SITE ASSESSMENT
UNION MINE GUN RANGE
EL DORADO COUNTY, CALIFORNIA

February 14, 2001

A Report Prepared for:

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1 INTRODUCTION

El Dorado County Environmental Management Department (El Dorado County) retained Kleinfelder to perform a site assessment of the Union Mine Gun Range located in El Dorado County, California. This report presents the results of Kleinfelder's recent site assessment. The purpose of this assessment was to evaluate potential contamination due to the usage of the gun range. From this assessment, El Dorado County can evaluate current site conditions, potential risks or environmental impacts of current operations, potential mitigation or remediation alternatives, and corrective measures to prevent future impacts of gun range operations.

Kleinfelder evaluated the site based on the results from 46 soil sample locations and one surface water sample. Assessment areas include:

- Background Locations
- Fire Lines
- Berms and Target Backstops
- Hillside behind the Berms and Backstops
- Drainage Areas
- Trap Range

In general, the constituents of concern at the El Dorado County gun range are lead, copper, nickel and zinc. These four metals are associated with bullets and shell casings. Samples collected from the Union Mine site were analyzed for these four metals. A sample from an impact berm was additionally analyzed for CAM 17 metals to assess whether other metals were present at elevated levels.

Other potential constituents of concern may be polynuclear aromatic hydrocarbons (PAHs) associated with the "clay pigeons" used at the trap range and the lime used for the stabilization of lead in the berms. In discussions with gun range personnel, the "clay pigeons" are thought to be inert with little potential for environmental impact. Recent sampling by Kleinfelder at another gun range site indicated that PAHs might be present in the "clay pigeons" used at trap ranges. Therefore, a sample from the trap range was additionally analyzed for volatile organic and semi-volatile organic constituents. Lime is apparently stored at the site and added to the soil in the gun range berms. Select soil samples were analyzed for pH to assess the effects of adding lime to the soil.

This report presents information regarding the site background, field activities and sampling, sample preparation and analysis, summary of analytical results, current regulatory oversight, gun range technology, risk evaluation of lead, site use and recommendations.

2 BACKGROUND

The Union Mine Gun Range is located on Dub Walker Road, east of Union Mine Road, south of the town of El Dorado, California (Plate 1). The Union Mine Gun Range is currently used as a shooting range by the Placerville Rod and Gun Club, the El Dorado Sheriff's Department, and the public. The Union Mine Gun Range consists of the following site activities and conditions (Plates 2A and 2B):

- Two pistol ranges (north and south) with target stops in the slope of the hillside.
- One pistol and large bore range with an intermediate soil berm and hillside target stop.
- One hillside trap range.
- Gun ranges were graded and built into fractured, weathered metamorphic bedrock.
- Anticipated depth to groundwater is at a depth greater than 50 feet below grade.
- Surface drainage is to Martinez Creek.

North Pistol Range

South Pistol Range

Intermediate Berm

End Wall Berm

Pistol and Large Bore Range

Pistol and Large Bore Range

Trap Range

Based on conversations with county employees, we understand that the trap range has been in operation since 1977 and the main gun range has been in operation since around 1979. Prior to that time, the site was reportedly vacant. Aerial photographs prior to 1977 were not available to evaluate previous land uses. Soil sampling and site assessment activities have not been performed at this site prior to Kleinfelder's investigation. Neighboring properties appear to be open vacant land and the Union Mine Landfill.

Site visits were conducted by Kleinfelder staff on October 5, October 17, October 26, November 3, and November 22, 2000. The site visits were conducted to plot sampling locations, to coordinate range access and to perform sample collection. Ms. Sarah Belway, Kleinfelder's environmental engineer, performed the site visits. Proposed sample locations were coordinated with Mr. Jeff Rusert of the El Dorado County Environmental Management Department. Gun range access and sampling times were coordinated with Mr. Hal Pringle. Sample access dates and hours were limited due to the frequent use of the gun ranges.

During the site visits, it appeared that the southern pistol range, the pistol and large bore range and the trap range were operational. The northern pistol range did not appear to be operational. In addition to the range status, an uncovered pile of lime was observed at between the northern pistol range, and the pistol and large bore range. Apparently the Gun and Rod Club adds lime to the berms to stabilize lead in the soil in accordance with recommendations from gun range management programs.

The main gun range consisted of a compacted gravel surface with exposed bedrock on the upper hillside to the west and thick brush covering loose sandy silt with rock on the downward slope to the east. Shell casings covered the firing lines, and bullets were visible in the target areas and berms.

The trap range consisted of a relatively flat compacted gravel surface. The north slope of the range consisted of loose rock on a fairly steep slope. This slope flattened out as it continued northward. As the slope flattened out, soil conditions consisted of mostly sandy silt with rock, roots and vegetation debris. Vegetation on the hillside consisted of mostly mountain manzanita and poison oak which was thick near the top of slope and thinned out as the slope extended downward to the north. "Clay pigeons" were observed on the north side of the trap range to approximately 300 feet north of the trap shacks. The largest amount was observed between 75 and 150 feet north of the trap shacks. Shot pellets were not observed on the hillside.

The trap range is situated east of the gun range at a higher elevation. "Clay pigeons" are shot directly north from the range. On the north side of the trap range is a slope that extends approximately 600 to 800 feet to an intermittent stream that runs down from the gun range and separates the gun range property from the adjacent landfill property. According to El Dorado County employees, shot from the trap range has landed as far as the adjacent Union Mine landfill property on the north side of the intermittent stream.

Kleinfelder submitted a proposal to the El Dorado County Environmental Management Department dated April 10, 2000 to perform an environmental site assessment. A contract for services was signed on September 12, 2000. A site specific Sampling and Analysis Plan, dated October 13, 2000, and Site Assessment Permit application and fee were submitted to El Dorado County Environmental Management Department for review and approval. The approved permit is included in Appendix A.

3 FIELD ACTIVITIES AND SAMPLING

Bullets and shot in the berms, hillside backstops and soil surrounding the ranges are considered the primary source of gun range metals. The general scope of work was to collect soil samples at 0.5 feet and 2 feet below the ground surface. Two samples were collected at each sample depth. The shallow samples were analyzed and the deeper samples held in Kleinfelder's sample control. Depending on the analytical results of the shallow samples, the deeper samples were submitted for analyses.

On October 5, 2000, sample locations were selected and plotted using Global Positioning System (GPS) equipment fitted with a real-time terrestrial signal processor. The samples collected on the slope of the trap range were not surveyed due to thick brush and inaccessibility. These samples locations were measured from the trap shacks, and the positions were estimated. The sample locations were presented in the Sampling and Analysis Plan. On October 17, 2000, Sarah Belway met Jeff Rusert on site to discuss revised sampling locations at the trap range and adjacent slope. The trap range sample locations were selected in a radial pattern at 75, 150, 300, 450 and 600 feet down the north slope from the trap shacks (the direction of fire). The trap range slope samples were selected based on the anticipated carry of shot and the concentration of "clay pigeon" fragments between 75 and 300 feet.

On October 26, 2000 Sarah Belway outlined the sampling areas in the field and notified Underground Services Alert (USA) of the pending underground work. The sampling locations were cleared under USA Ticket #346960.

3.1. SOIL SAMPLING

On November 3, 2000 Sarah Belway collect soil samples from the trap range, and on November 22, 2000, Sarah Belway, Steve Dalton and Mark Lee of Kleinfelder collected soil samples at the trap range and gun ranges. The sample locations are shown on Plates 2A and 2B. Sample locations that were not accessible with a backhoe were sampled using hand equipment consisting of a shovel and/or trowel. Samples were generally collected at 0.5 feet and 2 feet below grade unless refusal was encountered. Refusal was encountered at locations S1, S2, S4, S18, S19, S20 and S36. Samples accessed with the backhoe were collected directly from the backhoe bucket, and the soil sampled was not in contact with the backhoe bucket. Hand sampling equipment was cleaned with a non-phosphate wash and rinsed with distilled water between each sampling location. The sample locations were backfilled with native soil.

Operations at the site included the use of wall berms and intermediate berms. Wall berms existed at the pistol ranges and the large bore range. The wall berms consisted of on-site material generally weathered bedrock and soil. The intermediate berms were located on the large bore range between the firing line and the wall berms. There are two such berms that are approximately 5 feet high (Plate 2A). The intermediate berms consisted of mostly sandy silt. Lime had been added to berms apparently to stabilize the lead.

Soil samples from the ranges were placed in glass jars (2 jars per location), labeled, and transported to Kleinfelder's sample control under chain-of-custody controls. At sample location S36 at the trap range additional soil was collected at 0.5 and 1 foot in two clean brass tubes and capped with Teflon and plastic end caps. These samples were later submitted for volatile and semi-volatile organic constituent analyses.

Soil samples from 46 locations were collected from the pistol and large bore ranges, and the trap range. The samples were collected at the following locations:

- Site Background – S18 and S30
- Gun Range Hillsides – S1, S2, S3, S19 and S29
- Gun Range Fire Lines – S6, S7, S13, S14, S16, S17, S23, S24 and S25
- Large Bore Range Drainage Areas – S8 and S15
- Gun Range Wall Berms – S4, S5, S26, S27 and S28
- Gun Range Berms – S9, S10, S11 and S12
- Gun Range Sidewall – S20, S21 and S22
- Trap Range Fire Line – S31 through S34
- Trap Range North Slope (75 to 600 feet) – S35 through S39 and S41 through S47

3.2. SURFACE WATER SAMPLING

In addition to the 46 soil sample locations, one surface water sample (109080) was collected from the drainage below the trap and gun ranges. A surface water sample from the intermittent creek immediately down slope of the gun range was not collected due to the dry weather and lack of water. Therefore, a sample of first encountered surface water below the two ranges was collected as it exited through a culvert at the bottom of the hill. The surface water sample was collected in a clean, unpreserved, polyethylene container. The sample was collected by holding the container under a culvert outlet. The sample was placed on ice and transported under chain-of-custody controls to Kleinfelder's sample control.

Surface Water Sample Location from Culvert

4 SAMPLE PREPARATION AND ANALYSIS

The shallow soil and surface water samples collected from the Union Mine Gun Range site were analyzed for four metals associated with bullets and shell casings (lead, copper, nickel and zinc). Most of the samples required preparation before being submitted to the analytical laboratory.

4.1. SAMPLE PREPARATION

4.1.1. Soil Samples

The objective of the initial sample analysis was to assess whether elevated metals had impacted the shallow soil and berms at the gun range site. When a soil sample is submitted for total metals analysis, the analytical laboratory digests the sample with acid. The digestion of a bullet or bullet fragment would alter the analytical results for the soil sample. Therefore, the soil samples to be analyzed for metals were oven dried and then sieved through a 2-millimeter screen in accordance with EPA SW-846. The purpose of this procedure is to obtain a better assessment of the bullet's impact to soil rather than assessing the metal concentrations of a bullet. The samples were weighed before and after the oven drying to obtain moisture content. This was done to obtain a wet weight of the sample for comparison purposes, if needed.

Shallow samples from 43 of the 46 sample locations were sieved for metals analysis. The deeper samples from two of the intermediate berm locations at the pistol and large bore range (S10 and S11) were sieved for metals analysis. This was done to provide a more complete assessment of the berm material.

To reduce the potential for cross contamination of the samples, the samples were sieved in order from least likely to be impacted (background) to most likely to be impacted (berms). Sieves were cleaned between sieving using a clean brush and wiped down with paper towels. These samples were placed in new glass jars, labeled and transported to the analytical laboratory.

4.1.2. Surface Water Sample

After the surface water was collected in a clean unpreserved container, it was then filtered through a 0.45 μm filter using a peristaltic pump and polyethylene tubing. The filtered sample was then transferred to a preserved container, labeled, placed on ice, and transported to the analytical laboratory.

4.2. SAMPLE ANALYSIS

Initially, soil samples from 46 locations and one surface water sample were submitted under chain-of-custody controls to CLS Laboratory in Rancho Cordova, California, to provide a quantitative assessment of potential contaminants in the soil and water. The shallow sieved samples from 43 of the 46 sample locations, the deeper sieved samples from two of the large bore range intermediate berm locations, and the surface water sample were submitted for the following analysis:

- Copper
- Lead
- Nickel
- Zinc

The sieved sample from S8 was not analyzed for the four metals. The sieved gun range berm sample from location S12 was submitted for the remaining CAM 17 metals. This sample was collected from an area where bullet fragments were observed while sieving and elevated metal concentrations were anticipated. The complete list of CAM 17 metals were analyzed to assess whether other metals were present at elevated levels.

The two soil samples collected at a depth of 0.5 and 1 foot from location S36 at the trap range were analyzed for volatile and semi-volatile organic constituents. These samples were collected where "clay pigeon" fragments were observed at the surface and were analyzed to see if organic constituents potentially associated with the "clay pigeons" were present in the soil.

The sieved soil samples for gun range drainage locations S8 and S15 and wall berm location S26 were analyzed for pH. These samples were analyzed to assess the potential impact of lime stockpiled on site and used in the berms.

CLS Laboratory analyzed the samples on a regular turnaround schedule. A summary of analytical results is presented on Table 1. A summary of the detected CAM 17 metals for location S12 is presented on Table 2. A summary volatile and semi-volatile organic constituents detected in the two samples from trap range location S36 is presented in Chapter 5 of this report. Chain-of-Custody forms and laboratory data sheets are included in Appendix B.

Following the receipt of the initial analytical results, the deeper sample from large bore range drainage location S15 was dried, sieved and analyzed for lead and copper. This sample was selected due to an elevated level of these constituents in the shallow sample.

5 SUMMARY OF ANALYTICAL RESULTS

The analytical results provided by CLS are summarized in Table 1, and the laboratory data sheets are included in Appendix B.

5.1. SURFACE WATER SAMPLE RESULTS

The surface water sample collected from the drainage culvert at the bottom the hill was analyzed for the four gun range metals. Copper, nickel and lead were not detected above laboratory reporting limits in the water sample. A low concentration of zinc was detected at 23 ug/L in the water sample. The secondary Maximum Contaminant Level (MCL) for zinc in drinking water is 5,000 ug/L. This sample may not be representative of gun range runoff during wet conditions or storm events; therefore, additional sampling may be warranted during a storm event to better evaluate potential impact to surface water.

5.2. BASIS FOR EVALUATION OF ANALYTICAL RESULTS FOR SOIL SAMPLES

The following criteria were used to evaluate the metal results of the soil sampling:

- Detected Concentrations – Samples were submitted for analysis and detected concentrations were levels present above laboratory reporting limits.
- Background Levels – To establish apparent background concentrations, soil samples were collected in areas (S18 and S30) that had little potential to be impacted by site activities. Results that exceed background levels of constituents may indicate potential impact from site activities.
- US EPA, Region 9 Preliminary Remediation Goals 2000 (PRGs) – The EPA has developed both residential and industrial preliminary remediation goals. These goals specify values that are considered protective of humans, including sensitive groups, over a lifetime. Chemical concentrations above these levels would not automatically designate a problem; however, exceeding a PRG suggests that further evaluation of the potential risks may be warranted.
- Total Threshold Limit Concentration (TTLC) – The California Code of Federal Regulations, Title 22, has established Total Threshold Limit Concentrations (TTLCs) used to designate a

material as a hazardous waste for disposal evaluation. If the total concentration exceeds the TTLC, then the soil may be designated as a hazardous waste when considering landfill disposal. In order to evaluate leaching potential of a constituent, the California Waste Extraction Test (WET) may be run to evaluate the Soluble Threshold Limit Concentration (STLC). If the TTLC or STLC are exceeded then the disposal material may be classified as a hazardous waste and require Class I landfill disposal or remediation if removed from the site. If the material exceeds the TTLC or STLC then the Toxicity Characteristic Leaching Procedure (TCLP) analyses may be used to determine if the material is a RCRA or nonRCRA waste. Although native material or insitu soil are not considered wastes, the levels detected can be compared to the TTLC values for general evaluation.

5.3. SOIL SAMPLE RESULTS

Soil samples collected from the main gun range and trap range included background, firing lines, berms, hillside, drainage area and the trap hillside locations. The analytical results of the soil samples are summarized in Table 1. Samples S1 through S30 were collected from the main gun range, and samples S31 through S47 were collected from the trap range.

5.3.1. Background Metals Soil Results

Background soil samples S18 and S30 were collected in areas unlikely to have potential impact from the use of the gun range. The following background concentrations were detected for the four gun range metals:

- Copper 76 and 83 mg/kg
- Nickel 42 and 45 mg/kg
- Lead 29 and 31 mg/kg
- Zinc 78 and 89 mg/kg

The detected concentrations in the two background samples were consistent, and the levels were well below the residential PRGs.

The highest nickel result at the gun range site was 70 mg/kg at location S20 at the top of a target stop wall at the northern pistol range. All of the nickel concentrations detected at the site were well below the residential PRG of 150 mg/kg and appear to be consistent with background nickel concentrations.

The highest zinc result at the gun range site was 120 mg/kg at locations S20 at the top of a target stop wall at the northern pistol range and S44, 600 feet down slope of the trap range. All of the zinc concentrations detected at the site were well below the residential PRG of 23,000 mg/kg and appear to be consistent with background zinc concentrations.

The highest copper result at the gun range site was 360 mg/kg at location S5 at the end wall berm at the pistol and large bore range. Elevated copper concentrations ranging from 130 to 360 mg/kg were detected in four of the gun range samples collected from berms or wall berms. The remaining copper concentrations detected at the site appear to be consistent with background copper concentrations. All of the copper concentrations detected at the site (including the four elevated berm samples) were well below the residential PRG of 2,900 mg/kg.

The highest lead result at the gun range site was 29,000 mg/kg at location S4 at the end wall berm at the pistol and large bore range. Many of the lead concentrations detected appear to be above background concentrations, and elevated lead concentrations ranging from 140 to 29,000 mg/kg were detected in 16 of the gun range samples. The residential PRG for lead is 400 mg/kg, and nine gun range samples had lead levels above the residential PRG.

5.3.2. Additional Metals Soil Results

The sieved samples from the gun range site were analyzed for gun range metals lead, copper, nickel and zinc. The sieved gun range berm sample from location S12 was submitted for analyses of the remaining CAM 17 metals. This sample was collected from an area where bullet fragments were observed while sieving and elevated metal concentrations were most likely to be encountered. The complete list of CAM 17 metals were analyzed to assess whether other metals were present at elevated levels.

Twelve of the CAM 17 metals were detected in the sample collected from S12. Elevated levels of lead and copper were detected in the sample, however remaining CAM 17 metals were well below the residential PRGs. The CAM 17 results for the S12 sample along with the residential PRGs, industrial PRGs and TTLC values are included in Table 2. Based on the CAM 17 results for the S12 berm sample, no other metals besides lead appear to be constituents of concern at the gun range site.

5.3.3. Soil pH Results

Drainage soil samples S8 and S15 were collected in the drain areas from the pistol and large bore range. These two samples along with berm sample S26 were submitted for pH analysis. The samples from S15 and S26 were also analyzed for the four gun range metals. During the sampling, an uncovered pile of lime was observed at the site. Apparently the lime is added to the gun range berms in an attempt to stabilize lead in the soil. Lime was observed in the sample sieved from berm location S26. Lime has a pH of up to 12. The two drainage samples and the berm sample with observed lime were analyzed to assess the pH impact.

The drainage area sample from S8 had a pH of 5.13, and the drainage sample from S15 had a pH of 5.31. The berm sample from S26 had a pH of 12.65. The storage or use of lime at the main gun range has not impacted the soil at the drainage area sample locations, but the lime has apparently elevated the pH of the berm soil.

5.3.4. Soil Volatile and Semi-Volatile Organic Results

In discussions with gun range personnel, the "clay pigeons" were thought to be inert with little potential for environmental impact. Recent sampling by Kleinfelder at another gun range site indicated that polynuclear aromatic hydrocarbons (PAHs) might be present in some "clay pigeons". Therefore the shallow and deep samples collected at location S36 from the trap range were additionally analyzed for volatile organic and semi-volatile organic constituents. Location S36 (150 feet from the trap shacks) was selected because the majority of the "clay pigeon" fragments were observed between 75 and 150 feet from the trap shacks. Minor amounts of the "clay pigeon" fragments were observed at 300 feet but little was observed at 450 and 600 feet.

No volatile organic constituents were detected above laboratory reporting limits, but the following semi-volatile organic compounds were detected in the two samples:

Semi-VOC Results Summary
Trap Range Slope Location S36

Constituent (mg/kg)	S36 at 0.5 feet	S36 at 1 feet	Residential PRG	Industrial PRG
Benzo (a) anthracene	1.2	ND	0.62	2.9
Benzo (b) fluoranthene	1.9	.59	0.62	2.9
Benzo (g,h,i) perylene	0.96	ND	NG	NG
Benzo (a) pyrene	1.6	0.45	0.062	0.29
Chrysene	1.1	0.38	0.62	290
Fluoranthene	0.91	ND	2,300	30,000
Indeno (1,2,3,-c,d) pyrene	1	ND	0.62	2.9
Pyrene	0.94	0.35	2,300	54,000

mg/kg - micrograms per kilogram
ND = Not detected above the laboratory reporting limit
NG = Not given

In the shallow sample collected from S36, residential PRGs were exceeded for benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene and indeno(1,2,3-c,d)pyrene. The industrial PRG was exceeded for benzo(a)pyrene. In the deeper sample collected from S36, residential and industrial PRGs were exceeded for benzo(a)pyrene only. The "clay pigeon" apparently contains heavy hydrocarbons similar to tar. The two samples submitted for volatile organic and semi-volatile organic constituents were collected and sealed in clean brass tubes. The samples were not screened or sieved. "Clay pigeon" fragments were observed in the duplicate shallow sample sieved from S36. It is possible that a piece of "clay pigeon" may have been digested during the analysis, therefore elevating the PAH results.

5.3.5. Distribution of Lead in the Soil Samples

The analytical results and evaluation of total metal concentrations detected in the soil samples indicate that lead is the primary metal of concern at the site. The following is a discussion of the occurrence of lead in the 46 soil samples analyzed.

- Hillside Samples – Soil Samples S1, S2, S3, S19 and S29 were collected at 0.5 feet on the hillsides above the two pistol ranges, the pistol and large bore gun range. The shallow samples collected at S2, S3, S19 and S29 had lead levels that appear to be typical of background and were well below residential PRGs. The sample collected from S1 had a lead concentration of 5000 mg/kg, which exceeds the residential and industrial PRGs, and the TTLC. Due to the rocky soil in this area, a deeper sample was not collected at S1 for additional analysis. Location S1 is in the hillside approximately 30 feet directly behind the back wall berm of the pistol and large bore range.

- Firing Line Samples – Soil samples S6, S7, S13, S14, S16, S17, S23, S24 and S25 were collected at 0.5 feet from the fire lines of the two pistol ranges, the pistol and large bore gun range. Soil samples S31, S32, S33 and S34 were collected from the firing lines of the trap range. The lead concentrations detected in all but one of these samples appear to be typical background concentrations (18 to 49 mg/kg). The lead concentration in S14 (middle firing line of the pistol and large bore range) was 190 mg/kg, which is well below the residential PRG of 400 mg/kg.

- Drainage Area Samples – Soil samples were collected at 0.5 and 2 feet from location S15 at the main drainage area of the pistol and large bore gun range. The 0.5 foot sample from S15 was initially analyzed and had a lead concentration of 480 mg/kg and a copper concentration of 65 mg/kg. Upon receiving the results of the initial analyses, the deeper sample from S15 was analyzed for copper and lead. The deeper sample along the edge of the drainage area had a copper level of 90 mg/kg and lead level of 1,200 mg/kg. The lead levels in both samples are above the residential PRG, and the level in the deeper sample is above the industrial PRG and TTLC. It appears that elevated lead concentrations may have accumulated in this area due to years of drainage and runoff, or the past movement of gun range soil.

- Sidewall Samples – Soil samples S20, S21 and S22 were collected at a depth of 0.5 feet from the sidewalls of the two pistol ranges. The lead concentrations detected at S20 and S21 appear to be typical background concentrations (45 and 61 mg/kg). The lead concentration in S22 was 270 mg/kg, which is well below the residential PRG of 400 mg/kg.

- Trap Range Hillside Samples – Soil samples S35 through S47 were collected below the trap range on the hillside at distances of 75, 150, 300, 450 and 600 feet below the trap shacks. The lead concentrations detected in five of these samples appear to be typical background concentrations (16 to 41 mg/kg). The lead concentrations in the remaining six locations ranged from 57 to 300 mg/kg. All of the lead concentrations detected in the trap range hillside were well below the residential PRG of 400 mg/kg.

- Berm Samples – Soil samples S4, S5, S9, S10, S11, S12, S26, S27 and S28 were collected from the intermediate berms and end berms of the three gun ranges. The six samples from S4, S5, S10, S11, S12 and S28 had elevated lead concentrations ranging from 3,100 to 29,000 mg/kg. These concentrations are above both the residential and industrial PRGs and the TTLC value. The lead concentrations in the remaining berm samples were below residential PRGs.

Based on the metals analysis of the soil samples, lead is the primary metal and constituent of concern at the site. With the exception of three samples collected from two locations, lead concentrations above the residential PRG were limited to the berms and target backstops. Lead concentrations above the residential PRG of 400 mg/kg were also detected in hillside sample S1 located directly behind the end target berm of the pistol and large bore range and the two drainage area samples from S15 along the edge of the pistol and large bore range. The elevated lead levels in the berms and backstops were anticipated based on the gun range use. The elevated lead concentration at the hillside location indicates that some rounds from the pistol and large bore range are going over the end berm wall. The elevated lead concentrations in the drainage area samples indicate that elevated lead may be present in the soil and water runoff from the pistol and large bore range, or that soil has been moved or graded in the past.

6 CURRENT REGULATORY OVERSIGHT

Representatives of several agencies including the California Department of Toxic Substances Control, Regional Water Quality Control Board, and an adjacent county environmental management department were contacted regarding gun range regulation. The agency contacts were individuals known to Kleinfelder from past non-gun range projects, and the inquiries were not project or site specific. The agencies were asked if they have groups that regulate gun range sites or if they were aware of environmental regulations or requirements for gun range sites. The answers from the agencies were generally the same.

Operating gun range sites are not specifically regulated by the agencies, and the agency contacts were not aware of requirements for sampling or assessment of operating gun ranges or berms. If the gun ranges are closed or the firing berms are to be moved or disposed of, then the sites would be regulated under the general waste to land criteria. The general consensus was that if a gun range berm is moved, it becomes a waste due to elevated lead concentrations and is therefore regulated as a waste. The owner/operator of the site would be required to characterize the soil or berm material for proper disposal or remediation and confirm that potentially elevated lead or metal concentrations associated with the former berms have been mitigated.

We asked regulatory agency contacts about remodeling an existing berm into a new berm or bullet containment system. The general feeling was that remodeling an existing berm was a “gray area” as far as waste to land regulations. The overall feeling was that if the active gun range berm was not moved away from the site or the general berm area and the site remained an active gun range, then the remodeled berm would not be regulated as a waste.

We reviewed potential stormwater issues including the National Pollutant Discharge Elimination System (NPDES) and Total Maximum Daily Loads (TMDLs) for polluted water set by the State. The federal NPDES requires stormwater management and permitting for industrial sites that discharge to waterways or nontreated stormwater conveyance systems. The purpose is to control non-stormwater discharges to the stormwater conveyance system. There are numerous listings of industrial and manufacturing categories that require Stormwater Pollution Prevention Plans and monitoring, however gun ranges are not included in the lists. In general, gun ranges do not appear to be included on the list of sites required to have a Stormwater Management Plan or to have a Stormwater Monitoring Program.

The Clean Water Act calls on States to work with interested parties to develop Total Maximum Daily Loads (TMDLs) for polluted water. This would apply if drainage from the site flows into known polluted waters as defined by the State of California. Currently, there are proposed TMDL regulations that would establish more specific listing methodology and broaden the scope of the list of threatened waterbodies. It is not known whether gun ranges would be included in the list of sites required to monitor potential pollutants in surface water discharge.

The regulatory information presented in this report is based on site visits, discussions with El Dorado County and range personnel and general inquires to three other regulatory agencies. The inquires were general to gun range regulation and were not site specific. The site and parties involved with the site were not mentioned to the agencies. The agencies' responses to the questions were not site specific. If El Dorado County requires additional information regarding potential regulatory oversight or site specific information, then the State agencies should be contacted with site specific information for review and discussion.

7 GUN RANGE TECHNOLOGY

The National Rifle Association (NRA) is one of the most prominent gun range management sources. The NRA has issued a Range Source Book that includes operations and management and range design that address safety and environmental issues. In addition, they give several seminars on range development and operations during the year throughout the United States. The NRA recommends that all gun range facility owners and operators be proactive in keeping up with environmental concerns, possible future regulations, and the newest in range technology for health and safety.

7.1. GUN RANGE TECHNOLOGY

Currently, gun range technology exists that considers management of metal impacted soil. The NRA refers to the following sources of information in their NRA Range Source Book:

- Environmental Compliance and Liability for Outdoor Shooting Ranges - Potential Problems and Feasible Solutions by Stuart Z. Cohen Ph.D., CGWP, President, Environmental & Turf Services, Inc., Wheaton, Maryland.
- Resource Conservation & Recovery Act (RCRA) passed in 1976. RCRA regulations may apply to outdoor ranges if lead shot or bullets are recycled, present in any shipment of lead contaminated soil being disposed, or if contamination of the site could endanger human health or the environment.

Kleinfelder screened the soil samples analyzed to remove bullets and bullet fragments per EPA SW-846. Intact bullets and large bullet fragments are generally not considered a soluble lead source. According to a NRA publication, "… there have been repeated attempts by citizens to consider spent ammunition lying on the ground as a solid waste, EPA rulings have declared otherwise."

Gun range technology appears to focus on safety of the users, and containment and recovery of the bullets.

Some examples of technology that may aid in addressing environmental issues include:

- Earthen Berms – Soil berms are still used at gun ranges. The berms are effective backstops and depending on the material used, the berms may reduce the potential for bullet ricochet. Bullet removal/recycling is possible, although it may not be as easy or as cost effected as other containment techniques. The earthen berms do require a large volume of material and this material can be impacted by elevated lead concentrations. The earthen berms may have more material requiring proper disposal as a hazardous material.

- Steel Backstops – Steel backstops can be designed to contain or direct bullets to a containment area. A smaller volume of earthen material is required to contain the bullets and may aid in the lead recovery process. The smaller volume of soil would also mean lower disposal cost if the range were closed. One gun range manager with a steel backstop system indicated that there were some problems with the durability of the steel with heavy use and that bullet ricochets can be a problem.

- Rubberized Bullet Containment Systems – These systems capture bullets through the use of polyurethane materials and rubber media. Since the bullets are captured and contained within the rubber media, this apparently reduces the potential for bullet ricochets and the problem of air-borne lead dust generation. Bullets and fragments are able to be recovered by a removal contractor with a bullet recovery system. There is little material requiring disposal if the system is removed.

7.2. LIME APPLICATION FOR LEAD STABILIZATION

It is our understanding that the use of lime in soil berms may be suggested by gun range management courses. Lead associated with bullets and gun range operation is potentially more mobile in an acidic environment. The use of lime, which has a pH of up to 12, apparently creates a more basic environment, thereby stabilizing the lead in the soil. Apparently, a pH greater than 6.5 is needed to provide this stabilization. The pH level detected in the berm at the pistol and large bore range was 12.65. This is much higher that the 6.5-pH level that may be needed to stabilized the lead.

Kleinfelder has not reviewed any programs or recommendations for the application of lime to the berms or surrounding soil. We are not aware of any recommendations for the application of the lime or if there is an optimum soil to lime ratio for the proposed application. If the use of lime is proposed for the site, care should be taken in both the use and storage of lime at the gun range site. The storage of lime in an open pile could create elevated pH levels in stormwater runoff, and the over application of lime to the soil berms could create elevated pH levels in the soil and potentially elevated levels in stormwater runoff. The agency contact from the Regional Water Quality Control Board expressed concern regarding potentially elevated pH levels in surface water runoff.

Lime may be corrosive, and care should be taken when handling by site personnel. Material Safety Data Sheets should be obtained and consulted for proper handling, use and disposal of lime products

Kleinfelder recommends that lime be stored in a controlled environment and not exposed to rain or stormwater runoff. The potential use of lime should be monitored in both the soil and surface water runoff to confirm that the pH of the discharge is not elevated. The pH of runoff or permitted discharge should be between 6.5 and 8.

8 RISK EVALUATION OF LEAD

Non-cancer risks from lead exposures were estimated using the California DTSC's lead spreadsheet model for estimating lead uptake (i.e., blood lead levels) in adults and children. The DTSC lead spreadsheet model includes the evaluation of both the ingestion pathway and the inhalation pathway. Kleinfelder collected multiple soil samples throughout the site. These samples were grouped according to location, and lead uptake was evaluated for each of the following groups:

- Local Background
- Firing Line
- Drainage Area
- Berm, Wall Berm, Sidewall, and Top of Wall
- Hillside
- Trap Range

Table 3 lists the maximum lead concentration detected and the average sample concentration evaluated for each location group. Kleinfelder assumed a worst-case scenario using the maximum concentration detected in each group and a most probable scenario using the average sample concentration in each group. The estimated blood lead level was calculated for both children and adults in each scenario assuming ingestion and inhalation of lead.

Table 4 compares the estimated blood level results of the two scenarios for both children and adults based on the detected soil sample concentrations of lead. The Food and Drug Administration (FDA) recommends a blood lead level limit of 10 ug/100 milliliters (10 ug/deciliter) for children and 30 ug/dl for adults, based on the neurological effects of lead. The calculations indicate that the Berm grouping and the one Hillside sample contain lead concentrations that can potentially result in blood lead level concentrations greater than the limits recommended by the FDA, in both the maximum and the average sample concentration evaluations. Detected concentrations in the background and trap ranges resulted in calculated blood lead level concentrations less than the recommended FDA limit values. Lead concentrations detected in the Firing Line and Drainage Area group resulted in blood lead levels below the FDA recommended limit values, with the exception of children in the worst-case scenario (i.e., maximum concentration detected in that grouping).

The blood lead level calculations assume the lead contribution from ingestion is greater than 90% for children and greater than 80% for adults. However, it is not likely that soil will be ingested at the site. Therefore, the most likely lead exposure would be inhalation of lead in air. Kleinfelder used the default value of 0.028 ug/m^3 for lead in air because site specific air concentrations were not collected. The air default value is based on monitoring data from the California Air Resources Board (CARB) and is likely to be similar to that at the subject site. Evaluation of the air default value yields a likely blood lead level in children of 1.2 ug/dl and 0.6 ug/dl in adults. The calculated blood lead level concentrations for inhalation of lead in air are below the FDA recommended blood lead level limits. Therefore, based on the risk characterization and the assumption that lead will not be ingested at the site, lead is not likely to pose an adverse risk at the Union Mine Gun Range.

9 SITE USE

The site is currently an operational gun range, and El Dorado County may elect to maintain the site as a gun range in the future. Potential future uses of the site and prospective regulatory requirements are evaluated below:

- No Change - The site will continue to be used as a gun range. Normal operating activities at a gun range are not specifically regulated by the environmental agencies contacted for this report. It appears that environmental sampling and assessment are not required by these agencies as long as the range is operational and the berms are not moved.

- Gun Range Modifications - Current use stays the same; however there may be modifications such as removal of impacted soil berms or changes in the technology. If the soil berms or end wall berms are to be modified significantly or removed from the site, then the soil needs to be handed, remediated or disposed of as a hazardous material. The lead levels detected in the berm soil exceed the TTLC for designation as a hazardous waste for disposal evaluation. The material requiring disposal should be additionally analyzed for Toxicity Characteristic Leaching Procedure (TCLP) to determine if the material is a RCRA or nonRCRA waste for Class I landfill disposal. It would be much more economical to dispose of a nonRCRA waste.

- Future Development – If the gun range were closed, the berms and end wall berms would need to be remediated or excavated and transported for proper disposal at a Class I facility. Confirmation soil samples would be necessary to confirm the removal of the lead. If residential development was considered for the site, then lead would need to be mitigated or removed to a level below the concentration that would result in a blood lead level greater than 10 ug/dl, based on DTSC's lead spread model. Besides the berms, the residential PRG was also exceeded in the hillside behind the pistol and large bore range and in the drainage area soil sample. These two areas also would need to be further assessed and mitigated. The California DTSC lead spreadsheet model for estimating lead uptake indicates that a soil lead level of 323 mg/kg could result in 10 ug/dl concentration of lead in blood in children, which is the maximum FDA recommended limits. Therefore soil lead levels at the site may need to be below 323 mg/kg if residential development is considered.

10 RECOMMENDATIONS

Based on the sampling performed by Kleinfelder, elevated lead levels above residential PRGs were limited in the berms and wall berms of the gun ranges, the one hillside location directly behind the pistol and large bore range, and the drainage area sample of the pistol and large bore range. Lead levels above the residential PRG were not detected at the trap range, the firing lines of the gun ranges, the remaining hillside locations and the background locations. Based on the current understanding of environmental regulation of gun range sites, additional assessment or mitigation of the Union Mine Gun Range is not required at this time. Additional assessment or mitigation should not be required until the gun ranges are closed; the berms and soil are significantly modified or moved; or until environmental regulations regarding gun range sites change. The hillside location behind the pistol and large bore range and the drainage area within the pistol and large bore range can be considered part of the range and berm system, and elevated lead levels would be anticipated at these locations.

Although additional assessment or mitigation of the elevated lead is not required based on our understanding of current regulations, El Dorado County may want to further evaluate the following site conditions and potential impacts.

- <u>Trap Range</u> – Elevated semi-volatile organic constituents (PAHs) were detected in the two soil samples analyzed from one location at the trap range. It is assumed that the detected constituents are associated with the "clay pigeons" used at the range. The samples analyzed for semi-volatile organic constituents were not screened or sieved, and "clay pigeon" fragments were observed in the duplicate shallow sample sieved from S36. It is possible that a piece of "clay pigeon" may have been digested during the analysis, therefore elevating the PAH results. Additional soil sampling can be performed, and the samples screened prior to analysis to confirm that fragments are not included in the samples. El Dorado County may want to evaluate the composition of the "clay pigeons" used at the site. If soluble PAHs are present in the "clay pigeons" currently used at the site, El Dorado County may want to investigate whether alternative products are available.

- Hillside behind Pistol and Large Bore Range – Elevated lead was detected in the single sample collected from the hillside behind the pistol and large bore range. Bullets from the firing lines may be going over the end wall berm, and it is likely that other hillside locations have elevated lead levels. The hillside soil can be interpreted as part of the pistol and large bore range, therefore, the soil does not need to be assessed further or mitigated as long as it is not moved and the gun range is operational. If the gun range is closed then this area will need to be assessed further and remediated. El Dorado County may want to evaluate the placement of a large berm system or backstop at the end of the pistol and large bore range to contain the bullets going over the end wall berm.

- Drainage Area along Pistol and Large Bore Range – Elevated lead was detected in two samples collected at one drainage area location along the eastern edge of the pistol and large bore range. The elevated lead could be from direct fire, the past movement of soil, or soil and surface water runoff. The drainage area location sampled can be interpreted as part of the pistol and large bore range, therefore, the soil does not need to be assessed further or mitigated as long as it is not moved and the gun range is operational. El Dorado County may want to perform additional soil sampling down the slope to the east of the pistol and large bore range to evaluate the presence of elevated lead levels. Surface water sampling could also be performed to evaluate the lead and pH levels of stormwater runoff.

- Lime Storage and Use – Lime is stored at the site and applied to the soil berms. Lead associated with bullets and gun range operation is potentially more mobile in an acidic environment. The use of lime, which has a pH of up to 12, apparently creates a more basic environment, thereby stabilizing the lead in the soil. Apparently, a pH greater than 6.5 is needed to provide this stabilization. The pH level detected in the berm at the pistol and large bore range was 12.65. This is much higher that the 6.5-pH level that may be needed to stabilize the lead. A protocol for the storage and application of lime at the site should be developed. The storage of lime in an open pile could create elevated pH levels in stormwater runoff, and the over application of lime to the soil berms could create elevated pH levels in the soil and potentially elevate levels in stormwater runoff. Lime may be corrosive, and care should be taken when handling by site personnel. Material Safety Data Sheets should be obtained and consulted for proper handling, use and disposal of lime products.

- Lead Risk Evaluation – Elevated lead levels were detected in the berms and end wall berms. The estimated blood lead level concentrations for inhalation of lead in air by adults and children are below the FDA recommended blood lead level limits. The blood level calculations indicate that the Berm and Hillside samples contain lead concentrations that can potentially result in blood lead level concentrations greater than the limits recommended by the FDA if the soil is ingested. Therefore, based on the risk characterization and the assumption that lead will not be ingested at the site, lead is not likely to pose an adverse risk at the Union Mine Gun Range. Access to the berms, especially by children should be limited to avoid contact and ingestion of the soil. Additionally, contact with the berm soil with an elevated pH should be controlled.

11 LIMITATIONS

Kleinfelder performed this investigation in accordance with generally accepted standards of care, which exist in Northern California at this time. The findings of this report were based upon:

- Background information provided by El Dorado County.
- Forty-six soil samples and one surface water samples.
- The observations of Kleinfelder field personnel.
- The analytical results provided by CLS Laboratory.

Kleinfelder has prepared this report in accordance with the generally accepted standards of care, which exist in Northern California at the time of writing. It should be recognized that definition and evaluation of geologic and chemical subsurface conditions are difficult. Judgments leading to conclusions and recommendation are generally made with an incomplete knowledge of the subsurface and/or historic conditions applicable to the site. More extensive studies may further reduce the uncertainties associated with this assessment. Kleinfelder should be notified for additional consultation if the client wishes to reduce the uncertainties beyond the level associated with this report. No warranty expressed or implied is made.