plan should include:

- Name, address and telephone number of the range
- The name, address and telephone number of the range owner and operator

using or working on the range should be encouraged to wash their hands often and facilities provided for this purpose. You may consider prohibiting Food, drinks and use of tobacco products on the range.

You should consult National Association of Shooting Ranges, an Industrial Hygienist or Occupational Safety and Health Administration (OSHA) for information about human lead exposure.

3.8 REMEDIATION/CLOSURE/LAND USE CHANGE AT SHOOTING RANGES

Remediation is very different from the ongoing management of an active range. However, the range operator needs to be aware of this issue. Remediation is usually associated with range closure and a change in the land use. Implementating BMPs while the range is active will help reduce the scope and cost of future remediation. Some remediation activities may involve managing materials including soils and other environmental media that may be considered hazardous waste under federal, state, or local law. Such activities require considerable coordination and detailed planning.

FDEP highly recommends that facilities work closely with the Department in preparing a work plan and have the Department approve the plan prior to conducting any remediation activity.

LEAD REMOVAL AND RECLAMATION ACTIVITIES AT ACTIVE RANGES

You may conduct routine lead removal and reclamation activities, at active ranges, without having a DEP approved plan, as long as all of the activities take place within the same range, or area of contamination (AOC). For the purpose of this BMP, AOC at your range is a contiguous contaminated area consisting of one or more ranges that are not separated by non-contaminated area including woods and surface water bodies. Any storage or placement of contaminated soils or materials outside for the type of activities you want to conduct at your facility.

REMEDIATION/CLOSURE PLAN

Any range that is conducting remediation for closure involving soil, groundwater or surface water remediation must prepare a detailed closure plan. A DEP approved closure plan is also required if you plan to store or place contaminated soils or material in a non-contaminated area or in a different AOC. Such plan is also required if there is going to be a change in the land use.

Some of the major items for inclusion in the remediation or closure plan should include:

- Name, address and telephone number of the range
- The name, address and telephone number of the range owner and operator
- Appropriately-scaled site plan
- Contour map or topographic map showing boundary of the range
- Scaled drawing of the area to be remediated
- Soil, groundwater and surface water sampling plan
- Proposed and future land use information
- Quality assurance procedures, for sampling of any media in accordance with Chapter 62-160, F.A.C. You should select a NELAPS certified laboratory to perform the analyses
- Details of on-site treatment of soils, sediments or groundwater if required, and any other planned activities
- Location and method of storage of material and media to be recycled, managed or excavated and the identification of other materials that may be disturbed such as vegetation
- Plan for off-site shipment for recycling and disposal of materials removed from the range
- Proposed cleanup levels for soils, sediments or groundwater
- Security procedures
- Health and safety training and equipment
- Schedule of remediation and closure activities

Section 3.9 points t
recommended BMP

3.9 SUMMARY OF K
SHOOTING RANGES

This manual contains sev
BMPs for you to implemer
Appendix M identifies the
of BMPs associated with
appendix serves as a qui
BMPs.

SUMMARY OF KEY BMPS

BMPs for Preventing Lead Migration

Monitoring and Adjusting pH

BMP Option	Advantages	Disadvantages
Lime Spreading	1. Easy 2. Inexpensive 3. Effective	1. Does not offer a permanent solution 2. Will not work in extremely acidic conditions

Immobilizing Lead

BMP Option	Advantages	Disadvantages
Phosphate Spreading	1. Easy 2. Inexpensive 3. Effective	1. Does not offer a permanent solution

Controlling Runoff

BMP Option	Advantages	Disadvantages
Vegetative Ground Cover (e.g., grass, etc.)	1. Easy 2. Aesthetically pleasing 3. Relatively inexpensive 4. Effectively slows and can redirect runoff 5. Some may "bioabsorb" lead	1. Requires periodic maintenance 2. Must be removed or reduced prior to reclamation 3. Excessive vegetation will interfere with reclamation
Organic Surface Cover (e.g., mulch and compost)	1. Easy 2. Aesthetically pleasing 3. Relatively inexpensive 4. Effectively slows and can redirect runoff	1. Requires periodic maintenance 2. Must be removed prior to reclamation 3. May not be suitable at ranges with acidic soil conditions
Filter Beds	1. Diverts and treats lead contaminated runoff 2. Low maintenance 3. Assists with range drainage	1. May require hiring a licensed engineer 2. Higher initial setup cost

The remainder of the Florida BMP manual consists of reference Appendices:

A	Case Studies and Model Ranges
B	Case Law and Legal References
C	Example Self-Inspection Checklist
D	Template for Environmental Stewardship Plan
E	Record Keeping
F	Glossary of Terms
G	Frequently Asked Questions (FAQs)
H	Resources
I	Information on Florida Soils

The remainder of the Florida BMP manual consists of reference Appendices:

J	Do's and Don'ts for Siting Shooting Ranges
K	County Extension Offices
L	Common Range Characteristics
M	Summary of Key BMPs
N	Examples of Lead Reclamation Equipment
O	Sample Bullet Containment Devices
P	New Technologies for Lead Removal

Of 150 pages in the manual -- 2/3 are appendices

Splash page on the CDROM that links to the electronic BMP manual, checklists, forms and Internet resources.

Programs
- Waste Home
- Petroleum Storage Systems
- Solid and Hazardous Waste
- Waste Cleanup

Information
- Data Reports
- Forms
- News
- Publications and Reports
- Rules

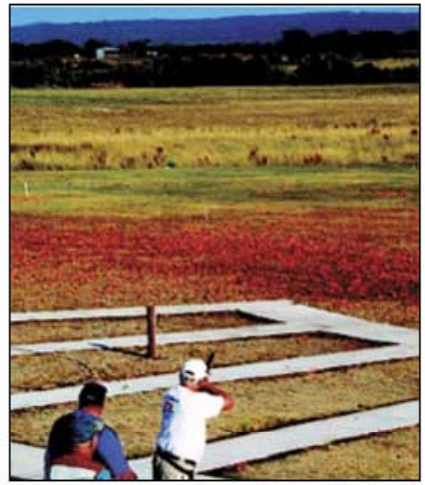
Navigation
- Site Map
- Search
- Waste Management

Lead Management at Florida Shooting Ranges

Florida depends on groundwater for its drinking water supply, and on surface water for the outdoor recreation industry. High rainfall and acidic conditions, typical in Florida, cause lead to be more mobile in the environment. Therefore, proper management of outdoor shooting ranges is especially important in the Sunshine State.

The manual, available below, was designed to assist in developing Best Management Practices (BMPs) at outdoor shooting ranges. It was developed through a cooperative effort by members of the shooting range community and industry, the United States Environmental Protection Agency, and the Florida DEP.

» View or Download the full manual of Best Management Practices for Environmental Stewardship of Florida Shooting Ranges (5.7mb PDF file)



Example Forms and Templates:

- Self Inspection Checklist - (Word) or (PDF)
- Template for an Environmental Stewardship Plan - (Word) or (PDF)
- Record Keeping Forms - (Word) or (PDF)

Other Resources:

- List of Internet Resources - (PDF)

The manual contains guidance for characterizing site conditions for outdoor shooting ranges, and for developing a stewardship plan for implementing management techniques that will help minimize the environmental impact of lead at a range.

Also included are appendices on a number of topics and resources that a shooting range manager might wish to explore.

For more information concerning this publication please call Florida DEP, Bureau of Solid and Hazardous Waste, at (850) 245-8773 or email Steve Ray.

Portions of the Best Management Practices for Outdoor Shooting Ranges detailed in the Florida DEP manual were taken from publications by the United States Environmental Protection Agency and the National Association of Shooting Ranges.

U.S. [illegible]

Interstate Technology Regulatory Council Small Arms Firing Range Documents

National Association of Shooting Ranges

Highligh
- Hazardous Waste Main
- Biennial Hazardous Was
- BRS Data Entry and Disp
- County Hazardous Was
- Programs Contact List
- District Offices
- Hazardous Waste in Bu
- Government and Educat
- Hazardous Waste Requ
- Household Hazardous W
- Lead in Shooting Range
- Publications
- Related Links
- Rules & Related Laws

Internet resources are posted on DEP's Web site at:

http://www.dep.state.fl.us/waste/categories/hazardous/pages/lead.htm

Last upd

Bureau of Solid & Hazardous Waste #850-245-8707 MS #4550
2600 Blair Stone Road, Tallahassee, Florida 32399-2400

Questions & Comments Form

They include Range Operator's Checklists:

and from EPA's publication

RANGE OPERATOR CHECKLIST

FACILITY NAME:	_____
FACILITY ADDRESS:	_____
MAILING ADDRESS:	_____
CITY:	_____
COUNTY:	_____
STATE:	_____
ZIP CODE:	_____
LATITUDE/LONGITUDE:	_____
TELEPHONE:	_____
FACILITY CONTACT:	_____
TITLE/POSITION:	_____
OPERATING SCHEDULE: (DAYS/HOURS/ANNUAL)	_____

Also included – a template for developing a Range's Environmental Stewardship Plan from FDEP's Appendix D:

ENVIRONMENTAL STEWARDSHIP PLAN

[Club Name]
[Street Address]
[City/Town,] FL [Zip Code]

[Date]

And record keeping forms from FDEP's Appendix D:

FACILITY NAME: _____
Lime and Phosphate Addition Form

Date:_____ Employee_____
Time:_____

Type of Lime:_____

Source of Lime:_____

Type of
Phosphate:_____

Source of
Phosphate:_____
Firing Lane Location of Lime Addition:
_____
_____
_____
_____

Amount of Lime Added at each Firing Lane:
_____
_____
_____
_____

Firing Lane Location of Phosphate Addition:
_____
_____
_____
_____

Amount of Phosphate Added at each Firing Lane:
_____
_____
_____
_____

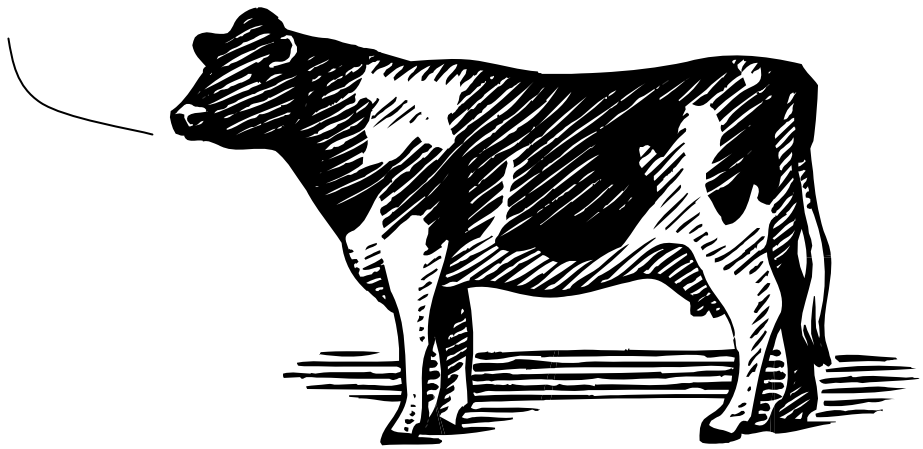
Notes:_____
_____

Range Environmental Management Goals

- Range environmental management goal
  - Manage potential detrimental impacts posed by range activities to the environment, public health or public welfare
- Range environmental management objectives
  - Keep lead on-site and in its metallic form
  - Prevent surface migration of lead and other hazardous constituents
  - Prevent projectiles from impacting wetlands or surface waters
  - Prevent projectiles from landing off property
  - Reduce noise impacts to surrounding properties

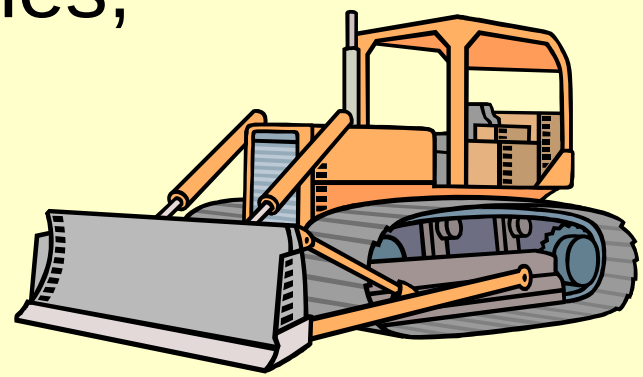
The BMP Cow

Get a mooove on managing your site!

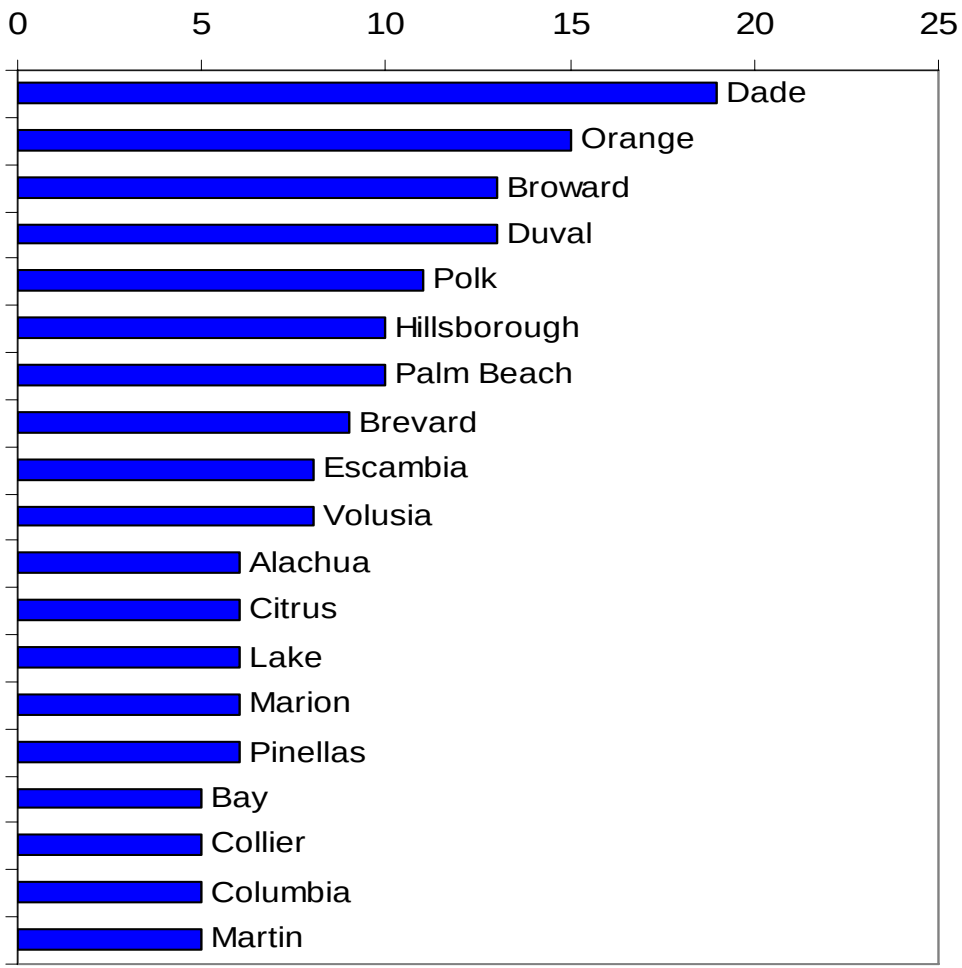


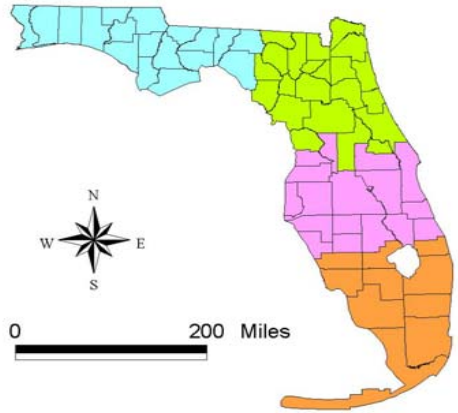
Cleanup at Shooting Ranges

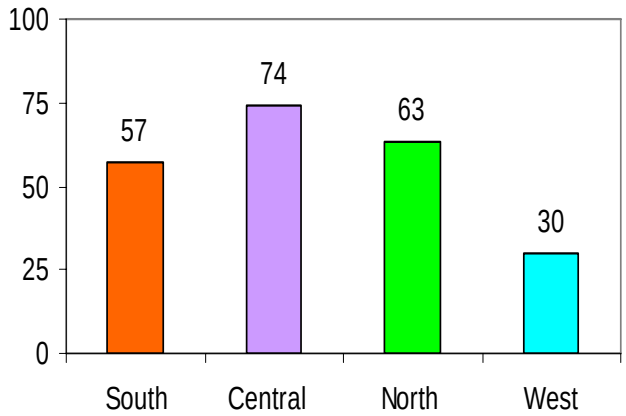
- Location of ranges in Florida;
- Potential range contaminants;
- Operational areas likely to be contaminated;
- Select assessment sampling topics;
- Typical remedial technologies;
- Site cleanup closure.



Distribution of Florida shooting ranges







Potential Contaminants

Constituent	Comment
Lead	Primary projectile constituent
Antimony	Increases hardness
Arsenic	Used to increase roundness of small shot
Tin	Increases hardness
Copper and zinc	Jacket alloy metal
Tungsten	Ammunition
Nickel	Coating improves shot performance; an alloy in center fire ammo
PAHs (Polycyclic Aromatic Hydrocarbons)	In limestone matrix of clay targets used at shotgun ranges

Lead Bullets in Soil

Knight’s Trail Park in Sarasota County, near Venice, FL

Lead Facts

- Metallic lead is subject to breakdown into bio-available and toxic form;
- Lead has no biological benefit;
- Not naturally elevated above risk based levels;
- High percent of ranges have years/decades of accumulation;
- Most ranges have not implemented lead recovery programs or BMPs that effectively manage lead.

Florida environment

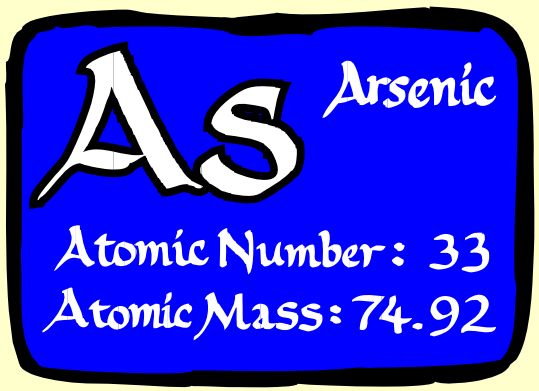
- **Easily elevated due to low soil background Pb concentrations**
  - **Range = 0.18-290 ppm**
  - **Geometric mean = 5.4 ppm**
- **Enhance chemical reactions**
  - **High temperature and humidity**
  - **Acid soil pH**
- **Favour chemical leaching**
  - **High rainfall**
  - **Sandy soil**
  - **Shallow groundwater**

Lead Mobility

- Metallic lead insoluble;
- Pb + O_2 → lead oxide, hydroxide, etc. (soluble)
- pH < 7– increased dissolution;
- Precipitation rate affected by presence of metals with greater solubility;
- Organic matter and clays may provide considerable sorption and arrest transport.

Arsenic Facts:

- Arsenic is a known human carcinogen;
- Associated with lead at outdoor ranges;
- Naturally present in Florida soils with concentrations that often exceed risk based corrective action criteria;
- More soluble and mobile than lead.



Technical/Regulatory Guidelines

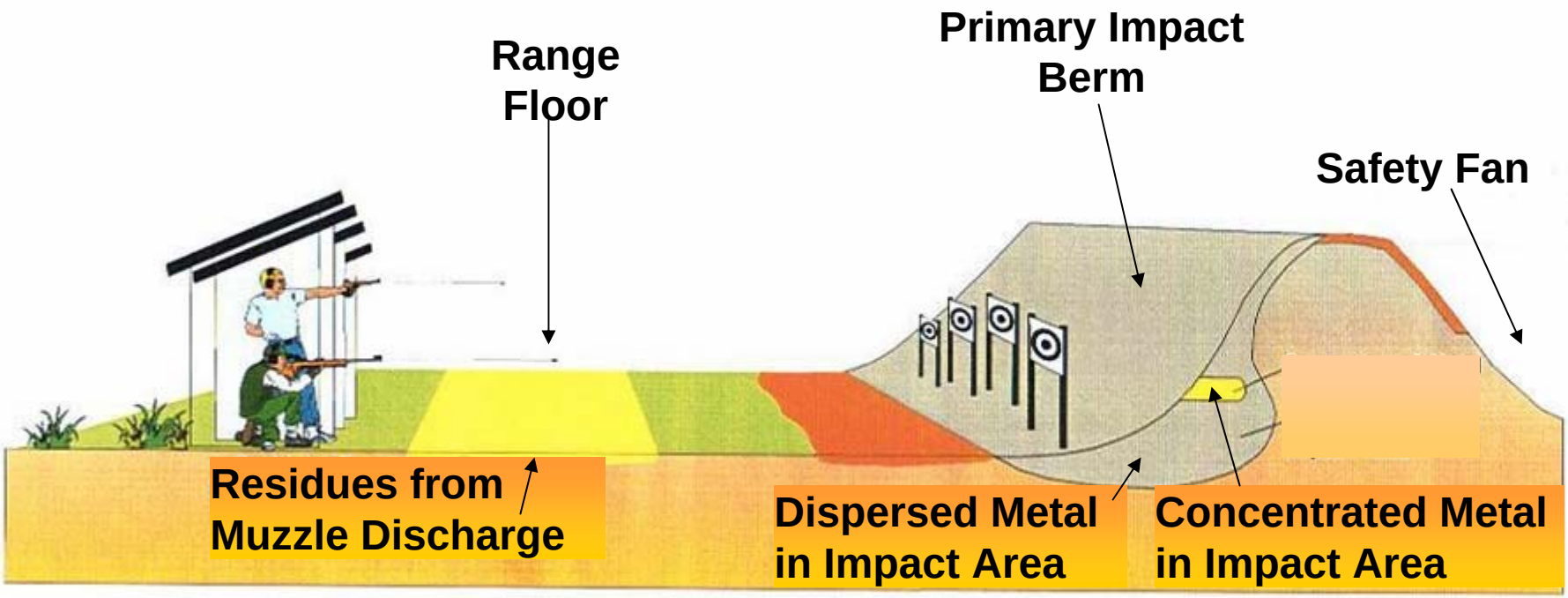
Characterization and Remediation of Soils at Closed Small Arms Firing Ranges

http://www.itrcweb.org/

January 2003

Prepared by
Interstate Technology and Regulatory Council
Small Arms Firing Range Team

Characterization - Static Rifle and Handgun Range



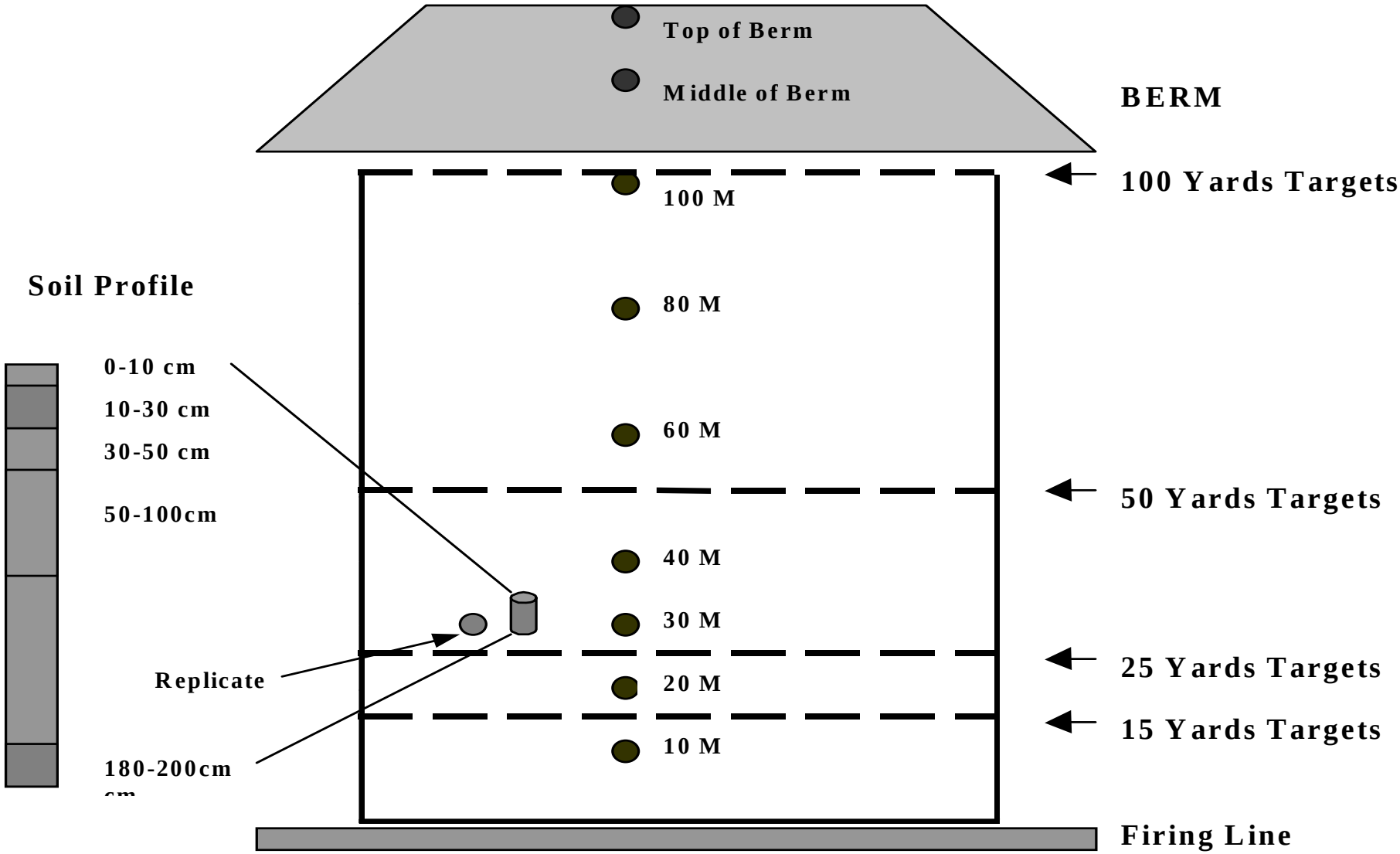
Lateral Berm Not Shown

A 100-Yard Pistol/Rifle Range


Panama City
Pace
Lake City
Ocala
N
Sampled
Lakeland
Indian River
Charlotte
Broward

Sample collection at a 100-Yard Range

Soil sampling in a 100-yard rifle/pistol range



Concentrations of Pb and As (ppm) and pH in surface soil of 100-yard rifle/pistol range

Distance (m)	Total Pb	Total As	Soil pH
10	1,201	1.37	6.7
30	4,448	3.69	6.1
60	1,793	1.84	5.6
80	875	2.90	5.4
100	1,723	1.71	5.5
Top of berm	10,138	3.57	6.8
Middle of berm	17,850	6.12	7.7

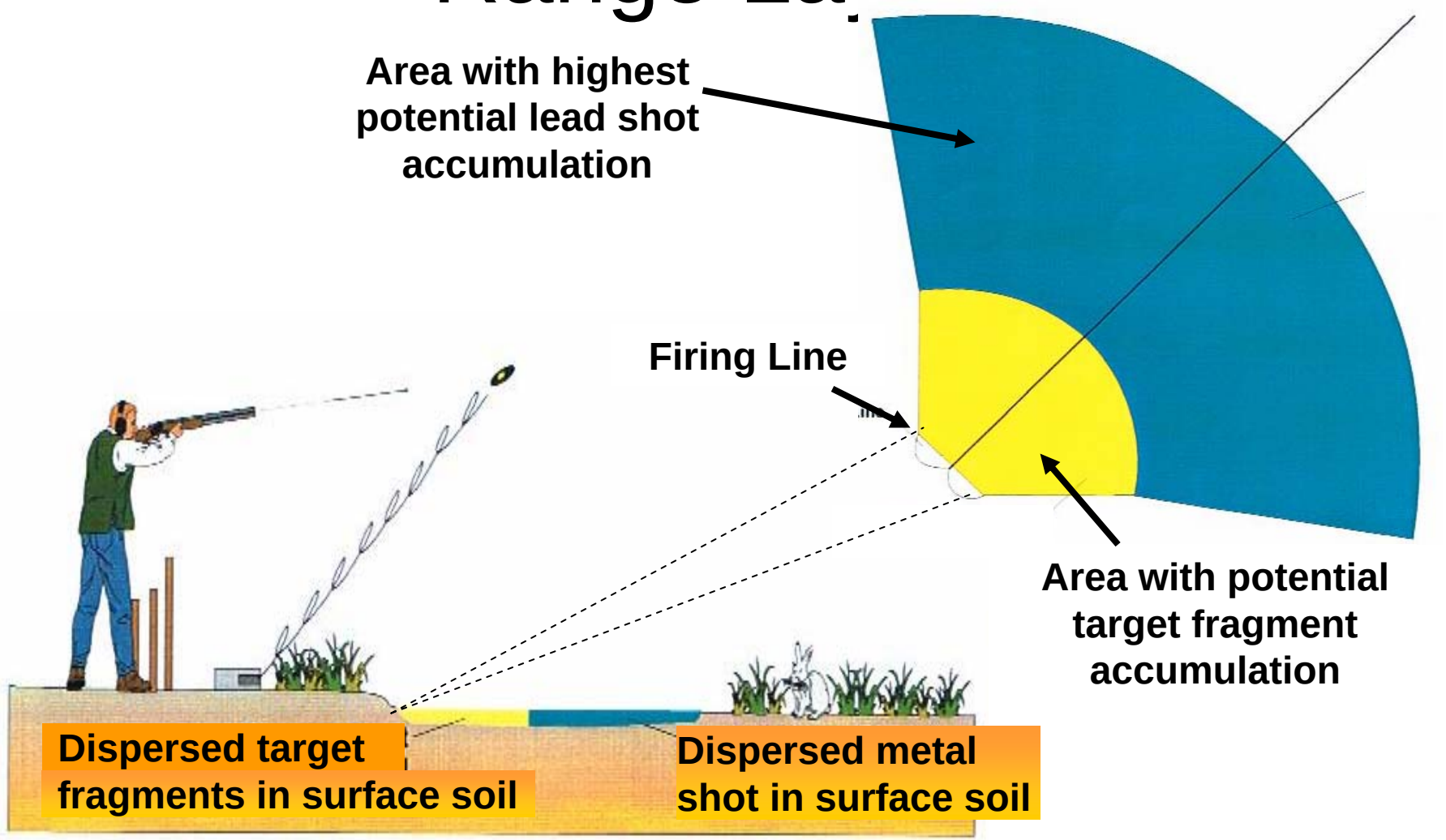
Total Pb and As (ppm) in soils of a 200-yard rifle/pistol range

Distance (m)	Total Pb	Total As
3	715	2.82
43	336	2.75
83	754	1.58
103	147	0.23
143	366	1.02
183	16,983	1.64
Berm (Mean of 3)	18,322	33.8

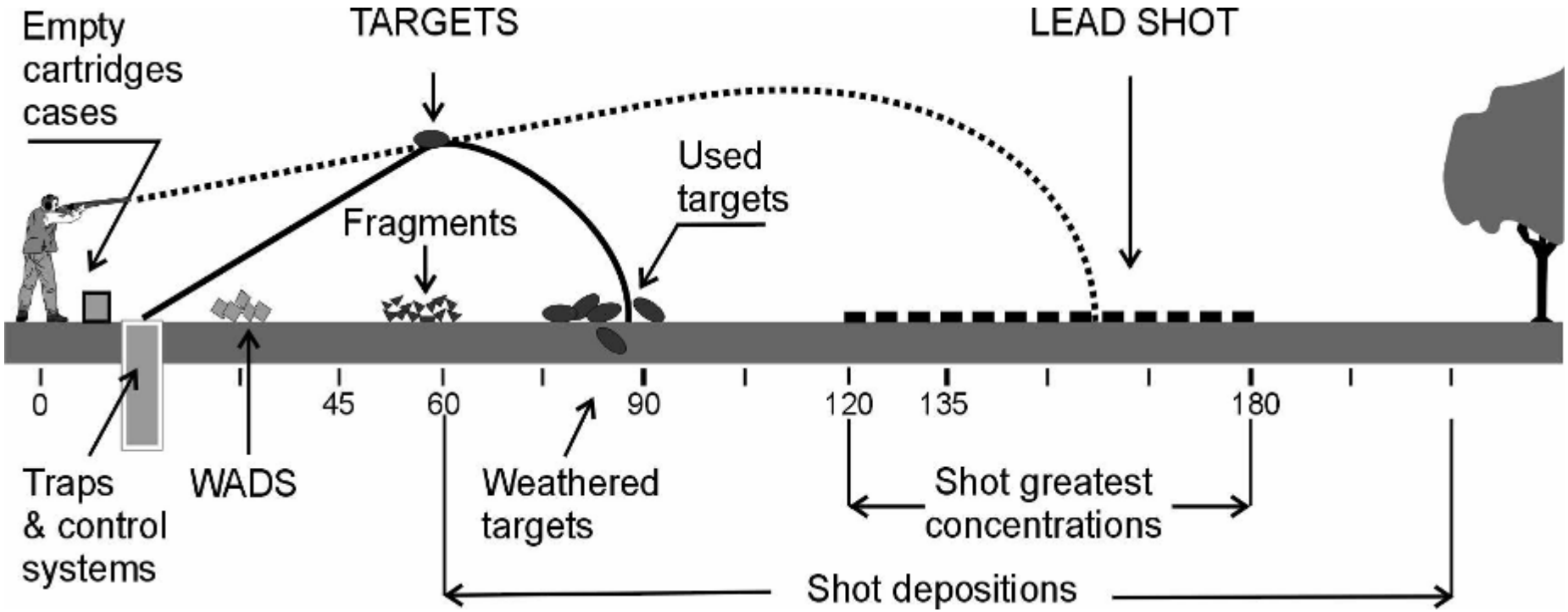
Concentrations of Pb & As (ppm) and pH in a soil profile of a 100-yard pistol range

Depth (cm)	Total Pb	Total As	pH
0-10	2,357	2.03	6.7
10-30	83.0	1.10	5.9
30-50	13.2	0.86	5.0
50-100	9.0	0.80	4.8
180-200	9.8	0.54	5.1

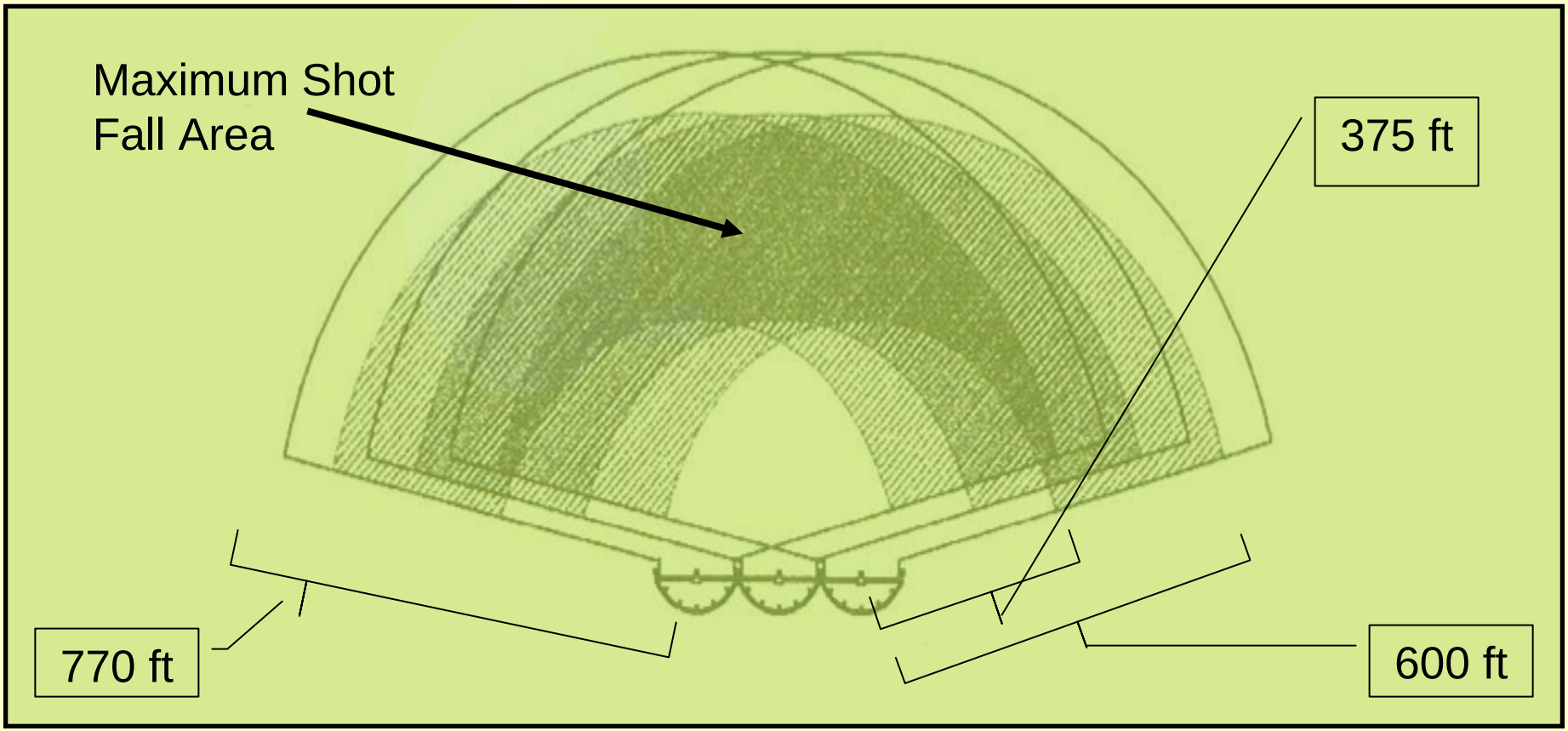
Characterization - Shotgun Range Layout



Cartridges, Clay Targets, and Litter



Characterization - Skeet Range Layout



Select Assessment Topics

- Soil screening for lead and arsenic using X-ray fluorescence (XRF);
- Soil sample sieving;
- TCLP and SPLP analysis;
- Clay target fragments / PAHs.

XRF Screening

- Can quickly define widespread areas of gross metals contamination;
- Equipment is rugged and portable;
- Cost effective for large scale assessment;
- Confirmation by laboratory analysis is needed for contamination boundary
- Interference with collocated metals.

XRF Screening Tool

Table 1 Interference-free detection limits (DLs)

Element	Detection Limit, ppm (Interference-Free, 2-minute Test Time)
Pb	13
As	9

*As values represent latest (Aug. 2003) values.

Results on laboratory-analyzed samples are shown in Fig. 1a and 1b for arsenic and lead respectively. Correlations are good in a variety of soil samples, exhibiting R2 values of 0.99 in each case. The XRF calibration method – Compton Normalization method as described in EPA Method 6200 – provides good results without the need for site-specific calibration corrections.

fig. 1a As Results: Portable XRF Analysis of Soil Samples

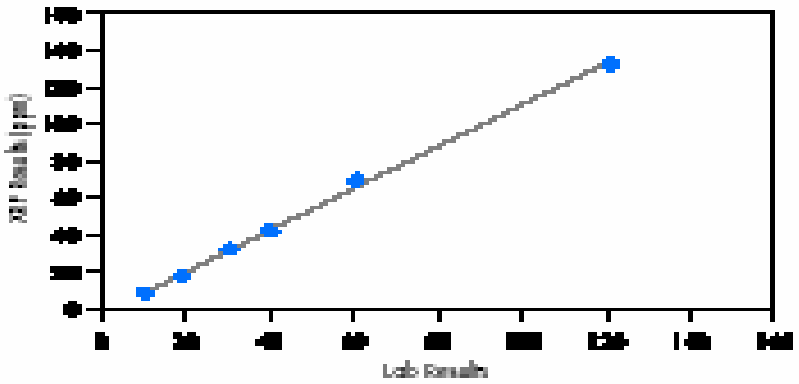
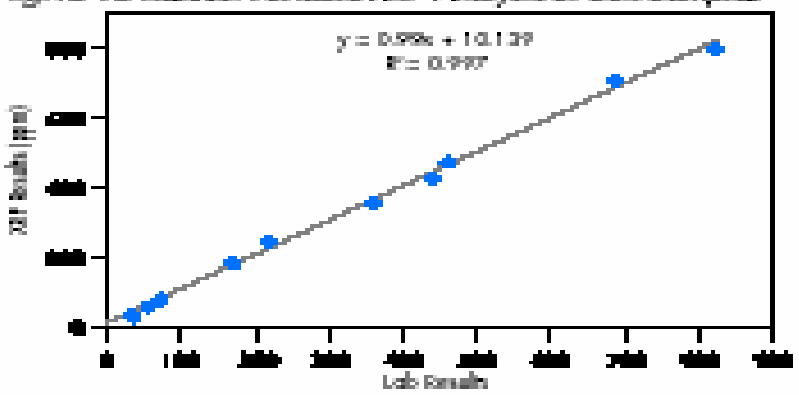


fig. 1b Pb Results: Portable XRF Analysis of Soil Samples



XRF Vendors

Manufacturer	Model	License or State Registration Required to Operate	Purchase		Rent				
			Purchase Price	Maintenance	Day	Week	Month	Minimum Rental Period	Contact Information
Thermo Noran Spectrace	TN 9000	Yes	$58,000	• General Maintenance $1,000/Year • Common Sources include Cd-109 which lasts about 1.5 years and costs $2,700 to replace and Fe-55 which lasts about 2.7 years and costs $1,600 to replace	N/A	2 weeks $3,500	$6,000	2 Weeks	800-736-0801 sales@thermont.com
Innov-X	XT-260	X-Ray Tube No License Requirements	$32,500	• General Maintenance $1,000/Year • Tube Replacement Every 4-5 Years Cost $3,500*	$300	$1,400	$4,800	2 Days	781-938-5005 info@Innov-Xsys.com
Metorex	XMET-2000	Yes	$30,000	• General Maintenance $1,000/Year • Common Sources include Cd-109 which lasts about 2 years and costs $2,700 to replace and AM-241 which has an infinite life	N/A	N/A	$3,000	1 Month	609-406-9000 http://www.metorex.com
Metorex	XMET-3000T	X-Ray Tube No License Requirements	$30,000	• General Maintenance $1,000/Year Tube Replacement Every 4-5 Years Cost $3,500*	N/A	N/A	$3,000	1 Month	609-406-9000 http://www.metorex.com
Niton	XL-700	Yes	$29,000 (Single-Source Unit) to $50,000 (Tri-Sourced unit) Depending on Configuration	• Common Sources include Cd-109 which lasts about 1.5 years and costs $2,700 to replace, Fe-55 which lasts about 2.7 years and costs $1,600 to replace, and AM-241 which has a life of about 400 years and is essentially maintenance free	N/A	Duel Source High Resolution Thin/Bulk Sample Analyzer $2,780	Duel Source High Resolution Thin/Bulk Sample Analyzer $7,340	1 Week	877-255-6943 http://www.niton.com/

To sieve or not to sieve?

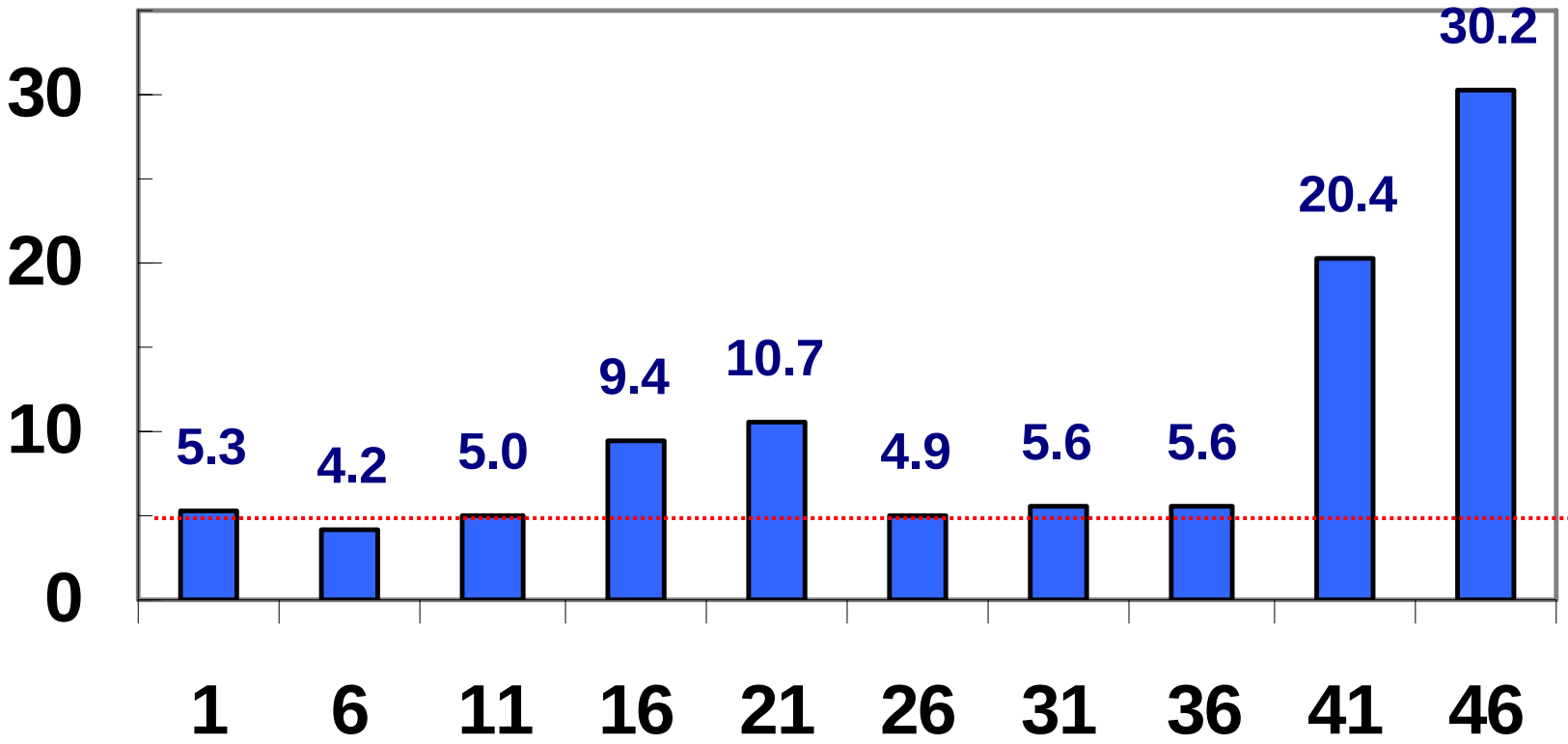
- Field samples are often sieved using a #10-mesh screen for extraneous matter;
- Laboratories often use #10 & #30-mesh screen sieves for soil during sample prep;
- Should sieve prepared XRF samples;
- End use of results should figure into extent of soil sample matrix separation.

TCLP/SPLP Tests

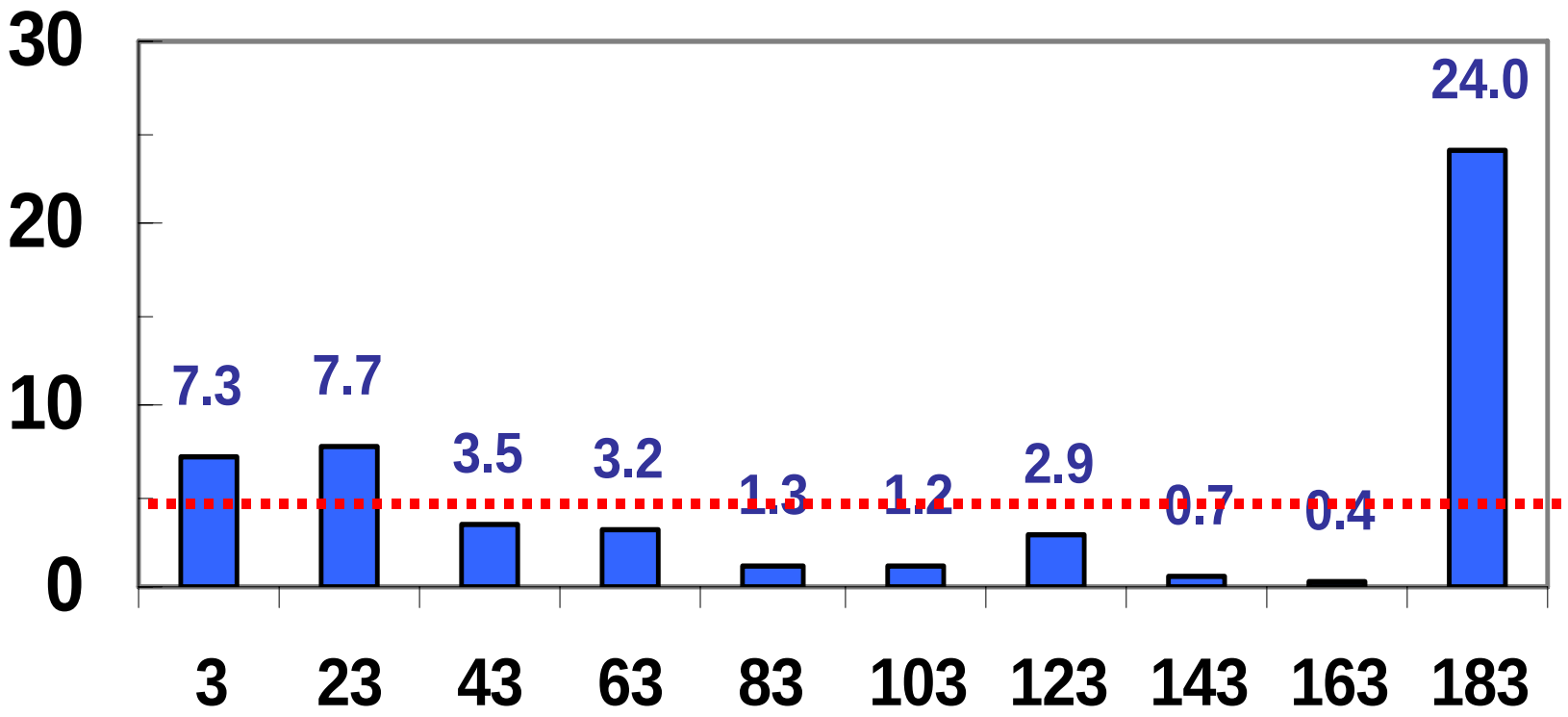
- **Toxicity Characteristic Leaching Procedure (TCLP)**
  - **Hazardous waste determination under conditions of municipal landfills under RCRA**
  - **TCLP regulatory limit for Pb = 5 mg/L**
- **Synthetic Precipitation Leaching Procedure (SPLP)**
  - **Metal leachability ug/L**
  - **under simulated rainfall**
  - **SPLP regulatory limit for Pb = 15**


Panama City
Pace
Lake City
Ocala
N
Sampled
Lakeland
Indian River
Charlotte
Broward

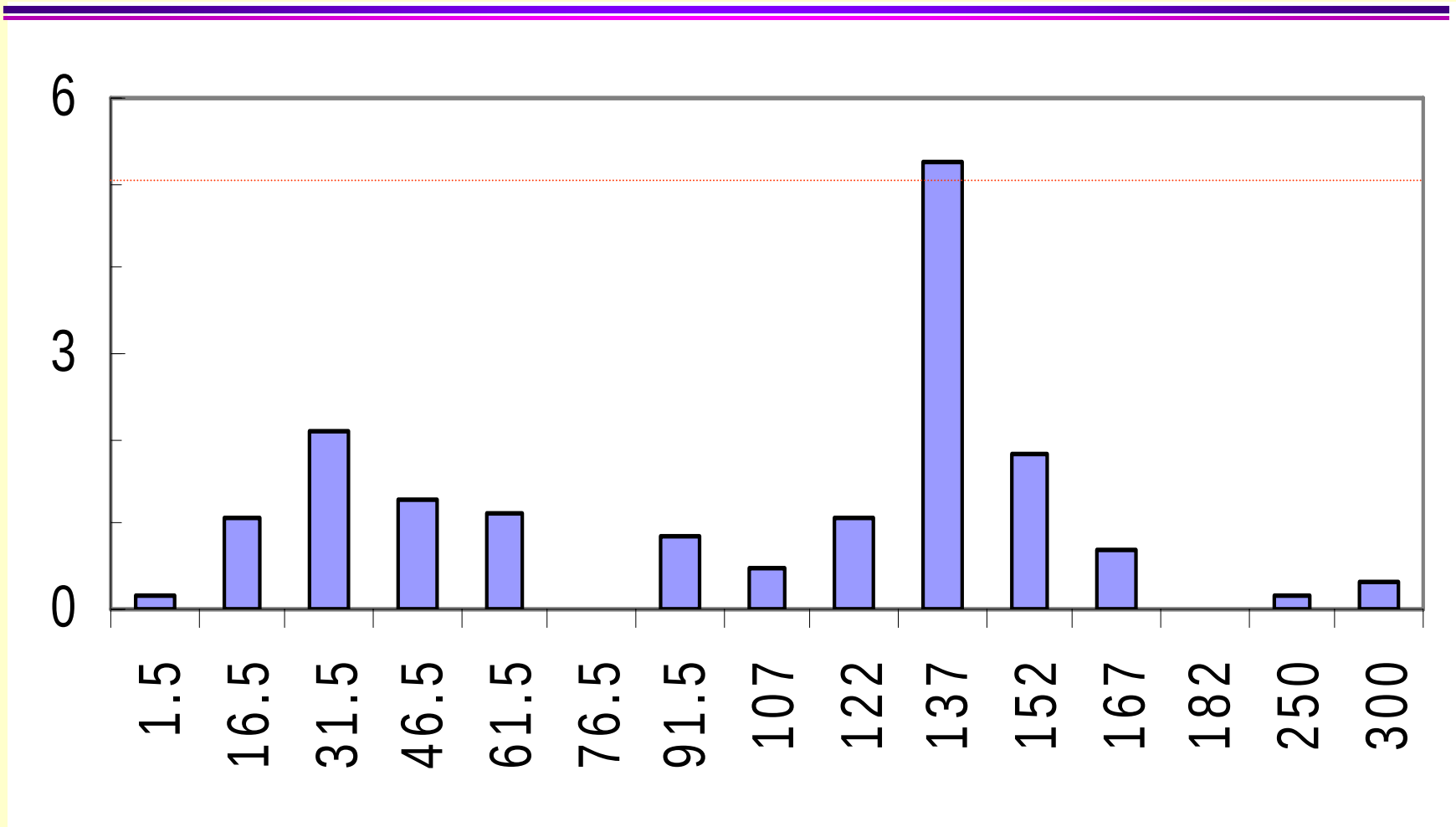
TCLP Pb (ppm) in surface soil of a 50-yard pistol range



TCLP Pb (ppm) in surface soil of a 200-yard rifle range



TCLP Pb (ppm) in surface soil of a sport clay range



TCLP- & SPLP- Pb in Berm Soils

Berm	TCLP-Pb	SPLP-Pb
50-P-30y	1,568	13.4
50-P-10y	1,408	1.0
200-R-30y	544	6.1

TCLP / SPLP Pb at Ranges

- Surface soils in shooting ranges contained elevated TCLP Pb (>5 ppm)
- Highest TCLP Pb was observed in berm soil (240-1,568 ppm)
- Highest SPLP Pb was observed in berm soil (1.0-13.4 ppm)

Clay Targets

Trap & Skeet Clay Targets

- Contain PAHs, non-toxic and not bio-available;
- Broken target fragments are solid waste;
- Impacts are limited to very near surface unless accumulation zone soil is reworked;
- Targets now available that don’t contain PAHs.

Remedial Options:

- Dig and Haul;
- Soil washing/Particle separation;
- Soil stabilization/solidification;
- Chemical extraction.

Regulatory Perspective

- Depending on conditions at the range and range siting, different federal and state environmental laws *may* apply
  - Clean Water Act
  - Wetlands Protection Act
  - RCRA

RCRA Requirements

- Lead bullets/shot are not a solid or hazardous waste when discharged; no RCRA permit is required;
- Recycled lead bullets are considered a scrap metal and exempt from RCRA waste management;
- Processed reclamation soil is RCRA exempt if reused in backstop or shotfall areas at an active range;
- Soil removed from range site must be characterized;
- Lead left in media after a range closes is subject to a RCRA 7002/7003 cleanup order if it poses harm.

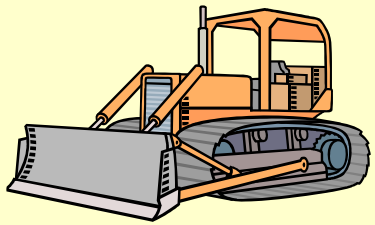
Site Cleanup Closure

- Closure plan required at time of changing land use;
- BMP Manual has checklist of major items that need to be included;
- RCRA waste management concerns can be addressed early in remediation order;
- Florida Legislature mandated that “principals of risk-based corrective action” be utilized regarding cleanup at ranges.

Cleanup at Shooting Ranges

When is a range subject to RBCA ?

- Usually when there is a range closure and change in land use;
- Third party complaint for offsite contamination;
- The range owner(s) may request assistance from the Department with site assessment.



Helpful Documents

- **Colorado Department of Public Health and Environment, Hazardous Materials and Waste Management Division, *Corrective Action at Outdoor Shooting Ranges Guidance Document*, Version One, January 2005. (http://www.cdphe.state.co.us/hm)**
- **Interstate Technology and Regulatory Cooperation Work Group, Technical/Regulatory Guidance: *Characterization & Remediation of Soil at Closed Small Arms Firing Ranges*. January 2003 (http://www.itrcweb.org/SMART-1.pdf)**
- **U.S. EPA, Office of Solid Waste and Emergency Response/ Brownfields Technology Support Center, *Analysis of Considerations for Developing a Methods Applicability Study- Small Arms Firing Range, Bluffton, South Carolina*. April 2003**

Cleanup Squirrel