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# M E M O R A N D U M


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**Date:** October 17, 2018

**To:** Eric Riddiough, P.E., City of Santa Maria Public Works Department

**Project:** Los Flores Shooting Range Project

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**cc:** Ryan Hostetter, Rodger Olds, Ivana Yeung

**Re:** Lead Exposure Management

The purpose of this memorandum is to evaluate potential lead exposure health and environmental effects and best management practices to reduce lead exposure, in support of the California Environmental Quality Act (CEQA) environmental review process for the proposed Santa Maria Police Department (SMPD) outdoor shooing range at the Los Flores Ranch property. The information contained in this memorandum is based on published literature and personal communication with Officer Ken Reed from the Arroyo Grande Police Department.

This memorandum summarizes: (1) lead and human health impacts; (2) lead exposure at shooting ranges; (3) environmental impacts; and, (4) best management practices to reduce lead exposure.

## Environmental and Regulatory Setting

Lead, chemical element Pb, is a heavy metal characterized as being dense, soft, and malleable. Scientific research has demonstrated that lead is a toxic substance and that lead exposure can result in multiple long-term detrimental impacts to human and environmental health (Laidlaw et al 2017).

There are an estimated 9,000 non-military outdoor shooting ranges in operation in the United States (NIOSH 2012). Individuals present at a shooting range, including shooters and staff, can potentially be exposed to health risks from lead exposure. Research has indicated that higher than normal blood lead levels (BLLs) are widespread for individuals that regularly use shooting ranges. Based on a review of 36 separate research articles of BLLs from shooters at firing ranges, the majority of the 36 articles reported at least one BLL that exceeded 20 micrograms of lead per deciliter of blood (µg/dL) and all 36 studies indicated BLLs of shooters exceeded 2 micrograms of lead per deciliter of blood (µg/dL). For reference, the geometric mean of BLL in the U.S. adult population was measured at 1.2 µg /dL and the current reference level recommended by the U.S. Centers for Disease Control and Prevention/National Institute of Occupational Safety and Health is 5 µg /dL (Laidlaw et. al. 2017).

There are two main sources of lead exposure from firearms: the lead-based bullet projectiles themselves and the primer that ignites in a firearm barrel to provide propulsion. Primer is composed of approximately 35 percent lead styphnate and lead peroxide. Lead particles, dust, and fumes from the primer and bullet fragments are ejected from the gun barrel at high pressures during ignition (Laidlaw et. al. 2017). Therefore, lead exposure at shooting ranges can occur through the following pathways:

- Inhalation: Inhalation of lead particles, dust, and fumes by a shooter or range employees.
- Ingestion: fine and course particulates from the bullet fragments and primer can attach to hands, clothing, firearms, and other surfaces. Through direct contact with hands, lead particulates can be inadvertently ingested.
- Environmental exposure: changing of targets or other soil disturbing activities at the range can lead to exposure to lead that has accumulated in soil or dust, which can lead to inhalation or inadvertent ingestion.

There are several regulatory human exposure limits for airborne lead exposure set by federal agencies. The Occupational Safety and Health Administration (OSHA) has established two different limits for airborne exposure to lead (29 Code of Federal Regulations1910.1025). The action level for airborne lead exposure is 30 micrograms per cubic meter of air (µg/$m^3$) as an 8-hour time weighted average and the permissible exposure limit for airborne exposure to lead is 50 µg/$m^3$ as an 8-hour time weighted average. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit for airborne lead is also 50 µg/$m^3$ as an 8-hour time weighted average.

The Resource Conservation and Recovery Act (RCRA), implemented by the U.S. Environmental Protection Agency (EPA), is the public law that sets the framework for the proper management of hazardous waste. Under RCRA, lead bullets/shot are not considered a hazardous waste subject to the requirement of the law at the time it is discharged from a firearm because it is used for its intended purpose. However, lead bullets/shot can be considered a regulated hazardous waste if it is abandoned and forgotten. Therefore, range operators are at risk to legal action under RCRA if they fail to routinely recover and reclaim lead, do not take steps to minimize lead release or migration, or if they abandon lead in berms (EPA 2005, EPA n.d.).

**Analysis of Proposed Project**

The proposed project involves an outdoor shooting range for use by SMPD. The site plans include four pistol ranges separated by berms and backed by bullet collection walls. The project itself includes several design and operational features that would serve to reduce human lead exposure compared to other types of shooting ranges. First, the project is an outdoor shooting range. At outdoor ranges, lead particles, fumes, and dust disperse more widely, and therefore reduce lead concentrations, compared to

indoor ranges where air is confined indoors. Second, members of the public and children would not be allowed to use the range. Therefore, the project would not result in lead exposure to the general public but would be limited to SMPD employees that sporadically utilize the range for training and practice and to range employees. Third, although the range will allow lead bullets, the range would require that only full metal jacket lead bullets be used. Full metal jacket lead bullets involve a lead core which is mostly encased in a shell of harder material except at the base of the bullet. By requiring the use of full metal jacket bullets, fewer lead particles and fragments would be ejected from the bullet compared to lead bullets without jackets. Fourth, due to the distance of the collection berms from the firing line (approximately 200 feet), dust ejected from the berm when the berm is struck by a bullet would likely not reach shooters and expose them to lead via the ejected dust. Nonetheless, range users and employees will be exposed to lead. Recommendations to reduce human exposure to lead are provided in the following section.

The project may result in soil or groundwater exposure to lead through several pathways. Lead-containing bullet particles themselves can move through soil, surface water, or groundwater and lead from bullet fragments can also dissolve into water and be transported off-site through groundwater or stormwater. There are no jurisdictional waters or drainages on or adjacent to the site (Rincon Consultants 2018). Therefore, the project does not have the potential to result in contamination of surface or navigable waters. Nonetheless, contaminated soil may be transported off-site through wind or stormwater erosion, stormwater can carry contaminated soil from the site, and dissolved lead can migrate through soils to groundwater which can be carried off-site. The migration rate of lead is affected by the physical characteristics of the soil. Generally, lead reacts more and may become more mobile under acidic conditions (pH less than 6) or higher alkaline (pH greater than 8) conditions.[1] Therefore, the idea soil pH at a shooting range is 6.5 to 8.5 (EPA 2005). According to the Biological Resources Assessment prepared for the project site, on site soils include Gaviota Sandy Loam and Corralitos Loamy Sand (Rincon Consultants 2018). Gaviota Sandy Loam tends to be medium acidic (pH 6) and Corralitos Loamy Sand tends to be neutral (pH 7) (USDA 2018). Recommendations for bullet and shot containment techniques and for preventing lead migration are provided in the following section.

**Best Management Practices and Recommendations**

The following best management practices (BMPs) at a shooting range can minimize the risks associated with the firing of lead bullets. The BMPs are divided into two categories: (1) hygiene and safety practices for shooters, and (2) range design and operational practices.

*Hygiene and Safety Practices for Shooters*

- The following BMPs should be implemented to reduce lead exposure: Wash hands thoroughly with cold water and soap after shooting or spending time in the shooting area. Cold water is preferable because warm water enlarges pores, increasing the potential for lead compounds to enter the skin.
- While on the range, refrain from actions that bring your hands into contact with your mouth or nose, such as eating, drinking, or smoking.
- Clothes and shoes should be changed at the range after shooting, housekeeping or maintenance activities, and placed in an airtight bag for transport to prevent lead from being tracked into cars and homes. At home, range clothes should be stored separately from other clothes and washed

[1] Acidity is measured as pH on a scale between 1 (most acidic) and 14 (most alkaline, or basic) where 7 is termed neutral.

separately from other laundry. Alternately, disposable shoe coverings can be used while shooting or performing housekeeping or maintenance activities and then discarded when leaving the range.

- Range personnel or anyone who spends a great amount of time at the range should regularly consult a physician regarding lead exposure.

*Range Design and Operational Practices*

The following specific considerations should be taken regarding the SMDP shooting range's design and operation to reduce lead contamination and exposure:

- Lead exposure safety guidelines, including best hygiene practices for shooters described above, should be displayed in clear signage.
- Dry sweeping should not occur in the range as this will generate airborne lead dust. Instead, wet wiping or mopping for non-porous surfaces and HEPA vacuuming for porous surfaces.
- An "Environmental Stewardship Plan" should be developed prior to range opening and should be implemented throughout the life of the range. An example template of an Environmental Stewardship Plan is included in Appendix E of the EPA's report "Best Management Practices for Lead at Outdoor Shooting Ranges." An employee or team of employees should be assigned the responsibility of implementing and tracking operations in accordance with the Stewardship Plan.
- Soil used at the berms should be tested annually to ensure the pH level is in the desired range of 6.5 and 8.5 to reduce lead migration. Testing should occur in the uppermost layer to a depth of 24 inches from the surface. Lime and phosphate may be added to adjust the pH to be within the range.
- Ensure that the uppermost surface does not contain rocks or debris, which may increase ricochet and bullet fragmentation.
- To ensure that lead is not considered "abandoned" within the meaning of the RCRA statute, spent bullets and bullet fragments should regularly be physically removed from berms and backstop. Removing bullet fragments may involve:
    - Hand raking and sifting (by personnel with proper protective gear and a breathing apparatus per OSHA standards) the surface layer of the berm to remove spent bullets and fragments from the soil while leaving the soil in place, or removal and replacement of affected portions of the berm. Once collected, lead may must be taken to a recycler or reused and should be stored on-site for extended periods of time.
    - Purchasing or renting mechanical separation machinery. Various types of screening or shaking machines and vacuums are available to rent or purchase
    - Hiring a professional reclamation company. Lead reclamation companies claim to recover 75-95% of the lead in soils through a variety of methods dependent on the site characteristics.
- Lead reclamation should occur approximately every one to five years. The exact frequency of how often lead removal should take place depends on the site conditions (i.e.: pH of soil as discussed above) and number of rounds fired. Approximately 100,000 rounds per firing lane can occur before lead reclamation. Therefore, record keeping procedures to monitor the number of rounds fired should be established.
- All activities at the range with respect to BMPs and lead reclamation and recycling should be documented for the life of the range.

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