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TA-00

LOS ALAMOS NATIONAL LABORATORY

ENVIRONMENTAL RESTORATION PROJECT

VOLUNTARY CORRECTIVE ACTION PLAN

FIELD UNIT ONE, TA-00
POTENTIAL RELEASE SITE 0-016
INACTIVE SMALL-ARMS FIRING RANGE

March 1996

Revision 0

6825

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1.0 INTRODUCTION

The United States Forest Service (USFS) and the County of Los Alamos have requested the cleanup of Potential Release Site (PRS) 0-016, the Former Small-Arms Firing Range, located immediately west of Guaje Pines Cemetery, prior to transfer of the land from the USFS to a local developer as part of a larger public-private land exchange. This Voluntary Corrective Action (VCA) plan is being proposed due to time constraints placed on the Los Alamos National Laboratory (LANL) Environmental Restoration (ER) Project by the pending land exchange.

An earlier VCA plan was prepared in 1993 and partially executed in 1993 and 1994. The previous VCA plan involved remediation of the firing range berms through soil washing to remove the lead and lead fragments from the soil. Approximately 6000 cubic yards (yds^3) of the lead-contaminated soil was cleaned by soil washing at the end of the 1994 field season, and approximately 5000 yds^3 remain.

At the beginning of the 1995 field season, the active Protection Technology of Los Alamos (PTLA) firing range in Tech Area 72 (TA-72) indicated several thousand cubic yards of soil was needed to improve the berms at the existing ranges. The option of moving the soil to the active PTLA firing range was considered by the New Mexico Environment Department (NMED) to be a cost-effective and "good common-sense" alternative to washing the remaining soil. Approval from the NMED to proceed with this option was not officially granted; however, the soil washing operations were discontinued based on an indication from the NMED that they would approve of moving the soil if certain conditions were met. After LANL complied with the conditions of the approval, the NMED and EPA determined that the soil should not be moved without first being processed to remove the lead, or unless LANL establishes a CAMU at the active PTLA firing range in TA-72. Due to the time required to prepare and process a CAMU application and a Class 3 permit modification, LANL has determined that the best way to move forward with the site cleanup is to remove the remaining bullets in the soil. This VCA plan provides the approach to removing a sufficient quantity of the lead from the remaining soil to facilitate transferring the soil to the active PTLA firing range or other appropriate LANL facility for re-use.

1.1 Site Type and Description

The Former Small-Arms Firing Range is located on a ridge between two small valleys which converge about one-quarter mile to the east (Annex 7.3, Figure 1). The ephemeral streams in these valleys feed into the upper end of Rendija Canyon. The terrain at the site varies from relatively flat on the ridge top to steep grades at the edges of the site which are associated with the valley walls.

With the exception of the areas with soil stockpiles, the site is covered by a thin veneer of soil overlying the Bandelier Tuff. In places, weathered Bandelier Tuff crops out. Soil thickness increases in the colluvial soils on the adjacent valley slopes and is thickest in the alluvial deposits on the valley bottoms.

Ephemeral surface-water conditions occur in the adjacent drainages and are associated with snow-melt runoff in the spring and localized thunderstorms during the period of July through September. The main aquifer beneath the site is approximately 1300 feet below the land surface and occurs within the Puye Formation and Santa Fe Group sediments.

The site is identified in Module VIII of LANL's RCRA permit, also known as the hazardous and solid waste amendments (HSWA) permit, as a Solid Waste Management Unit (SWMU) requiring a RCRA Facility Investigation (RFI). This PRS was not included in Table A of the 1990 HSWA permit and was subsequently added to the permit in 1994, via a February 1993 Class 3 permit modification.

1.1.1 Operational History

The small-arms range was constructed for use by security forces for the Atomic Energy Commission (AEC). Construction of the range was conducted after January, 1947, when control of all Manhattan Project sites was transferred to the Atomic Energy Commission (AEC). The range was used by security forces for small-arms target practice until the present firing range in Sandia Canyon was built in the early 1960s. The site has been used unofficially by the general public in the intervening years. The Department of Energy (DOE) released the range and surrounding areas to the USFS in 1976.

1.1.2 COPCs and Rationale for Proposed Remedial Action

The composition of the lead bullets and fragments is predominantly lead with minor amounts of other elements (Heath, et. al., 1991). The extracted lead will be containerized and sent to a recycling center.

Studies conducted by the Naval Engineering Laboratory indicate that metallic (elemental) lead (Pb) is the prime contaminant in small-arms firing ranges, but copper (Cu) and zinc (Zn) may also be found (Heath, et. al., 1991). Other forms of lead, such as oxidized lead, are not commonly found in small-arms ranges and would not be expected to be present in the arid environment found in Los Alamos. Existing analytical data indicate Cu and Zn are not present in concentrations exceeding 140 and 120 mg/kg, respectively.

2.0 SITE CHARACTERIZATION

2.1 RFI Information/Other Decision Data

The USFS conducted a study of the area in 1991 in which 11 of 21 samples taken from the PRS failed the toxicity characteristic leaching procedure (TCLP) test for lead. The data are not available, but a summary is given in Memorandum 7400, USFS, 1992; however, the contamination was attributed to the presence of lead bullets and fragments within the earthen berms. USFS Memorandum 7400 concludes that, because the TCLP test did not reproduce the essentially pH-neutral soil conditions at the site, the lead-contaminated soil does not constitute a release of a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act. The Forest Service memorandum further maintains that the lead in the earthen berms does not constitute a threat to the ground water in the area due to the great depth to water (approximately 1300 feet below ground surface).

In 1993, the USFS and a private developer reached an agreement on a land exchange that includes the Former Small-Arms Firing Range. To date, only the land adjacent to the range has been exchanged. The agreement calls for the range to be exchanged also, if it could be cleaned up within two years of the initial exchange. Although more than two years has passed, the range land is still available to the developer but he is now in jeopardy of losing it. The USFS, the private developer, and the County of Los Alamos want the cleanup to be completed in order to open the entire area for development; and have requested DOE to remediate the site immediately. Therefore, this VCA plan is being proposed as an amendment to the original VCA plan.

2.2 Nature and Extent of Contamination

The nature of small-arms ranges dictates that lead bullets and lead fragments be largely restricted to the range itself, with the majority of the lead in the target and backstop berms. At PRS 0-016, some bullets are also present in the area immediately behind the backstop berms. Thus, the extent of significant contamination is very limited. The area behind the backstop berms was found to contain a significant number of bullets upon initial investigation, and was subsequently cleaned up in 1994 by removing the soils containing elevated levels of lead. These soils were added to the stockpiled soils in the central portion of the site.

3.0 PROPOSED REMEDY

3.1 Description of the Proposed Remedial Action

Approximately 5000 yds^3 of stockpiled soil will be processed to remove the lead bullets. Most of the bullets in the soil are approximately .45 caliber. A dry screening process will be used to separate out the size-fraction of the soil that contains bullets of this size. Removal of the bullet-size fraction of the soils will greatly reduce the total lead content and lead leachability.

The bullets will be separated from the stockpiled soil using a sand and gravel sorting apparatus, referred to as a Shaker Plant, that is equipped with various sizes of screens. The soil will be processed through the shaker plant twice to facilitate removal of the size-fraction containing the bullets. First, the soil will be sieved using a 1/8-inch (approximate) screen which will allow the material that is finer than the bullet-size fraction to be segregated from the bullets and larger material. This larger fraction, containing the bullets, will then be sieved a second time using a 1/2-inch (approximate) screen which will allow the bullets and bullet-sized material to pass though, and all materials greater than 1/2-inch will be captured by the screen. The course fraction consisting of boulders, cobbles, and coarser gravels will be considered non-hazardous because the bullets and fine lead fragments will have been removed from this fraction through the sieving process. The fine fraction containing the lead fragments will be sampled at regular intervals for waste characterization.

A significant correlation was established between X-ray fluorescence (XRF) and inductively-coupled plasma (ICP)/atomic emission spectroscopy and optical emission spectroscopy analytical results for lead (SW 846 Methods 6010, 7420, and 7421), as well as between total lead (XRF/ICP) and TCLP lead concentrations, based on data from previous operations at the site. The correlation is described in Section 3.2. Because a significant correlation exists between total lead by ICP, total lead by XRF, and leachable lead by TCLP, the results of XRF analysis may be used to determine if the processed soil will exceed the TCLP limit. For this purpose, a total lead concentration of 940 ppm will be used as the basis for collection of samples for TCLP lead analysis or determining if the soil is hazardous. For example, if XRF analysis indicates 940 ppm lead, then based on the correlation, the TCLP lead concentration would be 5 mg/L, and the TCLP limit would not be exceeded. The correlation is based on a conservative analysis of the data; therefore, the actual TCLP lead concentration in a sample containing 940 ppm total lead by XRF analysis, would likely be significantly lower than 5 mg/L. Thus, if the total lead concentration determined by XRF is below 940 ppm, then analysis of the corresponding TCLP sample would not be necessary to characterize the soil as non-hazardous.

The XRF will be used as a guide to ensure that the material is being effectively cleaned during the bullet-removal process and for quickly identifying "hot spots" within the processed soil. The processed soil will be sampled for waste characterization in 25 yd^3 units to ensure adequate characterization. One discrete grab sample will be collected from each 25 yd^3 unit of processed soil at a randomly selected location and analyzed for lead using an on-site XRF unit. In addition, a TCLP lead sample will be collected from each 25 yd^3 unit at the same location (split) as the XRF sample, and will be stored pending analysis. If an XRF sample exceeds 940 ppm lead, then the TCLP lead sample collected from the same location (split) may be submitted for analysis to verify that the unit of soil is hazardous. If an XRF sample contains less than 940 ppm lead, then the TCLP lead sample will not be analyzed, and the 25 yd^3 unit of processed soil will be characterized as non-hazardous based on the total lead results determined using XRF.

If XRF lead results for a 25 yd^3 unit of processed soil are below 940 ppm, the soil will be transferred to the active PTLA Firing Range or other industrial facility for re-use. The acceptance criteria for industrial facilities is based on the Preliminary Remediation Goal (PRG) for industrial land-use sites of 1000 ppm total lead. If the XRF lead results exceed 950 ppm and TCLP lead content in the soil exceeds 5 mg/L (if analyzed), the soil will be shipped off-site for treatment and disposal at a permitted hazardous waste landfill.

Visual observations will also be used as a guide to segregating soils with potentially higher lead concentrations. As the soil is processed through the shaker plant, observations will be made as to how many bullets accumulate on the screen with respect to the quantity of soil passing through the plant. If observations indicate that there is a relatively high density of bullets in portions of the soil, then these materials will be segregated from soils that yield fewer bullets until analytical results are available to characterize the material.

Soil will be transferred from the soil stockpiles to the Shaker Plant using a front-end loader. The soil will be sprayed with water, as necessary, to minimize the amount of lofted dust. Airborne dust and lead will be monitored at the site in accordance with the Site-Specific Health and Safety Plan (SSHASP). Personnel and area monitoring for lead will be conducted during initial soil processing operations to ensure that site workers are not exposed to lead. Based on archival data and previous monitoring at the site, it is very unlikely that concentrations of airborne lead will approach action levels. It is expected that a negative initial determination will be made following the first few days of processing, allowing the monitoring to be discontinued.

A VCA Report will be prepared and submitted to the EPA when the project is completed. Copies will be provided to the USFS and the future site owner.

3.2 Basis for Using XRF to Segregate Suspect Hazardous Waste

Statistical analysis of the existing soil grab samples collected from PRS 0-016 indicate that lead XRF analysis will be useful in providing near real-time data to help segregate suspect hazardous waste from non-hazardous waste. This statement is based on two correlations in the PRS 0-016 results. First, there is a strong correlation between the lead analyzed by ICP and the lead analyzed by XRF. This relationship is illustrated below in Figure 1, and implies that a result XRF is roughly equal to the ICP result for the concentration range of zero to 200 mg/kg. Second, there is a strong correlation between lead measured by ICP and TCLP analysis of the same sample. This relationship is shown in Figure 2, below, and suggests that the best estimate of the TCLP result is a 0.32% ratio of the ICP result. An upper confidence limit of this ratio is 0.53%. In other words, the ppm of leached lead from the TCLP analysis correlates with 0.0053 times the total lead in ppm. Because of the 20 fold dilution factor used in the TCLP analysis, an absolute maximum value for this ratio is 5%. The 5% maximum value is based on assuming that the lead is 100% leachable under the weak acid digestion used in the TCLP analysis (i.e., 0.53 % is approximately one tenth of 5%). Thus, the upper confidence limit of 0.53% implies that the lead is approximately 10% leachable in the TCLP analysis.

Based on the correlation analysis of the XRF, ICP and TCLP data for PRS 0-016, a ratio of 0.53% is a reasonable basis for segregating potentially hazardous quantity of lead from non-hazardous quantities of lead. This ratio would imply that 940 mg/kg, measured by XRF would equal 5 mg/L by TCLP. Because the correlation is conservative, however, it is likely that the TCLP concentration would be well below 5 mg/L. This value is much less than the lowest lead sample determined by NM Bureau of Mines to exceed the 5 mg/L value (reported as 1474 mg/kg)[1].

[1] Note that the NM Bureau of Mines did not report actual TCLP results if they exceeded 5 mg/L. The TCLP result was reported as >5 mg/L.

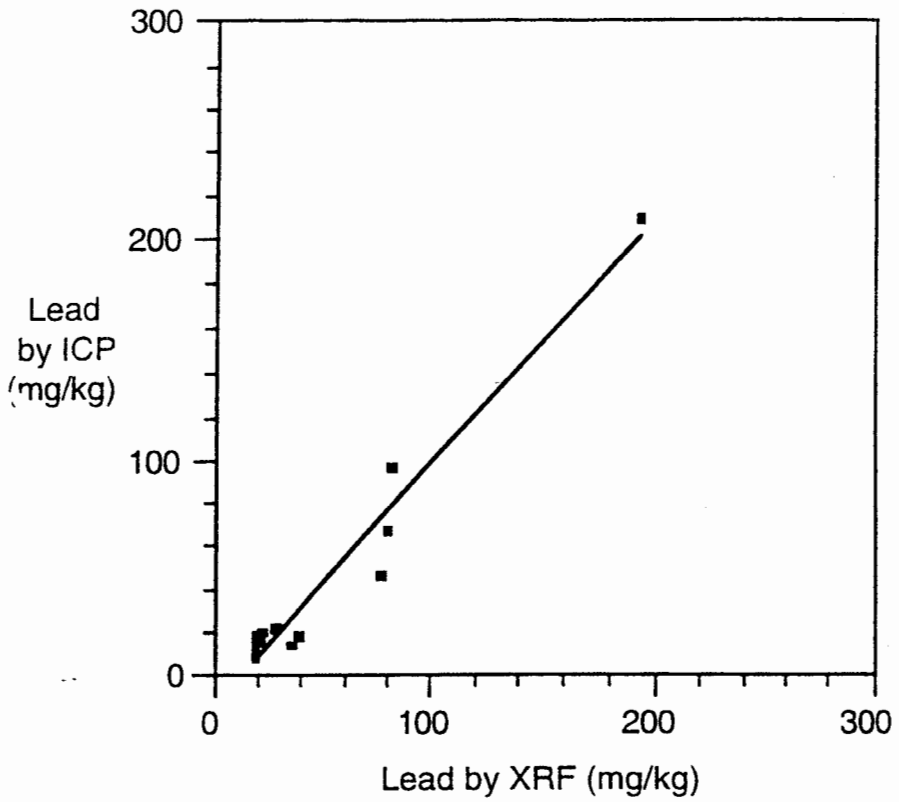

Figure 1. Correlation between lead measured by two methods from grab samples collected in PRS 0-016. There were 14 soil samples analyzed by both methods and a linear regression analysis yielded the following formula:

ICP = -11.2 + 1.11 * XRF, where the correlation coefficient is 0.976.

This correlation is highly significant.

The data used in the statistical analysis are summarized in Table 1.

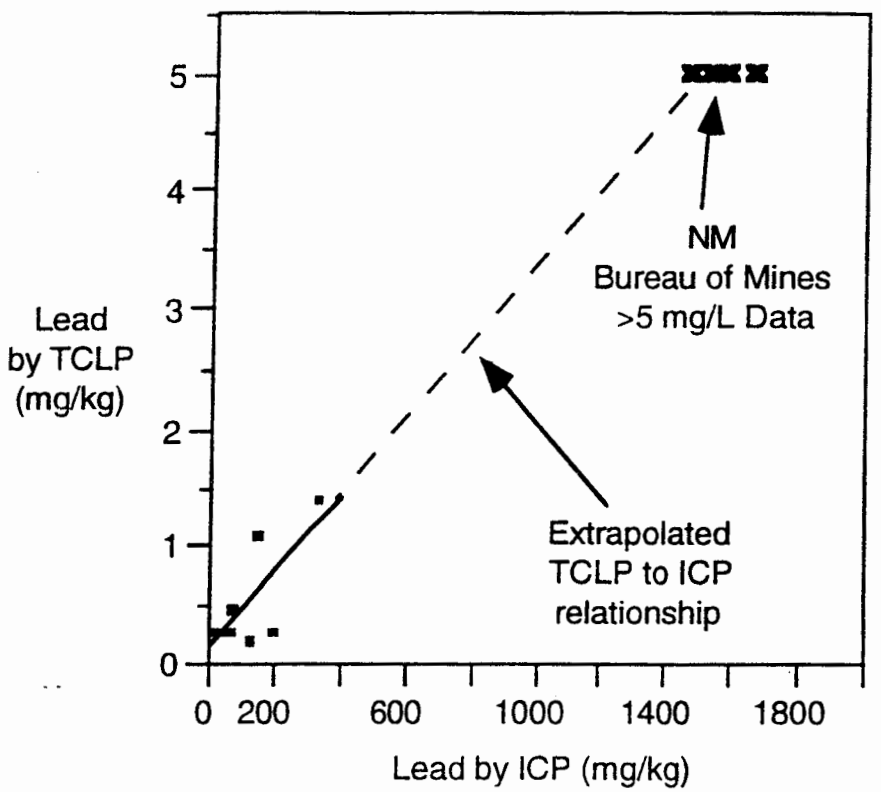

Figure 2. Correlation between lead measured by ICP and TCLP from grab samples collected in PRS 0-016. There were 10 soil samples analyzed by both methods and a linear regression analysis yielded the following formula:

TCLP = 0.163 + 0.00322 * XRF, where the correlation coefficient is 0.729. This correlation is highly significant.

The data used in the statistical analysis are summarized in Table 1.

Table 1
Summary of Data used in the Statistical Analysis

Sample ID	Location ID	Lead by XRF (mg/kg)	Lead by ICP (mg/kg)	Lead by TCLP (mg/L)
AAA6270	00-1440	76	46	NA
AAA6273	00-1422 *	19	11	NA
AAA6274	00-1422 *	19	13	NA
AAA6275	00-1423 *	28	23	NA
AAA6276	00-1424 *	19	17	NA
AAA6277	00-1425 *	19	19	NA
AAA6278	00-1426 *	22	21	NA
AAA6696	00-1440	36	14	NA
AAB2415	00-1441 *	193	210	NA
AAB2415D	00-1441 *	NA	140	NA
AAB2416	00-1442 *	81	97	NA
AAB2417	00-1443 *	79	68	NA
AAB2424	00-1444 *	20	17	NA
AAB2425	00-1444 *	39	20	NA
AAB2426	00-1445 *	19	8.2	NA
NM BofM	CT-L-1	NA	147	1.1
NM BofM	CT-S-9	NA	66	0.3
NM BofM	CT-L-2	NA	1582	>5
NM BofM	CT-S-6	NA	81	0.5
NM BofM	CT-S-12(B)	NA	1670	>5
NM BofM	CT-L-4(B)	NA	2434	>5
NM BofM	CT-S-12(A)	NA	1474	>5
NM BofM	CT-L-4(A)	NA	4386	>5
NM BofM	CT-S-11	NA	1531	>5
NM BofM	CT-L-5	NA	3285	>5
NM BofM	CT-S-7	NA	126	0.2
NM BofM	CT-S-3	NA	194	0.3 †
NM BofM	CT-S-8	NA	328	1.4
NM BofM	CT-S-1	NA	20	0.3 †
NM BofM	CT-S-2	NA	78	0.5
NM BofM	CT-S-4	NA	55	0.3 †
NM BofM	CT-S-5	NA	74	0.5

NM BofM = NM Bureau of Mines samples.
* = Back-area grab samples.
NA = Not Analyzed
† = Value was reported as <0.3 mg/L.

3.3 Basis for Cleanup Levels

Lead concentrations at the site following the removal of the soil stockpiles will be reduced to concentrations at or below the Screening Action Level (SAL) of 400 ppm. This SAL is based on risk analysis results for a residential land use scenario and will ensure that there is minimal health risk to future site residents and to the environment. Verification/confirmation samples will be collected from the range floor to determine if cleanup levels have been achieved.

Cleanup levels for the soil stockpiles following removal of the bullets will be based on the RCRA hazardous waste determination limit of 5 mg/L for TCLP lead and the PRG for industrial land-use sites of 1000 ppm total lead. Processed soils that meet these criteria will be moved to the active PTLA Firing Range in TA-72 or another suitable industrial location.

3.4 Site Restoration

Following VCA activities, the site will be released to the USFS for completion of the land transfer to the land developer. Site restoration activities will be minimal, at the request of the land developer.

4.0 WASTE MANAGEMENT

4.1 Estimated Types and Volumes of Waste

The types of waste to be generated as a result of the VCA activities will include a bullet/gravel mixture to be recycled, processed soil that is non-hazardous; and possibly, processed soil that is hazardous.

The bullets segregated from the soil will be mixed with bullet-sized gravels as a result of the size-separation process. It is estimated that approximately 30 drums of this material will be generated. The drums will be stored on-site until arrangements are in place to transfer the lead/gravel to a recycling center.

The processed soil that is determined to be non-hazardous based on XRF screening and TCLP lead analysis, will be segregated from other materials and stockpiled on-site pending transfer to the active PTLA Firing Range, or other industrial LANL facility, for re-use.

The soils processed through the Shaker Plant are not expected to exceed the TCLP limit for lead; however, in the event that portions of the material are determined to be hazardous based on TCLP lead analysis, these portions will be segregated, properly contained, and stored on-site until proper shipping and disposal can be arranged.

4.2 Method of Management and Disposal

The drums of lead/gravel mixture will be stored on-site pending transfer to a recycling center. The processed soil that is determined to be non-hazardous will be stockpiled on-site pending transfer to an appropriate facility for re-use (e.g., TA-72 PTLA Firing Range). Soil that is determined to be hazardous will be contained and stored on-site pending appropriate transportation and disposal at a LANL-approved treatment, storage, and disposal facility (TSDF).

5.0 DESCRIPTION OF CONFIRMATORY/VERIFICATION SAMPLING

A total of 23 confirmation/verification samples will be collected from the site. Twenty of these will be collected from the firing range floor and areas covered by the soil stockpiles at randomly selected locations based on a 50-foot grid laid over the entire site. An additional three samples will be collected from the first-order drainages that capture the bulk of the surface water from the site. Confirmation/verification samples will be analyzed by an approved contract laboratorv for total lead, copper, and zinc by EPA SW-846 Method 6010.

6.0 ESTIMATED TIME TO COMPLETE THE ACTION AND UNCERTAINTIES

The estimated duration of the VCA activities is 5 weeks. Mobilization of equipment and materials will require approximately 1 week and Shaker Plant soil processing will require approximately 4 weeks. Hauling the processed soil off-site is estimated to require 2 weeks and verification sampling will be completed in approximately 2 days.

ANNEX 7.1

Risk-Based Cleanup Level Assumptions and Calculations

ANNEX 7.2

RFI Analytical Results

This section does not apply because no RFI field investigations have been conducted at this site. VCA analytical results are provided in Section 3.2 of this VCA plan.

ANNEX 7.3

Site Map

ANNEX 7.4

Implementation SOPs

See Environmental Restoration Standard Operating Procedures, Volumes I and II, November 17, 1993, Los Alamos National Laboratory.

ANNEX 7.5

Quality Assurance Plan

See Quality Program Plan and Quality Assurance Project Plan for Environmental Restoration, February 1995 revision, Los Alamos National Laboratory.

ANNEX 7.6

Site-Specific Health and Safety Plan

The site-specific Health and Safety Plan is currently under development. See the Los Alamos Laboratory Environmental Restoration Project Health and Safety Plan, February 11, 1995, Los Alamos National Laboratory.

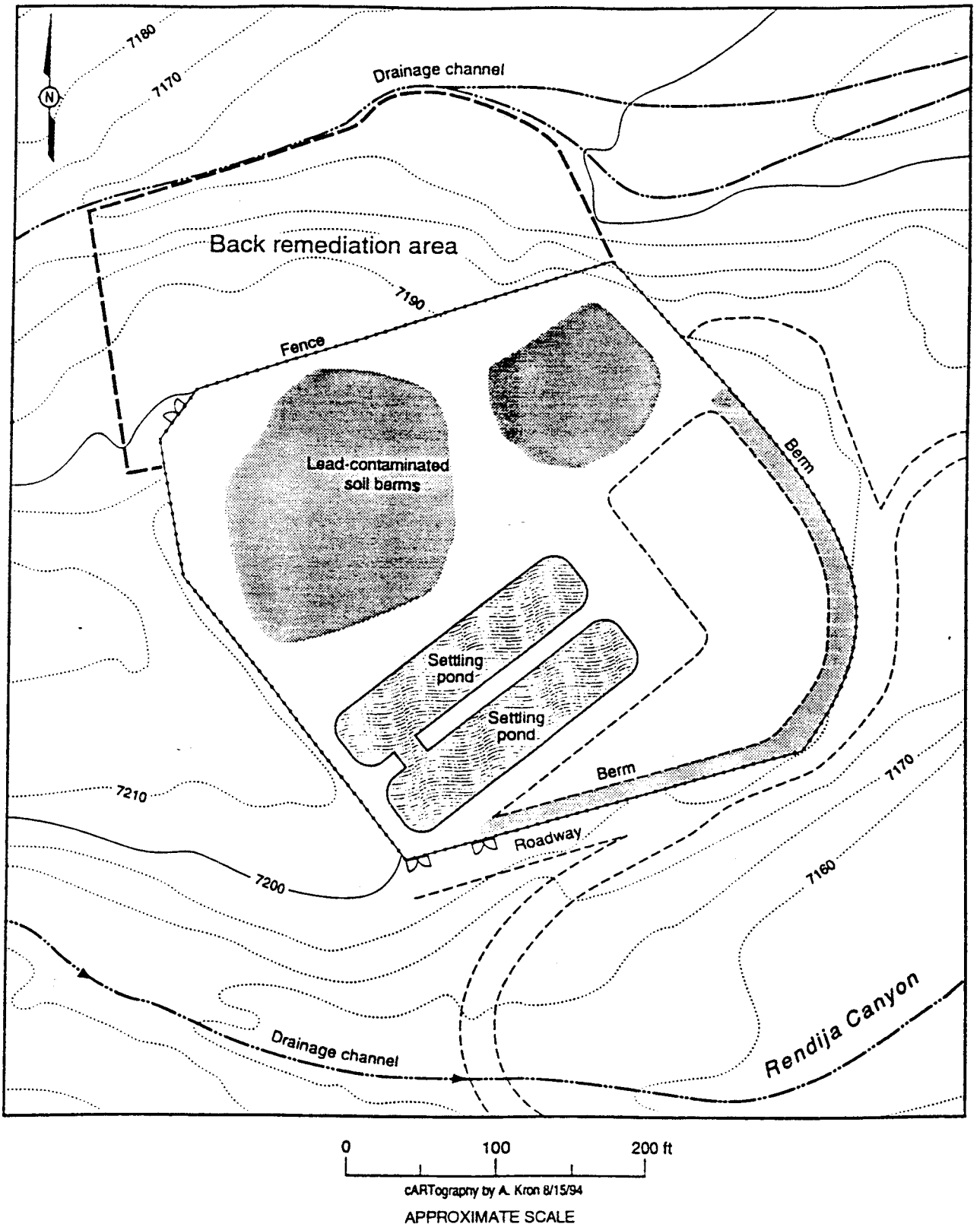

Figure 1. Inactive firing range site map, PRS 0-016

ANNEX 7.7

Waste Management Checklist

A site-specific Waste Characterization Strategy form has not yet been developed for the VCA operations presented in this plan.

ANNEX 7.8

Voluntary Corrective Action
Checklist and Fieldwork Authorization Form

PRS No. _____ HSWA or AOC

_____ PCOC(s) defined.

_____ Nature and extent defined or field screening method available to guide where not defined.

_____ Remedy is obvious.

_____ Time for removal is less than 6 months.

_____ Land use assumptions straightforward.

_____ Treatment, Storage, Disposal Facilities are available for waste type and volume.

_____ Cleanup cost is reasonable for the planned action, and meets accelerated decision logic criterion for decision to proceed with VCA.

Explain criteria not checked above._____

_____

_____

Through reviewing the above criteria associated with this site, I believe that a VCA is the appropriate Accelerated Cleanup approach.

FPL _____ Date _____

FPC _____ Date _____

Through reviewing the VCA Plan, for site _____, and believing that the above criteria have been met, I authorize the fieldwork to proceed.

DOE ER Program Manager_____ Date_____

7.9 VCA Cost Estimate

(Assumption: Processed soil will be non-hazardous)

Pre-Field Activities

Field Preparation/Readiness Review	Subtotal	$ 15,000

Field Activities

Field Team (FOM, FTM, FTL/Sampler/Waste Manager, SSO, XRF Analyst, etc.)	$ 50,000
Geodetic Surveys	$ 1,500
Shaker Plan Operating Costs	$ 20,000
Transportation of Processed Soil for Re-use (non-hazardous)	70,000
Hazardous Waste Disposal ($ 200 per cubic yard including transportation)	$0
Site Restoration	$ 5,000
Subtotal	$ 161,500

Analytical Costs

XRF Rental	$ 5,000
Waste Characterization Samples (assumes analyzing 50% of TCLP samples)	$ 25,000
Verification Sampling	$ 5,000
Subtotal	$ 35,000

Post Field Activities

Acceptance Inspection	$ 1,000
Final Report	$ 25,000
Subtotal	$ 26,000

Total Estimated Cost	**$ 222,500**

7.9 VCA Cost Estimate

(Assumption: Processed soil will be non-hazardous)

Pre-Field Activities

Field Preparation/Readiness Review	Subtotal	$ 15,000

Field Activities

Field Team (FOM, FTM, FTL/Sampler/Waste Manager, SSO, XRF Analyst, etc.)	$ 50,000
Geodetic Surveys	$ 1,500
Shaker Plan Operating Costs	$ 20,000
Transportation of Processed Soil for Re-use (non-hazardous)	70,000
Hazardous Waste Disposal ($ 200 per cubic yard including transportation)	$0
Site Restoration	$ 5,000
Subtotal	$ 161,500

Analytical Costs

XRF Rental	$ 5,000
Waste Characterization Samples (assumes analyzing 50% of TCLP samples)	$ 25,000
Verification Sampling	$ 5,000
Subtotal	$ 35,000

Post Field Activities

Acceptance Inspection	$ 1,000
Final Report	$ 25,000
Subtotal	$ 26,000

Total Estimated Cost	**$ 222,500**