

## Evaluation of Potential Ecological Effects of Munitions Constituents in Surface Water of Playas Adjacent to the Marine Corps Air Ground Combat Center Twentynine Palms, California, to Receptors of Concern

### 1. Summary

The munitions constituents (MC) TNT and RDX are predicted by screening level evaluation of surface water transport to potentially migrate from operational ranges via surface water runoff at the Marine Corps Air Ground Combat Center (MCAGCC) Twentynine Palms, California to adjacent playa lakes. Potential ecological exposure to TNT and RDX accumulating in the lake waters and the effects of that exposure were evaluated. The Mojave fringe-toed lizard and desert tortoise are receptors of concern. The playa lake habitat is limited and its use by both receptors is considered negligible. In addition, neither receptor is likely to drink water that occasionally accumulates in the playa lakes because of the saline nature of playa water. Even if the Mojave fringe-toed lizard and desert tortoise were to drink water from the lakes, concentrations of TNT and RDX predicted to occur in lake waters are well below concentrations that would cause adverse effects. Therefore, TNT and RDX predicted to potentially migrate to playa lakes adjacent to MCAGCC Twentynine Palms are highly unlikely to pose a threat to ecological receptors of concern.

### 2. Background

A Range Environmental Vulnerability Assessment (REVA) is being conducted at the MCAGCC Twentynine Palms, California. Operational ranges are being assessed to identify areas and activities that are subject to possible impacts from external influences, as well as to determine whether a release or substantial threat of a release of MC from an operational range to an off-range area creates an unacceptable risk to human health or the environment. Preliminary screening level surface water modeling was used to predict MC migration via surface water runoff from six loading areas at MCAGCC Twentynine Palms to two playa lakes, Bristol Dry Lake and Dale Lake, located east and south of the installation (Figure 1). The highly conservative screening level modeling, which incorporated evaporative concentration and accumulation of MC in playa lake environments, predicted RDX in Bristol Dry Lake and TNT in Bristol Dry Lake and Dale Lake would occur at concentrations above the REVA thresholds (Table 1). REVA thresholds are based on a median analytical method detection limit (MDL).

Table 1. Screening Level Estimates of Annual Average Munitions Constituent Concentrations in Runoff Entering Playa Lakes.

Munitions Constituent	REVA Threshold (µg/L)	Post-mixing Concentrations Entering Bristol Dry Lake (µg/L)	Post-mixing Concentrations Entering Dale Lake (µg/L)
RDX	0.16	0.19	0.15
TNT	0.08	0.25	0.12

There are no known human receptors in Bristol Dry Lake and Dale. However, ecological receptors may potentially become exposed to RDX and TNT present in surface water.

Two ecological receptors, the Mojave fringe-toed lizard (MFTL) (*Uma scoparia*) and desert tortoise (*Xerobates agassizii*) were identified as receptors of concern. Exceedance of a REVA MDL-based threshold does not necessarily equate to a concentration above which ecological receptors may be adversely impacted. Therefore, the purpose of this evaluation is to determine if the MFTL or desert tortoise will be adversely affected by the MC predicted to accumulate in surface waters of Bristol Dry Lake and Dale Lake.

The potential for adverse ecological effects to occur is determined using a weight of evidence approach. The potential for the MFTL and desert tortoise to become exposed to MC through the ingestion of surface water at Bristol Dry Lake and Dale Lake is assessed by this process. This exposure assessment includes a description of the habitat present at the playa lakes and descriptions of the natural history of both species. The ecology toxicity of TNT and RDX is then assessed. Since published information on the toxicity TNT and RDX to reptiles is scarce, their toxic effects on aquatic biota, mammals, and birds are described for context. Results of the exposure and toxicity assessments are combined to make the weight of evidence determination.

This evaluation is not intended to be a formal ecological risk assessment such as described by EPA (1997). Instead, it uses elements of the exposure and toxicity assessment processes of risk assessment to make a qualitative determination of potential impact to receptors of concern.

### **3. Exposure Assessment**

#### **3.1. Playa Lake Habitat**

Bristol Dry Lake is located adjacent to the eastern boundary of MCAGCC Twentynine Palms and Dale Lake is located southeast of the installation (Figure 1). MCAGCC Twentynine Palms is located in one of the more arid parts of the Mojave Desert with a climate characterized by hot days and cool nights with low humidity and low annual rainfall (USMC 2007). Temperature extremes range from an average daily high of 105.4° F in July to an average daily low of 51.6° F in January. The average total annual precipitation is approximately 4.16 inches with 46 percent falling between November and March and 43 percent falling between July and September. Winter storms are relatively gentle while violent thunderstorms may occur during July through September causing flash floods.

Playas are dry, vegetation free, flat areas that form in the lowest parts of undrained desert basins<sup>1</sup>. Ephemeral lakes form on the playas during wet periods, but evaporation results in the accumulation of dissolved solids (mainly salts) on lake surfaces. When the

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<sup>1</sup> Source: U.S. Geological Service (<http://pubs.usgs.gov/of/2004/1007/plays.html>)

groundwater table is at or near the surface of the playa, soluble salts will precipitate and form ephemeral crusts that may or may not survive subsequent wetting episodes.

Bristol Dry Lake is a commercial source of calcium chloride and sodium chloride (Ver Planck 1958). The lowest part of Bristol Dry Lake (known as Salt Lake) is covered by a thin crust of salt that is permeated with brine. The principal commercial source of salt at Bristol Dry Lake is a horizontal bed of rock salt located at a maximum depth of 6 or 7 feet. Calcium chloride is recovered from brine that seeps into excavations sunk through this shallow salt bed. As the brine in the excavations become concentrated through solar evaporation, the sodium chloride precipitates leaving a concentrated calcium chloride liquid. The brines found at Bristol Dry Lake have a dissolved solids content of 279,000 ppm (27 percent) of which approximately 67 percent is sodium chloride. By contrast, sea water contains 35,000 ppm dissolved solids with a sodium chloride content of approximately 78 percent.

Dale Lake also serves as a commercial source of sodium chloride and sodium sulfate salts (Ver Planck 1958). A saline efflorescent surface crust covers the lake bed. Brine pumped from wells sunk about 250 feet served as the source of commercial salts. The brines found at Dale Lake have a dissolved solids content of 298,000 ppm of which approximately 74 percent is sodium chloride.

Standing water will occasionally accumulate in Bristol Dry Lake and Dale Lake following heavy rains. The frequency, extent, and duration of inundation are variable. For example, Dale Lake has standing water in low-lying areas about once or twice a year and it will remain for a period ranging from two days to two weeks<sup>2</sup>. No published data on the surface water quality at either Bristol Dry Lake or Dale Lake were located. However, Dr. James Calzia<sup>3</sup>, a geologist who has studied both lakes, believes that surface water accumulating in the lakes would readily dissolve the salt crusts producing highly saline surface waters.

The saline nature of the ephemeral surface waters at Bristol Dry Lake and Dale Lake make them unsuitable as a drinking water source for most animals.

### **3.2. Mojave Fringe-toed Lizard Natural History Summary**

The MFTL is a member of the reptile class and is a California Department of Fish and Game (CDFG) species of special concern and a U.S. Bureau of Land Management (BLM) designated sensitive species<sup>4</sup>. It is closely related to the Coachella Valley fringe-toed lizard (*Uma inornata*) which is a U.S. Fish and Wildlife Service (FWS) threatened species and CDFG endangered species. The MFTL is known to occur in the Bristol Dry Lake and Dale Lake areas.

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<sup>2</sup> Source: Personal communication with Cindy and Gerry Grott, Superior Salt, Inc., Dale Lake, CA.

<sup>3</sup> Source: Personal communication with Dr. James Calzia, U.S. Geological Survey, Menlo Park, CA.

<sup>4</sup> Hollingsworth, B.D., and K.R. Beaman. Mojave Fringe-toed Lizard. Available at <http://www.blm.gov/ca/pdfs/cdd.pdf/fringe1.PDF>.

The MFTL is restricted to areas with fine, wind-blown sand including large and small dunes, margins of dry lakebeds and washes, and isolated pockets against hillsides<sup>4</sup>. They have numerous adaptations associated with their sand-dwelling life style. These adaptation include elongated scales on the hind feet (“fringes”) for added traction in loose sand, a shovel-shaped head and lower jaw adapted to aid diving into and moving short distances beneath the sand, elongated scales covering their ears to keep sand out, and unique internal nostrils that allows them to breath below the sand without inhaling sand particles. During the hottest months, the closely related Coachella Valley fringe-toed lizard must burrow 5 cm in the shade or much deeper in the sun to escape the extreme temperatures<sup>5</sup>. The MFTL is active from March to October and hibernates buried in the sand during the cooler winter period<sup>4</sup>. Specific habitat requirements for the Coachella Valley fringe-toed lizard include access to shaded sand for thermoregulatory burrowing and this is likely required for the MFTL as well.

The MFTL is omnivorous predominantly feeding on plant material (dried seeds, flowers, grasses, and leaves) in the spring and arthropods (insects and scorpions) later in the year<sup>4</sup>. It is assumed that they will get most or all of their water through their diet<sup>6</sup>. The MFTL is known to drink water while in captivity, but documented evidence of water consumption in the wild is lacking.

Nagy (1988) evaluated the water balance of the two Mojave Desert reptiles, the chuckwalla (*Sauromalus ater*) and side-blotched lizard (*Uta stansburiana*). Chuckwallas obtain all of their water from their herbivorous diet. They hibernate during winter and estivate in rock crevices during the summer drought. When rainwater from summer thunderstorms became available, chuckwallas did not emerge from their crevices to drink. It is suspected that drinking water in the summer may be detrimental to their carefully-maintained water balance. The side-blotched lizard is active year-round consuming newly-growing annual plants in the spring and arthropods throughout the year. They obtain all of their water from their diet and maintain a favorable water balance through adaptations such as use of burrows, functional nasal salt glands, and minimal evaporation.

The Colorado Desert fringe-toed lizard (*Uma notata notata*) was found to be water independent when maintained in the laboratory at humidities and temperatures comparable to those in nature on a diet of meal worms (Deavers 1972). Fringe-toed lizards save considerable quantities of water by burying in the sand, seldom excrete liquid urine, and posses a functional nasal salt gland with the ability to concentrate and eliminate salts. These adaptations enable fringe-toed lizards to maintain a favorable water balance under the environmental extremes they encounter in their natural habitats.

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<sup>5</sup> Source: Coachella Valley Multiple Species Habitat Conservation Plan available at [http://www.cvmshcp.org/sp\\_06.htm](http://www.cvmshcp.org/sp_06.htm)

<sup>6</sup> Personal communication with Dr. Bradford Hollingsworth, San Diego Natural History Museum, San Diego, CA.

Dr. Hollingsworth of the San Diego Natural History Museum, believes it is unlikely the MFTL would cross the barren salt crust zone found along the shore of Bristol Dry Lake or Dale Lake to drink water from those lakes<sup>6</sup>.

The MFTL is unlikely to be found in playa lakes because the lake beds do not provide the wind-blown sand habitat and do not support the vegetative communities they require. In addition, few sand deposits are found around Bristol Dry Lake<sup>7</sup>. Since these lizards hibernate during the winter rains, they will not be exposed to surface waters of Bristol Dry Lake and Dale Lake during this season. Based on the above discussions it can be concluded that fringe-toed lizards get most of their water from their diet and are unlikely to consume surface water from either lake because of its saline nature.

### **3.3. Desert Tortoise Natural History Summary**

The desert tortoise is a member of the reptile class and a FWS threatened species and CDFG threatened species. It is distributed throughout much of the Mojave Desert which includes the Bristol Dry Lake and Dale Lake areas (FWS 1994).

Desert tortoise habitat requirements include suitable plants for forage and cover, and suitable substrates for burrow and nest sites (FWS 1994). They primarily inhabit flats and alluvial fans with soils ranging from sand to sandy-gravel and vegetation characterized by scattered shrubs with abundant inter-shrub space for growth of herbaceous plants. Desert tortoises may also be found on rocky terrain and slopes in parts of the Mojave region.

Desert tortoises spend much of their lives hibernating and estivating in their burrows, emerging to feed and mate during late winter and early spring (FWS 1994). In the western Coachella Valley located west of the Bristol Dry Lake and Dale Lake areas, nesting extends from April through at least July<sup>8</sup>. They will remain active through the spring and may become active following summer storms. Desert tortoises eat a wide variety of herbaceous vegetation, particularly grasses and flowers of annual plants.

The desert tortoise is well adapted to desert life (FWS 1994). During unfavorable periods, they generally enter their burrows where they become inactive or dormant, reducing water loss and minimizing energy expenditures. They are able to effectively manage their water balance and can survive for more than a year without access to free water. Unlike the Mojave fringe-toed lizard, tortoises do not have salt glands through which salts can be excreted to help maintain water balance. Their primary springtime diet of succulent annual vegetation contains high levels of potassium (Longshore et al 2003). Tortoises must void these ions as urinary waste, but to minimize water loss, they may accumulate ions and other wastes in their urinary bladders for months. Summer rainstorms in the eastern Mojave Desert provide tortoises an essential drinking water

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<sup>7</sup> Personal communication with Mr. Rhys Evans, Natural Resources and Environmental Affairs, MCAGCC Twentynine Palms, CA.

<sup>8</sup> Source: Coachella Valley Multiple Species Habitat Conservation Plan available at <http://www.cvmshcp.org/>

source, which allows them to void the concentrated urine and replenished their body water and electrolyte balance.

Dr. Kristin Berry, an expert on desert tortoise ecology, has noted that they create depressions in their territories to collect rainwater and will occasionally sit in the depression in anticipation of summer storms<sup>9</sup>. Ingestion of summer rainwater not only allows the tortoise to establish a favorable water balance, but allows them to feed upon the dry grasses and herbs present during the summer (Nagy 1988).

Although desert tortoises have been noted as crossing playa lakes, Dr. Berry has never observed or heard of anyone observing them drinking water from playa lakes including Bristol Dry Lake and Dale Lake<sup>9</sup>. This observation is consistent with the high salinity of the surface water in these lakes and the need for tortoises to manage their internal water and electrolyte balance.

#### **4. Toxicity Assessment of TNT and RDX**

There is a paucity of data describing the toxic effects of TNT and RDX in reptiles in general and no specific data for the MFTL or desert tortoise. Laboratory toxicity tests are commonly conducted on standardized test species for which testing protocols have been developed. Results of tests on standardized test species are routinely extrapolated to species in the same class. Therefore, extrapolation of toxicity data from other reptile species to the MFTL and desert tortoise is necessary and acceptable practice.

This toxicity assessment includes a broad discussion of the toxicity of TNT and RDX that includes aquatic biota, mammals, and birds. This information provides a context for interpretation of toxicity data on reptiles.

##### **4.1. Aquatic Toxicity**

Talmage et al. (1999) derived ecological screening benchmarks for eight nitroaromatic munitions compounds. The freshwater benchmarks were derived following U.S. Environmental Protection Agency guidelines. When sufficient toxicological data were available for a compound, the thresholds were derived using the national water quality criteria methodology (Stephen et al. 1985). This methodology requires acute effects data of suitable quality from at least eight different aquatic families and chronic effects data of suitable quality from at least three different aquatic families. When less toxicological data were available, benchmarks were derived using methods described in *Proposed Water Quality Guidance for the Great Lakes System* (U.S. EPA 1993). The Great Lakes method is similar to the national water quality criteria method, except the threshold are multiplied by adjustment factors to account for the uncertainty associated with having less than the optimal amount of toxicological data.

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<sup>9</sup> Personal communication with Dr. Kristin Berry, U.S. Geological Survey, Riverside, CA.

The ephemeral nature and high salinity of Bristol Dry Lake and Dale Lake limits the variety of aquatic organisms that may live there. An internet search for information describing the biology of these lakes was unsuccessful. It is possible that some organisms have adapted to living in this harsh environment.

Talmage et al. (1999) calculated a chronic freshwater benchmark for TNT of 90 µg/L using the national water quality criteria methodology. The TNT benchmark is 360 times greater than the potential concentration predicted for Bristol Dry Lake (0.25 µg/L) and 750 times greater than the potential concentration predicted for Dale Lake (0.12 µg/L). Talmage et al. (1999) calculated a chronic freshwater benchmark for RDX of 190 µg/L. The RDX benchmark is 1000 times greater than the potential concentration predicted for Bristol Dry Lake (0.19 µg/L). Based on these aquatic benchmarks, adverse effects from TNT and RDX on aquatic biota are unlikely to occur at the concentrations of TNT and RDX predicted to occur in Bristol Dry Lake and Dale Lake.

#### **4.2. Mammalian and Avian Toxicity**

Talmage et al. (1999) derived ecological screening benchmarks for eight nitroaromatic munitions compounds. They derived a chronic oral no observed adverse effects level (NOAEL) of 1.60 mg/kg/d for TNT based on laboratory toxicity test results on rats. The chronic NOAEL for RDX was 7 mg/kg/d based on laboratory toxicity test results on mice. Data were insufficient for deriving toxicity values for birds.

Talmage et al. (1999) then used body weight scaling to extrapolate chronic NOAELs from the laboratory test species to seven mammalian wildlife species. The mammalian wildlife species used in this analysis were the short-tailed shrew, white footed mouse, meadow vole, cottontail rabbit, mink, red fox, and whitetail deer. Based on the estimated water intake rate for each species, they were then able to calculate a safe drinking water benchmark for each species. The mammalian drinking water benchmarks ranged from 6,600 to 19,000 µg/L for TNT and 17,000 to 49,000 µg/L for RDX. The minimum threshold for TNT is approximately 26,000 times greater than the potential concentration predicted to occur in surface water of Bristol Dry Lake or Dale Lake (0.25 µg/L). The minimum threshold for RDX is approximately 90,000 times greater than the potential concentration predicted to occur in surface water of Bristol Dry Lake (0.19 µg/L).

The U.S. Army Center for Health Promotion and Preventive Medicine (CHPPM) recently published wildlife toxicity assessments for TNT (CHPPM 2000) and RDX (CHPPM 2002) where they developed ecological toxicity values for wildlife. No toxicity data for TNT and RDX were found for reptiles. The CHPPM calculated several toxicity values, the lower oral toxicity value being either a NOAEL or the lower 95 percent confidence limit of the 10<sup>th</sup> percentile of the dose response curve (LED<sub>10</sub>). For mammals, the LED<sub>10</sub> values were 0.2 mg/kg/d for TNT and 1.19 mg/kg/d for RDX. The mammalian toxicity value for TNT is approximately eight times lower than the toxicity value used by Talmage et al. (1999) and the mammalian toxicity value for RDX is approximately six times lower than value used by Talmage et al. Use of the CHPPM mammalian toxicity values for calculation of the mammalian wildlife drinking water benchmarks described in

Talmage et al. would lower the benchmarks proportionally to the reduction of the toxicity value. Therefore, mammalian wildlife drinking water benchmarks derived using the USACHPPM toxicity values would still be at least four orders of magnitude above the potential concentrations of TNT and RDX predicted to occur in Bristol Dry Lake and Dale Lake.

The CHPPM (2000, 2002) also derived toxicity values for birds. The avian NOAEL is 0.07 mg/kg/d for TNT and the avian LED<sub>10</sub> is 3.65 mg/kg/d for RDX. The avian toxicity values are comparable to the CHPPM mammalian toxicity values for TNT and RDX. Assuming water consumption rates are similar for birds and mammals, use of the CHPPM avian toxicity values should yield avian drinking water benchmarks that are several orders of magnitude above the potential concentrations of TNT and RDX predicted to occur in Bristol Dry Lake and Dale Lake.

Based on the preceding analysis, TNT and RDX migrating from MCAGCC Twentynine Palms to surface waters of Bristol Dry Lake and Dale Lake are predicted to occur at concentrations far below those that could cause adverse effects to mammals and birds that consume the surface water.

### 4.3. Reptilian Toxicity

The CHPPM (2000, 2002) noted that toxicity data for TNT and RDX were unavailable for reptiles. Dr. Craig McFarland of CHPPM is in the process of evaluating the toxicity of MC to lizards<sup>10</sup>. He has completed a study on TNT and has initiated a study on RDX. In these studies, western fence lizards (*Sceloporus occidentalis*) are exposed to a range of oral doses of MC over three different exposure periods; an acute single dose, a subacute 14-day period, and a subchronic 60-day period. Unpublished results of the TNT subchronic 60-day study show that survival was high at all doses (0, 3, 15, 25, 35, and 45 mg/kg/d). Adverse effects (i.e., growth and food intake) were noted at the 35 mg/kg/d dose, but not at the 25 mg/kg/d dose. The 25 mg/kg/d reptilian NOAEL is greater than the mammalian (0.2 mg/kg/d) and avian (0.07 mg/kg/d) toxicity values developed by the CHPPM (2000, 2002), indicating that reptiles are at least two orders of magnitude less sensitive to TNT than mammals and birds. Since it was shown in Section 4.2 that mammals and birds will not be adversely affected by drinking lake waters containing TNT, it can be safely concluded that the MFTL and desert tortoise would not be adversely affected.

Results of the unpublished study of TNT toxicity to reptiles<sup>10</sup> shows that if the MFTL or desert tortoise were to occasionally consume water from Bristol Dry Lake or Dale Lake, they would not be adversely affected by TNT potentially migrating from MCAGCC Twentynine Palms. Since the mammalian and avian toxicity values derived by the CHPPM (2000, 2002) for TNT and RDX are similar, it is not unreasonable to assume that reptiles would demonstrate similar tolerance to RDX as they do to TNT. Therefore, it is

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<sup>10</sup> Personal communication with Dr. Craig McFarland, U.S. Army Center for Health Promotion and Preventive Medicine, Aberdeen Proving Ground, MD.

reasonable to assume that if the MFTL and desert tortoise were to occasionally consume surface water from Bristol Dry Lake and Dale Lake, they would not be adversely affected by RDX in those waters.

## 5. Conclusions

Bristol Dry Lake and Dale Lake are unsuitable habitats for the MFTL and desert tortoise. The MFTL probably obtains all of its water from its omnivorous diet and the likelihood of drinking surface water from these playa lakes is considered negligible. The desert tortoise does need to drink water, but would normally obtain water that collects in natural or tortoise-constructed depressions in the soil following summer thunderstorms. The saline nature of the surface water in the playa lakes would detour tortoises from drinking the water because of the electrolyte imbalance it could cause.

The concentrations of TNT and RDX predicted to occur in the surface waters of Bristol Dry Lake and Dale Lake are at least three orders of magnitude less than concentrations expected to adversely affect aquatic biota that might live in the lakes. These concentrations are at least five orders of magnitude less than concentrations expected to adversely affect mammals and birds that might drink water from the lakes. An unpublished study of the effects of TNT on lizards showed that lizards were more tolerant to TNT than either mammals or birds. Since the toxicity of TNT and RDX to birds and mammals was similar, the assumption that the sensitivity of reptiles to RDX is similar to TNT is reasonable. Hence, even if the MFTL and desert tortoise drink water from these playa lakes, neither TNT nor RDX are expected to cause adverse effects at the predicted surface water concentrations.

Based upon the results of the exposure assessment provided in Section 3 and the toxicity assessment provided in Section 4, concentrations of TNT and RDX predicted to occur in Bristol Dry Lake and Dale Lake are unlikely to pose a threat to the MFTL or desert tortoise.

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## SMALL ARMS RANGE ASSESSMENT

### Introduction

The purpose of the Range Environmental Vulnerability Assessment (REVA) is to identify whether there has been a release or there is a substantial threat of a release of munitions constituents (MC) of concern from the operational range or range complex areas to off-range areas. This is accomplished through the use of fate and transport modeling and analysis of the REVA indicator MC based upon site-specific environmental conditions at the operational ranges and training areas at an installation.

For small arms ranges, the fate and transport parameters are based entirely on site-specific geochemical properties, which cannot be determined solely by physical observation. Therefore, small arms ranges associated with the installation are qualitatively reviewed and assessed to identify factors that influence the potential for lead migration at the operational range, including:

- design and layout,
- the physical and chemical characteristics of the area, and
- current and past operation and maintenance practices.

In addition, potential receptors and pathways must be identified relative to the small arms range being assessed. The potential for an identified receptor to be impacted by MC migration through an identified pathway will be evaluated.

MC associated with small arms ammunition commonly used at operational ranges include lead, antimony, copper, and zinc. REVA focuses on lead as the MC indicator for small arms ranges because lead is the most prevalent (by weight) potentially hazardous constituent associated with small arms ammunition. No specific quantitative conclusions can be made regarding the fate and transport of lead since it is unlike any other MC. Lead is geochemically specific regarding its mobility in the environment. Site-specific conditions must be known (i.e., geochemical properties) in order to quantitatively assess lead migration. Site-specific geochemical properties are only identified via sampling and cannot be observed physically. Without site-specific physical and chemical

characterization, lead cannot effectively be modeled using fate and transport modeling like the other indicator MC in REVA. The scientific community has established that metallic lead (such as recently fired, unweathered bullets and shot) generally has low chemical reactivity and low solubility in water and is relatively inactive in the environment under most ambient or everyday conditions. However, a portion of lead deposited on a range may become environmentally active if the right combination of conditions exists.

This Small Arms Range Assessment Protocol was developed in lieu of collecting site-specific information for every small arms range. The protocol will help to determine which ranges necessitate data collection of site-specific geochemical properties or further assessment based the range's overall prioritization regarding the potential for an identified receptor to be impacted by potential lead migration through an identified pathway.

### **Purpose**

This Small Arms Range Assessment Protocol outlines a qualitative approach to assess the small arms ranges in the REVA process in lieu of collecting site-specific geochemical properties at every range. This qualitative approach helps to identify and assess factors that influence the potential for lead to migrate at an operational range.

This protocol is to be used for:

- 1) Identifying the small arms ranges within the Marine Corps that have the greatest potential for environmental concern (i.e., potential for lead migration to impact identified receptors) and
- 2) Assessing the need for implementing further actions. Recommended further actions may include, but are not limited to, the following:
  - Sampling surface water, groundwater, and/or soil
  - Conducting additional studies
  - Implementing best management practices (BMPs)

## **Data Collection and Documentation**

The qualitative assessment process for a small arms range involves first capturing and documenting its physical and environmental conditions, as well as how the range is utilized and maintained (including dates of use and types and amounts of small arms ammunition expended). The small arms range data collection form within Section 3 of the REVA Reference Manual is a guide to collecting and documenting the necessary information in order to complete the evaluation forms presented later in this protocol (Tables 1 through 6). It includes a comprehensive list of data elements that are useful in establishing the historical and current physical and environmental conditions, as well as capturing the types of information on conditions that influence lead's potential to migrate from the range. The data collection form is organized by major topics or information areas associated with the operational range, including the following:

- Basic range information
- Current range layout
- Current range operations
- Historical range operations
- Amount of lead potentially deposited
- Environmental Characteristics
- Potential receptors
- Surrounding land use
- Environmental activities conducted on the range
- Summary

The data collection form in the REVA Reference Manual can be modified, where needed, to fully capture the major factors that can potentially influence lead's ability to migrate from each specific small arms range.

## **Qualitative Assessment**

The small arms range can be qualitatively assessed once the conditions of the range have been fully understood and documented. The assessment process involves a discussion of

possible factors that can influence the potential for lead to migrate off range. Several of these factors are listed below, followed by a detailed discussion:

- Range use and range management (source)
- Surface water
- Groundwater and soil
- Pathways
- Receptors

#### ***Range Use and Range Management (Source)***

The amount of lead and other MC deposited on a range is a combination of the following factors:

- Duration of use
- Current and historical frequency of range usage
- Amount and types of small arms ammunition expended on the range
- Scope and frequency of any range maintenance activities involving the removal of lead from the range
- Presence and duration of bullet-capturing technologies

#### ***Surface Water***

Under specific pH conditions, lead from shot or bullets can slowly dissolve in water. Runoff and groundwater recharge could transport this dissolved lead off range. The primary factors influencing the potential for dissolved lead to migrate via surface water include, but are not limited to, the following:

- pH of the water
- Duration of water contact with the lead
- Intensity and frequency of rainfall
- Steepness of the slope containing lead
- Amount and type of vegetation on the slope
- Infiltration rate of surface soils
- Presence of engineering controls or BMPs to modify or control surface water runoff

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### ***Groundwater and Soil***

The amount of lead that dissolves in water is primarily influenced by the pH of the water and the duration of water contact with the lead. Once lead is dissolved in water, the amount of lead that attaches to the soil and/or enters the groundwater is determined by several factors, including the following:

- Organic carbon content of the soil
- pH of the soil
- Properties of the soil, including porosity, irreducible water content, and hydraulic conductivity
- Amount of recharge percolating through the vadose zone
- Clay content of the soil (lead attaches to clay minerals more than other soil fractions)
- Depth to groundwater

### ***Pathways***

The REVA Small Arms Range Assessment involves developing a conceptual site model (CSM) for the range to identify the range's physical and environmental conditions. The CSM's purpose is to identify if a potential for source-receptor-pathway interaction may exist. Factors that influence the potential for a source-receptor-pathway interaction (e.g., heavy range use, potable water supply wells in proximity to the range), as well as factors that decrease the potential for such interactions, should be discussed in the assessment.

Potential pathways include:

- groundwater used as a source of potable or agricultural water,
- the use of surface water downstream of a range as a source of potable or agricultural water, and
- the use of the soil, surface water, or groundwater by sensitive species.

### ***Receptors***

Receptors in REVA can include on-range and off-range personnel and sensitive species and ecosystem areas. Factors considered when assessing the potentially complete exposure pathways for receptors include, but are not limited to, the following:

- The number and proximity of water supply wells relative to the range
- The characteristics of nearby water supply wells (e.g., depth to groundwater, well construction details)
- The uses of the surface water or groundwater (e.g., agriculture, drinking water)
- The locations of nearby sensitive species areas, such as endangered species habitats (i.e., within proximity to the range)

### **Small Arms Range Assessment Protocol**

This Small Arms Range Assessment Protocol is based on evaluating the potential environmental concerns posed by MC. Environmental concern evaluation rankings for surface water and groundwater conditions are established for each small arms range. The rankings range between High (indicating the highest potential environmental concern) and MINIMAL (indicating the lowest potential environmental concern). Sites for which there is insufficient information to complete the evaluation are placed into an Evaluation Pending ranking. Possible recommended actions are based on the relative environmental concern evaluation rankings assigned by the protocol. High rankings necessitate further actions. Further actions may included sampling, additional site-specific studies, and/or BMPs. These actions will be evaluated based on site conditions for each range.

#### ***Protocol Instructions***

1. For Tables 1 through 5:
  - a. Enter the appropriate score for each criteria in the site score column. Use the highest (i.e., most conservative) value if no information is known to complete the score. Professional judgment may be used at any time to override a designated score. If professional judgment is used, mark the score column appropriately (\*) and fill in the notes section at the bottom of the table with text detailing why professional judgment was used and how it impacted the scores.
  - b. Sum the site scores in the last row.
2. Transfer the scores from Tables 1 through 5 onto Table 6 in the appropriate rows.
3. Use the scores in Table 6 to determine the surface water and groundwater environmental concern evaluation rankings.

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### ***Evaluation Ranking Designation***

Once Table 6 is complete, the protocol finishes with two scores: the sum of surface water elements and the sum of groundwater elements. These scores are used to identify the appropriate evaluation ranking (High, Moderate, Minimal) for surface water and groundwater (as mentioned in step 3 of the protocol instructions).

The surface water concern evaluation ranking and the groundwater concern evaluation ranking identify the potential impact for lead migration for each of those pathways at the small arms range. The ranking designations and their descriptions follow:

- High = Small arms range most likely has the potential for lead migration and environmental concern, creating the greatest level of environmental concern and requiring additional action(s).
- Moderate = Small arms range may have the potential for lead migration and environmental concern, most likely indicating that there is no immediate environmental concern, but actions may be necessary to prevent a greater concern.
- Minimal = Small arms range has minimal or no potential for lead migration and environmental concern, indicating minimal threat of environmental concern, but actions may be necessary to ensure that the no concerns elevate.

These rankings are used to determine whether additional actions are appropriate. The higher environmental concern evaluation ranking (surface water or groundwater), as determined in Table 6, is used to evaluate if further actions are suggested, based on the guidelines for recommended actions (Table 7, provided on Page C-9).

The overall range evaluation rankings should be compared to each range within the installation and to the overall rankings of all ranges across the Marine Corps. These rankings will assist in determining how funding should best be allocated across the Marine Corps to prevent environmental concerns due to small arms ranges.

### **Assessment Report**

Once the Small Arms Range Assessment Protocol has been completed and appropriate actions have been designated and implemented, the assessment should be written into a report that describes the process taken, details the information used to score Tables 1

through 5, outlines the scores and evaluation rankings, and identifies the additional actions taken. The report should detail whether an identified receptor is or is not impacted by lead migration through the identified pathway(s). The completed protocol tables should be included as an appendix to the report.

### **Best Management Practices for Small Arms Ranges**

BMPs are important for all ranges and should be used appropriately to maintain the sustainability of operational ranges. However, this protocol prioritizes which small arms ranges may need BMPs to address specific possibilities of lead migration.

Following the Small Arms Range Assessment, BMPs may be recommended based on the environmental concern evaluation ranking. Prior to selecting and implementing BMPs, the management objectives must be established. Depending on the range-specific site conditions and the management objectives, the following BMPs should be considered:

- Bullet and shot containment techniques (e.g., berms, backstops, traps)
- Prevention of soil erosion from berms, aprons, and other range areas
- Soil amendments
- Recovery and/or recycling of lead

Negative impacts of implementation should also be considered when selecting a BMP. For example, using soil amendments may affect water quality of nearby water bodies or modifying surface water runoff may impact nearby habitats.

The prevention of soil erosion can be achieved by implementing one or several of the following practices:

- Maintaining vegetation on berms and drainageways
- Reducing runoff rates by adjusting site drainage patterns
- Providing sediment traps such as a vegetated detention basin or infiltration area
- Preventing the creation of a “point source”

Soil amendments may be an effective BMP by implementing one or both of the following practices:

- Increasing the retentive capacity of soil by adding organic matter, fertilizer, and/or lime
- Maintaining a pH range between 6 and 8 by adding triple superphosphate, bone meal, or other applicable additives

The recovery and recycling of lead from operational ranges should be considered as a way to control the migration of lead. The following should be considered when implementing recovery and recycling practices:

- Focus on safety as the primary concern of the proposed activities
- Avoid practices that appear as treatment activities (e.g. acid leaching, fixation, etc.)
- Dispose lead by using a lead recycler or smelter
- Use residual soil for the original purpose (e.g. berm/target area soil) following lead recovery practices.

<b>Table 7: Guidelines for Recommended Actions</b>	
<b>Environmental Concern Evaluation Ranking</b>	<b>Recommended Action</b>
<b>High</b>	Action required. 1) Consider sampling appropriate media (groundwater, surface water, and/or soil). 2) Identify and implement BMPs, if necessary.
<b>Moderate</b>	1) Consider identifying and implementing BMPs, if necessary. 2) Consider sampling appropriate media (groundwater, surface water, and/or soil).
<b>Minimal</b>	1) No further action is needed at this time. 2) Consider identifying and implementing BMPs, if necessary.

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 1  
(Known Distance Rifle Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. Limited precipitation rates and partial engineered controls (earthen berms) reduce the potential for lead transport. While intense storms in the winter may cause runoff to act as the dominant transport mechanism, it is unlikely that lead fragments from range operations will be dissolved in runoff and transported 2.5 miles in measurable concentrations to the nearest intermittent water body (Mesquite Dry Lake). On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data indicates that lead migration on this range is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<b>Duration of Range Use</b>	Part of the original complex developed in 1955.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
<b>Bullet-Capturing Technology</b>	A bullet trap was installed in 2000/2001 but was removed due to ricochet concerns. The range use minus the length of time the bullet rap was in place is greater than 30 years.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range averages more than 1000 lbs of lead deposited per year.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	Lead has only been mined once at the range, in 2000/2001.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>15</b>
<p><u>Notes:</u></p> <p>The Known Distance Rifle Range was part of the original small arms range complex developed in 1955 (Archives Search Report).</p> <p>A bullet trap was installed at the Known Distance Range in 2000/2001, but was removed due to ricochet concerns. The bullet trap was present less than 5 years and the difference between the range duration and bullet capture duration is greater than 30 years. Sand is periodically added to the face of the berm where bullet pockets are formed from range use.</p> <p>Based on MC loading data from 2004 and 2005, the range averages more than 1000 lbs of lead per year (2004: 4,758 to 7,138 lbs; 2005: 5,287 to 7,932 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	A protective earthen berm prevents run-on of surface water from higher elevations. No engineering control is present for precipitation that falls directly on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>
<p><u>Notes:</u></p> <p>Based on stormwater measurements collected on January 5, 2005, the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.</p> <p>The average amount of rainfall at MCAGCC Twentynine Palms is between 3 and 4 inches per year (USDA).</p> <p>Based on visual survey and aerial photographs, the berms are greater than 10% slope.</p> <p>The berms are covered by less than 20% vegetation. The area contains light patches of creosote bushes and other scrub.</p> <p>Range 1 (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).</p> <p>Based on a review of aerial photographs, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. This control does not affect surface runoff from precipitation that falls directly on the range.</p>			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Surface water bodies at MCAGCC are not used for drinking water. Surface water features are intermittent, with water present only after severe rainfall events. The closest downstream water resource is Mesquite Dry Lake, is located approximately 2.5 miles southwest of the MTU. The MTU drains to the west through gullies that are dry except after heavy rains. The primary drainage channel for the area begins west of the access road and continues parallel to Rifle Range Road until it connects with the storm sewers along Del Valle Road (Battelle, 1998; installation GIS orthophotographs).</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit that the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	15								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>27</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	15								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>32</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Ranking reduced to Minimal based on professional judgment of the REVA Team (See Page B-10 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 1A  
(Unknown Distance Rifle Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score for this range. The range has been in use for a short period of time, and the distance to the nearest intermittent surface water body (2.5 miles) makes it unlikely that lead from range operations will migrate to this point of exposure. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Minimal score, primarily due to the depth to groundwater and the lack of groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impact to groundwater.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The range was under construction when the Archive Search Report was being prepared (1998).	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	1
<b>Bullet-Capturing Technology</b>	Bullet-capture technology is not used at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range averages more than 1000 lbs of lead per year.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	No lead has been removed from this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>11</b>
<p><u>Notes:</u></p> <p>The Unknown Distance Rifle Range was under construction when the Archives Search Report was being prepared in 1998 (Archives Search Report).</p> <p>Lead recovery has not been conducted at this range.</p> <p>Based on MC loading data from 2004 and 2005 the range averages more than 1000 lbs of lead per year (<b>2004:</b> 3,603 to 5,406 lbs; <b>2005:</b> 4,444 to 6,667 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The protective earthen berm prevents run-on of surface water from higher elevations. No engineered control is present for precipitation that falls directly on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>
<p><u>Notes:</u></p> <p>Based on stormwater measurements collected on January 5, 2005, the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.</p> <p>The average amount of rainfall at MCAGCC Twentynine Palms is between 3 and 4 inches per year (USDA).</p> <p>Based on visual survey and aerial photographs, the berms are greater than 10% slope.</p> <p>The berms are covered by less than 20% vegetation. The area contains light patches of creosote bushes and other scrub.</p> <p>Range 1A (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).</p> <p>Based on a review of aerial photographs, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. This control does not affect surface runoff from precipitation that falls directly on the range.</p>			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b>			
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Surface water bodies at MCAGCC are not used for drinking water. Surface water features are intermittent, with water present only after severe rainfall events. The closest downstream water resource is Mesquite Dry Lake, is located approximately 2.5 miles southwest of the MTU. The MTU drains to the west through gullies that are dry except after heavy rains. The primary drainage channel for the area begins west of the access road and continues parallel to Rifle Range Road until it connects with the storm sewers along Del Valle Road (Battelle, 1998; installation GIS orthophotographs).</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The water bearing unit where the wells are located is upgradient of the Mesquite Basin.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b>			
<b>(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>23</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>28</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
Notes:										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 2  
(Known Distance Pistol Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. The presence of a bullet trap on this range greatly limits the potential for lead deposition and migration, as the majority of the lead is captured. Limited precipitation rates reduce the potential for lead migration, and there are no surface water receptors identified in proximity to the range. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Minimal score, primarily due to the depth to groundwater and the lack of groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impact to groundwater.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	Part of the original complex developed in 1955.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
<b>Bullet-Capturing Technology</b>	A bullet trap was installed in the early 2000s. However, based on the age of the range and the timeframe when the bullet trap was installed, the duration of use is greater than 30 years.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range averages more than 1000 lbs of lead per year, based on the MC loading data from 2004 and 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	Lead fragments no longer enter the berm. Lead fragments are collected from the bullet trap on a quarterly basis.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	1
<b>Source Element Score</b>			<b>11</b>
<p><u>Notes:</u></p> <p>The Known Distance Pistol Range was originally constructed in 1955 and contained a 15, 25, and 50 yard firing line (Archives Search Report).</p> <p>A bullet trap was installed at the Known Distance Pistol Range in the early 2000s. However, based on the original year of range construction 1955 and the timeframe in which the bullet trap was installed, the duration of use is greater than 30 years.</p> <p>Based on MC loading data from 2004 and 2005 the range averages more than 1000 lbs of lead per year. (<b>2004:</b> 3,805 to 5,708 lbs; <b>2005:</b> 4,747 to 7,121 lbs) However, the range has a bullet trap which prevents bullets from entering the berms. Therefore, the total amount of lead accumulating in the berms surrounding the Known Distance Pistol Range is less than 100 lbs per year. Lead was recovered from the berms of the Known Distance Pistol Range during the same project in which the bullet trap was installed. The lead fragments are now captured and removed by a contractor quarterly.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/ Erosion Engineering Controls</b>	A bullet trap is in place at the Known Distance Pistol Range. The bullet trap serves as an effective engineering control to prevent the accumulation of lead in the environment. An earthen berm located behind the bullet trap and drainage system add additional runoff control.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-10
<b>Surface Water Pathway Score</b>			<b>3</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms is between 3 and 4 inches per year (USDA).			
Based on site reconnaissance the bullet trap has a slope greater than 10% slope.			
Areas surrounding the range are covered by less than 20% vegetation. The area contains light patches creosote bushes and other scrub.			
Range 2 (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).			
A bullet trap is in place at the Known Distance Pistol Range to prevent the accumulation of lead into the environment. The bullet trap serves as an effective engineered control to prevent the accumulation of lead in the environment. In addition, an earthen berm located behind the bullet trap serves to prevent entry of surface water from precipitation onto the range from higher elevations to the north. Surface water from precipitation that falls directly on the range is captured by a drain at the northern end of the range, between the bullet trap and the rear berm. The drain routes collected runoff to the nearby natural drainage channel.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b>			
(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Surface water bodies at MCAGCC are not used for drinking water. Surface water features are intermittent, with water present only after severe rainfall events. The closest downstream water resource is Mesquite Dry Lake, is located approximately 2.5 miles southwest of the MTU. The MTU drains to the west through gullies that are dry except after heavy rains. The primary drainage channel for the area begins west of the access road and continues parallel to Rifle Range Road until it connects with the storm sewers along Del Valle Road (Battelle, 1998; installation GIS orthophotographs).</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit that the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
<b>Element</b>	<b>Table</b>	<b>Score</b>								
Range Use and Range Management (Source)	1	11								
Surface Water Pathways	2	3								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>18</b>								
<b>Groundwater</b>										
<b>Element</b>	<b>Table</b>	<b>Score</b>								
Range Use and Range Management (Source)	1	11								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>28</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table border="0"> <thead> <tr> <th><u>Environmental Concern Evaluation Ranking*</u></th> <th><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
Notes:										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 2A  
(Combat Pistol Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. This range has been operational for a shorter period of time than the other MTU ranges and training activities result in only moderate deposition of lead in berms. Limited precipitation rates and partial engineered controls (earthen berms) reduce the potential for lead transport, and there are no surface water receptors identified in proximity to the range. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Minimal score, primarily due to the depth to groundwater and the lack of groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impact to groundwater.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The date of establishment of the Combat Pistol Range is unknown; it is estimated to be between 10 and 30 years.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3*
<b>Bullet-Capturing Technology</b>	There is no bullet-capturing technology used at Range 2A.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range average less than 1000 lbs of lead, but more than 100 lbs of lead per year, based on the MC loading data from 2004 and 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
<b>Range Maintenance</b>	Lead recovery has not been documented at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>11</b>
<p><u>Notes:</u></p> <p>*The date of establishment of the Combat Pistol Range is not known. However, based on its description in the 1998 data collection for the Archive Search Report, it is estimated that Range 2A is between 10 and 30 years old.</p> <p>Lead recovery has not been conducted at this range.</p> <p>Based on MC loading data from 2004 and 2005 the range averages less than 1000 lbs of lead but more than 100 lbs of lead per year (<b>2004:</b> 144 to 215 lbs; <b>2005:</b> 150 to 225 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	A protective earthen berm prevents runoff of surface water from higher elevations. In addition, sand is periodically added to the face of the berm.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<u>Notes:</u>			
Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms is between 3 and 4 inches per year (USDA).			
Based on site reconnaissance and aerial photographs, this range contains many small berms (which protect the pop-up targets) and a large rear impact berm that are greater than 10% slope. Each berm has a slope greater than 10%.			
The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
Range 2 (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).			
Sand is periodically added to the face of the berm where bullet pockets are formed from range use. In addition, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. This control does not affect surface runoff from precipitation that falls directly on the range.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Surface water bodies at MCAGCC are not used for drinking water. Surface water features are intermittent, with water present only after severe rainfall events. The closest downstream water resource is Mesquite Dry Lake, is located approximately 2.5 miles southwest of the MTU. The MTU drains to the west through gullies that are dry except after heavy rains. The primary drainage channel for the area begins west of the access road and continues parallel to Rifle Range Road until it connects with the storm sewers along Del Valle Road (Battelle, 1998; installation GIS orthophotographs).</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit that the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p> <p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p> <p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>23</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>28</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
Notes:										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 3  
(BZO Grouping Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. The presence of a bullet trap on this range greatly limits the potential for lead deposition and migration, as the majority of the lead is captured. In addition, very limited loading of lead is occurring at this range, given the activities conducted at a BZO Range. Limited precipitation reduces the potential for lead migration, and there are no surface water receptors identified in proximity to the range. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Minimal score, primarily due to the depth to groundwater and the lack of groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impact to groundwater.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The BZO Range was originally established in 1974.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
<b>Bullet-Capturing Technology</b>	A bullet trap was installed in 2000/2001.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	-2
<b>MC Loading Rates</b>	The range averages less than 100 lbs of lead per year, based on MC loading data from 2004 and 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	1
<b>Range Maintenance</b>	Lead is removed from the bullet traps on a regular basis and does not accumulate in the berms surrounding the range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	1
<b>Source Element Score</b>			<b>5</b>
<p><u>Notes:</u></p> <p>The BZO Range was initially established as the Outdoor Small Arms Range Facility in 1974 (Archive Search Report).</p> <p>A bullet trap was installed at Range 3 in 2000/2001. Lead is removed from the bullet traps on a regular basis and does not accumulate in the berms surrounding the range.</p> <p>Based on MC loading data from 2004 and 2005, the range averages less than 100 pounds of lead accumulation per year (<b>2004</b>: 37 to 56 lbs; <b>2005</b>: 35 to 54 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The bullet trap serves as an effective engineered control to prevent the accumulation of lead in the environment. The protective earthen berm prevents run-on of surface water from higher elevations. No engineered control is present for precipitation that falls directly on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-10
<b>Surface Water Pathway Score</b>			<b>3</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
Based on site reconnaissance and aerial photographs the berms are greater than 10% slope.			
The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
Range 3 (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).			
Based on aerial photographs and site reconnaissance a bullet trap is present at Range 3 to prevent the accumulation of bullets in the berms surrounding the range. The bullet trap serves as an effective engineered control to prevent the accumulation of lead in the environment. In addition, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. Surface water from precipitation that falls directly on the range is captured by a drain at the northeastern end of the range, between the bullet trap and the rear berm. The drain routes collected runoff to the nearby natural drainage channel.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b>			
<b>(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Surface water bodies at MCAGCC are not used for drinking water. Surface water features are intermittent, with water present only after severe rainfall events. The closest downstream water resource is Mesquite Dry Lake, is located approximately 2.5 miles southwest of the MTU. The MTU drains to the west through gullies that are dry except after heavy rains. The primary drainage channel for the area begins west of the access road and continues parallel to Rifle Range Road until it connects with the storm sewers along Del Valle Road (Battelle, 1998; installation GIS orthophotographs).</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Water supply wells are located in the Surprise Springs groundwater basin, located west-northwest of the MTU. The water bearing unit that the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	5								
Surface Water Pathways	2	3								
Surface Water Receptors	4	13								
<b>Sum of Surface Water Element Scores</b>		<b>21</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	5								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>22</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
Notes:										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 3A  
(BZO Grouping Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. Limited precipitation rates and partial engineered controls (earthen berms) reduce the potential for lead transport. While intense storms in the winter may cause runoff to act as the dominant transport mechanism, it is unlikely that lead from range operations will be dissolved in runoff and transported 2.5 miles in measurable concentrations to the nearest intermittent water body (Mesquite Dry Lake). On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data from nearby MTU ranges indicates that lead migration on this range is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The range was originally established in 1969.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	5
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is used at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range averages more than 1000 lbs of lead per year, based on MC loading data from 2004 and 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	Lead recovery has not been conducted at this range. Sand is periodically added to the face of the berm where bullet pockets are formed during range use.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>15</b>
<p><u>Notes:</u></p> <p>This range was initially established as the Skeet Range, Facility #2135 and the Small Arms Range, Facility #2142, in 1969 (Archives Search Report). It is listed in the Archives Search Report as the Moving Target Pistol Range.</p> <p>Lead recovery has not been conducted at this range. Sand is periodically added to the face of the berm where bullet pockets are formed from range use.</p> <p>Based on MC loading data from 2004 and 2005 the range averages more than 1000 pounds of lead per year (<b>2004:</b> 1,927 to 2,891 lbs; <b>2005:</b> 1,561 to 2,342 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The protective earthen berm prevents run-on of surface water from higher elevations.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>
<p><u>Notes:</u></p> <p>Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.</p> <p>The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).</p> <p>Based on site reconnaissance and aerial photographs the berms are greater than 10% slope.</p> <p>The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.</p> <p>Range 3A (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).</p> <p>Based on a review of aerial photographs, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. Surface runoff from precipitation that falls directly at the range collects within a low point to the northwest of the range, below the earthen berm. Water collected within this low point infiltrates through the sandy soils or evaporates.</p>			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils are characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<p><u>Notes:</u></p> <p>The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).</p> <p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p> <p>The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).</p>			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Mesquite Dry Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b>			
<b>(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>Most surface water runoff from precipitation that falls on the range collects in a low spot on the range floor and infiltrates or evaporates. Some drainage during intense storms may flow to the south and west, for eventual discharge to into the Mesquite Dry Lake, located approximately 2.5 miles southwest of the MTU. Surface water bodies at MCAGCC are not used for drinking water.</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Mesquite Dry Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>While surface water may infiltrate into the subsurface at the low elevation spot on the range floor, most of the water is likely to evaporate due to the arid conditions. Water supply wells are located in the Surprise Springs groundwater basin, located west-northwest of the MTU. The groundwater bearing unit that the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	15								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>27</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	15								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>32</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<b>Notes:</b>										
*The Groundwater Environmental Concern Evaluation Ranking reduced to Minimal based on professional judgment of the REVA Team (See Page B-58 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** MTU Range 4  
(Multi-Purpose Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. Limited precipitation rates and partial engineered controls (earthen berms) reduce the potential for lead transport. While intense storms in the winter may cause runoff to act as the dominant transport mechanism, it is unlikely that lead from range operations will be dissolved in runoff and transported 18 miles in measurable concentrations to the nearest intermittent water body (Dale Lake). On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data indicates that lead migration on this range is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The exact age of the range is not known. It is assumed that the range is between 10 and 30 years old.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3*
<b>Bullet-Capturing Technology</b>	No bullet capture technology is in place at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The range averages greater than 1000 lbs of lead per year, based on the 2004 and 2005 MC loading rates.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	No lead recovery has been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>13</b>
<p><u>Notes:</u></p> <p>The date in which Range 4 was established is not known, based on the information in the Archives Search Report. However, the report does indicate this range has no previous use (at the time of the assessment). Therefore, it is assumed that Range 4 is between 10 and 30 years old.</p> <p>Lead recovery has not been conducted at this range.</p> <p>Based on MC loading data from 2004 and 2005 the range averages greater than 1000 lbs of lead accumulated on the range per year (<b>2004</b>: 1,591 to 2,386 lbs; <b>2005</b>: 1,987 to 2,981 lbs).</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on the visual survey and the aerial photographs, the berms have a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The area contains light patches of creosote bushes and other scrub vegetation.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The protective earthen berm prevents precipitation from higher elevations from running on to the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
Based on site reconnaissance and aerial photographs the berms are greater than 10% slope.			
The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
Range 4 (and the entire MTU) contains soils characterized as Cajon loamy sand, 2 to 8 percent slopes. This soil series is predominantly sandy, which are very deep, somewhat excessively drained soils with negligible to low runoff (NRCS, 2002).			
Based on a review of aerial photographs, a protective earthen berm is present on the backside of the range to prevent run-on of surface water from the higher elevations to the north. In addition, surface runoff from precipitation that falls directly at the range collects within a low point on the north side of the range, below the earthen side berm. Water collected within this low point infiltrates through the sandy soils or evaporates.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest depth-to-groundwater measurement (1.3 miles west) was approximately 400 feet.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	0
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	The soils at the MTU are classified as entisols or aridisols with a pH value range of 8.0 to 9.1.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	1
<b>Soil Type/Infiltration Conditions</b>	Soils characterized as Cajon loamy sand, which is predominantly sandy and somewhat excessively drained, with negligible to low runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Soils characterized as Cajon loamy sand which is a predominantly sandy soil.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>13</b>
<b>Notes:</b>			
The nearest depth-to-groundwater measurement is from a well approximately 1.3 mile west of the range (IRP Site 16). Depth to groundwater at that point was approximately 400 feet (Battelle 1998).			
In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).			
The soils at the MTU are classified as entisols and aridisols and are moderately to strongly alkaline with pH values in the range of 8.0 to 9.1 (Battelle, 1998).			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used for drinking water.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Surface water features are intermittent, with water present only after severe rainfall events. Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Dale Lake.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	Given the distance of the closest surface water body and the high infiltration rate at the MTU, it is unlikely that lead will migrate to Dale Lake.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b>			
<b>(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Notes:</b>			
<p>Most surface water runoff from precipitation that falls on the range collects in a low spot on the range floor and infiltrates or evaporates. Ephemeral washes around Range 4 appear to move to the east, into the East Mainside drainage basin, which drains into Dale Lake, 18 miles from the installation boundary. The installation boundary is 1.8 miles from the range. Surface water features are intermittent, with water present only after severe rainfall events. Surface water is not used as a drinking water source.</p> <p>Lead has been sampled at the MTU by Battelle and the Navy. Lead concentrations were greatest in the berms and fell off rapidly with increasing distance from the berms. The Navy reported visible fragments of lead out to several thousand feet beyond the impact berms. However, based on the data reviewed to date no studies have been done to collect samples from the dry washes leaving the MTU. Given the distance to the closest intermittent water body receiving runoff and the high rate of infiltration through the sandy soils on range, it is unlikely that lead will migrate to Dale Lake.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit is located upgradient of the Mesquite Basin.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells located on the installation. Surface water and stormwater runoff are used for irrigation purposes.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>While surface water may infiltrate into the subsurface at the low elevation spot on the range floor, most of the water is likely to evaporate due to the arid conditions. Water supply wells are located in the Surprise Springs groundwater basin, located to the west-northwest of the MTU. The groundwater bearing unit the water wells pump from is located upgradient of the Mesquite Basin. The Mesquite Basin is not used as a drinking water source because of high mineral content. The known depth to groundwater near the MTU is approximately 400 feet.</p>			
<p>There are no known agricultural wells located on the installation. Surface water and stormwater is used for irrigation purposes. Based on soil sampling results from the Small Arms Range Maintenance and Repair Project at MCAGCC Twentynine Palms (Battelle, 1998) and previous Navy studies, the vertical migration of lead in the soil column is between four and eight inches from the soil surface.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>25</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Groundwater Pathways	3	13								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>30</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Ranking reduced to Minimal based on professional judgment of the REVA Team (See Page B-67 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** Range 101  
(Armor, Gun Training Range (Subcaliber))  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score for this range. The range has been in use for a short period of time, minimal lead loading is occurring, and the distance to the nearest intermittent surface water body makes it unlikely that lead from range operations will migrate to this point of exposure. In addition, all surface water draining Range 101 is contained on-range; as such, there are no human receptors, as REVA only addresses potential migration and exposure to receptors in off-range locations. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Minimal score, primarily due to the depth to groundwater and the lack of groundwater receptors. On the basis of the SARAP, there is minimal potential for lead migration and impact to groundwater.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Duration of Range Use</b>	The range began operation around 1980. It is first documented in the 1984 Range Standard Operating Procedure.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is used at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The average lead loading at Range 101 is less than 100 lbs of lead per year, based on the expenditure data from 2001 to 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	1
<b>Range Maintenance</b>	This range does not have impact berms and lead recovery has not been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			9
<p><u>Notes:</u></p> <p>Range 101 began operation around 1980. The range is first documented in the 1984 Range Standard Operating Procedure.</p> <p>Based on MC expenditure data from 2001 to 2005, the average lead loading at Range 101 is less than 100 pounds per year.</p> <p>The range does not have a specific impact berm; lead recovery is not conducted at this range.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on aerial photography and GIS data there is no back stop berm at Range 101. The ground slope is less than 5%.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	1
<b>Vegetation</b>	The range is covered by less than 20% vegetation, predominantly creosote bushes and other scrub.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Bluepoint sand, 2 to 8 percent slopes. The soil series is predominantly sandy, consisting of very deep, somewhat excessively drained soils.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	Based on aerial photographs and site reconnaissance there are no engineered controls at the range to prevent erosion or control surface water. Two large surface drainages bisect the northern and central sections of the range fan.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	0
<b>Surface Water Pathway Score</b>			<b>9</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on USGS data the pH of precipitation in California is between 5.3 and 5.5. "Natural" rain will be slightly acidic (pH of 5.6) because of the presence of carbon dioxide in the air which forms carbonic acid when it is mixed with water. However, once the rainfall comes into contact with the ground, the pH increases. Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
Based on aerial photographs and GIS data there is no back stop berm at Range 101. The ground slope in the area is less than 5%. A small hill is located approximately 2000 ft down range (the same distance as one of the targets). However, on average, the slope is less than 5%.			
The range is covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
Range 101 contains soils characterized as Bluepoint sand, 2 to 8 percent slopes. This soil series is predominantly sandy, consists of very deep, somewhat excessively drained soils with very low or low runoff and rapid infiltration (NRCS, 2006).			
Based on aerial photographs and site reconnaissance there are no engineered controls present at the site to prevent erosion or to control surface water. Two large surface drainages bisect the northern and central sections of the range fan.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The closest well to the range is located approximately 2 miles away.. The depth to groundwater at the well was 134.54 ft below ground surface.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	Bluepoint sands are typically slightly alkaline to strongly alkaline.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	3
<b>Soil Type/Infiltration Conditions</b>	Bluepoint sands are predominantly sandy soils that are somewhat excessively drained with very low to low runoff rates.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Bluepoint sands are predominantly sandy soils.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>16</b>

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>An observation well is located approximately 2 miles from Range 101. The depth to groundwater at the well was 134.54 ft below ground surface (MCAGCC FMD, 2006). However, there is a fault that acts as a groundwater barrier running under Deadman Lake. The depth to groundwater east of Deadman Lake is generally unknown; Range 101 is located east of Deadman Lake. The downgradient groundwater flow under Range 101 is towards Mainside. The groundwater under Range RTA is of generally poor water quality due to high mineral content.</p>			
<p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p>			
<p>Bluepoint sands, which are typically associated with Sandhill soil types are generally slightly alkaline to strongly alkaline (USDA NCRS – Official Soil Description).</p>			

<b>Table 4: Surface Water Receptors Element</b>			
<b>(These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)</b>			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used as a drinking water source at the installation.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Two large drainage features are present in the northern and central sections of the range fan, which drain to the southern portion of Deadman Lake. This intermittent water body is fully contained within the range boundaries; therefore, there are no potential off-range releases or exposures.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	The intermittent water body is fully contained within the range boundaries, therefore no off-range MC releases and exposures to surface water.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u> Surface waterbodies in the area are not used for drinking water. Range 101 drains to the west through gullies that are dry except after heavy rains (aerial photographs and topography). Two large drainage features are present in the northern and central sections of the range fan, which lead to the southern end of Deadman Lake, located approximately 1.25 miles northwest of the range. This intermittent water body is fully contained with the range boundaries; as REVA is limited to the assessment of potential off-range MC releases and exposures, there are no potential receptors for surface water at Range 101.			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	A non-potable water well is located near Deadman Lake. The water supply wells for the installation are located west of the Range. The hydrogeologic basin that the water supply wells are located in is separated from the range by a large fault. Downgradient groundwater basins are not used as drinking water sources because of the high mineral content.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells on the installation. Surface water and stormwater are used for irrigation purposes in the cantonment area. Surface water that accumulates in Deadman Lake generally evaporates.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharges located near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>The depth to water at the non-potable water well near Deadman Lake is 25.09 feet below ground surface. The closest water supply wells are located west of where the range is located. The groundwater below Range 101 is separated from the water supply groundwater basin by a fault that runs under Deadman Lake.</p>			
<p>There are no water supply wells near Range 101. Water supply wells are located in the Surprise Springs groundwater basin, located to the west. Surprise Springs is located upgradient of the range and is hydrogeologically separated from the range by a large fault. The downgradient groundwater basin, Mesquite Basin, is not used as a drinking water source because of high mineral content.</p>			
<p>There are no known agricultural wells located on MCAGCC. Surface water and stormwater is used for irrigation purposes. The surface water that accumulates in Deadman Lake generally evaporates.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	9								
Surface Water Pathways	2	9								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>22</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	9								
Groundwater Pathways	3	16								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>29</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
Notes:										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** Range 101A  
(Small Arms BZO Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. The infrequent precipitation and distance to the nearest intermittent surface water body (Deadman Lake, 1.25 miles to the northwest) makes it unlikely that lead from range operations will migrate to this point of exposure in high concentrations or quantities. In addition, Deadman Lake is fully contained on-range; as such, there are no surface water receptors to be considered, as REVA addresses only off-range releases and receptors. Therefore, on the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data at a similar range location (MTU ranges) indicates that lead migration is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<b>Duration of Range Use</b>	The range began operation around 1980. The range is first documented in the 1984 Range Standard Operating Procedure.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is used at the range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The average lead loading is more than 1000 lbs of lead per year, based on the MC expenditure data from 2001 to 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	No lead recovery has been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>13</b>
<p><u>Notes:</u></p> <p>The Small Arms BZO Range began operation around 1980. The range is first documented in the 1984 Range Standard Operating Procedure.</p> <p>Based on MC expenditure data from 2001 to 2005, the average lead loading at Range 101A is more than 1000 lbs per year.</p> <p>Lead recovery has not been conducted at this range.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on aerial photographs the backstop berm has a slope greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The range is covered by less than 20% vegetation, primarily creosote bushes and other scrub.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Bluepoint sand, 2 to 8 percent slopes. The soil series is predominantly sandy, consisting of very deep, somewhat excessively drained soils.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The range has a rear impact berm and two side berms which act as partial engineered controls to preventing run-on of surface water. There is no engineered control for precipitation that falls directly on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<u>Notes:</u>			
Based on USGS data the pH of precipitation in California is between 5.3 and 5.5. "Natural" rain will be slightly acidic (pH of 5.6) because of the presence of carbon dioxide in the air which forms carbonic acid when it is mixed with water. However, once the rainfall comes into contact with the ground, the pH increases. Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
The ground slope of the backstop berms at the range is greater than 10%.			
The range is covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
Range 101A contains soils characterized as Bluepoint sand, 2 to 8 percent slopes. This soil series is predominantly sandy, consists of very deep, somewhat excessively drained soils with very low or low runoff and rapid infiltration (NRCS, 2006).			
Range 101A contains a rear impact berm and two side berms. The berms act as a partial engineered control by preventing run-on of surface water from higher elevations to the north and east. This control does not affect surface runoff from precipitation that falls directly on the range.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The closest well to the range is located to the southwest. The depth to groundwater at the well was 134.54 ft below ground surface.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	Bluepoint sands are generally slightly alkaline to strongly alkaline.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	3
<b>Soil Type/Infiltration Conditions</b>	Bluepoint sands are predominantly sandy soils that are somewhat excessively drained with very low to low runoff rates.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Bluepoint sands are predominantly sandy soils.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>16</b>

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>An observation well is located southwest of Range 101A. The depth to groundwater at the well was 134.54 ft below ground surface (MCAGCC FMD, 2006). However, there is a fault that acts as a groundwater barrier running under Deadman Lake. The depth to groundwater east of Deadman Lake is generally unknown; Range 101A is located east of Deadman Lake. The downgradient groundwater flow under Range 101A is towards Mainside. The groundwater under Range RTA is of generally poor water quality due to high mineral content</p>			
<p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p>			
<p>Bluepoint sands, which are typically associated with Sandhill soil types are generally slightly alkaline to strongly alkaline (USDA NCRS – Official Soil Description).</p>			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used as drinking water sources at the installation.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	The range drains to the southern portion of Deadman Lake. This intermittent water body is fully contained within the range boundaries; therefore, there are no potential off-range releases or exposures.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	The intermittent water body is fully contained within the range boundaries, therefore no off-range MC releases and exposures to surface water.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>
<p><u>Notes:</u></p> <p>Surface waterbodies in the area are not used for drinking water. Range 101A drains to the west through gullies that are dry except after heavy rains (aerial photographs and topography). Two large drainage features are present in the northern and central sections of the range fan, which lead to the southern end of Deadman Lake, located approximately 1.25 miles northwest of the range. This intermittent water body is fully contained with the range boundaries; as REVA is limited to the assessment of potential off-range MC releases and exposures, there are no potential receptors for surface water at Range 101A.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	A non-potable water well is located near Deadman Lake. The water supply wells for the installation are to the west. The hydrogeologic basin that the water supply wells are located in is separated from the range by a large fault. Downgradient groundwater basins are not used as drinking water sources because of the high mineral content.	10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown  5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells on the installation. Surface water and stormwater are used for irrigation purposes in the cantonment area. Surface water that accumulates in Deadman Lake generally evaporates.	5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown  3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably  1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharges located near the range which could result in lead migration from groundwater to surface water.	5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources  1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>The depth to water at the non-potable water well near Deadman Lake is 25.09 feet below ground surface. The closest water supply wells are located approximately 7 miles to the west of where the range is located. The groundwater below Range 101A is separated from the water supply groundwater basin by a fault that runs under Deadman Lake.</p>			
<p>There are no water supply wells near Range 101A. Water supply wells are located in the Surprise Springs groundwater basin to the west. Surprise Springs is located upgradient of the range and is hydrogeologically separated from the range by a large fault. The downgradient groundwater basin, Mesquite Basin, is not used as a drinking water source because of high mineral content.</p>			
<p>There are no known agricultural wells located on MCAGCC. Surface water and stormwater is used for irrigation purposes. The surface water that accumulates in Deadman Lake generally evaporates.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>25</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Groundwater Pathways	3	16								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>33</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Rankings were reduced to Minimal based on professional judgment of the REVA Team (See Page B-88 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** Range 105A  
(Small Arms BZO Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. This score is predominantly based on the short period of use and level of lead loading occurring at the range. In addition, the earthen berms at the range serve as a partial engineering control to prevent run-on from entering the range. The proximity of the range to an intermittent surface water body (Deadman Lake) represents a concern for potential lead transport. However, transport of lead is likely minimized by the limited precipitation in the area. In addition, Deadman Lake is fully contained on-range; as such, there are no human receptors to consider, as REVA only addresses potential migration and exposure to receptors in off-range locations.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. The Groundwater Pathway score is based mostly on the sandy nature of the soils, lack of clay in the soil unit, and the estimated depth to groundwater. While the depth to groundwater east of Deadman Lake is not known, groundwater depths tend to become shallower as the local topography flattens towards a playa. It is noted that previous sampling data at a similar range location (MTU ranges) indicates that lead migration is limited to a maximum of eight inches from the soil surface. As such, it is the professional judgment of the REVA team that the ranking is more accurately described as a Minimal level, given the very limited potential for lead migration through the vadose zone.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<b>Duration of Range Use</b>	Range 105A was not documented in the Archive Search Report, which was prepared in 1998. It is assumed that the range is less than 10 years old.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	1
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is used at Range 105A.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The average lead loading is between 100 and 1000 lbs of lead per year, based on MC expenditure data from 2001 through 2005. There has been a sharp increase in lead loading since 2003.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
<b>Range Maintenance</b>	No lead removal has been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>8</b>
<p><u>Notes:</u></p> <p>Range 105A is located next to the Gas Chamber (Range 105) in the Range RTA. The Archives Search Report does not describe this range. The report does identify a Range BZO; however, the range is located in the Cleghorn Pass RTA. Based on the fact that the Small Arms BZO Range is not mentioned in the Archive Search Report it is assumed that the range was built after 1998 (date of the Archives Search Report site visit and data collection process). Therefore, the range is estimated to be less than 10 years old.</p> <p>Based on MC expenditure data from 2001 to 2005 the average lead loading at Range 105A is between 100 and 1000 lbs per year. There has been a sharp increase in the amount of lead loading at the BZO Range between 2003 and 2005.</p> <p>Lead recovery is not conducted at this range.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on aerial photographs the slope of the backstop berm is greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The range is covered by less than 20% vegetation, primarily creosote bushes and other scrub.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Ariz dry-twobitter association sands which are very deep, excessively drained soils.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The rear and side impact berms provide a partial engineering control preventing run-on of surface water from higher elevations. There are no controls for precipitation that falls directly on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on USGS data the pH of precipitation in California is between 5.3 and 5.5. "Natural" rain will be slightly acidic (pH of 5.6) because of the presence of carbon dioxide in the air which forms carbonic acid when it is mixed with water. However, once the rainfall comes into contact with the ground, the pH increases. Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
The slope of the backstop berm is greater than 10%.			
The range is covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
The soil units present on Range 105A are characterized as Arizo dry-twobitter association sands with 2-8% slopes (NRCS). Arizo soils are very deep, excessively drained soils that formed in mixed alluvium with little to no clay.			
Range 105A contains a rear impact berm and two side berms. Based on a review of aerial photographs, the berms appear to act as a partial engineered control by preventing run-on of surface water from higher elevations to the north and east. This control does not affect surface runoff from precipitation that falls directly on the range.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The closest water well is located near Deadman Lake. The depth to groundwater at the non-potable water well is 25.09 ft below ground surface.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	3*
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	Arizo series soils are generally neutral to strongly alkaline soils.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	3
<b>Soil Type/Infiltration Conditions</b>	Arizo two-bitter sands are generally excessively drained soils.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Arizo two-bitter sand contain little to no clay.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>18</b>
<p><u>Notes:</u></p> <p>The closest water well is located near Deadman Lake. The depth to groundwater at the well is 25.09 ft below ground surface (MCAGCC FMD, 2006). However, there is a fault that acts as a groundwater barrier running under Deadman Lake. The depth to groundwater east of Deadman Lake is generally unknown; Range 105A is located east of Deadman Lake. The downgradient groundwater flow under Range 105A is towards Mainside. The groundwater under Range RTA is of generally poor water quality due to high mineral content.</p> <p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p> <p>Arizo two-bitter sands, which are part of the Arizo soil series are generally neutral to strongly alkaline in nature. (USDA NCRS– Official Series Description)</p>			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used as drinking water sources at the installation.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	Water that falls on Range 105A drains through gullies towards Deadman Lake, located 0.25 miles west of the range. Deadman Lake is an intermittent water body that is entire contained within the range. No off-range MC releases or exposures are anticipated for this range.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	The intermittent water body is fully contained within the range boundaries, therefore no off-range MC releases and exposures to surface water.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u> Surface water bodies in the area are not used for drinking water. Range 105A drains to the southwest through gullies that are dry except after heavy rains (aerial photographs and topography). Deadman Lake is the closest surface body, located downstream of the range less than a quarter mile to the west. This intermittent water body is fully contained within the range boundaries; as REVA is limited to the assessment of potential off-range MC releases and exposures, there are no potential receptors for surface water at Range 105A.			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	A non-potable water well is located near Deadman Lake. The water supply wells for the installation are located approximately 6 miles to the west. The hydrogeologic basin that the water supply wells are located in is separated from the range by a large fault. Downgradient groundwater basins are not used as drinking water sources because of the high mineral content.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells on the installation. Surface water and stormwater are used for irrigation purposes in the cantonment area. Surface water that accumulates in Deadman Lake generally evaporates.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharges located near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>There are no water supply wells near Range 105A. The depth to water at the non-potable water well near Deadman Lake is 25.09 ft below ground surface. The closest water supply wells are located approximately 6 miles west of where the range is located. The groundwater below Range 105A is separated from the water supply groundwater basin by a fault that runs under Deadman Lake.</p> <p>There are no known agricultural wells located on MCAGCC. Surface water and stormwater is used for irrigation purposes. The surface water that accumulates in Deadman Lake generally evaporates.</p> <p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	8								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>20</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	8								
Groundwater Pathways	3	18								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>30</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Rankings were reduced to Minimal based on professional judgment of the REVA Team (See Page B-98 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** Range 113  
(Multi-purpose Machine Gun Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. Low precipitation and partial engineered controls, which help to minimize surface runoff from entering the range floor, generally limit lead migration from Range 113. In addition, the distance to the nearest intermittent surface water body makes it unlikely that lead from range operations will migrate in significant concentrations or quantities to this point of exposure. In addition, there are no surface water receptors associated with this range. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data at a similar range location (MTU ranges) indicates that lead migration is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<b>Duration of Range Use</b>	Range 113 was originally a Tank Combat Course. It was converted to the Multi-Purpose Machine Gun Range between 1988 and 1998. It is assumed that the range is between 10 and 30 years old.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is present at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The average lead loading rate is greater than 1000 lbs of lead per year, based on the MC expenditure data from 2001 through 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	5
<b>Range Maintenance</b>	Lead recovery has not been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>13</b>
<p><u>Notes:</u></p> <p>Range 113 was originally designated as a Tank Combat Course. The range was converted to the Multi-Purpose Machine Gun Range between 1988 and 1998. Based on this information, Range 113 is between 10 and 30 years old.</p> <p>Based on MC expenditure data from 2001 to 2005, the average lead loading at Range 113 is greater than 1000 lbs per year.</p> <p>Lead recovery is not conducted at this range.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	Based on aerial photographs there is no impact berm present on the range. The slope of the range area is generally less than 5%.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	1*
<b>Vegetation</b>	The range is covered by less than 20% vegetation, primarily creosote bushes and other scrub.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Arizo sands, which are generally excessively drained soils.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/ Erosion Engineering Controls</b>	Based on aerial photographs a surface drainage control (either a berm or a ditch) is in place at the center of the range fan to divert surface runoff and prevent run-on.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5*
<b>Surface Water Pathway Score</b>			<b>4</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on USGS data the pH of precipitation in California is between 5.3 and 5.5. "Natural" rain will be slightly acidic (pH of 5.6) because of the presence of carbon dioxide in the air which forms carbonic acid when it is mixed with water. However, once the rainfall comes into contact with the ground, the pH increases. Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
Based on aerial photographs, a surface drainage control (either a ditch or berm) is in place in the center of the range fan to divert surface runoff and prevent run-on. Based on topography of the area, the slope is generally less than 5%. This control does not affect surface runoff from precipitation that falls directly on the range.			
The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
The soil units present on Range 113 are characterized as Arizo sands (USDA NRCS). They are thick, excessively drained soils that formed in mixed alluvium with little to no clay.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The closest well to the range is located southwest of the range. The depth to groundwater at the well was 98.22 ft below ground surface. Based on the higher elevation of the range, it is assumed the depth to groundwater is greater than 100 ft.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	Arizo sands are generally neutral to strongly alkaline.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	3
<b>Soil Type/Infiltration Conditions</b>	Arizo sands are predominantly excessively drained soils with little or no runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Arizo sands are sandy soils with little or no clay.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>16</b>

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>An observation well is located near Deadman Lake, located south of Range 113. The depth to groundwater at the well was 98.22 ft below ground surface (MCAGCC FMD, 2006). However, there is a geologic fault that acts as a groundwater barrier located under Deadman Lake. The depth to groundwater east of Deadman Lake is generally unknown; Range 113 is located east of Deadman Lake. The downgradient groundwater flow under Range RTA is towards Mainside, the water is of generally poor water quality due to high mineral content.</p> <p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p> <p>Arizo sands are generally neutral to strongly alkaline (USDA NCRS – Official Soil Description).</p>			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used as drinking water sources at the installation.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	The range drains into the northern portion of Deadman Lake. This intermittent water body is fully contained within the range boundaries; therefore, there are no potential off-range releases or exposures.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	The intermittent water body is fully contained within the range boundaries, therefore no off-range MC releases and exposures to surface water.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>
<p><u>Notes:</u></p> <p>Surface water bodies in the area are not used for drinking water. Deadman Lake is the closest surface body, located downstream of the range 2.5 miles to the south-southeast. This intermittent water body is fully contained with the range boundaries; as REVA is limited to the assessment of potential off-range MC releases and exposures, there are no potential receptors for surface water at Range 113.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	A non-potable water well is located near Deadman Lake. The water supply wells for the installation are located to the southwest. The hydrogeologic basin that the water supply wells are located in is separated from the range by a large fault. Downgradient groundwater basins are not used as drinking water sources because of the high mineral content.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells on the installation. Surface water and stormwater are used for irrigation purposes in the cantonment area. Surface water that accumulates in Deadman Lake generally evaporates.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharges located near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>The depth to water at the non-potable water well near Deadman Lake is 25.09 feet below ground surface. The closest water supply wells are located approximately 7 miles southwest of where the range is located. The groundwater below Range 113 is separated from the water supply groundwater basin by a fault that runs under Deadman Lake.</p>			
<p>There are no water supply wells near Range 113. Water supply wells are located in the Surprise Springs groundwater basin, located approximately 7.5 miles to the southwest. Surprise Springs is located upgradient of the range and is hydrogeologically separated from the range by a large fault. The downgradient groundwater basin, Mesquite Basin, is not used as a drinking water source because of high mineral content.</p>			
<p>There are no known agricultural wells located on MCAGCC. Surface water and stormwater is used for irrigation purposes. The surface water that accumulates in Deadman Lake generally evaporates.</p>			
<p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Surface Water Pathways	2	4								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>21</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	13								
Groundwater Pathways	3	16								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>33</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Ranking has been reduced to Minimal based on professional judgment of the REVA Team (See Page B-108 for rationale).										

**INSTALLATION:** MCAGCC TWENTYNINE PALMS  
**LOCATION:** TWENTYNINE PALMS, CALIFORNIA  
**RANGE:** Range 113A  
(Machine Gun BZO Range)  
**DATE:** August 20, 2007

**PRELIMINARY ASSESSMENT RESULTS:**

The Surface Water Environmental Concern Evaluation Ranking resulted in a Minimal score. Low precipitation and partial engineered controls, which help to minimize surface runoff from entering the range floor, generally limit lead migration from Range 113A. In addition, the distance to the nearest intermittent surface water body makes it unlikely that lead from range operations will migrate in significant concentrations or quantities to this point of exposure. In addition, there are no surface water receptors associated with this range. On the basis of the SARAP, there is minimal potential for lead migration and impact to surface water.

The Groundwater Environmental Concern Evaluation Ranking resulted in a Moderate score. However, it is the professional judgment of the REVA Team that the overall concern for lead migration and exposure to groundwater receptors is more accurately categorized as a Minimal level. The Groundwater Pathway score is biased high based on the sandy nature of the soils, and lack of clay in the soil unit. Previous sampling data at a similar range location (MTU ranges) indicates that lead migration is limited to a maximum of eight inches from the soil surface. In addition, the depth to groundwater and the lack of groundwater receptors in the area likely precludes any significant groundwater impacts. Therefore, on the basis of professional judgment, there is minimal potential for lead migration and impact to groundwater resources.

<b>Table 1: Range Use and Range Management (Source) Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
Criteria	Evaluation Characteristics	Score Criteria	Site Score
<b>Duration of Range Use</b>	Range 113A was established at an unknown date. Based on the establishment of Range 113 (between 1998 and 1998), it is assumed that the BZO range is approximately the same age, between 10 and 30 years old.	5 if usage > 30 years 3 if usage is 10 to 30 years 1 if usage < 10 years	3
<b>Bullet-Capturing Technology</b>	No bullet-capture technology is used at this range.	If [range usage duration = bullet capture duration], then apply a <b>negative</b> score so that the [range usage duration + bullet capture duration] = 1  If [range usage duration – bullet capture duration] = 10 to 30 years, then apply a <b>negative</b> score so that the [range use duration + bullet capture duration] = 3  0 if [range usage duration – bullet capture duration] > 30 years	0
<b>MC Loading Rates</b>	The average lead loading rate is between 100 and 1000 lbs of lead per year, based on the expenditure data from 2001 through 2005.	5 if MC loading > 1000 pounds/year 3 if MC loading = 100 to 1000 pounds/year 1 if MC loading < 100 pounds/year	3
<b>Range Maintenance</b>	No lead recovery has been conducted at this range.	5 if lead is removed less than every three years  3 if lead is removed more than every three years but less than annually  1 if lead is removed at least annually	5
<b>Source Element Score</b>			<b>11</b>
<p><u>Notes:</u></p> <p>Range 113A was established at an unknown date. Given its use as a BZO range in support of training activities at the adjacent Range 13, it is likely that the range is between 10 and 30 years old.</p> <p>Based on MC expenditure data from 2001 to 2005, the average lead loading at Range 113A is between 100 and 1000 lbs per year. There has been a sharp increase in expenditures between 2003 through 2005.</p> <p>Lead recovery is not conducted at this range.</p>			

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>pH of Water</b>	The pH of surface water is estimated to be between 8.5 and 8.8, based on stormwater measurements.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>Slope of Range</b>	The slope of the backstop berm is greater than 10 percent.	5 if slope > 10% 3 if slope = 5% to 10% 1 if slope < 5%	5
<b>Vegetation</b>	The range is covered by less than 20% vegetation, primarily creosote bushes and other scrub.	5 if vegetation cover < 20% 3 if vegetation cover = 20% to 50% 1 if vegetation cover > 50%	5
<b>Soil Type/Runoff Conditions</b>	Soils are characterized as Arizo sands which are excessively drained soils.	5 if soil type is clay / silty clay 3 if soil type is clayey sand / silt 1 if soil type is sand/gravel	1
<b>Runoff/Erosion Engineering Controls</b>	The rear and side impact berms prevent run-on of surface water from higher elevations. No controls affect precipitation that falls on the range.	0 if no engineering controls -5 if partial engineering controls -10 if effective engineering controls	-5
<b>Surface Water Pathway Score</b>			<b>8</b>

<b>Table 2: Surface Water Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
Based on USGS data the pH of precipitation in California is between 5.3 and 5.5. "Natural" rain will be slightly acidic (pH of 5.6) because of the presence of carbon dioxide in the air which forms carbonic acid when it is mixed with water. However, once the rainfall comes into contact with the ground, the pH increases. Based on stormwater measurements collected on January 5, 2005 the surface water pH at MCAGCC Twentynine Palms is between 8.5 and 8.8.			
The average amount of rainfall at Twentynine Palms between 3 and 4 inches per year (USDA).			
Based on aerial photographs a back stop berm is located behind the targets at the BZO Range. The berm has a slope greater than 10%.			
The berms are covered by less than 20% vegetation. The area contains patches of creosote bushes and other scrub.			
The soil units present on Range 113A are characterized as Arizo sands (USDA NRCS). They are thick, excessively drained soils that formed in mixed alluvium with little to no clay.			
Range 113A contains a rear impact berm and two side berms. Based on a review of aerial photographs, the berms appear to act as partial engineering controls by prevent run-on of surface water from higher elevations to the northwest. This control does not affect surface runoff from precipitation that falls directly on the range.			

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Depth to Groundwater</b>	The nearest groundwater well is located approximately 6 miles south of Range 113A. The depth to water at this observation well was measured at 98.22 ft below ground surface. Based on the higher elevation of the range, it is assumed the depth to groundwater is greater than 100 ft.	5 if depth to groundwater < 20 feet 3 if depth to groundwater = 20-99 feet 1 if depth to groundwater = 100-300 feet 0 if depth to groundwater >300 feet	1
<b>Precipitation</b>	The average rainfall amount at the installation is between 3 and 4 inches per year.	5 if precipitation > 40 inches/year 3 if precipitation = 20-40 inches/year 1 if precipitation < 20 inches/year	1
<b>pH of Water</b>	The pH of groundwater is approximately 8.0, based on water quality sampling conducted in the Surprise Springs and Deadman Basins.	5 if pH < 6.5 1 if pH ≥ 6.5	1
<b>pH of Soil</b>	Arizo sands are generally neutral to strongly alkaline.	5 if pH < 6.5 3 if 6.5 ≤ pH ≤ 8.5 1 if pH > 8.5	3
<b>Soil Type/Infiltration Conditions</b>	Arizo sands are predominantly excessively drained soils with little or no runoff.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Clay Content in Soil</b>	Arizo sands are sandy soils with little or no clay.	5 if soil type is sand/gravel 3 if soil type is clayey sand / silt 1 if soil type is clay / silty clay	5
<b>Groundwater Pathway Score</b>			<b>16</b>

<b>Table 3: Groundwater Pathways Characteristics Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>An observation well is located west of Deadman Lake, approximately 6 miles from Range 113A. The depth to groundwater at the well was 98.22 ft below ground surface (MCAGCC FMD, 2006). However, there is a geologic fault that acts as a groundwater barrier located under Deadman Lake. The depth to groundwater east of Deadman Lake is generally unknown; Range 113A is located east of Deadman Lake. The downgradient groundwater flow under Range RTA is towards Mainside, the water is of generally poor water quality due to high mineral content.</p> <p>In 1952, the USGS, in conjunction with the Department of the Navy and the Marine Corps, drilled 12 test wells in the Deadman and Surprise Springs groundwater basins to assess the groundwater quality at what is now MCAGCC Twentynine Palms. Based on water quality sampling conducted in 1952, the pH of groundwater tested from ranged from 7.3 to 9.0 (Riley and Worts, 1952).</p> <p>Arizo sands are generally neutral to strongly alkaline (USDA NCRS – Official Soil Description).</p>			

<b>Table 4: Surface Water Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Drinking Water Usage</b>	Surface water bodies are not used as drinking water sources at the installation.	<p>10 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has a reasonable potential to move toward a surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>5 if contamination in the media has moved or is expected to move only slightly beyond the source (tens of feet) or could move, but is not moving appreciably, toward surface water body used as a potable water supply or if a designation as a potable water source is unknown</p> <p>2 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	2
<b>Agricultural or Other Beneficial Usage</b>	The range drains to the northern portion of Deadman Lake. This intermittent water body is fully contained within the range boundaries; therefore, there are no potential off-range releases or exposures.	<p>5 if analytical data or observable evidence indicates that contamination in the media is present at, is moving toward, or has moved to a point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if contamination in the media has moved only slightly beyond the source (tens of feet) or could move but is not moving appreciably.</p> <p>1 if low possibility for contamination in the media to be present at or migrate to a point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened or Endangered Species</b>	The intermittent water body is fully contained within the range boundaries, therefore no off-range MC releases and exposures to surface water.	<p>10 if identified receptors have access to possibly contaminated media and/or are located adjacent to the range boundary</p> <p>5 if potential for receptors to have access to possibly contaminated media</p> <p>1 if little or no potential for receptors to have access to possible contaminated media</p>	1
<b>Surface Water Receptor Score</b>			<b>4</b>
<p><u>Notes:</u></p> <p>Surface water bodies in the area are not used for drinking water. Deadman Lake is the closest surface body, located downstream of the range 3.5 miles to the south-southeast. This intermittent water body is fully contained with the range boundaries; as REVA is limited to the assessment of potential off-range MC releases and exposures, there are no potential receptors for surface water at Range 113A.</p>			

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<b>Wells Identified as Potable Water Sources</b>	A non-potable water well is located on the southwestern edge of Deadman Lake. The main water supply wells are located to the southwest. The hydrogeologic basin that the water supply wells are located in is separated from the range by a large fault. Downgradient groundwater basins from the range are not used as drinking water sources because of the high mineral content.	<p>10 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as a potable water source is unknown</p> <p>5 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>2 if low possibility for MC to be present at or migrate to within a reasonable radius of influence or point of exposure</p>	2
<b>Wells Identified for Agricultural or Other Beneficial Usage</b>	There are no agricultural wells on the installation. Surface water and stormwater are used for irrigation purposes in the cantonment area. Surface water that accumulates in Deadman Lake generally evaporates.	<p>5 if analytical data or observable evidence or site conditions indicate that MC may be within or moving toward a reasonable radius of influence of a well or other point of exposure or if a designation as agricultural or other beneficial usage is unknown</p> <p>3 if analytical data or observable evidence or site conditions indicate that MC have moved only slightly beyond the source (tens of feet) or could move toward a reasonable radius of influence of a well or other point of exposure, but are not moving appreciably</p> <p>1 if low possibility for MC to be present at or migrate to within a reasonable radius of influence of a well or point of exposure</p>	1
<b>Sensitive Species Habitat and Threatened and Endangered Species</b>	There are no groundwater discharges located near the range which could result in lead migration from groundwater to surface water.	<p>5 if identified receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>3 if potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p> <p>1 if little or no potential for receptors exposed to potentially MC-impacted water from groundwater or groundwater sources</p>	1
<b>Groundwater Receptor Score</b>			<b>4</b>

<b>Table 5: Groundwater Receptors Element</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)			
<b>Criteria</b>	<b>Evaluation Characteristics</b>	<b>Score Criteria</b>	<b>Site Score</b>
<u>Notes:</u>			
<p>There are no water supply wells near Range 113A. The depth to water at the non-potable water well near Deadman Lake is 25.09 feet below ground surface. The closest water supply wells are located southwest of where the range is located. The groundwater bearing unit that the water wells pump from is located upgradient of the range and is hydrogeologically separated from the range by a large fault. The downgradient groundwater basin, Mesquite Basin, is not used as a drinking water source because of high mineral content.</p> <p>There are no known agricultural wells located on MCAGCC. Surface water and stormwater is used for irrigation purposes. The surface water that accumulates in Deadman Lake generally evaporates.</p> <p>While groundwater is likely found at shallow depths near playas, there are no known groundwater discharge locations near the range which could result in lead migration from groundwater to surface water.</p>			

<b>Table 6: Relative Environmental Concern Evaluation</b> (These definitions only apply for the purposes of the Small Arms Range Assessment Protocol.)										
<b>Surface Water</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Surface Water Pathways	2	8								
Surface Water Receptors	4	4								
<b>Sum of Surface Water Element Scores</b>		<b>23</b>								
<b>Groundwater</b>										
Element	Table	Score								
Range Use and Range Management (Source)	1	11								
Groundwater Pathways	3	16								
Groundwater Receptors	5	4								
<b>Sum of Groundwater Element Scores</b>		<b>31</b>								
<p>The relative environmental concern evaluation ranking for each media is determined by selecting the appropriate score based on the data elements for that media:</p> <table style="margin-left: 40px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Environmental Concern Evaluation Ranking*</u></th> <th style="text-align: left;"><u>Score Range</u></th> </tr> </thead> <tbody> <tr> <td>High</td> <td>50-65</td> </tr> <tr> <td>Moderate</td> <td>30-49</td> </tr> <tr> <td>Minimal</td> <td>0-29</td> </tr> </tbody> </table> <p>*Use the Environmental Concern Evaluation Ranking to determine if further actions are warranted based on the guidelines for recommended actions, as defined in Table 7.</p>		<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>	High	50-65	Moderate	30-49	Minimal	0-29	
<u>Environmental Concern Evaluation Ranking*</u>	<u>Score Range</u>									
High	50-65									
Moderate	30-49									
Minimal	0-29									
<b>Surface Water Environmental Concern Evaluation Ranking</b>		<b>MINIMAL</b>								
<b>Groundwater Environmental Concern Evaluation Ranking</b>		<b>MODERATE*</b>								
<u>Notes:</u>										
*The Groundwater Environmental Concern Evaluation Ranking has been reduced to Minimal based on professional judgment of the REVA Team (See Page B-117 for rationale).										