Final

Pollution Prevention Overview
(Small Arms Range Supplement)

January 2007

Prepared for
Massachusetts Army National Guard
Camp Edwards

Prepared by
URS

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FINAL

POLLUTION PREVENTION OVERVIEW PLAN
(SMALL ARMS RANGE SUPPLEMENT)

Prepared for:

Massachusetts Army National Guard
Camp Edwards

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EXECUTIVE SUMMARY

The Massachusetts Army National Guard has dual federal and state missions to maintain properly trained and equipped units, available for prompt mobilization for war, national emergency, or as otherwise needed by the President as Commander-in-Chief of the Armed Forces and to provide protection and assistance to the community during natural disasters and civil emergencies. Camp Edwards, as part of the Massachusetts Military Reservation (MMR), provides facilities and personnel to support both the federal and state missions of the Army National Guard. Training facilities available at Camp Edwards include small arms ranges (SARs), training areas, battle positions, observation posts, and training roads. These facilities can support a variety of training activities to include small arms marksmanship. In particular, the SARs support training and qualification in basic infantry skills with small arms weapons systems, including pistols, rifles, machine guns, and shotguns. Currently, training soldiers to military standards at Camp Edwards is significantly limited by the prohibition against firing lead small arms ammunition.

In order for the MAARNG to resume effective small arms training there are two significant legal drivers that define the path forward; they are the EPA Region 1 Administrative Order 2 issued to the Guard in 1997 and the Massachusetts' Chapter 47 of the Acts of 2002. The Guard, in its endeavor to meet the requirements of the two legal drivers, will follow the tenants of the Army's Strategy for the Environment - Mission, Environment, and Community.

As required under both legal drivers, the Guard is developing a Small Arms Range (SAR) Pollution Prevention (P2) plan to provide the management strategy for the Camp Edwards SARs. The P2 plan will consist of two components: a **Pollution Prevention Overview (Small Arms Range Supplement)** (hereinafter referred to as the **SAR P2 Overview**), based on installation-specific information, coupled with range-specific plans for each SAR. With agency concurrence, MAARNG will select the most appropriate BMP(s) for each SAR. The BMPs may include those currently in use at other military ranges, those in use on civilian ranges, and newly designed techniques to mitigate impacts while still ensuring soldiers are trained to military standards. Because of past environmental issues at Camp Edwards, the Administrative Order and Chapter 47 prescribe a fairly specific process for the Guard to receive approval from the regulatory agencies to resume small arms training. This process is a unique requirement for Camp Edwards and not typical for other military installations.

This SAR P2 Overview identifies best management practices (BMPs) that allow the employment of small arms at Camp Edwards in a manner that:

- meets current and future training needs; and,
- employs maximum feasible use of pollution prevention to protect the Upper Cape Water Supply Reserve, managed as a MassDEP Zone II for public water supplies.

This SAR P2 Overview provides information to stakeholders to support a phased approach for re-incorporating lead small arms ammunition, in conjunction with appropriate SAR BMPs, into training where needed to meet current military standards. Under this phased approach, Camp Edwards will develop range-specific Design, Operations and Maintenance (O&M) plans. The plans will include range-specific BMPs, applicable monitoring practices, and specific triggers for metals recovery (e.g. time intervals, number of rounds fired). Prior to the return of lead firing on any SAR, Camp Edwards will present these O&M plans to EMC and EPA for review and approval.

This SAR P2 Overview and the range-specific plans will specifically support the ongoing Massachusetts Environmental Policy Act (MEPA) Notice of Project Change, in which the Massachusetts National Guard (MANG) proposes to modify the current Camp Edwards Lead Prohibition Environmental Performance Standard (EPS) to permit the use of lead small arms ammunition. This proposed change would be subject to an approval process conducted in accordance with Chapter 47 of the Acts of 2002. The contents of this overview and the range-specific plans will assist MANG, in consultations with the EMC, EPA Region 1, and MassDEP, to determine the exact process and requirements necessary to resume training with lead small arms ammunition.

MANG will explain in detail all aspects, potential impacts, and proposed mitigation of the proposed changes. The preferred range-specific BMP(s) will then be formally presented to the EMC and EPA for their approval. Implementation of the BMPs and initiation of live-fire training will be subject to the availability of appropriate funding. Lead core ammunition will only be fired at Camp Edwards SARs as BMPs are funded and implemented.

Small Arms Range Requirements for the Camp Edwards Training Mission
MANG has approximately 6,000 soldiers and 2,500 airmen who train at Camp Edwards. Additionally, other military units and civilian agencies (e.g., law enforcement) have fired weapons at Camp Edwards ranges during recent years. It remains an important training area for soldiers completing missions here at home and across the world, including the many Massachusetts National Guardsmen currently deployed overseas to Afghanistan, Iraq, and Bosnia and activated at home for flood assistance and events like the Boston Marathon.
Table ES-1 is a current list of SARs and the weapons that traditionally have been fired on them and are proposed to be fired on them.

Table ES-1. Camp Edwards Small Arms Ranges

Range	Range Area	Location	Historic Range Use	Proposed Range Use
A	West	Burgoyne/Wood Road Junction	.50 caliber machine gun	.50 caliber and 7.62mm machine gun
B	West	Burgoyne Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers)	Currently no proposed use
C	West	Burgoyne Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers)	Currently no proposed use
D	West	Burgoyne Road	7.62mm rifle and machine gun	Currently no proposed use
E	West	Burgoyne Road	Pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]	Pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
G	South	Pocasset-Forestdale Road	7.62mm rifle (M60); 5.56mm rifle (M16) and SAW machine gun; pistols (all	Currently no proposed use

Range	Range Area	Location	Historic Range Use	Proposed Range Use
			calibers)	
H	South	Pocasset-Forestdale Road	Pistols (all calibers)	Currently no proposed use
I	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW machine gun; submachine gun (.45 caliber and 9mm); pistol (all calibers); shotgun	Currently no proposed use
ISBC	North	Gibbs Road	.22 caliber rifle; 5.56mm rifle (M16) and SAW machine gun; 7.62mm machine gun; 40mm grenade launder; 22mm subcaliber round for 81mm mortar	.22 caliber rifle; 5.56mm rifle (M16) and SAW machine gun; 7.62mm machine gun; 40mm grenade launder; 22mm subcaliber round for 81mm mortar
J	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW-ball and tracer submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
K	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW-ball and tracer submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers(e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
KD	South	Pocasset-Forestdale Road	7.62mm machine gun and rifle; 5.56mm rifles and SAW; submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun, TOW, LAW, 90mm recoilless rifles	7.62mm machine gun and rifle; 5.56mm rifles and SAW M249, M240, M60, and M2
N	East	Greenway Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers); shotgun	Currently no proposed use
O	East	Greenway Road	Pistols (all calibers); shotgun	Currently no proposed use
P	East	Greenway Road	5.56mm rifle (ball and tracer); pistol (all calibers); shotgun	Currently no proposed use
SE	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun	5.56mm rifle (M16)
SW	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun	5.56mm rifle (M16)
T	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]; .50 caliber plastic; M939 9mm tracer round for AT-4	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]

Camp Edwards needs to operate sufficient numbers of each type of range to allow soldiers to train with all required small arms weapons (e.g., pistols, rifles, and machine guns) in accordance with current doctrine. Soldiers need familiarization, qualification, and tactical operations training. Ranges at Camp Edwards need to allow soldiers to zero their weapon and become familiar with its care, practice marksmanship, and test and qualify with each weapon system. After these essential and basic training requirements, soldiers need to practice small tactical unit operations on an integrated course that tunes their communication and maneuver skills and allows engagement of targets within multiple objectives.

Environmnetal Setting of Camp Edwards Small Arms Ranges

Camp Edwards is located over the Sagamore lens and obtains its drinking water from this part of the aquifer, which is about 100–250 ft thick. The surface of the Sagamore lens is shaped like a mound that rises about 70 ft above sea level, and groundwater flows in a radial pattern from the top of the mound beneath Camp Edwards and adjoining Sandwich neighborhoods toward the coasts. Figure ES-1 shows the SARs and groundwater contours under Camp Edwards.

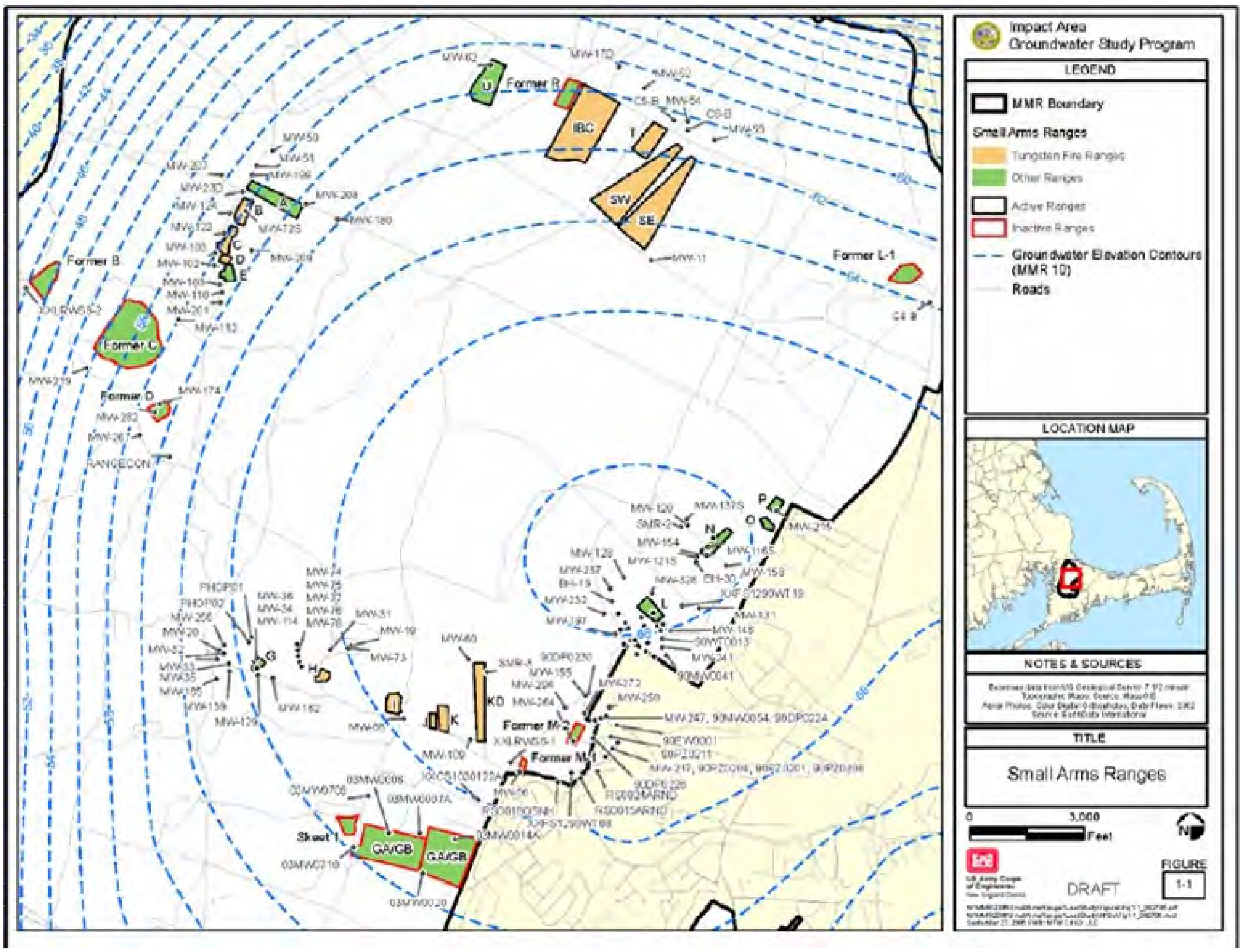


Figure ES-1. Small Arms Ranges, Groundwater Contours, and Water Supply Wells

Historically, small arms training at Camp Edwards was conducted using lead-bullet ammunition. On 10 April 1997, EPA issued an Administrative Order (AO) under the Safe Drinking Water Act to the National Guard Bureau and MANG requiring that certain training activities (including the firing of lead small arms ammunition, artillery fire, and mortar fire) cease pending the completion of environmental investigations at the training ranges and Central Impact Area.

These investigations are underway. In 1998, a berm soil maintenance project was conducted at Camp Edwards to remove metallic lead and fix leachable lead in soil at 16 ranges (A, B, C, D, E, G, H, I, J, K, KD, N, O, P, SE, and SW). Soils containing Toxicity Characteristic Leaching Procedure leachable lead concentrations greater than 5.0 mg/L were removed and/or treated in situ and ex situ during the program.

In 1999, the Army manufactured its first series of "green" ammunition, the 5.56mm round. This green ammunition was a new lead-free combat ammunition and was composed of a tungsten-nylon matrix. Information at that time identified tungsten as insoluble and therefore immobile in soil, making it a good substitute for lead. MANG began using this green ammunition in 1999 and continued until 2006.

In 2001, MANG proposed the ban of lead-bullet ammunition in its Final Environmental Impact Report (EIR). EPSs were also created during the Final EIR process to provide a common foundation for environmental stewardship, which would allow for and sustain compatible military training while protecting natural resources, with special emphasis on protection of groundwater. The EPSs also identified a list of banned military training activities, one of which was the use of lead-bullet ammunition.

As a result of MANG's Final EIR and subsequently Chapter 47 of the Acts of 2002, the EMC has been providing additional environmental oversight of Camp Edwards. This oversight initiated MANG's efforts to review and assess whether the use of tungsten-nylon bullets represented a threat to the ecosystem. In 2004, the available science on tungsten was changing—suggesting tungsten was in fact mobile. MANG engaged the Army Environmental Command to conduct a mobility study at Camp Edwards. After preliminary results detected tungsten in groundwater, the Governor and MANG decided to suspend the use of tungsten-nylon ammunition until further information became available to make permanent decisions. MANG implemented a berm maintenance project to identify, excavate, and consolidate tungsten-impacted soil. Soil was removed and consolidated on two operational ranges, C Range and KD Range. Soil was placed in the shape and configuration of berms or elongated mounds and covered on all sides with an impermeable geotextile then covered again with a canvas-like material to provide weight and UV protection and to keep soil from coming into contact with rain water. This was done to ensure that tungsten in soil does not continue to leach into groundwater.

Given the suspension of tungsten-nylon ammunition, MANG is proposing to develop and implement BMPs on the SARs at Camp Edwards to support returning to firing lead core ammunition. The BMPs will support small arms training at Camp Edwards in a manner that meets doctrinal training requirements and protects human health and the environment (particularly groundwater).

Priority Small Arms Ranges

MANG is proposing to return to firing lead core ammunition on a subset of ranges that are the most critical to satisfying current small arms training requirements. Pending the availability of funds, MANG plans to implement the BMPs deemed necessary and appropriate, through coordination with the EMC, MassDEP, and EPA Region 1, to manage the environmental impacts associated with small arms training on these priority SARs. Lead core ammunition will only be fired at Camp Edwards as BMPs are funded and implemented

To prioritize the SARs for a return to firing lead small arms ammunition, Camp Edwards:

- Identified current and anticipated training requirements. These requirements are evaluated in terms of type of weapon, type of target, distances to target, and needed terrain.
- Compared the capability and condition of the current inventory of SARs to the training requirements and identified ranges that satisfy the requirements and any shortfalls thereof.
- Evaluated the complexity involved with managing the environmental impacts of live-fire training on each range.

Table ES-2 compares the SARs required to those available to meet Camp Edwards' small arms training requirements.

Table ES-2. Summary of Small Arms Range Training Requirements at Camp Edwards

Required Range Type (Facility Category Code)	Corresponding Camp Edwards Range	Notes
Combat Pistol/MP Firearms Qualification Course (17821)	E Range	Currently being upgraded to Army standard.
Rifle/Machine Gun Zero Range (17801)	T, J, and K Ranges	Satisfy requirement to zero M16 rifle and SAW M249 and M240 machine gun.
Automated Record Fire Range (17805)	S Complex (SE and SW)	SE and SW Ranges are currently being upgraded to meet the requirement for 10 lanes.
Sniper Field Fire Range (17812)	KD Range	2006 Range and Training Land Program Development Plan (RDP) proposes to modernize KD Range to meet this requirement.
Infantry Squad Battle Course (17895)	ISBC	Current ISBC does not fully meet requirement. 2006 RDP proposes to modernize.
Convoy Live Fire Range (179XX)	Proposed Convoy Live Fire Range	Newly identified requirement. 2006 RDP proposes range modernization project to meet this requirement
Multipurpose Machine Gun Range (17833)	A Range or S Complex	A Range and SE and SW Ranges currently meet limited machine gun marksmanship training tasks. KD Range may also be modernized to meet a limited set of these training tasks.
Forward Operating Base (17XXX)	Forward Operating Base	Newly identified requirement. 2006 RDP proposes range modernization project to meet this requirement.

Based on a comparison of the current inventory of SARs and training requirements, the following list of SARs represents the sequence in which Camp Edwards plans to pursue approval to transition to live-fire with lead small arms ammunition. Figure ES-2 shows the following phases.

<u>Phase 1</u>

- T Range (25-m zero range with STAPP™ bullet containment system)

- E Range (Combat Pistol/MP Firearms Qualification Course)

Phase 2
- A Range (300 m Machine Gun Field Fire Range)
- SE/SW Range (Automated Record Fire Range – M16 qualification)
- J Range (25-m Zero Range)
- K Range (25-m Zero Range)

Phase 3
- KD Range (600-yard Known Distance Range)
- ISBC (Infantry Squad Battle Course – squad tactical maneuver/engagement)
- Other ranges as required and deemed appropriate

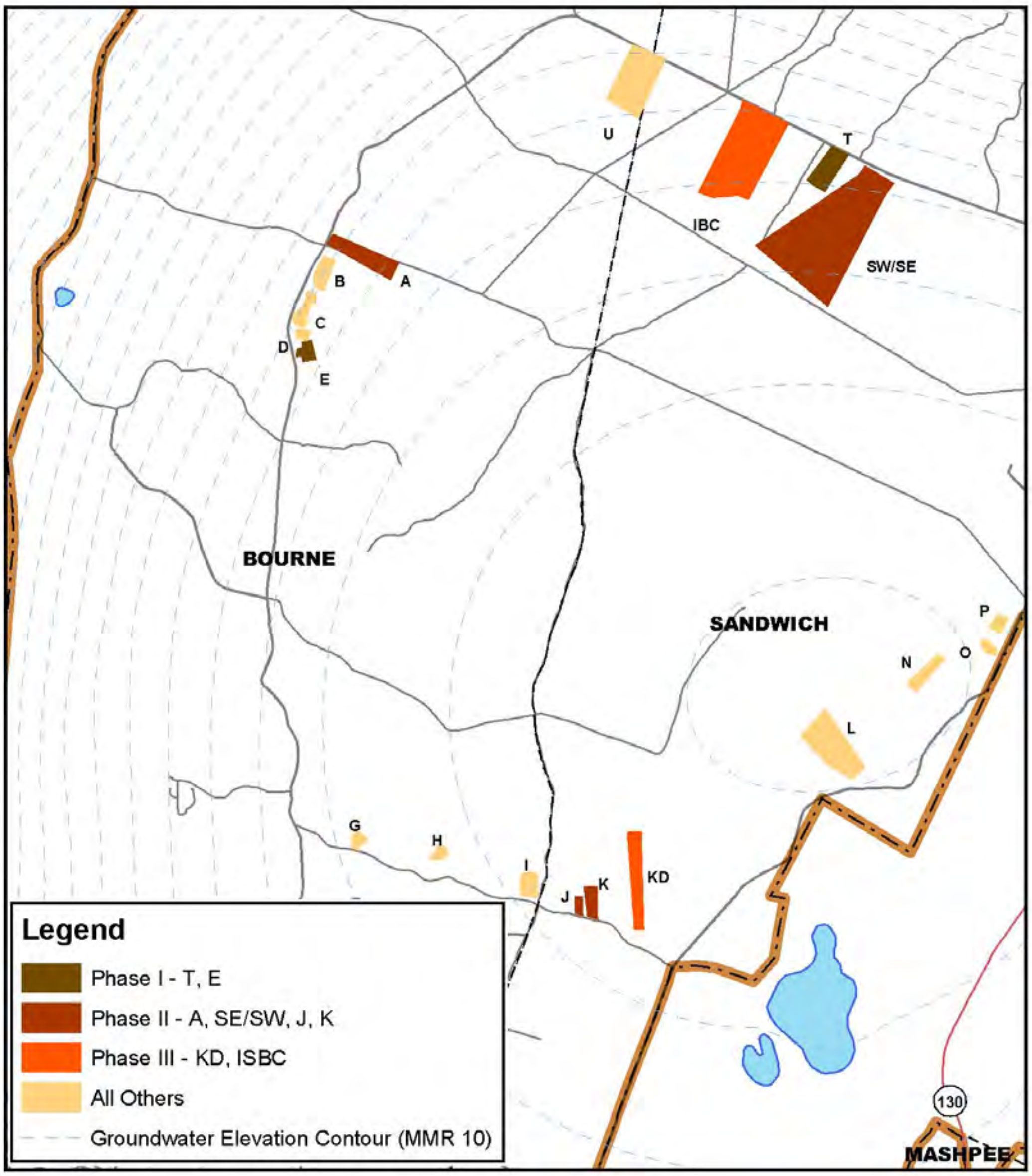


Figure ES-2. Small Arms Ranges and Phases for Return to Live-Fire with Lead Ammunition

These ranges, once modernized and managed with appropriate BMPs, will provide units with the ability to meet basic small arms training requirements. The proposed Convoy Live Fire Range involves units firing plastic projectiles only; however, this may change in the future. Also, there is no current capability to support sniper/counter-sniper training. Camp Edwards may augment the capabilities of KD Range to support such training. Although a sufficient level of design has not been conducted to provide a detailed description of these new range facilities, the conceptual descriptions contained in this plan provide some understanding of how the BMPs apply.

Small Arms Range Best Management Practices

The SAR P2 Overview contains generally applicable BMPs from which Camp Edwards, working with other stakeholders and oversight entities, can select for implementation as each range is brought online with lead small arms ammunition. The plan also contains range-specific recommendations for training usage, range reconfigurations, and applicable BMPs for the priority SARs at Camp Edwards. The generally applicable BMPs are categorized into Operational BMPs, Administrative BMPs, and Design BMPs.

Operational BMPs include:

Ammunition Selection: Camp Edwards will use primarily standard lead-core ammunition. Although a variety of alternative ammunition is available, use of such ammunition is problematic due to decreased training realism, uncertainty regarding the interaction of alternative materials with the environment, availability of proven techniques to manage these materials in the environment, and difficulty in procuring large quantities of such ammunition. The Army conducts exhaustive testing of ammunition to accept bullets of alternative compositions before they are procured and stocked in the Army ammunition inventory. This process begins with the establishment of an Army-wide requirement for the alternative ammunition. If this requirement is approved, the Army tests the alternative ammunition for ballistic performance, safety of use, and insensitivity to shock, and dramatic changes in temperature. The Army ammunition inventory does not any alternative small arms bullet compositions besides the current tungsten-nylon composite (currently banned at Camp Edwards) because none meet the requirements for ballistics, safety, and capability to train a soldier to mission standard.[1]

MANG will continue to monitor the progress of the U.S. Department of Defense regarding potential use of non-lead small arms ammunition as it becomes available. Currently, MANG uses plastic ammunition to train weapons familiarization. Unfortunately, due to its ballistic properties, it is not a viable alternative for attaining and sustaining marksmanship proficiency or to qualify soldiers on their assigned weapons.

Standard Operating Procedures: Camp Edwards will develop, distribute, and enforce the following standard operating procedures (SOPs):

[1] The Army Training and Doctrine Command is responsible for testing alternative ammunition to ensure it meets these requirements. To meet these rigorous standards, the Army conducts a multi-year testing process for each new alternative. If met, the alternative ammunition would undergo a procurement process, as outlined in Army Regulation 710-2-2. As of Fiscal Year 2007, no other alternative met or exceeded standards and was not procured for the Army ammunition inventory.

- Unit Evaluation of Ranges: Provide a standardized method for units to report on training value and condition of range facilities.
- Erosion Reporting: Personnel observing significant erosion on the ranges can submit an erosion monitoring report form to Range Control. Range Control and Camp Edwards Natural Resources Managers will then develop plans to mitigate the erosion.
- Range Residue and Expended Cartridge Casing Management: Using units will be required to "police their brass" after the training day. Using units will visually inspect them to ensure no live rounds are present and turn over the expended casings to the Ammunition Supply Point for recycling. The SOP will describe and require proper use and disposal of weapons cleaning materials and equipment (e.g., targetry) maintenance materials.

SOPs will be monitored and enforced by Camp Edwards personnel.

pH Adjustment: Camp Edwards may adjust soil pH on range floors, firing points, berms, and other related range areas. Metals solubility is lower and transport is not as effective at pH values of 7 to 8. Lime addition to surface soils is standard practice for neutralizing pH and may help reduce lead migration.

Metals Monitoring/Sampling: Camp Edwards will institute a metals monitoring program in groundwater and soil where range use patterns and transport mechanisms indicate the likelihood of high metals concentrations. Lysimeters, underground devices used to gather soil-water samples, are used to collect and analyze pore water in soil 2–4 ft below likely areas of bullet accumulation (e.g., toes of berms). Use of lysimeters provides an early warning if dissolved metals are percolating toward groundwater. Camp Edwards will work with the EMC and EPA to identify the most appropriate methods and locations of monitoring and sampling. Camp Edwards will also work with the EMC and EPA to determine appropriate action levels and triggers for implementation of periodic metals removal or range design BMPs.

Periodic Metals Removal: Camp Edwards will work with the EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used.

Camp Edwards will develop a range-specific O&M plan for each SAR that will describe the triggers and method of metals removal. Metals removal will be conducted in a manner that protects human health and the environment, particularly groundwater, and minimizes collateral environmental and operational impacts. Camp Edwards will report the total amount of lead recovered. Planning and design of necessary removals will be coordinated with the EMC and EPA prior to implementation.

Administrative BMPs include:

Support Personnel and Training: Camp Edwards will employ personnel to effectively operate and maintain the SARs. MANG will provide these personnel with the training necessary to carry out their responsibilities. Camp Edwards currently has a range control officer whose responsibilities include ensuring that all ranges are in serviceable condition. Camp Edwards will provide personnel to oversee and support training operations at the ranges and ensure use of the ranges complies with SOPs and BMPs established in the range-specific P2 Design and O&M plans. Both current and new personnel will be trained in the details of the SAR P2 Overview and the range-specific design and O&M plans.

Budgeting and Funding: Camp Edwards will assess and program the funding requirements for the SARs and incorporate them into their budgeting process. Lead core ammunition will only be fired at Camp Edwards SARs as BMPs are funded and implemented.

SAR P2 Overview Update: Camp Edwards will review and update the SAR P2 Overview on a regular basis. The plan will be reviewed and updated annually or as conditions change or new ranges are brought online.

Design BMPs include:

Enhanced Soil Berm Designs: The earthen berm is the most widely implemented bullet containment method at military and civilian SARs. It is the containment system on which most SAR management guidance by the U.S. Army, EPA, a number of individual states, and the Interstate Technology & Regulatory Council is based. Camp Edwards will implement enhancements to standard soil berm designs to further reduce the transport of metals out of the berm. This BMP includes several berm design features, as shown in Figure ES-3, recommended for use on Camp Edwards SARs.

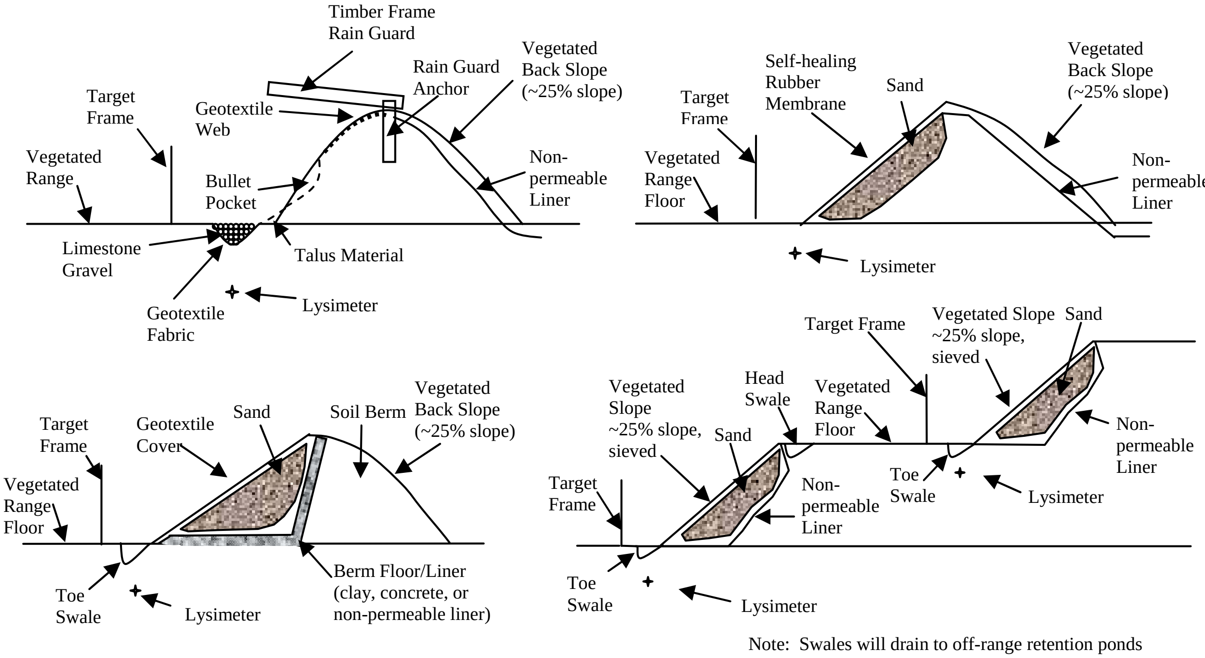


Figure ES-3. Enhanced Soil Berm Design Alternatives

Each design includes several useful options for new berm construction. Camp Edwards, working with the EMC and EPA, can choose exactly which combination of features is most appropriate for designated ranges. Figure ES-3 presents conceptual designs of improved soil berms that incorporate multiple features to reduce metal transport by limiting:

- Interaction of precipitation with berm soil and bullets,
- Dissolved metals percolation toward groundwater, and
- Dissolved metals and metal fines migration via erosion or storm water.

Bullet Containment System: Although the earthen berm is the most widely implemented bullet containment method at military and civilian SARs, advancements in materials and designs have made other bullet containment systems viable options on some ranges. Camp Edwards will implement bullet trap systems for some of its SARs. For example, Camp Edwards has already implemented the STAPP™ system on T Range. Figure ES-4 is a conceptual model of the recommended bullet trap design. This particular bullet containment system is recommended based on the compilation of information about bullet containment systems and the draft results of an extensive evaluation of current bullet containment system technologies conducted by the National Defense Center for Environmental Excellence described in Appendix H. Similar to the improved soil berm designs, the recommended bullet containment system incorporates multiple features to reduce metal transport by limiting:

- Interaction of precipitation with the containment matrix and bullets,
- Dissolved metals percolation toward groundwater, and
- Dissolved metals and metal fines migration via erosion or storm water.

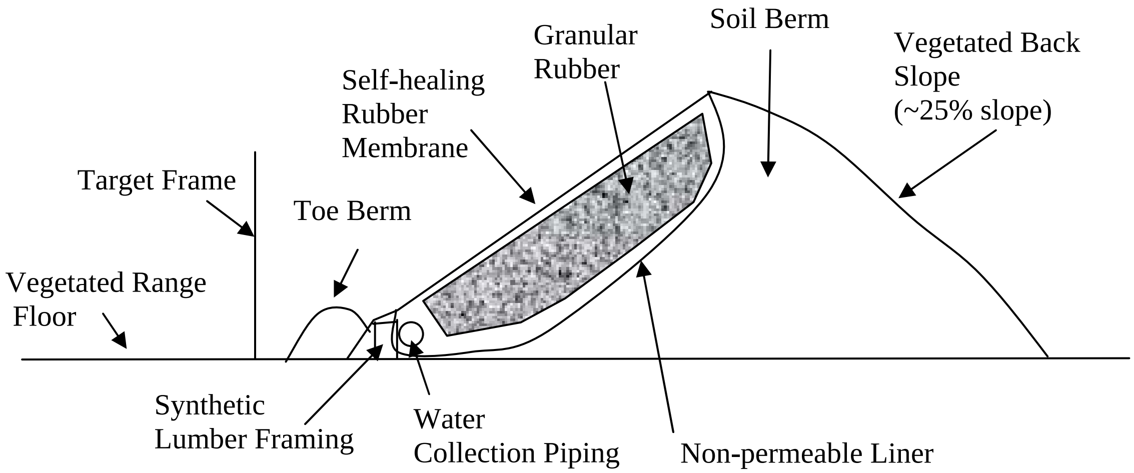


Figure ES-4. Conceptual Model of Bullet Containment System Design

The recommended bullet containment system features a granular rubber berm face, a self-healing rubber membrane cover, and a water containment and collection system. A bullet containment system applicable to pop-up targets has not been identified. The feasibility of using bullet containment systems on ranges with pop-up targets and other bullet containment systems will be evaluated on a case-by-case basis for applicability at specific ranges at Camp Edwards.

Vegetation: Camp Edwards may identify native, non-invasive vegetation that does not encourage animal browsing and is suitable for use in minimizing erosion and transport of metals.

Vegetation will be grown on all berms, backstops, the range floor, and when possible, areas immediately surrounding the range.

Range Contours: Camp Edwards may manage soil gradients to minimize surface water flow velocities. These gradients will be different depending on the area of range in question. Slopes of 25% are typical of range berms to minimize both erosion and ricochets. Range floors can have mild (virtually horizontal) slopes to minimize the rate of surface water flow without ponding. Areas around the outer perimeter of the range will slope away from the range to minimize the amount of water that moves onto the range.

Wind Breaks: Camp Edwards may identify native, non-invasive trees and shrubs suitable for use as wind breaks in areas where such breaks do not exist. Wind breaks can limit erosion and surface transport of metals when grown on or behind berms, backstops, and when possible, areas immediately surrounding the range.

Target Placement: Camp Edwards may install target holders close to the berm with enough space between the berm toe and target holders to allow personnel and equipment to safely carry out maintenance and inspection responsibilities.

Range-Specific BMPs

Although the final selection of BMPs implemented at Camp Edwards' SARs will be made in coordination with the EMC, EPA, and other stakeholders, the SAR P2 Overview includes recommendations for the training use, configuration, and management of the priority SARs. Implementation of these BMPs is subject to the availability of funding for these purposes. Lead core ammunition will only be fired at Camp Edwards as BMPs are funded and implemented.

Phase 1

Phase 1 ranges are the SARs on which Camp Edwards has placed the highest priority for returning to the use of lead small arms ammunition. It is currently envisioned that, upon receiving necessary approvals for a return to live-fire training with lead small arms ammunition at the identified Phase 1 ranges, MANG would begin small arms training at these ranges in Spring/Summer 2007 (the 2007 annual training cycle).

<u>T ("Tango") Range</u>

T Range represents the highest priority and first in the sequence of SARs that Camp Edwards will seek to bring online with lead small arms

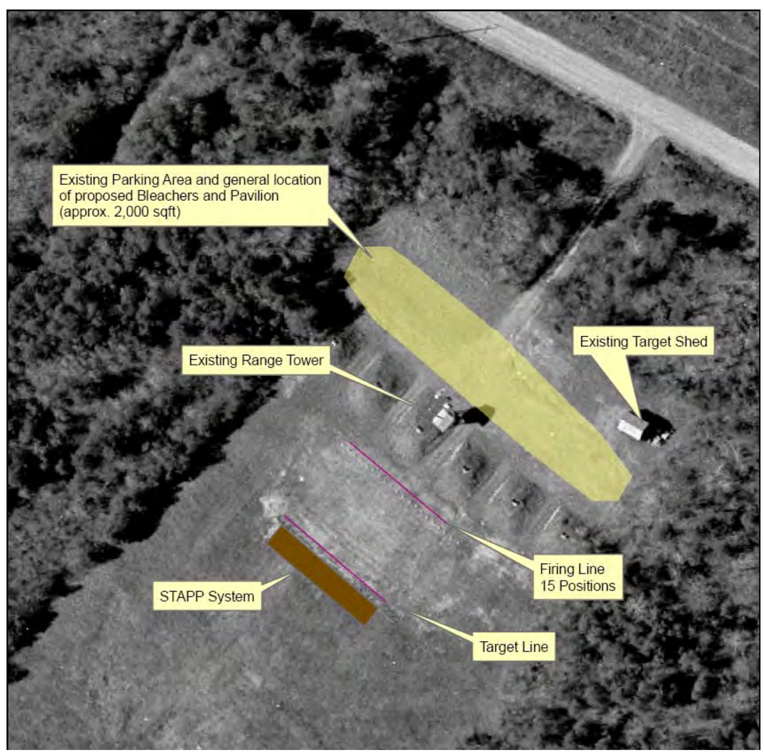


Figure ES-5. Aerial of Current T Range Configuration

ammunition (see Figure ES-5). T Range is a 25-m Rifle/Machine Gun Zero Range for both the M16 rifle and M249 and M240 machine guns. Zeroing is one of the most basic and universal training tasks for small arms marksmanship. T Range can also be used as an alternate range to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols.

In the late 1980s, T Range was an assault course where only blank ammunition was used. In 1990, MANG began firing .50 caliber machine guns on T Range. This range had two firing lines. The first firing line was 250 ft long and consisted of 6 large (approximately 22 × 40 × 8 ft) mounds, on top of which are 2 foxholes each, totaling 12 elevated machine gun firing positions. In the middle of the six mounds, next to the range tower, Camp Edwards hardened an area to allow for mounted machine gun firing. The second firing line was 144 ft long with 20 firing positions 50 ft in front of the machine gun firing positions.

Figure ES-6. Bullet Containment System at T Range

Camp Edwards recently installed a granular rubber (i.e., STAPP™) bullet containment system on T Range. The system is 100 × 30 ft and provides bullet containment for 15 firing lanes (see Figure ES-6). The system contains all the features recommended in the Bullet Containment System BMP described above, including an 18-in. granular rubber berm face, a self-healing rubber membrane cover, a synthetic lumber frame, an impermeable liner, and an internal water collection reservoir.

Camp Edwards will implement the appropriate Operational and Administrative BMPs listed previously for T Range. As part of the Metals Monitoring/Sampling BMP, Camp Edwards will install a groundwater monitoring well and lysimeters in soil under the toe of the bullet containment system. If lead from the ammunition is not contained by the system and dissolved lead begins to percolate through the pore water to the aquifer, the lysimeters will provide an early warning. The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs conducted. Camp Edwards will plant and maintain appropriate vegetative cover on the soil berm areas around the bullet containment system as well as the range floor to reduce erosion. Camp Edwards placed target frames to concentrate projectile impacts into the bullet containment system and to allow access to the system for maintenance. Camp Edwards plans to construct additional troop support facilities (i.e., bleachers and a pavilion for mess, ammunition issue, and weapon breakdown/cleaning) within the current parking areas of T Range.

E ("Echo") Range

E Range is designed to meet training and qualification requirements with all calibers of combat pistols (i.e., M9 and M11). This range type is used to train and test soldiers on the skills necessary to identify and engage infantry targets. E Range has 15 firing points. Pistol fire is to the east, with rounds impacting into the range floor or small manmade berms directly behind the targets (see Figure ES-7). Currently, E Range is under construction and being outfitted with modern targetry and troop support facilities, including a covered bleacher/pavilion. Current troop support structures include a range tower and maintenance shed.

Figure ES-7. E Range from Backstop to Firing Points

Additional Design BMPs recommended for E Range include implementation of the Metal Monitoring BMP. A groundwater monitoring well and the placement of lysimeters beneath the range at the depth of the frost line will allow for monitoring of potential lead migration and detection of such potential migration before it affects groundwater beneath Camp Edwards. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Because the anticipated point of impact for rounds fired on E Range is the range floor behind the targets, Camp Edwards plans to manage the range floor in a manner consistent with the Improved Soil Berm Design BMP. The range floor may consist of 18 in. of sifted sand to minimize bullet pulverization and facilitate implementation of the Periodic Metals Removal BMP. Behind the last row of targets, Camp Edwards is considering a number of options to contain and manage metals from bullet impacts. One option under consideration involves constructing a 4-ft plywood wall that will provide support for a short (approximately 2-ft) sand berm. The berm will capture those rounds fired at the last targets and the additional 2 ft of plywood will indicate whether rounds are striking above the berm. Another option is to install a shot curtain or other similar barrier at the back of the range to limit the distribution of bullets beyond the last row of targets. Camp Edwards intends to "demonstrate" selected bullet containment designs on one or two firing lanes and select the most effective and feasible option for full implementation. All appropriate Operational and Administrative BMPs will also be implemented on E Range.

Phase 2

A ("Alpha") Range

A Range is an approximately 300-m Machine Gun Transition Range that is currently used to support familiarization and basic marksmanship training with plastic bullets in .50 caliber (M2). This range is positioned in such a manner as to allow soldiers to engage targets emplaced on a hillside from raised firing positions, creating a negative angle of fire and reducing the effective surface danger zone (SDZ) of the weapons (see Figure ES-8). This reduced effective SDZ makes it possible to safely fire the .50 caliber machine gun, which can have a SDZ of up to 6,000 m. For this reason, Camp Edwards may use A Range to conduct a large portion of its .50 caliber and 7.62mm machine gun training in the future.

Notional design concepts include contouring the current target emplacements on the hillside to create a series of terraced (i.e., stepped) soil berms (see Figure ES-9). The inherent negative angle of fire combined with appropriate target placement lends itself to management of lead bullets using the Improved Soil Berm Design BMP. The use of vegetation, pH adjustment, and swales (for storm water management) will complement the features of the Improved Soil Berm BMP. Camp Edwards will also implement other appropriate Operational and Administrative BMPs.

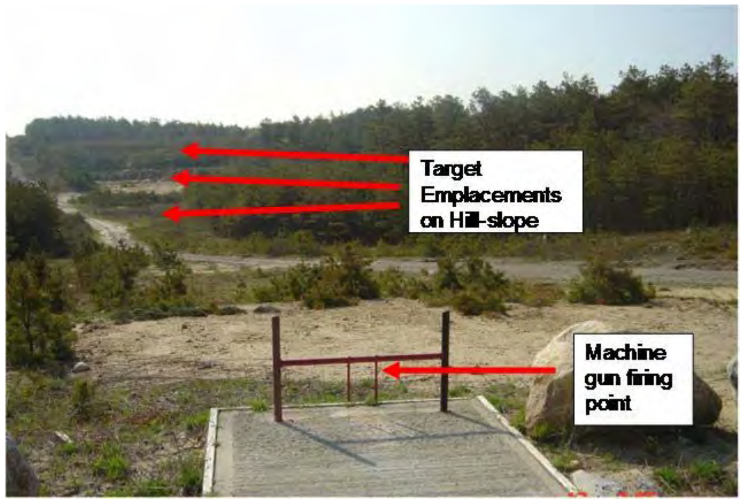
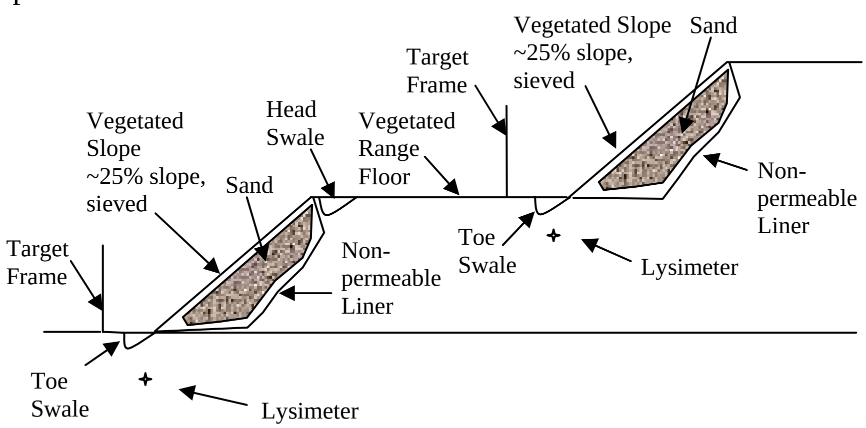


Figure ES-8. A Range from Elevated Firing Point



Note: Swales will drain to off-range retention ponds

Figure ES-9. Terraced Enhanced Soil Berm Design

S ("Sierra") Complex

SE and SW Ranges (hereinafter referred to as "S Complex") have historically functioned as two separate machine gun transition ranges. Each had five firing lanes to engage pop-up infantry targets out to 800 m. Mounded firing points exist at both ranges: five at SE Range along its 280-ft long firing line and five at SW Range along its 200-ft long firing line. A series of target berms are spaced between 100 and 800 m downrange from the firing points. Neither range has a backstop.

S Complex is currently being modernized into a standard Army Automated Record Fire Range to meet doctrinal training requirements for M16 qualification (see Figure ES-10). This range, once modernized, will include 10 firing lanes and many automated "pop-up" targets arranged over a large area (approximately 300 × 100 m). This type of range does not lend itself readily to management of lead using soil berms or bullet containment systems. Camp Edwards intends to implement appropriate generally applicable BMPs to include, where feasible, some variation of the Improved Soil Berm BMP or the Bullet Containment System BMP. They will also implement metals monitoring. Metals removal will be based on a number of factors to include, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Final BMP selection will be made in coordination with the EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

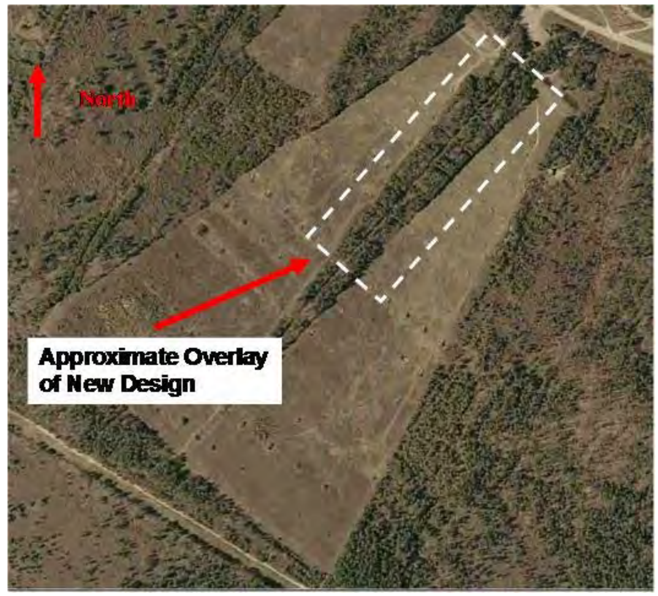


Figure ES-10. Former S Complex (Overlay of Proposed New Design)

J ("Juliet") Range and K ("Kilo") Range

J and K Ranges (see Figures ES-11 and ES-12) are 25-m Rifle/Machine Gun Zero Ranges for both M16 rifle and M249 and M240 machine guns. Zeroing is one of the most basic and universal training tasks for small arms marksmanship. Both of these ranges can also be used as alternate ranges to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols. Camp Edwards intended to implement some variation of the Improved Soil Berm

Figure ES-11. J Range Firing Points to Target Berm

Design BMP on both of these ranges and evaluate, through the Metals Monitoring/Sampling BMP, that lead can be managed in a soil berm at MMR. Final design features of the improved soil berms on J and K Ranges will be selected in coordination with the EMC, EPA, and other stakeholders. Other appropriate Operational, Administrative, and Design BMPs may also be implemented on J and K Ranges to include, but not be limited to, contouring, vegetation, SOPs, and pH adjustment.

Phase 3

<u>KD Range</u>
KD Range is a 600-yard Known Distance Range. Historically, KD Range has been a multipurpose range for small arms marksmanship and firing of the Dragon missile; the tube-launched, optically tracked, wire-guided (TOW) missile; the light anti-armor weapon (LAW) rocket; 40mm grenade launchers; and 90mm recoilless rifles.

Figure ES-12. K Range Firing Points to Target Berm

Currently, this range is divided into two subparts with two distinct firing line/target configurations and two distinct training uses (see Figure ES-13). On the west side of the range, four stations are situated at the firing line. Each station, or firing point, engages infantry targets at 100 yards, 200 yards, and 300 yards (from the station). The east side of the range has 5 firing lines each with 25 firing positions. The five firing lines are located on firing position berms at known distances from a single set of targets. The firing lines are at 100 yards, 200 yards, 300 yards, 300 m, and 600 yards. Each of the firing lines is intended to engage targets placed above a large soil berm located approximately 600 yards from the farthest firing point. Target frames designed to raise and lower targets are still present but in disrepair.

Figure ES-13. KD Range Aerial Photograph

In the future, Camp Edwards intends to use KD Range to serve multiple purposes. The east side of KD Range will continue to be used as a Known Distance Range and will support 10- and 25-m zero for machine gun and rifle. It may also support, in a limited capacity, machine gun marksmanship (e.g., familiarization and basic marksmanship) for the Squad Automatic Weapon (SAW) M249, M240, M60, and M2. There are no current plans to modernize and resume firing on the west side of KD Range.

For KD Range to support the desired training requirements in a manner that controls the migration of metals into the environment, many design features/modifications may be incorporated into the proposed range design.

- The position of the existing targets must be moved from the top of the backstop to the base of the backstop.
- The firing line (currently the 600-yard firing line on KD Range) can be elevated either through the addition and grading of fill soil or by the construction of an elevated firing platform. The firing line should be raised to the degree necessary to direct the angle of fire to the new target locations at the base of the 600-yard range backstop.
- An improved soil berm or granular rubber bullet containment system may be installed in the current earthen berm, which will continue to serve as the backstop for the eastern portion of the modernized KD Range.

Camp Edwards will also implement other appropriate Operational and Administrative BMPs.

<u>ISBC (“Infantry Squad Battle Course”)</u>
ISBC has historically been used as a squad offensive and defensive tactical training course. The current ISBC is a maneuver and live fire range that is roughly 600 × 300 m; however, the area previously used for this purpose was much larger. ISBC has several maneuver lanes/trails through natural terrain that allow small units to close with and assault two separate objectives. The objectives are made up of sandbags arranged to resemble machine gun nests.

To ensure that ISBC satisfies doctrinal training requirements in a manner that is protective of the environment, Camp Edwards plans to:

- Coordinate with using units to document ISBC training requirements;
- Develop a range design that incorporates truncated versions of the standard Army ISBC for the modernized ISBC (see design drawing in Figure ES-14);
- Implement Enhanced Soil Berm Design or Bullet Containment System BMP
  - Relocate objectives from hilltops to in front of the hill,
  - Excavate and contour hill slope to achieve optimized (approximately 25%) slope, and
  - Install an enhanced soil berm or other bullet containment system technology within the hill slope behind the target emplacements;
- Install targetry arrays per truncated standard Army ISBC design;
- Appropriately implement generally applicable BMPs (pH adjustment, vegetation, contouring, etc.); and
- Implement Periodic Metals Removal BMP, as indicated by factors such as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used...

Process for Returning to Live Fire at Small Arms Ranges
MANG will continue to consult and coordinate with EPA Region 1 to meet the process and requirements to resume training with lead small arms ammunition by following the steps outlined in AO No. 2 (AO2). MANG has also consulted with and is currently coordinating with the MassDEP on these matters. MANG will request of the EMC and EPA that training with lead small arms ammunition be reinstated in a phased approach on a range-by-range basis.

In the coming months, MANG is formally petitioning the EMC for modification of the Lead Prohibition EPS, under the statutory process of Chapter 47 of the Acts of 2002. MANG has consulted with and is currently coordinating with the EMC on this submission process, and the EMC has directed MANG to work with the EMC’s two advisory groups, the Scientific Advisory Council and Community Advisory Council, both of which host open public meetings.

MANG will explain in detail all aspects, potential impacts, and proposed mitigation of the proposed changes in range-specific design and O&M plans. These range-specific plans will be based on the recommendations of this SAR P2 Overview and will be coordinated with the EMC and EPA for their review and approval.

This SAR P2 Overview is being submitted to both the EMC (with its advisory groups) and EPA Region 1 for their input and approval to facilitate development of range-specific plans. To provide sufficient opportunity for the public and regulatory community to comment on this anticipated regulatory process, MANG is also engaged in environmental impact assessments under both the National Environmental Policy Act and MEPA. These processes will include opportunities for public review and comment on MANG proposed actions

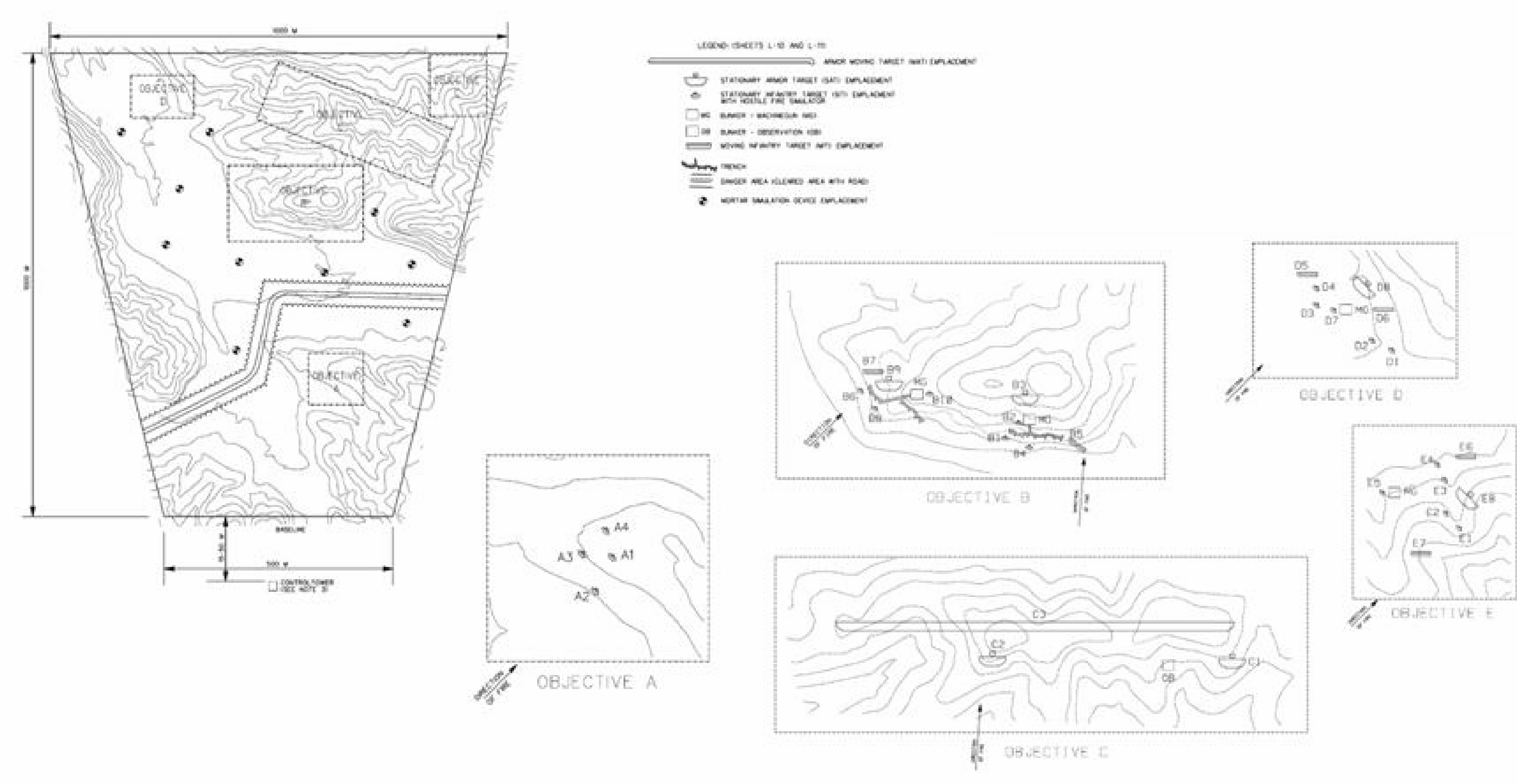


Figure ES-14. Army Standard ISBC Design Including Objectives

1. PURPOSE

The federal mission of the Army National Guard is to maintain properly trained and equipped units, available for prompt mobilization for war, national emergency, or as otherwise needed by the President as Commander-in-Chief of the Armed Forces. In keeping with the federal mission, the state mission of the Massachusetts Army National Guard (MAARNG), under the control of the Governor of Massachusetts, is to provide protection and assistance to the community during natural disasters and civil emergencies. Camp Edwards, as part of the Massachusetts Military Reservation (MMR), provides facilities and personnel to support both the federal and state missions of the Army National Guard, specifically the training of soldiers in basic infantry skills. Training soldiers in basic infantry skills includes several training tasks involving the employment of small arms (i.e., weapons firing ammunition size .50 caliber and below) and requires specialized facilities, including small arms ranges (SARs). MMR is a joint military training site providing training venues, to include the Camp Edwards SARs, for all other military Services and Reserve Components as well as the U.S. Coast Guard (USCG). Camp Edwards has also served as a training site for law enforcement agencies supporting their small arms qualification and proficiency training.

In order for the MAARNG to resume effective small arms training there are two significant legal drivers that define the path forward; they are the EPA Region 1 Administrative Order 2 issued to the Guard in 1997 and the Massachusetts' Chapter 47 of the Acts of 2002. The Guard, in its endeavor to meet the requirements of the two legal drivers, will follow the tenants of the Army's Strategy for the Environment - Mission, Environment, and Community.

As required under both legal drivers, the Guard is developing a SAR Pollution Prevention (P2) plan to provide the management strategy for the Camp Edwards SARs. The P2 plan will consist of two components: a **Pollution Prevention Overview (Small Arms Range Supplement)** (hereinafter referred to as the **SAR P2 Overview**), based on installation-specific information, coupled with range-specific plans for each SAR. With agency concurrence, MAARNG will select the most appropriate BMP(s) for each SAR. The BMPs may include those currently in use at other military ranges, those in use on civilian ranges, and newly designed techniques to mitigate impacts while still ensuring soldiers are trained to military standards. Because of past environmental issues at Camp Edwards, the Administrative Order and Chapter 47 prescribe a fairly specific process for the Guard to receive approval from the regulatory agencies to resume small arms training. This process is a unique requirement for Camp Edwards and not typical for other military installations.

The purpose of the SARP2 Overview is to identify best management practices (BMPs) that allow the employment of small arms at Camp Edwards in a manner that:

- meets current and future training requirements; and,
- employs maximum feasible use of pollution prevention to protect the Upper Cape Water Supply Reserve, managed as a MassDEP Zone II for public water supplies.

The SAR P2 Overview is an overarching (installation-wide) plan that will support the development of range-specific design and operations and maintenance (O&M) plans for each SAR on Camp Edwards. Per the phased approach outlined in Section 4.4, Camp Edwards will develop an O&M plan for each SAR. These plans will include range-specific BMPs, applicable monitoring practices, and specific triggers for metals management and recovery (e.g., time intervals, number of rounds fired). Prior to the return of lead firing on any SAR, Camp Edwards will present these O&M plans to the Environmental Management Commission (EMC) and U.S. Environmental Protection Agency (EPA) for review and approval.

To ensure the Camp Edwards SARs remain capable and available to support live fire training requirements in a manner that is compatible with environmental conditions, MAARNG will periodically review and update the contents of this SAR P2 Overview. After implementation of BMPs at each range, Camp Edwards will evaluate the effectiveness of the BMPs and notate lessons learned for the next phase. The SAR P2 Overview is a living document, whose continual updating will help develop future SAR design and O&M plans. New information will be incorporated into this SAR P2 Overview as Camp Edwards' mission changes, as the configurations or conditions of ranges change, as the industry's knowledge about range management improves, and as the collective understanding of the environmental science on SARs becomes more refined.

This plan is particularly relevant to the ongoing Massachusetts Environmental Policy Act Notice of Project Change, in which the Massachusetts National Guard (MANG) proposes to modify the current ban on lead-bullet ammunition and allow for the use of lead small arms ammunition, subject to an approval process conducted in accordance with Chapter 47 of the Acts of 2002. The contents of this plan will assist MANG in consultations with the EMC, EPA Region 1, and MassDEP to determine the exact process and requirements necessary to resume training with lead small arms ammunition. The preferred range-specific BMPs will then be formally presented to the EMC and EPA for their approval. Implementation of the BMPs and initiation of live-fire training will begin subject to the availability of appropriate funding. Lead core ammunition will only be fired at Camp Edwards SARs as BMPs are funded and implemented.

The SAR P2 Overview also manifests the Triple Bottom Line concept of "Mission, Environment, and Community" espoused in the Army Sustainability Initiative.[2] Properly trained and equipped units allow MANG to focus on the vision set forth by the Adjutant General (TAG) to sustain a ready, reliable, and essential force for the citizens of Massachusetts and America. By doing so, MANG honors its commitment to accomplish assigned missions for the benefit of the community. MANG not only pledges to protect and assist the community through its operational assignments, but also through the protection of the environment during both training and the execution of missions. This plan supports each of these critical ingredients to sustainable military installations.

[2] http://www.sustainability.army.mil/overview/overview.cfm.

2. SCOPE

The SAR P2 Overview considers all SARs and current small arms training requirements at Camp Edwards and prioritizes a subset of SARs for initial BMP implementation. As Camp Edwards successfully employs BMPs at its highest priority ranges, live-fire training and BMP implementation may also occur at additional ranges to support additional mission requirements. The analysis and BMPs recommended in this plan are based on the site-specific conditions at Camp Edwards, Massachusetts, and are not intended to apply to other Army or Department of Defense (DoD) installations or ranges.

The scope of the BMPs is not limited to typical environmental management options. Camp Edwards also investigated BMPs related to range design and O&M, as well as administrative BMPs related to funding, budgeting, training, and personnel.

The SAR P2 Overview is a living document, whose continual updating and recommendations will help develop SAR design and O&M plans. Camp Edwards will develop range-specific design plans and O&M plans that will include range-specific BMPs, applicable monitoring practices, and specific triggers for metals management and recovery (e.g., time intervals, number of rounds fired). After implementation of BMPs at each range, Camp Edwards will evaluate the effectiveness of the BMPs and notate lessons learned for the next phase. Prior to the return of lead firing on any SAR, Camp Edwards will present these O&M plans to the EMC and EPA for review and approval. These range-specific design and O&M plans are not part of this overview document.

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3. BACKGROUND

3.1 History of Camp Edwards

Camp Edwards, on MMR, has a long, proud history of training MANG soldiers. Camp Edwards itself is an integral part of the landscape of Upper Cape Cod—a sea of open space amidst development—where many thousands of soldiers have trained in the past and continue to do so today. Camp Edwards comprises a little more than 14,000 acres of MMR's total 21,000 acres.

Camp Edwards' story begins in 1911, when MANG soldiers trained in the woods south and west of the present-day MMR. Later, needing a large training area, the U.S. Army looked to Cape Cod to establish a new camp. In 1935, the War Department approved acquisition (purchase or lease) of up to 200,000 acres on the Cape for military training. That same year, the Governor of Massachusetts filed a bill appropriating funds to buy land for a campsite. Formal training began as early as summer 1936. In 1940, the Department of the Army (DA) leased Camp Edwards and undertook a major World War II mobilization construction program. Camp Edwards was heavily used by the Army, hosting several major units and conducting different activities devoted to troop training, primarily field artillery firing and field training.

At the conclusion of World War II, DA deactivated Camp Edwards and returned it to operation as an MAARNG facility. It remained an MAARNG facility until 1950, when it was reactivated for troop training support during the Korean Conflict and the Vietnam War.

In 1975, MAARNG once again assumed operational responsibility for Camp Edwards. From 1975 until the spring of 1997, Camp Edwards served New England as an active training facility for regional Guard and Reserve forces of the Army. Camp Edwards still supports a reduced set of training activities today.[3]

Currently, MMR is comprised of MAARNG Camp Edwards and Otis Air National Guard Base (ANGB). Otis ANGB is home to the 102nd Fighter Wing and U.S. Coast Guard Air Station Cape Cod, which conducts search and rescue missions and security along the East Coast. These installations are interdependent, each relying on the others to contribute to the operation of the infrastructure of MMR. Camp Edwards remains an important training area for soldiers completing missions here, at home, and across the world. Many of the state's nearly 6,000 soldiers train at Camp Edwards every year. Over the last several years, Massachusetts National Guardsmen have been deployed overseas, serving in Afghanistan, Iraq, and Bosnia. Currently, 800 service members are federally mobilized. During fiscal year 2006, MANG activated 1,400 Guardsmen to provide support and services for floods or events, such as the Boston Marathon.

[3] LTCOL William Fitzpatrick 2001. *The Lessons of Massachusetts Military Reservation,* AEPI-IFP-1001B, April.

3.2 Environmental Setting

MMR is divided into two major sections. The southern section is comprised of approximately 5,000 acres of cantonment area, which is the industrialized portion of the base where administrative buildings, barracks, vehicle and equipment maintenance shops, housing, and runways are located. The northern training area is a largely wooded area with rolling topography, trails, and paved roads. The northern training area encompasses approximately 15,000 acres and includes training areas, ranges, and a Central Impact Area. Current activities in the northern training area include small arms firing and maneuver training.[4]

Cape Cod's drinking water is provided by an unconsolidated water table aquifer comprising six groundwater lenses. Precipitation that falls directly on Cape Cod is the only source of fresh water to the aquifer. For this reason, in 1982, EPA designated the Cape Cod aquifer as a "sole source aquifer." The westernmost and largest lens of the aquifer is designated as the "Sagamore lens" and provides water to the Upper Cape towns of Bourne, Falmouth, Mashpee, and Sandwich, as well as MMR and its residents, commonly referred to as the 5th Upper Cape Township. MMR is located over the Sagamore lens and also obtains its drinking water from this part of the aquifer, which is about 100–250 ft thick. The surface of the Sagamore lens is shaped like a mound that rises about 70 ft above sea level, and groundwater flows in a radial pattern from the top of the mound beneath MMR and adjoining Sandwich neighborhoods toward the coasts. Figure 3-1 shows groundwater contours of the Sagamore lens under MMR.

The Sagamore lens is composed mostly of sand and gravel particles of varying coarseness. Rain and snowmelt infiltrate the sandy soils. Precipitation that is not evaporated or transpired by plants percolates down to the water table and recharges the aquifer. Below the water table, the pores between the sand and gravel particles are saturated with water that is referred to as groundwater. Groundwater flows at a rate of as much as 1–2 ft/day toward ponds, streams, and the ocean, where it discharges and eventually evaporates back into the atmosphere to complete the hydrologic cycle.

The average yearly precipitation on Upper Cape Cod is about 45 in. About 55% of the precipitation becomes recharge, or about 26 in. /year. The remaining 45% of this precipitation returns directly to the atmosphere through evaporation and transpiration by plants. The recharge rate of 26 in./year results in about 10.2 billion gal/year recharge over the northern training area of Camp Edwards, or about 392 million gal of water for each inch of recharge. The Camp Edwards area, however, is only part of the land area of the Sagamore lens. The U.S. Geological Survey (USGS) estimates that about 86 billion gal recharge to the Sagamore lens each year.

The characteristics of the permeable soils are excellent for recharge by precipitation, but they also permit migration of water soluble contaminants to the aquifer. Some remediation of contamination in the aquifer is already underway as investigation of the effects of past military and non-military practices continues.

[4] MMR 2005. *State of the Reservation Report*.

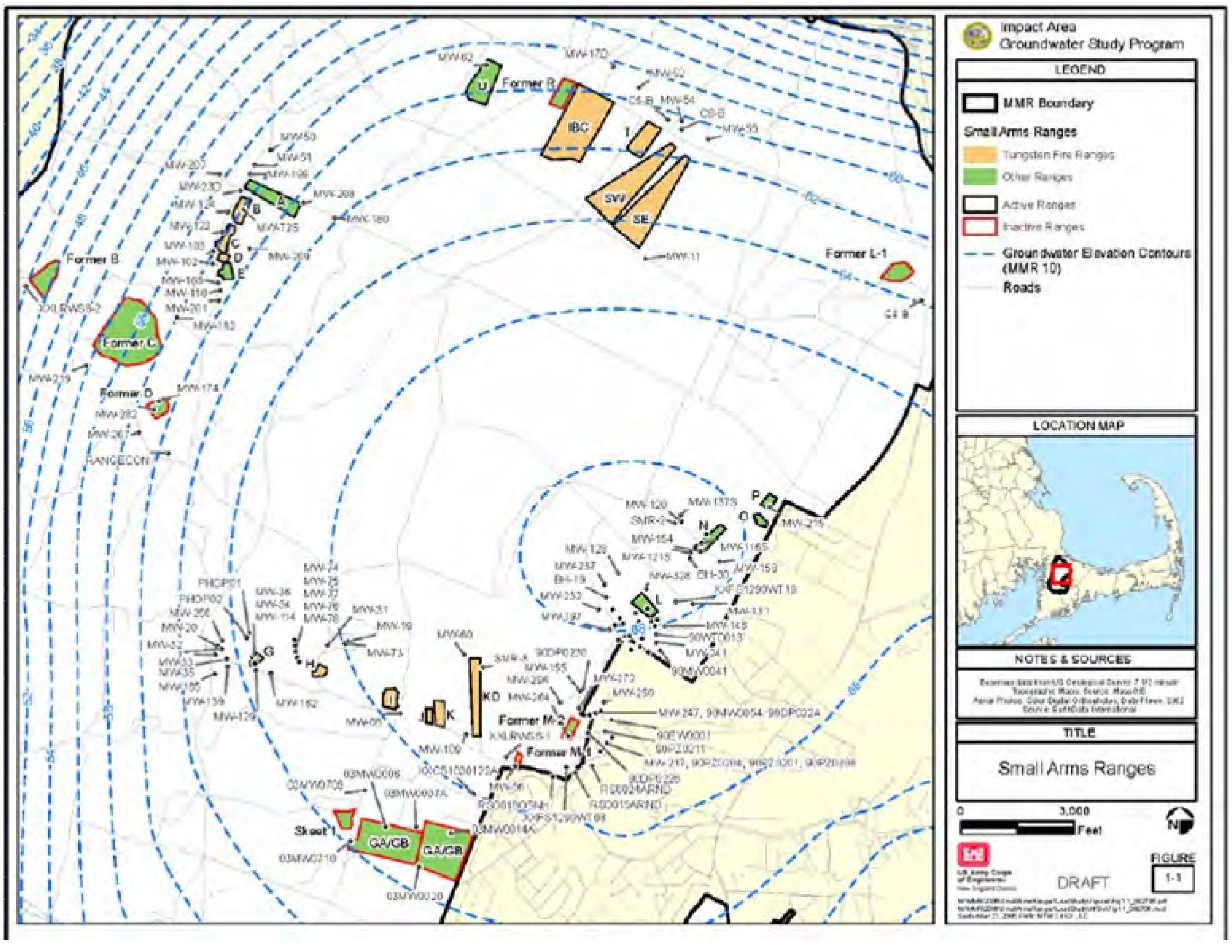

Figure 3-1. Groundwater Contours and Water Supply Wells

Camp Edwards' northern training area is also the Upper Cape Water Supply Reserve, hereinafter referred to as the Reserve/Training Area. In general, soils in the Reserve/Training Area are highly porous, well-drained sands and sand loams, often containing glacially deposited gravel or boulders. As a result, most of the soils have a high susceptibility to erosion, especially on steeper slopes and along roads.[5]

The northern training area contains a number of unique habitats and is home to numerous species of plants and animals, including 37 state-endangered species.

3.3 Training and the Environment

MANG currently has approximately 6,000 soldiers and 2,500 airmen who train at Camp Edwards. These soldiers and airmen train an average of 1 weekend/month and 2 weeks/year, totaling 39 days/year per person. Within the available 39 training days, MANG personnel must satisfy training and qualification requirements equal to those of the active duty forces. Training

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[5] U.S. Department of Agriculture Soil Conservation Service 1993. Soil Survey of Barnstable County, Massachusetts, In cooperation with Massachusetts Agricultural Experiment Station.

facilities available at Camp Edwards include SARs, training areas, battle positions, observation posts, and training roads. These facilities can support a variety of training activities such as land navigation; bivouacking; meteorological data collection; artillery, engineer, marksmanship, and infantry skills training; drivers training; and Reserve Officer Training Corps training. Potential environmental impacts associated with these activities include impacts to vegetation and/or erosion (associated with movement of troops and vehicles) within the training area. Such impacts are limited, however, because training is now conducted in compliance with certain Environmental Performance Standards (EPSs) (as described below), which limit activities that might affect wetlands or other sensitive areas.[6]

One of the more basic training facilities at Camp Edwards is the SAR. This type of range supports training and qualification in basic infantry skills with small arms weapons systems, including pistols, rifles, machine guns, and shotguns. As many as 14 SARs at Camp Edwards are used during a given year. Both military units and civilian agencies have fired weapons at these ranges in recent years. Historically, small arms training at Camp Edwards has been conducted using lead ball ammunition. Firing of lead was discontinued in 1997 in compliance with an administrative order (AO) from EPA. The primary environmental concern with respect to military training activities is the prevention of impacts to groundwater.

3.4 Administrative Order Restrictions

In February 1997, EPA Region 1 utilized its authority under the Safe Drinking Water Act to issue an AO concerning Camp Edwards. The DA, National Guard Bureau (NGB), and MANG received AO No. 1 (AO1), which required the NGB to investigate the nature and extent of contamination at and emanating from the training ranges and Central Impact Area at Camp Edwards.[7]

AO No. 2 (AO2) was issued in April 1997 to the NGB and MAARNG. It required that Camp Edwards cease certain training activities (including firing of lead small arms ammunition, artillery fire, and mortar fire) pending the completion of environmental investigations at the training ranges and Central Impact Area. To date, these activities are still prohibited at Camp Edwards.

3.5 Massachusetts Military Reservation Environmental Programs

All three major military commands of MMR, the Massachusetts Air National Guard, MAARNG, and USCG have environmental programs in place to ensure that current mission and training activities are protective of the environment. These programs are extensive, regulated by both state and federal agencies, and staffed with highly trained professionals.

MANG runs the Environmental and Readiness Center (E&RC) at Camp Edwards and coordinates with the DA, the Department of the Air Force, and NGB. E&RC is responsible for providing the expertise and resources necessary to follow through on an important

[6] MMR 2005. *State of the Reservation Report*.
[7] Camp Edwards Impact Area Groundwater Study Program web site: http://groundwaterprogram.army.mil/groundwater/admin/.

commitment—the commitment to provide realistic training for National Guard soldiers while protecting natural and cultural resources at MMR. E&RC is the primary link for coordination, communication, and information at MMR. E&RC is comprised of both military and civilian personnel; professionals in the areas of natural resource management, environmental compliance, cultural resources, community involvement, hazardous waste handling and reduction, and planning.

Two programs at MMR are responsible for investigation and cleanup of soil and groundwater contamination from past military activities. The Air Force Center for Environmental Excellence (AFCEE) runs the Installation Restoration Program (IRP) and the U.S. Army Environmental Command (USAEC) runs the Impact Area Ground Water Study Program (IAGWSP).

The IRP, under Air National Guard management, was established at MMR in 1982 as part of the Comprehensive Environmental Response, Compensation, and Liability Act cleanup. The IRP is primarily concerned with the cleanup of contamination originating in the southern portion of the installation (cantonment area). In 1996, oversight of the program was transitioned to AFCEE. Most of the actual cleanup of contamination conducted by the IRP has occurred since 1996. For additional information on the IRP, the point of contact is Mr. Doug Karson, Community Involvement Lead, HQ AFCEE/MMR, 322 East Inner Road, Otis ANGB, MA 02542-5028, telephone (508) 968-4678 extension 2. Interested parties can also research in-depth information about these sites and others within the IRP at MMR/IRP web site: www.mmr.org. A copy of AFCEE's annual report includes information on the progress of groundwater cleanup and is also available on this web site.

The IAGWSP is investigating the effects of past military training on groundwater underneath the training areas and the Central Impact Area, where the main contaminants of concern are explosive compounds and perchlorate. The IAGWSP is working to fully define all areas of groundwater contamination and their sources to determine and complete remedial actions as quickly as possible. The program will initiate interim remediation actions, as appropriate, while it completes the selection, design, and construction of final remedial solutions for all areas of contamination. For additional information on the IAGWSP, call 508-968-5626, or visit the IAGWSP web site: www.groundwaterprogram.army.mil. Information on the program is also available at the four Upper Cape public libraries.

3.6 Environmental Oversight Structure

To ensure the protection of the valuable natural resources found at the Reserve/Training Area, the Commonwealth of Massachusetts provides the highest level of environmental oversight for all activities conducted at Camp Edwards. The military is required to operate in compliance with several state, federal, and DoD laws and regulations to ensure protection of the environment. At Camp Edwards there is an additional level of environmental protection and oversight in the form of a landmark agreement between the Commonwealth of Massachusetts and the military. This agreement, and a subsequent state law, created the EMC, comprised of the heads of three state environmental agencies. The EMC has full-time staff at the base with access to all training lands, activities, and related information regarding the Reserve/Training Area. The EMC evaluates, and has the ability to suspend, any training activity in the Reserve/Training Area that they believe is a threat to the environment. This oversight structure has been written into the lease agreement the Army holds with the Commonwealth of Massachusetts for the use of Camp Edwards, which is located on state-owned land. As long as MANG remains at Camp Edwards, this unparalleled standard of environmental protection will be in place.

In October 2001, a Memorandum of Agreement (MOA) was signed establishing a management structure for the northern training area of Camp Edwards, also known as the Upper Cape Water Supply Reserve, and creating the oversight structure for the Reserve/Training Area as outlined in the Community Working Group Master Plan Final Report. The MOA was signed by:

- Governor of Massachusetts for the Commonwealth of Massachusetts
- Deputy Assistant Secretary of the Army (Environment, Safety & Occupational Health) for the DA
- Secretary of Executive Office of Environmental Affairs
- NGB
- MANG TAG
- Commissioner of the Massachusetts Department of Fish and Game (Mass DFG)
- Commissioner of the Massachusetts Department of Conservation and Recreation (DCR)
- Commissioner of MassDEP

On 5 March 2002, acting Governor Jane Swift signed legislation (Chapter 47 of the Acts of 2002) codifying into law the MOA, ensuring permanent protection of the drinking water supply and wildlife habitats in the Reserve/Training Area, while allowing compatible military training. Under the law, the compatibility of training with environmental protection would be verified through independent oversight, monitoring, and evaluation. For this purpose, the legislation created the EMC, consisting of the Commissioner of Mass DFG, Commissioner of MassDEP, and Commissioner of DCR. The EMC oversees compliance with and enforcement of the EPSs and coordinates the actions of environmental agencies of the Commonwealth in the enforcement of environmental laws and regulations within the Reserve/Training Area.

The legislation further directed that the EMC be assisted by two advisory councils. The Community Advisory Council (CAC), consisting of 15 members, assists the EMC by providing advice on issues related to the protection of the water supply and wildlife habitat within the Reserve/Training Area. The Science Advisory Council (SAC), consisting of nine members, assists the EMC by providing scientific and technical advice relating to the protection of the drinking water supply and wildlife habitat within the Reserve/Training Area.

Finally, the legislation established a full-time Environmental Officer (EO) for MMR. The EO in this capacity provides full-time monitoring of military and civilian activities on and uses of the Reserve/Training Area and the affect of those activities and uses on the water supply and wildlife habitats. Working directly for the EMC, the EO has unrestricted access to all data and information from the various environmental and management programs. The EO has full access to all points in the Reserve/Training Area and conducts inspections at any time to monitor, oversee, evaluate, and report to the EMC on the environmental impact of military training and other activities. The EO's on-site monitoring occurs prior to, during, and immediately following training and other activities. These monitoring activities include, but are not limited to, training sites, P2, and habitat protection activities for both military and contractors in the Reserve/Training Area, as well as coordinating and consulting with E&RC on various projects, initiatives, and issues, including SAR management. The EO is located full time at MMR and acts as a liaison among the EMC, SAC, CAC, military, general public, and various state agencies.

The EO also brings additional natural resource management experience to the management of water supply and training land. For example, the current EO, Mr. Mark Begley, has an extensive background in SAR management and has contributed to numerous BMP manuals, including the Interstate Technology & Regulatory Council (ITRC) *Environmental Management at Operating Outdoor Small Arms Firing Ranges*.

3.7 Environmental Performance Standards

MANG, in collaboration with a multi-disciplinary team of local, state, and federal regulators, began compliance with EPSs for Camp Edwards in 2001 as a part of its obligations under an MOA among the Commonwealth of Massachusetts, the U.S. Army, and the NGB. Firing of lead small arms ammunition at the SARs in the northern training area is currently prohibited under the EPSs. Table 3-1 lists EPSs that apply to the northern training area.[8]

Table 3-1. Camp Edwards Environmental Performance Standards

• Air Quality	• Hazardous Waste	• Storm Water Management
• Fire Management	• Noise Management	• Vegetation Management
• General Use and Access	• Pest Management	• Vehicle Performance
• Groundwater	• Rare Species	• Wastewater Performance
• Habitat Management	• Soil Conservation	• Wetlands and Surface Water
• Hazardous Materials	• Solid Waste Performance	• Wildlife Management

3.8 Berm Soil Maintenance Project

A berm soil maintenance project was conducted at Camp Edwards in 1998 in compliance with requirements articulated in the EPA AOs. Under this program, metallic lead was removed and leachable lead was fixed in soil at 16 ranges (A, B, C, D, E, G, H, I, J, K, KD, N, O, P, SE, and SW). Soils containing Toxicity Characteristic Leaching Procedure (TCLP) leachable lead concentrations greater than 5.0 mg/L were removed and/or treated in situ during the program.[9]

This project also involved characterization of the nature and extent of lead in and around the SAR berms at the 16 ranges in question. The results of this characterization are discussed in more detail in Section 5.2.1.

[8] State of Massachusetts 2001. *Memorandum of Agreement Between The Commonwealth of Massachusetts and The United States Army and National Guard Bureau*, 4 October.
[9] Ogden Environmental 1999. *Massachusetts Military Reservation Training Range and Impact Area Small Arms Berm Maintenance Removal of Metallic Lead and Fixation of Leachable Lead*, March 5.

3.9 Transition to Tungsten Ammunition

Since the introduction of gunpowder on the battlefield, lead has been the primary component of small arms projectiles. This is due to the relative abundance of the material, its high density, ease and low cost of manufacture, and its ballistic properties. The U.S. military has been using lead-based ammunition since the Revolutionary War and still uses it today. Lead is by far the most commonly used metal for the manufacture of small arms projectiles around the world.[10]

Prior to the EPA Region 1 ban on lead-based ammunition, Camp Edwards typically expended more than 1 million rounds of lead small arms ammunition a year from a variety of different weapons, including the 5.56mm M16 rifle, 5.56mm Squad Automatic Weapon (SAW), 9mm pistol, and 7.62 and .50 caliber machine gun.

After the EPA ban went into effect in 1997, MANG began using small arms ammunition containing a tungsten-nylon core instead of a lead core. Tungsten-nylon bullets were used from 2000 to February 2006, when the Governor of Massachusetts suspended this activity after USAEC identified tungsten in groundwater.

3.10 Tungsten-Impacted Soil Consolidation

In 2000, MAARNG began using tungsten-nylon ammunition at several SARs at MMR in response to the EPA Safe Drinking Water Act AO2. The AO prohibited the use of lead small arms ammunition on ranges due to concerns that lead bullets deposited on range surfaces and in backstop berms could leach into groundwater.[11]

The tungsten-nylon ammunition (also known as “green” ammunition) used at the SARs consists of a projectile composed of a high-density tungsten-nylon core and steel penetrator surrounded by a copper-alloy jacket. The tungsten that makes up the core is composed of tungsten grains ranging in size from 5 to 20 µm. Unlike lead bullets that will generally remain intact or splinter into pieces upon impact, a tungsten projectile will partially or wholly disintegrate after impacting the target, depositing a fine tungsten powder on the ground surface.

From July through December 2005, at the request of MANG and the EMC, USAEC sampled soil, pore water, and groundwater monitoring wells at I, C, and B Ranges. The goal of the sampling was to determine the fate and transport of tungsten in soil, pore water, and groundwater due to use of tungsten-nylon ammunition. USAEC also sampled for 11 additional metals, including lead, in the same media at each range to determine whether the presence of tungsten affected the mobility of these metals in soil and groundwater. The results of the soil and pore water sampling and the first of three rounds of groundwater sampling were received by the regulatory agencies in February 2006.

The results of the testing conducted by USAEC in summer/fall 2005 identified tungsten at I, B, and C Ranges at concentrations ranging from 17 to 1,534 mg/kg in soil, 0.07 to 400.2 mg/L in

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[10] MMR 2005. *State of the Reservation Report*.
[11] URS 2006. *Draft Tungsten Impacted Soil Screening Project, Small Arms Ranges B, C, D, E, G, I, ISBC, J, K, KD/(H), SE, SW, and T, Camp Edwards, Massachusetts*, 30 June.

pore water, and 15 µg/L in shallow groundwater at B Range in MW-72. Tungsten was not detected in groundwater from any other wells sampled during the first round of sampling, although the wells sampled may not have been well suited for this purpose given their location and screen depth.

In February 2006, MAARNG, under the direction of Governor Mitt Romney, suspended the firing of tungsten-nylon rounds at 13 Camp Edwards SARs. Recognizing that the tungsten-nylon rounds used at the ranges were the likely source of the tungsten contamination, MAARNG initiated discussions with the Governor of Massachusetts, the EMC, MassDEP, EPA Region 1, and other stakeholders to establish a prudent short-term management approach. A berm maintenance project was conducted utilizing MANG O&M monies to identify, excavate, and consolidate tungsten-impacted soil. Because there is no state or federal regulatory standard for tungsten in soil or groundwater, MANG used the background established in the USAEC study of 1.5 µg/g parts per million (ppm). Soils that exhibited concentrations of tungsten at 10 times that of the background concentration, or 150 ppm, and greater were targeted for removal and consolidation.

MAARNG identified 13 SARs [B, C, D, E, G, I, Infantry Squad Battle Course (ISBC), J, K, KD/(H), SE, SW, and T] where spent tungsten-nylon bullets had become concentrated and were potentially acting as a source of tungsten in groundwater (see Figure 3-2). MAARNG conducted pre-characterization screening, process screening, and post-excavation screening. MANG and its contractors used a field expedient x-ray florescence (XRF) analyzer to denote areas with tungsten concentrations greater than 150 ppm and guide the soil excavation and consolidation.

This effort was generally limited to areas known or observed to exhibit significant impacts, such as bullet pockets, impact berm faces, and toe slopes. Depending on the range configurations and usage histories, limited excavation was also conducted on the berm crest, back berm areas, and drop areas behind targets. No soil sampling or removal was conducted for range firing lines, range floors, or the range fan at large.

Based upon 513 XRF pre-characterization samples, it was determined that six ranges (B, C, G, I, J, and K) exhibited concentrations of tungsten greater than 150 ppm in berm soils that were uniform enough to warrant excavation and consolidation. During the course of soil excavation, the XRF was re-calibrated daily, and laboratory tests were conducted on a representative percentage of soils to ensure data quality. A total of 599 additional XRF process samples were collected, and an additional 414 XRF post-excavation samples were collected to confirm and document that the tungsten-impacted soil above the 150 ppm threshold had been removed.

Approximately 7,000 tons of soil were removed from six SARs at Camp Edwards and taken to one of two consolidation areas. Soil excavated from B and C Ranges was placed on the northern half of the range floor at C Range, while soil excavated from G, I, J, and K Ranges was placed on the range floor at K Range. Soil consolidated on both ranges was placed on the floor in the shape and configuration of a berm or elongated mound. Soil was placed on and covered with an impermeable geotextile and then covered again with a canvas-like material to provide weight and UV protection and to keep soil from coming into contact with rain water. This was done to ensure that the tungsten in soil would not continue to leach into groundwater.

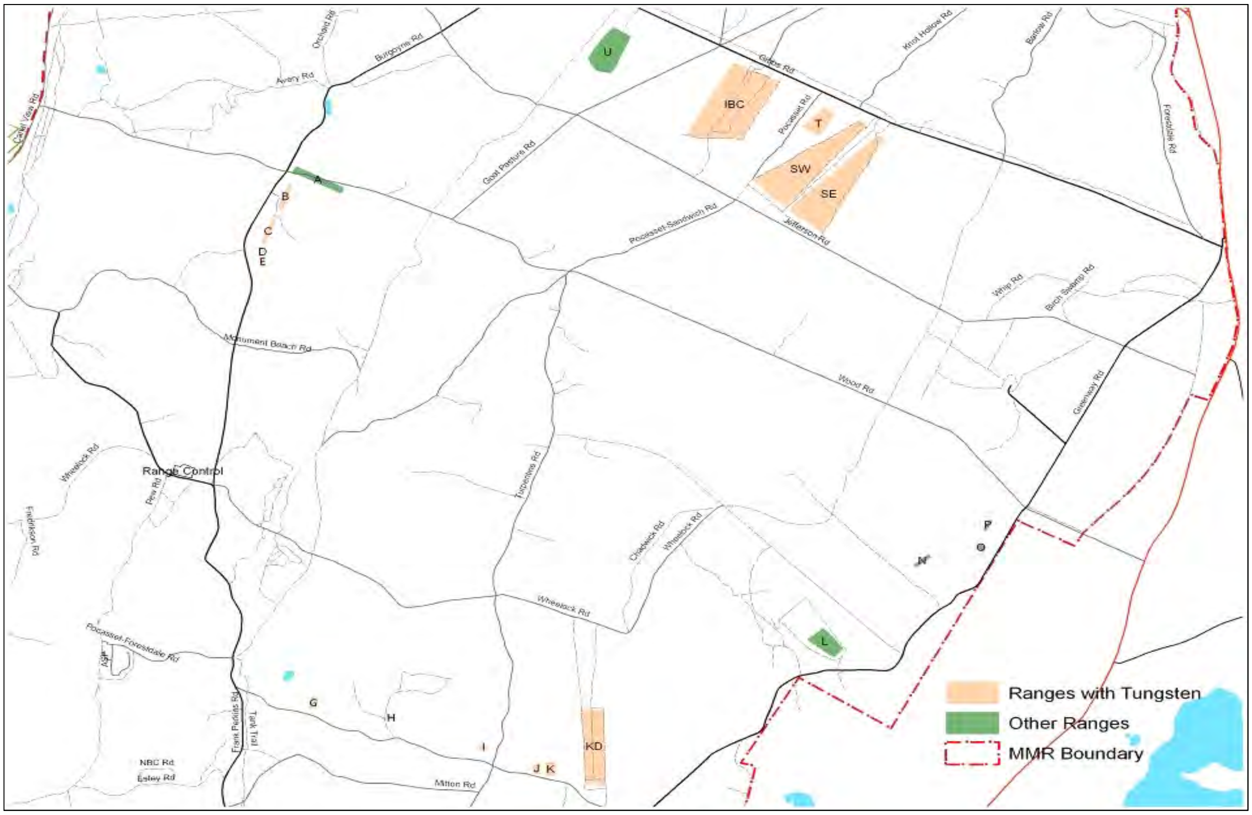

Figure 3-2. Ranges Where Tungsten-Nylon Bullets Have Been Fired

Of the seven remaining ranges [D, E, KD/(H), ISBC, SE, SW, and T] that did not meet the soil excavation and consolidation criteria, only three of the pre-characterization XRF samples indicated the presence of tungsten in surface soil above 150 ppm, and none of the belowground XRF samples indicated the presence of tungsten above the 150 ppm limit. Therefore, these soils were not excavated and stockpiled.

MANG, again in coordination with the EMC, MassDEP, EPA, and stakeholders, requested through NGB that USAEC expand their study to further determine the fate and transport of tungsten in the environment at Camp Edwards. Additional study will determine how far and how fast tungsten is percolating through soil and into groundwater. NGB approved an additional $720,000 to expand this study, which will be conducted through 2008.

USAEC also identified lead in soil at concentrations ranging from 90 to 1,092 mg/kg (ppm). The MassDEP Massachusetts Contingency Plan (MCP) soil classification S1/GW1 standard for lead is 300 µg/g (ppm). USAEC also detected lead in pore water in 7 of 20 samples ranging from 0.002 to 0.017 mg/L (ppm) and in shallow groundwater in MW-72 at 0.0014 mg/L (ppm). USAEC detected lead in MW-72 below the method detection limit of 1.8 parts per billion (ppb) and below the MassDEP MCP GW-1 standard of 15 µg/L (ppb). Currently, lead has not been identified as a contaminant of concern for groundwater at MMR.

Tungsten found by USAEC in soil at Camp Edwards SARs may be the result of the deposition of tungsten powder after the tungsten-nylon projectile strikes a target. It is also hypothesized that the presence of tungsten in pore water and groundwater is the result of infiltration from precipitation events, although the specific transport mechanism is unclear. One possibility is because of their small size, tungsten particles are transported directly into pore water and therefore also into groundwater via infiltration of precipitation into the vadose zone. Another potential explanation is that tungsten may oxidize and form highly soluble tungstates that percolate into soil, pore water, and groundwater due to infiltration. It is possible that the tungsten detected at MW-72 at B Range is a result of surface water containing tungsten entering the monitoring well via runoff from the backstop berm. A combination of these processes could also be at work.

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4. RANGE PRIORITIZATION

MANG must support the employment of small arms at Camp Edwards in a manner that meets training requirements and protects human health and the environment.

Camp Edwards recognizes that it has limited resources necessary to implement BMPs and that it must demonstrate the ability to manage and mitigate environmental impacts associated with small arms training. As a result, Camp Edwards decided to implement BMPs initially on a subset of ranges that are most critical to satisfying current small arms training requirements. This section describes the method and process of identifying the highest priority SARs where MANG will reinitiate training with small arms ammunition.

4.1 Small Arms Ranges at Camp Edwards

Weapons used in combat by a soldier are primarily small arms consisting of rifles, pistols, and machine guns. Small arms training is designed to train a soldier to be "qualified" in the use and maintenance of his/her assigned weapon. All soldiers in deployable units are required to qualify on their assigned weapon annually and become familiarized with other standard small arms weapons systems. Qualification must take place on a range designated for this purpose.[12]

Table 4-1 defines the terms used to describe the types of training conducted using small arms weapons systems.

Table 4-1. Small Arms Weapons Training Terms

Term	Description
Weapon Familiarization	Weapons familiarization is instruction in the components, operation, proper use, and safe handling of firearms.
Zero	Zeroing aligns the sights with the barrel so that the point of aim equals the point of impact given the standard issue ammunition.
Practice/Marksmanship	Marksmanship training by which soldiers learn how to accurately fire a given weapon system. It allows soldiers to attain and maintain proficiency in engaging targets with the weapon.
Transition	Transition firing provides the gunner the experience necessary to progress from 10-m firing to field firing at various target types and longer ranges. The gunner experiences and learns the characteristics of fire, field zeroing, range determination, and engaging targets in a timed scenario. Transition firing is conducted on specific types of ranges and is scored to provide the gunner with feedback.
Record Fire/Qualification	Record fire is when a gunner completes several phases of firing tasks to qualify to operate a particular weapon. Transition firing is conducted on specific types of ranges and is scored to provide the gunner with feedback and record the gunner's qualification.

[12] MANG 2001. *Final Area-Wide Environmental Impact Report for the Massachusetts National Guard Properties at the Massachusetts Military Reservation.*

Table 4-2 identifies all SARs, their locations, their historic use, and the weapons proposed for use on each range. Figure 4-1 is a map of all ranges and training land on Camp Edwards. The following sections describe the training conducted on Camp Edwards SARs, the weapons used for that training, and the current state of those ranges. For a more in-depth review of each range's operational and environmental characteristics, including detailed descriptions of the ranges, weather, and photo logs, see Appendix D.

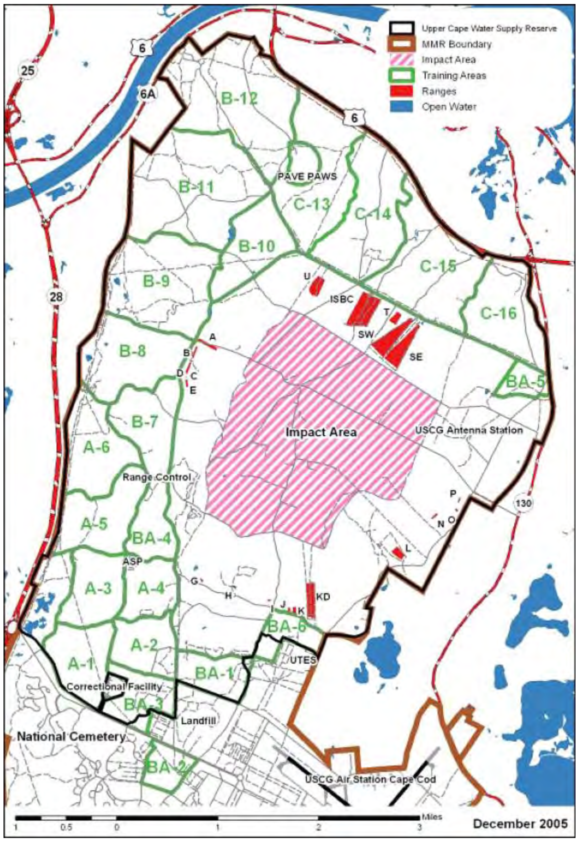

Figure 4-1. Ranges and Training Areas on Camp Edwards

Different source documents refer to the Camp Edwards SARs using different facility category codes (FCCs) and titles. The U.S. Army Active/Inactive Range Inventory aligns each SAR at Camp Edwards with an FCC. MAARNG Range and Training Land Program Development Plan (RDP) identifies the ranges by a slightly different set of FCCs and titles.[13] During the development of this plan, Camp Edwards compared the current conditions and capabilities of each range with the facility descriptions in DA Pamphlet 415-28, *Guide to Army Real Property Category Codes*, to attempt to resolve conflicts in naming conventions and identify the true FCC for each SAR. Table 4-3 compares the FCC and facility title used in the source documents and ones assigned during the range assessments conducted during the development of this plan. For consistency in the following sections, the ranges are grouped according to the "Actual Range Type (Based on Current Configuration and DA PAM 415-28)" in Table 4-3.

4.1.1 Machine Gun Transition Range

A Alpha

A Range is a .50 caliber Machine Gun Range for training soldiers in the use of mounted and unmounted .50 caliber machine guns. A Range is the only range of its type at Camp Edwards.

[13] MAARNG 2006. *Massachusetts Army National Guard, Range and Training Land Program Development Plan*.

Table 4-2. Camp Edwards Small Arms Ranges[14]

Range	Range Area	Location	Historic Range Use	Proposed Range Use
A	West	Burgoyne/Wood Road Junction	.50 caliber machine gun	.50 caliber and 7.62mm machine gun
B	West	Burgoyne Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers)	Currently no proposed use
C	West	Burgoyne Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers)	Currently no proposed use
D	West	Burgoyne Road	7.62mm rifle and machine gun	Currently no proposed use
E	West	Burgoyne Road	Pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]	Pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
G	South	Pocasset-Forestdale Road	7.62mm rifle (M60); 5.56mm rifle (M16) and SAW machine gun; pistols (all calibers)	Currently no proposed use
H	South	Pocasset-Forestdale Road	Pistols (all calibers)	Currently no proposed use
I	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW machine gun; submachine gun (.45 caliber and 9mm); pistol (all calibers); shotgun	Currently no proposed use
ISBC	North	Gibbs Road	.22 caliber rifle; 5.56mm rifle (M16) and SAW machine gun; 7.62mm machine gun; 40mm grenade launder; 22mm subcaliber round for 81mm mortar	.22 caliber rifle; 5.56mm rifle (M16) and SAW machine gun; 7.62mm machine gun; 40mm grenade launder; 22mm subcaliber round for 81mm mortar
J	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW-ball and tracer submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
K	South	Pocasset-Forestdale Road	5.56mm rifle (M16) and SAW-ball and tracer submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]
KD	South	Pocasset-Forestdale Road	7.62mm machine gun and rifle; 5.56mm rifles and SAW; submachine gun (.45 caliber and 9mm); pistols (all calibers); shotgun, TOW, LAW, 90mm recoilless rifles	7.62mm machine gun and rifle; 5.56mm rifles and SAW M249, M240, M60, and M2.
N	East	Greenway Road	5.56mm rifle (M16) and SAW machine gun; pistols (all calibers); shotgun	Currently no proposed use

[14] MMR 2005. *State of the Reservation Report*.

Range	Range Area	Location	Historic Range Use	Proposed Range Use
O	East	Greenway Road	Pistols (all calibers); shotgun	Currently no proposed use
P	East	Greenway Road	5.56mm rifle (ball and tracer); pistol (all calibers); shotgun	Currently no proposed use
SE	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun	SE/SW complex: 5.56 rifle (M16)
SW	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun	SE/SW complex: 5.56 rifle (M16)
T	North	Gibbs Road	5.56mm rifle (M16) and SAW machine gun; 7.62mm rifle and machine gun; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]; .50 caliber plastic; M939 9mm tracer round for AT-4	5.56mm rifle (M16); M249 and M240 machine guns; pistols [all calibers (e.g., .22, .357, .38, .40, 9mm, .45, and .44)]

4.1.2 Rifle/Machine Gun Zero Range

B	Bravo	C	Charlie	D	Delta
G	Golf	H	Hotel	I	India
J	Juliet	K	Kilo	N	November
T	Tango				

B, C, D, G, I, J, K, N, and T Ranges are Rifle/Machine Gun Zero Ranges. These ranges are designed for training shot-grouping and zeroing exercises with rifles and machine guns. They are used to train soldiers on the skills necessary to align the sights and practice basic marksmanship techniques against stationary targets.[15] This type of range can also be used as an "alternate course" to qualify on the M16 with targetry that uses reduced image size and perspective to simulate firing at a longer range. Previously, H ("Hotel") Range was a Rifle/Machine Gun Zero Range. At present, H Range is inactive. The firing points and targets were dismantled, and the range tower was moved to the parking lot. This range acts as a storage site for equipment used in the thermal treatment units for the IAGWSP. Prior to a recent range modernization effort, T Range was a non-standard SAR design that did not fully satisfy requirements associated with any specific range type. In July 2006, MANG installed new 25-m target frames, a new backstop, and 15 lanes of a granular rubber (i.e., STAPP™) bullet containment system. The STAPP™ system is capable of accepting tracer rounds as long as its self-healing rubber membrane is maintained. The tracer round identified (M939, 9mm) is used as a sub caliber simulation in the AT-4. It allows soldiers to become familiar with using and aiming the weapon and would be fired in very low numbers. Section 7.1 provides more information on the STAPP™ system.

[15] DA 2003. *Guide to Army Real Property Category Codes*, Pamphlet 415-28.

Table 4-3. Current Camp Edwards Ranges and Facility Category Codes

Range Name	Army Range Inventory	Camp Edwards RDP	Actual Range Type (Based on Current Configuration and DA PAM 415-28)	Comments
A (Alpha)	Machine Gun Transition Range FCC 17831	Machine Gun Transition Range FCC 17831	Machine Gun Transition Range FCC 17831	Current range configuration satisfies very limited basic marksmanship training tasks.
B (Bravo)	Field Fire Ranges, Non-automated FCC 17802	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Can be used for Alternate Pistol Qualification Course.
C (Charlie)	Field Fire Ranges, Non-automated FCC 17802	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Can be used for Alternate Pistol Qualification Course.
D (Delta)	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Distance from firing position to targets is approximately 10 m, restricting D Range to supporting 10 m zero, 10 m practice, and 10m qualification with M60/M240/M249 machine guns.
E (Echo)	Combat Pistol/ MP Firearms Qualification Course FCC 17821	Combat Pistol/ MP Firearms Qualification Course FCC 17821	Combat Pistol/MP Firearms Qualification Course FCC 17821	Currently undergoing modernization.
G (Golf)	Field Fire Ranges, Non-automated FCC 17802	Rifle/Machine Gun Zero Range FCC 17801	Basic 10m Firing Range FCC 17801	Distance from firing position to targets is approximately 10 m, restricting G Range to supporting 10 m zero, 10 m practice, and 10m qualification with M60/M240/M249 machine guns.
H (Hotel)	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	NA	This site is no longer configured to support any small arms training.
I (India)	Field Fire Ranges, Non-automated FCC 17802	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Tracks allow moveable targets to be used, but these tracks have never been used.
ISBC (Infantry Squad Battle Course)	Infantry Battle Squad Course FCC 17894	ISBC FCC 17894	ISBC FCC 17894	Current design and construction does not fully meet training requirements with respect to target types and distances.
J (Juliet)	Combat Pistol/ MP Firearms Qualification Course FCC 17821	Nonstandard Small Arms Range FCC 17814	Rifle/Machine Gun Zero Range FCC 17801	Can be used for Alternate Pistol Qualification Course.
K (Kilo)	Combat Pistol/ MP Firearms Qualification Course FCC 17821	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Non-standard range design with trees/shrubs between targets and berm.
KD (Known Distance)	Machine Gun Transition Range FCC 17831	Known Distance (KD) Range FCC 17810	Known Distance (KD) Range FCC 17810	Current range design and construction does not allow for 1,000 m distance from firing points to target as required by standard range design.
N (November)	Field Fire Ranges, Non-automated FCC 17802	Rifle/Machine Gun Zero Range FCC 17801	Rifle/Machine Gun Zero Range FCC 17801	Can be used for Alternate Pistol Qualification Course.
O (Oscar)	Field Fire Ranges, Non-automated FCC 17802	Nonstandard Small Arms Range FCC 17814	Nonstandard Small Arms Range FCC 17814	Range does not appear to be designed or constructed to support any specific training requirements.
P (Papa)	Combat Pistol/ MP Firearms Qualification Course FCC 17821	Nonstandard Small Arms Range FCC 17814	Nonstandard Small Arms Range FCC 17814	Range does not appear to be designed or constructed to support any specific training requirements. Most closely resembles a Basic 10 m–25m Firing Range, FCC 17801.
SE (Sierra East)	Machine Gun Transition Range FCC 17831	Machine Gun Field Fire Range FCC 17832	Machine Gun Field Fire Range FCC 17832	Currently being reconfigured to a single 10 lane version of an Automated Record Fire Range for M16 field fire and qualification.
SW (Sierra West)	Machine Gun Transition Range FCC 17831	Machine Gun Field Fire Range FCC 17832	Machine Gun Field Fire Range FCC 17832	
T (Tango)	Field Fire Ranges, Non-automated FCC 17802	Nonstandard Small Arms Range FCC 17814	Rifle/Machine Gun Zero Range FCC 17801	Most closely resembles a Basic 10m–25m Firing Range, FCC 17801 with STAPP bullet containment system.

4.1.3 Combat Pistol/MP Firearms Qualification Course

E Echo

E Range is undergoing a modernization project to upgrade the range design and targetry to meet standard Army doctrinal training and qualification requirements with combat pistols. This range type is used to train and test soldiers on the skills necessary to identify, engage, and hit infantry targets.[16] Currently, E Range is under construction and being outfitted with modern pop-up targetry and troop support facilities, including a covered canteen.

4.1.4 Known Distance Range

KD Known Distance

Camp Edwards' KD Range is designed for training rifle marksmanship and target engagement techniques. This range is used to train soldiers on the skills necessary to identify, calculate distance, engage, and hit stationary targets in a static array at a variety of distances from 50 to 600 yards.

4.1.5 Nonstandard Small Arms Range

O Oscar P Papa

Although classified as a Nonstandard Small Arms Range, O Range is used as Camp Edwards' sole shotgun familiarization range. Situated near an installation boundary, this range fell into disuse when lead was no longer allowed. Previously, local police, Federal Bureau of Investigation agents, and other law enforcement organizations used O Range more than MANG units. P Range closely resembles a Rifle/Machine Gun Zero Range, but it does not fully satisfy the training requirements associated with any current range design.

4.1.6 Machine Gun Field Fire Range

SE Sierra East SW Sierra West

SE and SW Ranges are side-by-side Machine Gun Field Fire Ranges. Camp Edwards is combining these two into S Complex. Modernization information regarding this range is discussed in Section 5.4.3. The extensive upgrade is designed to create an Automated Record Fire Range and to align the range with current U.S. Army small arms training standards.[17]

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[16] IBID.
[17] MMR 2005. *State of the Reservation Report*.

4.1.7 Infantry Squad Battle Course

ISBC Infantry Squad Battle Course

ISBC is a unique, four lane design that supports both offensive and defensive training. With two objectives to either attack or defend, troops learn to operate as a team on this large and diverse range. ISBC is used to train and test teams and squads on the skills necessary to conduct tactical movement techniques and to detect, identify, engage, and defeat objectives.

4.2 Need for Prioritization

In the long term, Camp Edwards would like to have all its SARs operational and capable of supporting the full range of infantry training requirements. This will involve returning all ranges to firing standard issue lead small arms ammunition in all small arms calibers. At present, the immediate need is for adequate numbers and types of SARs to support current training requirements. The SARs listed in Phases 1, 2, and 3 meet this immediate need. For those Camp Edwards SARs not included in this overview, future training requirements and lessons learned from BMP implementation may determine their future intended use. Future changes to training doctrine, force structure, weapon systems, or military threats could alter the numbers and types of ranges needed. Training requirements and activities at Camp Edwards include realistic, collective maneuver training and small arms weapons training.

It is unlikely that Camp Edwards could immediately operate and maintain its entire suite of SARs due to resource limitations. Camp Edwards will select and implement appropriate BMPs for those ranges needed to support current small arms training requirements. As it demonstrates the ability to responsibly operate those ranges required to support current training requirements, Camp Edwards will phase-in operations at additional ranges to support additional training missions as required.

4.3 Prioritization Methodology

To prioritize the SARs for a return to firing lead small arms ammunition, Camp Edwards:

- Identified current and anticipated training requirements. These requirements are evaluated in terms of type of weapon, type of target, distances to target, and needed terrain.
- Compared the capability of the current inventory of SARs to training requirements and identified ranges that satisfy requirements and any shortfalls thereof.
- Evaluated the complexity involved with managing the environmental impacts of live-fire training on each of the ranges.

4.3.1 Current and Future Training Requirements

Current training requirements include the need for small arms familiarization, zeroing sights, weapons qualification, and small unit tactics. These skills prepare soldiers to successfully accomplish real world missions assigned to them within the Commonwealth of Massachusetts, the United States, and around the world. Small arms familiarization includes a soldier zeroing his/her weapon and becoming familiar with its use and maintenance. Qualification includes identifying and engaging targets at appropriate distances and within set time intervals. Upon completion of familiarization and qualification skills, soldiers would begin small unit tactical training, in which they learn to act as a team in both offensive and defensive operations. This sequential training process is based on the crawl-walk-run training approach employed throughout the Army. Each phase in the crawl-walk-run sequence builds on the previous with the soldier or unit gaining capability and confidence in the trained tasks. The crawl phase typically consists of classroom learning, receiving instructions on the task from leaders, and introductory hands-on familiarization with the required equipment. The walk phase consists of a slow speed "walk through" of the task and practicing some of the building block skills associated with the task being trained. Any necessary remedial training is identified and conducted during these initial phases of training. The run phase consists of conducting the entire task at full speed under various sets of conditions (e.g., day/night, varying weather, nuclear/biological/chemical) that may be encountered on the battlefield. Soldiers and units are often evaluated and scored as to their "qualification" or "readiness" to conduct the task in the run phase.

The Army specifies certain areas and schedules for each training unit type and task. This includes area requirements to distribute the soldiers and equipment, the number of repetitions of the task needed to become proficient, and the number of days required for each repetition.

The activation and deployment of MANG soldiers in support of the Global War On Terrorism has brought a new perspective to basic soldier training requirements. Field commanders and soldiers with recent experience in Iraq and Afghanistan identified potential future requirements, including force protection during convoy operations and sniper/counter-sniper training.

According to the 2005 State of the Reservation Report, MAARNG has 5,552 soldiers who train an average of one weekend/month and one 2-week cycle during a training year. Eight ranges were used on 52 training days by 14 military units and 5 civilian agencies. All ammunition fired by the military on Camp Edwards ranges was lead free. The majority of training at Camp Edwards is conducted from April to October.

According to the 2006 Camp Edwards RDP[18], the number of ranges on Camp Edwards does not constrain training capacity. Rather, the types of ranges and their capabilities to satisfy Army standard small arms training requirements are the limiting factors. Table 4-4 lists the required ranges to meet Camp Edwards' small arms training requirements.

Table 4-4. Summary of Small Arms Range Requirements at Camp Edwards

Required Range Type (Facility Category Code)	Corresponding Camp Edwards Range	Notes
Combat Pistol/MP Firearms Qualification Course (17821)	E Range	Currently being upgraded to Army standard.
Rifle/Machine Gun Zero Range (17801)	T, J, and K Ranges	Satisfy requirement to zero M16 rifle and SAW M249 and M240 machine gun.
Automated Record Fire Range (17805)	S Complex (SE and SW)	SE and SW Ranges are currently being upgraded to meet the requirement for 10 lanes.

[18] MAARNG 2006. *Massachusetts Army National Guard, Range and Training Land Program Development Plan*.

Required Range Type (Facility Category Code)	Corresponding Camp Edwards Range	Notes
Sniper Field Fire Range (17812)	KD Range	2006 Range and Training Land Program Development Plan (RDP) proposes to modernize KD Range to meet this requirement.
Infantry Squad Battle Course (17895)	ISBC	Current ISBC does not fully meet requirement. 2006 RDP proposes to modernize.
Convoy Live Fire Range (179XX)	Convoy Live Fire Range	Newly identified requirement. 2006 RDP proposes range modernization project to meet this requirement
Multipurpose Machine Gun Range (17833)	A Range or S Complex	A Range and SE and SW Ranges currently meet a limited set of machine gun marksmanship training tasks. KD Range may also be modernized to meet a limited set of these training tasks.
Forward Operating Base (17XXX)	Forward Operating Base	Newly identified requirement. 2006 RDP proposes range modernization project to meet this requirement.

4.3.2 Range Capabilities

Camp Edwards needs to operate at least one range of each type required to train soldiers on pistols, rifles, and machine guns in accordance with current doctrine. Soldiers need familiarization, qualification, and tactical operations training. Ranges at Camp Edwards need to accommodate each range type on which soldiers can zero their weapon and become familiar with its care, practice marksmanship, and test and qualify. After these essential and basic training requirements, soldiers need to practice small tactical unit operations on an integrated course that tests their communication and maneuvering skills and allows engagement of targets within multiple objectives.

Ranges recommended for the first phase will support current and anticipated requirements based on the traditional throughput of soldiers at Camp Edwards. Once operational, these SARs will provide soldiers with well-managed ranges on which to practice marksmanship and maneuvering for real-world missions.

4.4 Prioritized Small Arms Ranges

Based on a comparison of the current inventory of SARs and training requirements, the following list of SARs represents the sequence in which Camp Edwards plans to pursue approval to transition to live-fire with lead small arms ammunition. Figure 4-2 shows the following phases.

<u>Phase 1</u>

- T Range (25-m zero range with STAPP™ bullet containment system)
- E Range (Combat Pistol/MP Firearms Qualification Course)

<u>Phase 2</u>

- A Range (300 m Machine Gun Field Fire Range)
- SE/SW Range (Automated Record Fire Range – M16 qualification)

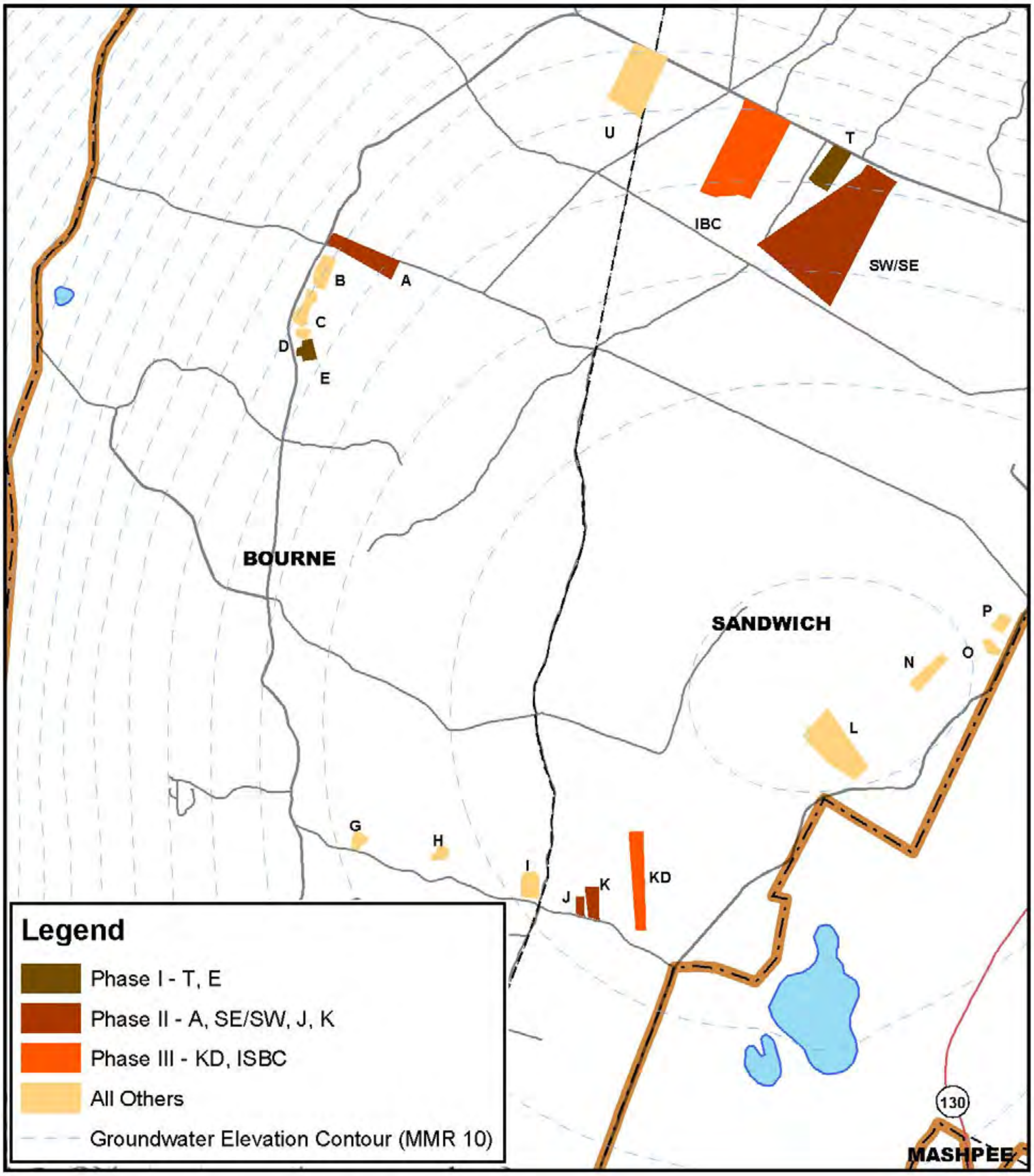

Figure 4-2. Small Arms Ranges and Phases for Return to Live-Fire with Lead Ammunition

- J Range (25-m Zero Range)
- K Range (25-m Zero Range)

Phase 3
- KD Range (600-yard Known Distance Range)
- ISBC (Infantry Squad Battle Course – squad tactical maneuver/engagement)
- Other ranges as required and deemed appropriate

These ranges will provide units with the ability to meet basic doctrinal training requirements. Although some ranges can be used as alternate ranges for training tasks for which they were not designed, training conducted in this manner is suboptimal. Each range type is designed to allow soldiers to conduct specific training tasks with specific weapons. There is some overlap in the mission and capabilities of ranges planned for a return to live-fire with lead ammunition, such as the 25-m zero ranges T, J, and K. Because zeroing weapons is one of the most basic marksmanship tasks and is conducted by nearly every soldier, MANG has plans to pursue approval for lead fire at each of these ranges. Currently, no range supports convoy training; thus, Camp Edwards is planning to develop a new range within the range complex that supports such training. The current plan for the proposed Convoy Live Fire Range involves units firing plastic projectiles only; however, this may change in the future. Also, there is no current capability to support sniper/counter-sniper training. Camp Edwards is considering augmenting the capabilities of KD Range to support such training. These range modernization projects are described in concept in Section 7. Although a sufficient level of design has not been conducted to provide a detailed description of these new range facilities, the conceptual descriptions contained in this report provide an understanding of how the BMPs apply.

The SARs listed in Phases 1, 2, and 3 meet the immediate need for basic doctrinal training requirements. For those Camp Edwards SARs not included in this overview, future training requirements and lessons learned from BMP implementation may determine their future intended use. Future changes to training doctrine, force structure, weapon systems, or military threats could alter the numbers and types of ranges needed.

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5. OPERATIONAL AND ENVIRONMENTAL ASSESSMENTS

Operational and environmental assessments were conducted at the Camp Edwards SARs. The purpose of the assessments was to identify, collect, and analyze basic information about the operational and environmental aspects of all the SARs. Operational data gathered and analyzed during the assessments included range design and O&M information as well as the type of weapons system and training that the ranges could support. Environmental data gathered and analyzed during the assessments included vegetation coverage, location of water bodies, rainfall data, and erosion characteristics.

5.1 Methodology

The operational and environmental assessments of the Camp Edwards SARs began with a literature review. MANG selected and reviewed documents from an extensive library of electronic and hardcopy reference documents related to SAR design, operations, maintenance, and environmental BMPs. Both range and environmental-related documents cited how best to mitigate and control environmental impacts from training while maintaining high quality training capability. Also, MANG focused on those sources that identified technologies and range designs that can be implemented to control deposition and migration of munitions constituents from small arms projectiles in the environment as well as possible maintenance schedules and remedial processes. Supplemental information on SAR design technologies was obtained from Fort Jackson, Fort AP Hill, Camp Edwards, and the U.S. Army Corps of Engineers (USACE).[19]

MANG gathered relevant operational information about training activities on the SARs at Camp Edwards. Documents such as the *State of the Reservation Report* identify critical information about the types and numbers of ranges, authorized weapons systems, and types of training required to be supported by Camp Edwards ranges. MANG compared current range conditions and configurations with standard Army range designs.[20]

MANG selected and reviewed numerous documents and data sources related to the environmental condition on and around the SARs. Some of the more relevant information included groundwater flow data and contaminant plume information that was available in geographic information system format. The Otis ANGB weather station provided annual precipitation data. Several reports related to the IAGWSP also provided soil, contaminant, and remediation data.

In addition to the literature review portion of the operational and environmental assessments, site evaluations of each SAR were conducted. The site evaluations occurred from 16 to 19 May 2006 and consisted of personnel interviews, visual inspections of the SARs, and photo documentation. Interviews were conducted with personnel directly involved with the operations, maintenance, and management of the SARs, including employees of E&RC, Range Control, and IAGWSP. The first goal of the interviews was to identify and document the operational requirements of the ranges and how the ranges and associated organizations supported those requirements. The

[19] ManTech Environmental Corporation 2006. Small Arms Range Technology Report, September.
[20] Army Training Support Center 2004. Training Circular 25-8, *Training Ranges*.

second goal of the interview was to gather information about the environmental impacts of training conducted at the SARs.

MANG conducted visual assessments and photo documentation of the environmental aspects of the ranges, including vegetation and erosion, as well as operational aspects of the ranges, including overall range layout, construction, condition, and evidence of historical and current use. A photo log for each range accompanies the operational and environmental assessments in Appendix D.

5.2 Literature Review Results

5.2.1 Berm Maintenance Program Data Review Results

MANG conducted a berm maintenance project in 1999 in response to AO2. Sixteen ranges were addressed during the implementation of the project, including B, E, KD, and SE/SW.

According to the Completion of Work Report prepared by Ogden Environmental and Energy Services, Inc.,[21] "the objective of the berm maintenance program was the removal of the maximum amount of lead munitions from SAR berm soils, and to minimize the possibility of lead fines (particles too small for physical removal) migrating toward groundwater."

According to the report, "The first phase of the program focused on sampling each of the range berms. Samples were collected and analyzed to determine the depth to which soils would be excavated and transported to a Central Processing Site for separation of lead munitions and application of MAECTITE® to lead fines." "Evacuation of berm soils containing bullet fragments was driven by visual observation. Berm soils containing bullet fragments were removed from the subject ranges and taken to a central location for screening and chemical fixation of lead." "Screening of excavated soils was performed to separate recyclable bullet fragments. The chemical fixation successfully reduced TCLP leachable lead concentrations to concentrations better than [US]EPA's requirements for the project. This success was documented by the process confirmation samples collected and analyzed. Processed soils were subsequently reused for reconstruction of berms and the small arms ranges."[22]

Pre- and post-sampling lead results for the ranges addressed in the program are presented in the Ogden report. These generally show that the project was effective in reducing the levels of both metallic and dissolved lead in soils at these ranges.

Finally, the report indicates "the data illustrates the limited extent of TCLP leachable lead in the berm and near-berm soils based upon the pre-excavation sample collection and analysis activities conducted at MMR. Typically, the highest TCLP leachable lead concentrations were detected within the first 2 ft of soil on the berm face." The report further states, "vertical migration of

[21] Ogden Environmental and Energy Services 1999. *Final Massachusetts Military Reservation Training Range and Impact Area, Small Arms Berm Maintenance Removal of Metallic Lead and Fixation of Leachable Lead*, March 5.
[22] IBID.

TCLP leachable lead (in concentrations greater than 5.0 mg/L) from the berms was typically limited to less than 10 feet measured perpendicular to the face of the berm."[23]

5.2.2 Cold Regional Research and Engineering Laboratory Study of Lead Mobility

Currently, the USACE Engineering Research and Design Center, Cold Regional Research and Engineering Laboratory (ERDC-CRREL) is conducting a comprehensive study of prior groundwater and soil studies to identify characteristics of metals migration at MMR. The objective of this study is to incorporate what is known about lead fate and transport with all MMR-specific information on lead to assess its site-specific mobility. ERDC-CRREL proposes to conduct a literature search on lead mobility of small arms ammunition at installations with similar site chemistry. In addition, they will analyze all MMR site-specific data available and review all reports that address lead in soil, sediment, surface water, and groundwater. The MANG, based on the results of the study, will analyze and select the appropriate BMPs for each SAR.

5.2.3 U.S. Army Corps of Engineers Range Evaluation Software Tool Evaluations

The USACE Range Evaluation Software Tool (REST) analyzes readily available data to estimate metals migration potential at SARs. REST is an Army-developed screening tool that analyzes several parameters to identify the potential for metals to migrate off-range. Those parameters include:

- Corrosion of expended small arms projectiles
- Groundwater transport
- Aerial transport
- Ammunition mass
- Surface water transport

The corrosion parameter analysis is based primarily on the soil type and climate data. The aerial transport analysis is based primarily on the intensity of wind, ammunition usage on the range, and ability of the ammunition to corrode and bind with soil in a form that could be carried to areas off-site. Surface water transport analysis is based primarily on storm event data, soil type, vegetation, and bullet fragment size. Variations in vegetation coverage have a significant impact on the variation of surface water analysis results. Groundwater transport analysis is based primarily on climate data, ammunition use, soil properties, and groundwater depth data. Because groundwater transport occurs by percolation through soil, groundwater transport analysis is affected significantly by range soil type.

Appendix E includes a more detailed description of the parameter inputs and calculations within the REST model. REST may be used in the future at Camp Edwards to provide an initial indication of the viability of metals migration pathways during the development of range-specific

[23] IBID.

design and O&M plans. It will not be used as a tool to make final BMP implementation decision. Rather, it will be used in conjunction with other site-specific data to make recommendations to focus metals management on the most viable migration pathways.

5.3 Site Evaluation Results

5.3.1 Range Design/Construction Results

Many of the Camp Edwards SARs were initially designed in the late 1960s to early 1970s. Initial design criteria were simple in nature and resulted in ranges that were not much more than land areas cleared of vegetation with soil berms built on three sides to contain fired bullets. Target designs were typically paper or cardboard stapled to wooden frames. In the 1980s, many of the range designs were upgraded to provide the soldiers moving and pop-up targets. These types of targets required electric power and target control mechanisms not necessary with simple paper/cardboard targetry. Some of the ranges, including SE, SW, and E, are currently undergoing further modernization that includes improved moving targetry and control systems.

Figures 5-1 and 5-2 are conceptual models for a typical bermed SAR at Camp Edwards, such as B, C, D, G, I, J, and N Ranges. The figures are not, however, indicative of some of the more complex ranges such as SE, SW, and ISBC.

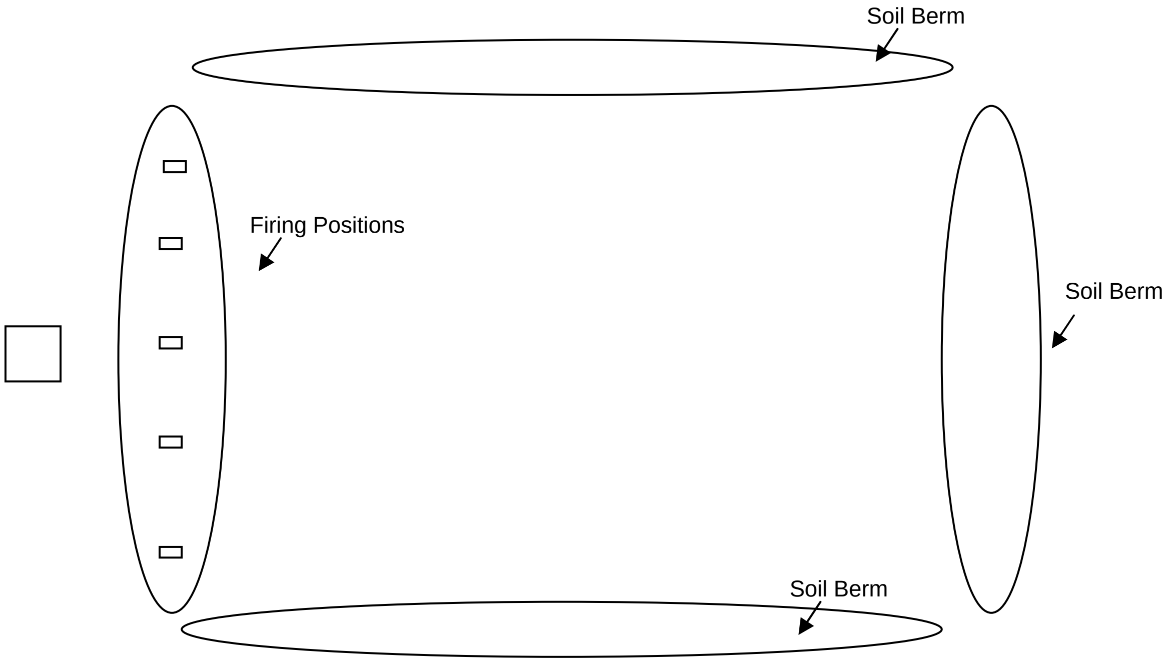


Figure 5-1. Aerial View of Conceptual Model of Typical Small Arms Range

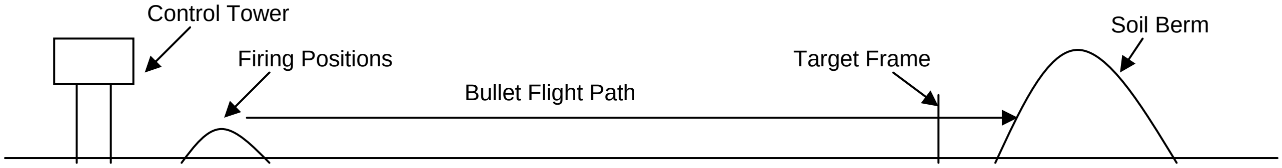


Figure 5-2. Lateral View of Conceptual Model of Typical Small Arms Range

While some of the SARs are being modernized, others have fallen into significant disrepair due to a lack of use since AO2 suspended the firing of lead small arms ammunition in 1997. Since the suspension reduced the ability to fire lead small arms ammunition on the ranges, funds for range modernization, operation, and maintenance have been put to other uses at Camp Edwards. Some ranges have significant growth of vegetation, trees, and shrubs, as well as berm degradation issues, which make them presently unsuitable for training purposes. Training on such ranges would require repair and maintenance.

5.3.2 Training and Doctrine Support Results

Camp Edwards 1994 to 2005 training records indicate that the SARs are not being used to their design capacity. Use of the ranges has declined significantly since 1997. Site evaluation results confirm the difference between designed range capacity and throughput of soldiers at Camp Edwards SARs.

A comparison of current range configurations with standard Army range designs found in Training Circular (TC) 25-8 revealed that many of the Camp Edwards SARs are non-standard ranges, meaning they do not meet the requirements for SARs set out in the TC. Typically, the Camp Edwards SARs do not have the required number of targets nor the types of targets required to meet the standard range designs. Also, the Camp Edwards ranges typically do not provide the required distances between firing points and targets to meet the most stringent qualification standards.

For most of its history, Camp Edwards has used standard lead small arms ammunition for soldier small arms training. This ammunition supports all Army training and doctrine requirements for live ammunition use. Since AO2 suspended lead small arms ammunition use, Camp Edwards has used alternate small arms ammunition for training. As part of the Army “Green Ammunition” Program, Camp Edwards used tungsten-nylon projectiles on several ranges. The bullet is only available in 5.56mm, so it can only be used in the M16 rifle, M4 rifle, and M249 SAW. Tungsten-nylon ammunition is not made for numerous other small arms weapons systems currently in use, or projected to be in use, at Camp Edwards, including:

- M9 and M11 pistols
- M240 machine gun
- M60 machine gun
- M2 .50 caliber machine gun

Camp Edwards also conducted training with plastic projectile small arms ammunition to help continue soldier training while under the lead small arms ammunition suspension. Camp Edwards uses plastic projectile ammunition for the M16 rifle, M4 rifle, and .50 caliber machine gun. Several currently used or proposed weapons systems still have no tungsten-nylon or plastic alternative ammunition existing or in development. The use of plastic projectile ammunition only supports a limited number of training requirements. The ballistic performance of the 5.56mm projectile is similar to that of lead small arms ammunition only to a distance of approximately 25 m. Past this distance, plastic projectiles have insufficient trajectories for most marksmanship training. The rifle must be fitted with different parts to fire the plastic projectile, and the shooter does not experience the same intensity of recoil, noise, and muzzle blast. Although the use of plastic projectiles is helpful to familiarize soldiers with the basic operation and handling of small arms, their use limits the realism and usefulness of live-fire training.

5.3.3 Environmental Results

Review of environmental management documents indicates that many of the Camp Edwards SARs have undergone extensive soil remediation efforts.

During the site evaluation portion of the operational and environmental assessments, several positive trends were identified that minimize erosion and transport of metals off the range and into the environment. Many of the SARs at Camp Edwards make good use of mature trees as wind breaks. This minimizes the affect of winds that may otherwise transport soil containing lead and lead particles off the range and into the environment. It does not appear that the wind breaks were necessarily part of the original design of the ranges, nor do they appear to be maintained as part of the normal range management program. This does not indicate that the wind breaks are ineffective; the density of vegetation and trees on several ranges was effective at minimizing the observable wind patterns. It is difficult on the larger ranges, such as KD Range and ISBC, to effectively employ wind breaks due to the large expanses of open land that are required to meet training requirements. ISBC does require natural vegetation in the form of grasses and shrubs, which are an effective alternative to masses of tall trees on the range periphery.

Besides tree lines that form wind breaks, many of the SARs have healthy grasses growing on the range floor, the berms, and associated range areas. Such vegetation prevents erosion and lead migration due to wind and surface water flow. There were very few observable signs of significant erosion at any of the prioritized ranges. Healthy vegetation is a major factor in that lack of erosion. Several ranges had well maintained grass of consistent species, density, height, and healthy appearance. E Range, which was under construction at the time of this evaluation, had grasses being planted on the berms. Certain ranges, such as ISBC, are required to have naturally occurring vegetation to support training requirements. So, although the grasses and vegetation on the range floor did not appear to be actively maintained, a healthy vegetative covering did exist, which both supports training and minimizes erosion and metals transport.

Another aspect of the ranges that minimizes contaminant transport is topographic contouring. Many of the range floors appear to be designed and constructed with minimal slope and few unintentional swales and low points. This contouring allows proper control and flow of any accumulated surface water and minimizes erosion. Berm slopes in general are less than the 25–26 degree slope normally associated with good soil stability on SAR berms. SARs with slopes less than approximately 26 degrees include B, C, E, I, ISBC, J, K, and KD. Ranges that have a greater slope include A, D, N, O, and P. It should be noted that A, O, and P Ranges have some of the most significant evidences of erosion of all the SARs. And, although D and N Ranges may not show significant erosion, they have not been used for training in several years.

5.4 Range-Specific Evaluation Results

5.4.1 T ("Tango") Range Results

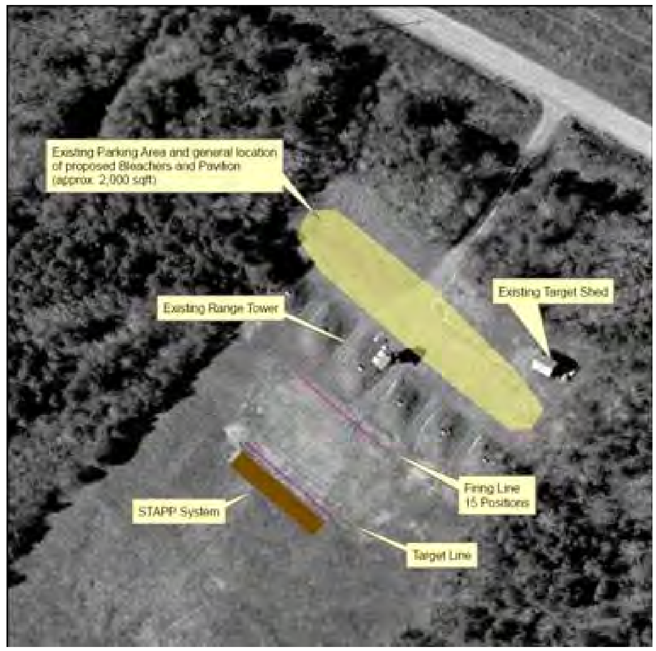


Figure 5-3. Aerial of Current T Range Configuration

In the late 1980s, T Range was an assault course where only blank ammunition was used. In 1990 or 1991, MAARNG began firing the .50 caliber M2 machine gun, using plastic bullets, on T Range. This range has two firing lines. The first firing line is 250 ft long and consists of 6 large (approximately 22- × 40- × 8-ft) mounds, on top of which are 2 foxholes each, totaling 12 elevated machine gun firing positions. In the middle of the six mounds, next to the range tower, Camp Edwards hardened a maintenance trail for mounted machine gun firing. The second firing line is 144 ft long with 20 pistol firing positions and sits 50 ft in front of the machine gun firing positions. Figure 5-3 is an aerial photograph of T Range and representations of the current bullet containment system and area proposed for additional troop support facilities.

Historically, soldiers engaged paper targets placed on wooden target holders placed 600 ft from the machine gun firing line. There is little visual evidence of tree damage beyond the old targets from the impact of projectiles occurring prior to installation of the current berm. Numerous plastic projectiles were found on the range floor. The range floor shows some signs of erosion with multiple swales that allow surface water flow from the east side of the firing points downrange toward the west side of the targets. Current target holders are placed 25 m downrange from the pistol firing positions.

The future intended use of T Range is as a Rifle/Machine Gun Zero Range (FCC 17801) where soldiers will fire 5.56mm (M16 and M249) and 7.62mm (M240 and M60) ammunition to engage paper targets on wooden holders. T Range will also be able to serve as an alternate range for pistol training. In addition to 5.56mm and 7.62mm ammunition, it is possible that .22, .357, .38, .40, 9mm, .45, and .44 caliber pistols could be fired on T Range. Law enforcement will most frequently use .38, .40, 9mm, and .45, while military pistol fire will likely be limited to 9mm. In

June 2006, Camp Edwards installed the STAPP™ bullet containment system. This effort is part of a technology demonstration/validation project in which Camp Edwards is working with USAEC to collect performance data to evaluate the use of this system. The system is 100 × 30 ft and provides bullet containment for 15 firing lanes (see Figure 5-4). The system includes an 18-in. granular rubber berm face, a self-healing rubber membrane cover, a synthetic lumber frame, an impermeable liner, and an internal water collection reservoir.

5.4.2 E ("Echo") Range Results

Between 1986 and 1989, E Range was relocated to its current site on Burgoyne Road. The range is used as a pistol range with 15 firing points. Pistol fire is to the east, with rounds impacting into small manmade berms and/or the hillside directly behind the berms (see Figure 5-5). The range is capable of supporting training with all calibers of pistol ammunition. Troop support structures include a latrine, range tower, and maintenance shed.

Storm water flows off the range at three distinct areas: (1) from the range, through the parking lot and down the driveway entrance to the road; (2) at the farthest north firing point corner into a swale that empties into a wooded area abutting D Range; and (3) on the opposite side of the range at the farthest south firing point where another swale empties into a wooded area (see Figure 5-6). Large rocks and boulders were found on the backstop, particularly between lanes 1 and 5.

Camp Edwards is upgrading E Range. Its future intended use is as a Combat Pistol/MP Firearms Qualification Course. It is possible that .22, .357, .38, .40, 9mm, .45, and .44 pistols could be fired at E Range. Law enforcement will most frequently use .38, .40, 9mm, and .45, while military pistol fire will likely be limited to 9mm. E Range is undergoing an upgrade as follows:

- Upgraded computer control system
- Upgraded targets and associated equipment and earthen berms
- New range control tower
- New covered canteen area

Construction was halted briefly in summer 2006 to test the range for tungsten-contaminated soil. Results were negative. Camp Edwards intends to continue with the construction and targetry replacement. Given the intended use of this range, metals management may focus on the range floor or on the backstop where bullet impacts are most likely. Erosion management could prevent metals movement from the backstop to the range floor and through the swales at either end of the firing line. There is also the potential for precipitation to transport metals vertically through the water column to the aquifer.

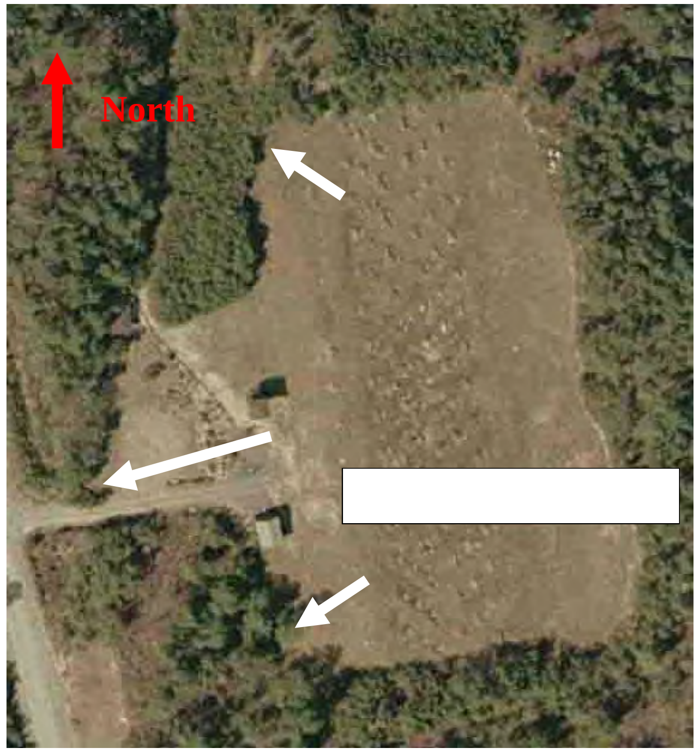


Figure 5-6. E Range Swales

5.4.3 J ("Juliet") Range Results

J Range is located directly north of Pocasset-Forestdale Road, west of K Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. J Range has been used as a 25-m pistol qualification range with 16 firing points spaced along the range floor width of 150 ft. Paper silhouette targets on wooden frames are located 25 m from the firing line, and a berm backstop is located approximately 50 ft behind the targets (see Figure 5-7). J Range is tentatively planned to be upgraded to a 25-m familiarization and qualification range in 2006.

Figure 5-7. J Range Firing Points to Target Berm

Fired rounds were found evenly spread across the backstop with only slight evidence of erosion in and around bullet pockets. Inspection of the backside of the berm revealed projectile fragments, indicating the possibility of ricochet or overshot.

No storm water controls are in place on J Range. Wind breaks are present around the range, along with a high percentage of vegetative cover on the range floor. No standing water or significant erosion was visible on the floor or the berm. The range is located more than 15,000 ft south of water supply wells on the installation.

5.4.4 K ("Kilo") Range Results

K Range is located directly north of Pocasset-Forestdale Road, east of J Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. K Range has been used as a 25-m pistol qualification range with 16 firing points spaced along the range floor width of 200 ft. Paper silhouette targets on wooden frames are located 25 m from the firing line, and a berm backstop is located approximately 60 ft behind the targets (see Figure 5-8).

Figure 5-8. K Range Firing Points to Target Berm

Fired rounds were found evenly spread across the backstop with only slight evidence of erosion on the backslope of the berm. Inspection of the backside of the berm also revealed projectile fragments, indicating the possibility of ricochet or overshot. Some small rocks were located on the berm surface within and around the bullet pockets, which may be responsible for some of the bullet ricochet.

No storm water controls are in place on K Range. Wind breaks are present around the range, along with a high percentage of vegetative cover on the range floor. No standing water or significant erosion was visible on the floor and only slight erosion on the backslope of the berm. The range is located more than 15,000 ft south of water supply wells on the installation.

MANG consolidated the tungsten-contaminated soil removed from G, I, J, and K Ranges on the range floor at K Range. Soil was formed in the shape and configuration of a berm or elongated mound and covered on all sides with geotextile to prevent further potential leaching of tungsten into groundwater (see Section 3.10).

5.4.5 S ("Sierra") Complex Results

Historically, SE and SW Ranges (hereinafter referred to as S Complex) functioned as two separate machine gun transition ranges. Each had five firing lanes to engage infantry pop-up targets. Mounded firing points exist at both ranges: five at SE Range along the 280-ft-long firing line and five at SW Range along the 200-ft-long firing line. A series of target berms are spaced between 100 and 800 m downrange from the firing points. Neither range has a backstop, and damaged trees downrange at the range boundaries indicate a significant amount of overshot. Figure 5-9 is an aerial photograph of SE and SW Ranges.

Camp Edwards began a project to upgrade the existing computer system (both hardware and software) and replace targets on both of the five-lane ranges. The project evolved into combining the ranges into a single 10-lane range with a new computer system, new targets, a new tower, a set of bleachers, and a pavilion. The extensive upgrade is designed to create an Automated

Record Fire Range and to align the range with current U.S. Army small arms training standards. In its future intended use as a Modified Record Fire Range, soldiers will engage new pop-up infantry targets for set time intervals at distances of 100, 125, 150, 200, 250, and 300 m from the firing lines (see Figure 5-10).

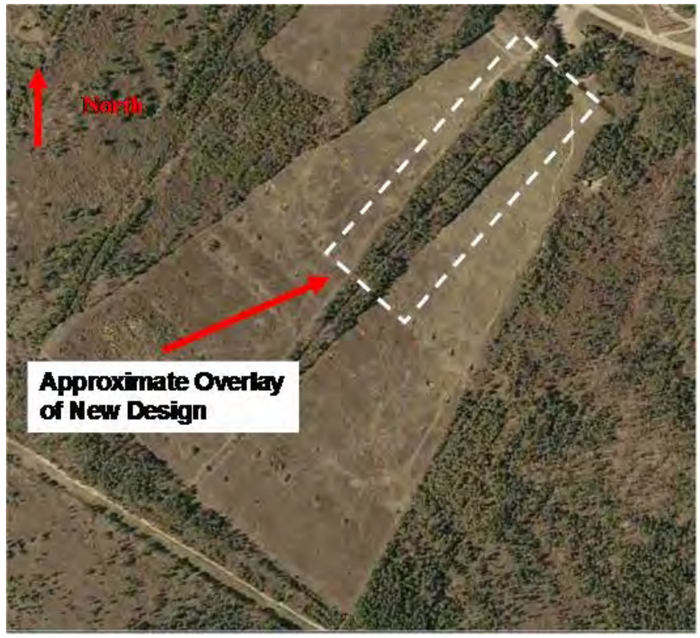


Figure 5-9. Former S Complex (Overlay of Proposed New Design)

To combine these separate ranges into one complex, construction started with removing and regrading a utility corridor that supported the two separate five-lane ranges. Additionally, new trench lines will be dug to support the electronics of the range. To ensure range construction meets the EPSs, soil used for the project will come from within MMR; any reseeding will be a native seed mix; and the range will be monitored for invasive species and those species will be removed if found.[24]

Figure 5-10. S Complex Modernization

At the time of the evaluation, this range complex was under construction; therefore, it was difficult to identify storm water swales and runoff. This large range does have tree breaks on all boundaries, but the wind may redirect off-range those projectiles that reach beyond 200 m from the firing lines.

5.4.6 A ("Alpha") Range Results

A Range has been used since the 1970s as an M2 (.50 caliber) machine gun range. Paper targets on wooden frames are engaged at various ranges from 100 to 300 m along a 1,000-ft firing line toward the east from one of three firing points, two for unmounted and one for mounted machine gun firing. A maintenance road, Wood Road, runs through the range from the south side of the firing positions to the north side of the targets and backstop. The width of the hillside berm on A Range is greater than the width of the firing line,

[24] MMR 2005. *State of the Reservation Report*.

which allows rounds fired from all three firing positions to impact the berm. While shooting prone, gun barrels are physically constrained by metal bars that inhibit both elevation and traverse to also help ensure that rounds impact the berm (see Figure 5-11).

Copper jackets were found on top of the berm and indicate that the distance between targets and the berm is not great enough to prevent overshot. Plastic bullets and large rocks were all over the range floor, as well as trees that had fallen due to erosion. Erosion was also evident at the berm, and large rocks capable of causing bullet pulverization were found in the berm surface. The extensive erosion may be attributed to the lack of vegetation on the range (see Figure 5-12).

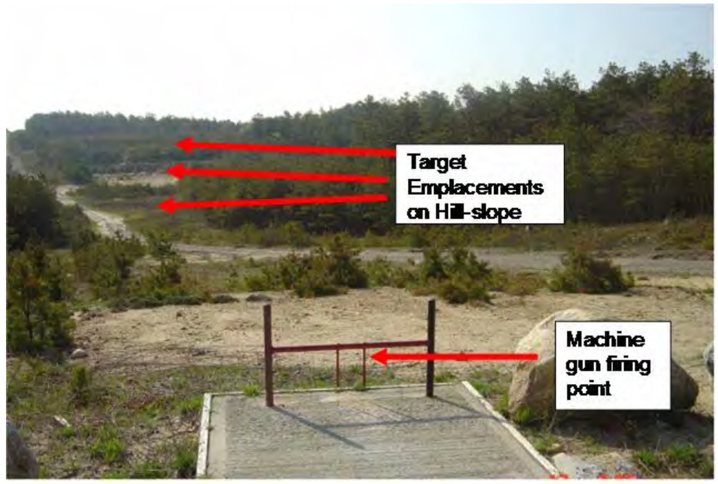


Figure 5-11. A Range from Elevated Firing Point

Camp Edwards is considering incorporating A Range into the proposed Convoy Live Fire Range. It may start at A Range's northern maintenance road, traverse A Range, and head across the range complex on Wood Road. If A Range also supports a portion of a convoy training range in the future, its use as a machine gun range could be limited. Support of a Convoy Live Fire Range may also involve the installation of removable pop-up targetry in accordance with the range designs in TC 25-8 (see Appendix F).

Figure 5-12. A Range Berm Surface Rocks and Erosion

Wind breaks are present around the range but do not appear to have a significant impact in preventing erosion. There are no drainage ditches or swales on the range; however, the shoulders of Wood Road act as swales for storm water runoff. A soil stabilization technique could be implemented on both the range floor and the berm to prevent erosion and metals migration via surface water and aerial transport.

5.4.7 KD ("Known Distance") Range Results

Historically, the KD Range has been a multipurpose range for small arms marksmanship and firing of the Dragon missile; the tube-launched, optically tracked, wire-guided (TOW) missile; the light anti-armor weapon (LAW) rocket; 40mm grenade launchers; and 90mm recoilless rifles.

Currently, this range is divided into two subparts with two distinct firing line/target configurations and two distinct training uses. There are two range access roads: one down the center, between both range subparts, and one on the far east side, ending behind the target berm. There is also a road down the third side of the range complex (see Figure 5-13). On the west side of the range are multiple targets at various distances from one firing line. On the east side of the range, soldiers engage one set of targets by firing from multiple firing lines at known distances.

Figure 5-13. Aerial Photo of KD Range

On the west side of the range, four stations are situated at the firing line. Each station, or firing point, engages infantry targets at 100 yards, 200 yards, and 300 yards (from the station). Other targets include mock building facades, fighting positions with overhead protection, and a tactical vehicle hulk. All four stations are overgrown with pine trees that obstruct line-of-sight to the targets. Debris observed in the vicinity of the infantry targets, bunkers, and mock building façade included expended 40mm target practice projectiles. Debris observed in the vicinity of the tactical vehicle hulk included expended practice rockets, 40mm target practice projectiles, expended 40mm pyrotechnics rounds, and assorted scrap metal debris.

The east side of the range has 5 firing lines each with 25 firing positions. The five firing lines are located on firing position berms at known distances from a single set of targets. The firing lines are at 100 yards, 200 yards, 300 yards, 300 m, and 600 yards. Some of the firing position berms had expended 40mm target practice projectile fragments, expended small arms cartridge casings, rocks, overgrowth, and erosion. There is a single large earthen berm on the north end of the east side of KD Range, 600 yards from the initial firing line. Behind this berm is a set of target lifter mechanisms for raising and lowering target frames for engagement from each of the KD firing lines. These lifters are in disrepair (see Figure 5-14). The placement of these targets above the berm would lend itself to the distribution of bullets into the heavily vegetated areas behind the target berm.

Figure 5-14. Target Lifter Behind Berm at KD Range

In the future Camp Edwards intends to continue to use the east side of KD Range as a Known Distance Range. It will also support 10- and 25-m zero for machine gun and rifle. It may also support, in a limited capacity, machine gun marksmanship (e.g., familiarization and practice marksmanship) for the SAW M249, M240, M60, and M2. Currently, Camp Edwards is considering using the west side of KD Range as a sniper range but has initiated no plans to modernize the range to meet this requirement. At this time, there are no plans to modernize and resume firing on the west side of KD Range.

5.4.8 ISBC ("Infantry Squad Battle Course") Results

Historically, ISBC has been used as a squad offensive and defensive tactical training course. The current ISBC is a maneuver and live fire range that is roughly 600 × 300 m; however, the area previously used for this purpose was much larger. ISBC has several maneuver lanes/trails through natural terrain that allow small units to close with and assault two separate objectives (see Figure 5-15). The objectives are made up of sandbags arranged to resemble machine gun nests (see Figure 5-16). Downrange from Objective 1 two tactical vehicles were used as targets when ISBC was in a larger configuration. The current Army design standard for such a range is much larger that the current footprint of ISBC and contains five more robust target arrays as objectives (see Figure 5-17).

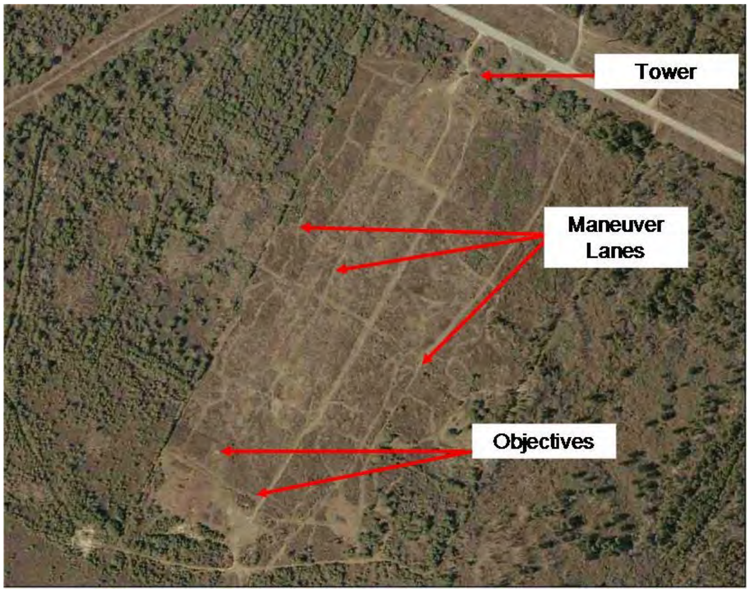


Figure 5-15. Aerial Photo of ISBC

Figure 5-16. ISBC From Mid-Range to Objective 1

In response to training requirements identified by the locally stationed Brigade Combat Team, Camp Edwards desires to reinstate offensive and defensive tactical movement and live fire on ISBC. The current placement of the objectives on the tops of hills would make metals management complex. Bullets would be distributed over a relatively large area due to the lack of a backstop or bullet containment system. The requirement to maintain the range with natural terrain and vegetation does not lend itself to bullet management or bullet recovery in the range's current configuration. Range modernization and implementation of design BMPs could improve metals management on ISBC.

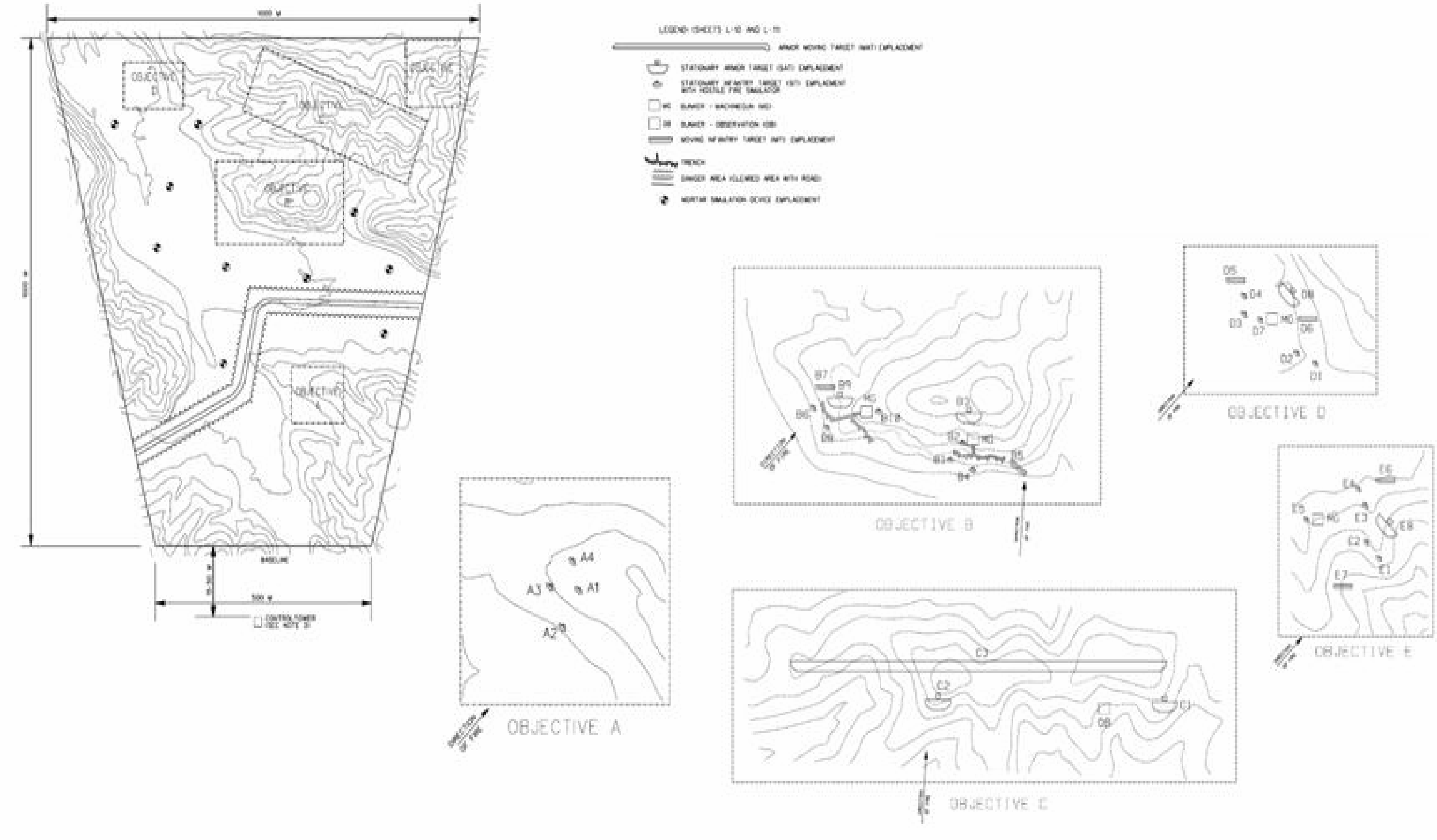


Figure 5-17. Standard Army Design for ISBC Including Objectives

5.5 Conceptual Site Model for Small Arms Ranges

The Conceptual Site Model (CSM) is a description of a site and its environment that is based on existing knowledge. It is used to developed site-specific hypothesis regarding the location and movement of environmental pollutants and any potential interaction (exposures) with humans and other environmental resources. The CSM is also used to identify methods to sever potential migration and exposure pathways. The basic components of a CSM are the source, pathway, and receptor. The CSM can vary in level of complexity and in the method of presentation. Sometimes written narrative provides sufficient description. In other circumstances figures and images may be used to represent the model. General descriptions of potential sources, pathways, and receptors are provided in the following sections. Figures 5-18 and 5-19 provide pictorial and graphic presentations of the general CSM for potential lead migration from SARs and potential exposure via multiple media and mechanisms.

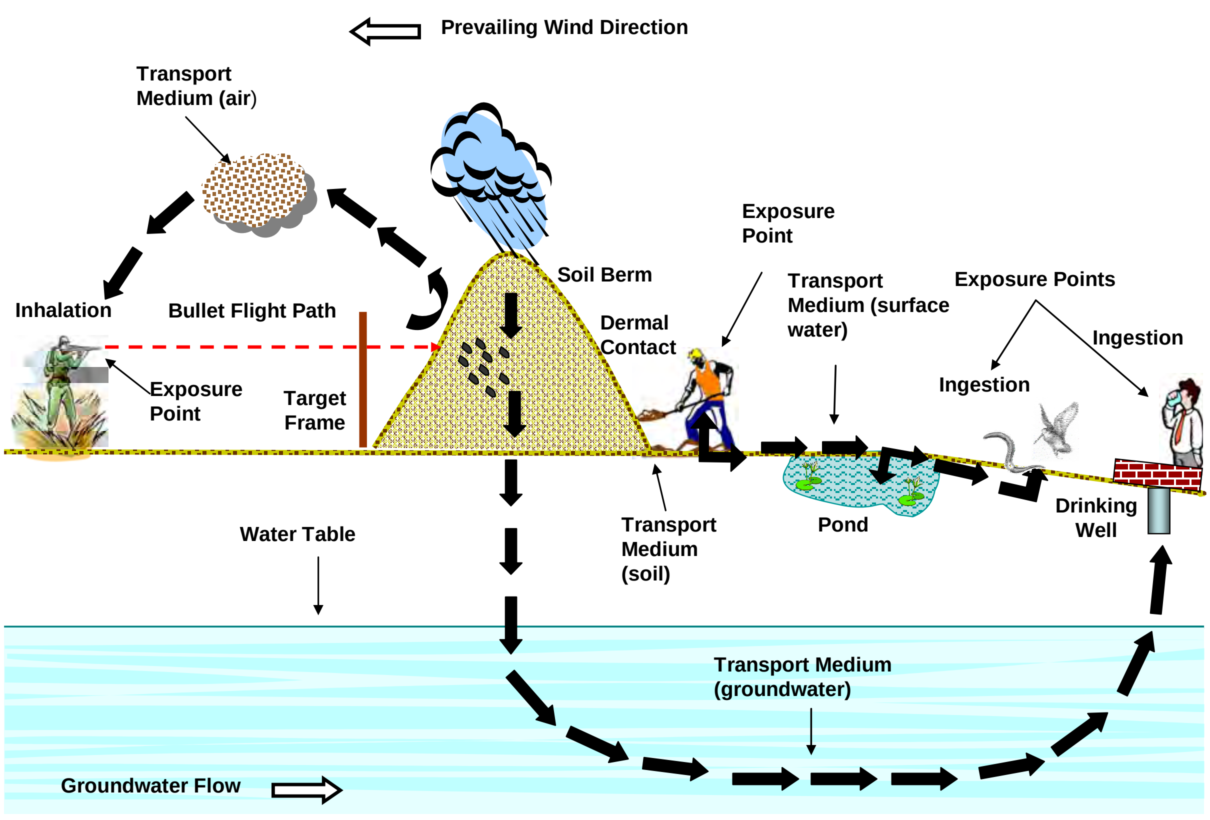


Figure 5-18. Pictorial Presentation of SAR CSM

5.5.1 Source

On Camp Edwards SARs, lead originates from small arms weapons fire. Lead is deposited into the environment through muzzle blast or bullet deposition on the range floor or into a range berm or backstop.

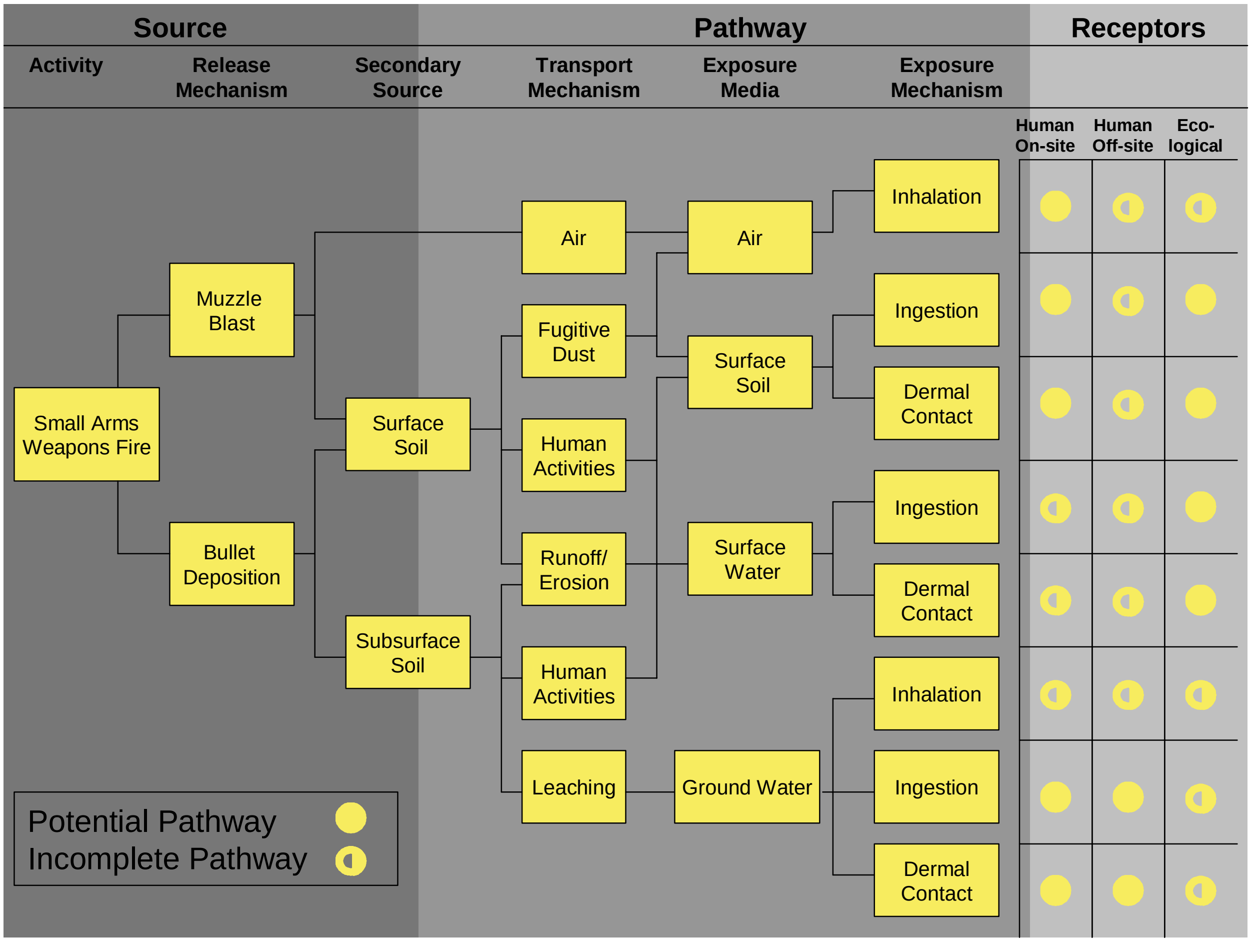


Figure 5-19. Graphic Presentation of SAR CSM

5.5.2 Pathway

Lead released from the muzzle blast and entrained in the air is expected to be a minor source of inhalation exposure limited to range users. Trace amounts of lead may fall out to surface soils and be available to other transport mechanisms.

Lead bullets fired onto the range may remain somewhat intact or may fragment if they strike rocks or other hard materials. Bullets may also strike other bullets previously deposited on the range, causing pulverization. Because of their lower mass and higher relative surface area exposed to weathering, small lead particles are more susceptible to transport mechanisms than intact bullets. Lead particles may remain free, may adsorb to soil, or may dissolve when exposed to precipitation (i.e., rain or snowmelt). Lead in these forms may be transported by air (through entrainment of fugitive dust), runoff/erosion, leaching, and human activities (e.g., construction, maintenance, and range use). Human and ecological receptors can come into contact with lead in air, surface soil, surface water, or groundwater.

5.5.3 Receptor

Human and ecological receptors could possibly be exposed to lead in air (e.g., through entrainment of fugitive dust) by inhalation. This transport and exposure mechanism is thought to be most significant to on-site receptors (e.g., range users, range operators, and maintenance personnel).

Receptors can absorb lead into their systems through ingestion or dermal contact with lead in surface soils. Erosion of large amounts of soil may make lead available some distance away from its source. Lead that has dissolved and leached to groundwater at Camp Edwards can move, through dispersion and convection, to drinking water wells. Because the Sagamore lens, below Camp Edwards, is the sole source drinking water aquifer for Upper Cape Cod, exposure via ingestion of groundwater (i.e., drinking water) is the mechanism of greatest concern within this CSM.

Figures 5-18 and 5-19 follow deposited lead through possible transport pathways. A complete exposure pathway includes all the following elements:

- A source and mechanism of release;
- A transport mechanism and exposure contact medium (e.g., water or soil); and
- An exposure (intake) route (e.g., ingestion or inhalation) to a receptor.

The absence of any of these elements results in an incomplete exposure pathway. A solid circle on the far right side of the figure represents a potentially complete pathway and exposure to humans on-site (range users, operators), humans off-site (community members), and/or ecological resources (flora/fauna).

The BMPs described in Sections 6 and 7 of this plan are designed to work in conjunction with one another as a system when implemented on a SAR. Combinations of BMPs should be selected and implemented that impede lead migration from SARs, breaking each of the potentially complete pathways and consequently preventing receptor exposure. Wind breaks and bullet containment systems can reduce risks associated with wind entrainment of lead. An improved soil berm or bullet containment system that limits the interaction of precipitation with bullets or that prevents percolation of dissolved metals toward groundwater can be used in combination with periodic metals removal, pH adjustment, and metals monitoring to ensure the groundwater/drinking water pathway is severed. Erosion prevention techniques such as maintaining proper slopes and vegetation can reduce the horizontal movement of metals and potential exposures to range workers and ecological resources.

6. GENERALLY APPLICABLE BEST MANAGEMENT PRACTICES

Based on current knowledge regarding SAR management, current range conditions, and proposed training requirements, Camp Edwards identified BMPs for the management of SARs. These BMPs will improve Camp Edwards' ability to support small arms training requirements in a manner that is efficient and cost effective and that protects human health and the environment. The BMPs are categorized into operational BMPs, administrative BMPs, and range design BMPs. Each will be implemented based on specific project priorities subject to the availability of funding. Lead core ammunition will only be fired at Camp Edwards SARs as BMPs are funded and implemented.

6.1 Operational Best Management Practices

6.1.1 Ammunition Best Management Practice

Camp Edwards SARs are used to support small arms training up to and including .50 caliber ammunition. The small arms ammunition fired at Camp Edwards is characterized by solid projectiles without any fuse mechanisms and without any incendiary or explosive capability[25].

Small arms training involves the use of a number of types of training ammunition that are appropriate for various training tasks. Blank ammunition and simunitions/paint ball ammunition allow soldiers and airmen to practice maneuver exercises and force-on-force exercises but are not appropriate for training marksmanship proficiency. Blank ammunition does not fire a projectile to practice and demonstrate marksmanship. Simunitions/paint ball projectiles do not have the ballistic properties associated with lead-core (combat) ammunition.

Plastic ammunition does not have the ballistic properties (e.g. the muzzle velocity, projectile trajectory, and point of impact at distance) or realism associated with the lead-core ammunition used in combat situations. Marksmanship proficiency with lead-core (combat) ammunition cannot be attained, maintained, and demonstrated (through weapons qualification) using plastic ammunition. Also, weapons must be modified (i.e., the use of a different (M2) bolt in the firing mechanism) to train with plastic ammunition. Soldiers and airmen engaging targets with plastic ammunition do not experience conditions (e.g., report, recoil, or shockwave) that are sufficiently representative of firing lead-core ammunition in combat situations.

Army small arms ammunition has been manufactured historically of lead. Copper coatings called "jackets" were introduced to improve the performance of the bullets and weapons systems. The vast majority of ammunition fired today in the U.S. military is manufactured with a lead core and

[25] Some SAR ammunition does have pyrotechnic material in the base of the projectile, which when fired burns and produces a colored trail (typically red). This "tracer" ammunition is typically used in machine guns in a 1:4 or 1:5 ratio of tracer to regular ball ammunition. The tracers allow gunners to identify where their fired rounds are impacting. For any range where tracers are proposed, the constituents of the tracers being proposed will be identified and P2 BMPs designed to manage potential impacts. These will be identified and BMPs included in the range-specific design and O&M plans. Tracers fired on Camp Edwards SARs will be managed in a manner that is protective of human health and the environment. For example, a well maintained STAPP™ system is capable of accepting tracer rounds as long as its self healing rubber membrane is maintained.

copper jacket. In more recent history, sportsman and the military have been interested in manufacturing and using ammunition that does not contain lead cores. Alternative materials for small arms ammunition include steel, copper, and tungsten-nylon (currently banned at Camp Edwards). There are commercially-available ammunition for 5.56mm M16 rifle and machine gun, .50 cal M2 machine gun, 9mm pistol and 12 gauge shotgun that use alternative bullet materials (i.e., copper or steel).

Copper and most steel bullets are not standard Army ammunition; the Army ammunition inventory does not stock copper bullets because they have not met requirements for ballistics, safety, and capability to train a soldier to mission standard[26]. To conduct realistic training and qualification of marksmanship skills, soldiers and airmen must become proficient with a combination of weapon and ammunition that precisely matches what they will employ during combat. The Army conducts a strict and exhaustive acceptance testing and type classification process for bullets of alternative compositions before they are procured and stocked in the Army ammunition inventory. It requires establishment of an Army-wide requirement, acceptance testing for ballistic performance, safety of use, insensitivity to shock and dramatic changes in temperature, etc. No copper and very few steel bullets have been tested and found to perform acceptably to be standard issue ammunition. MANG cannot be certain that these alternative bullet materials provide realistic and safe training for the soldiers and airmen. Employing an untested ammunition-type on the scale associated with military training may also result in safety mishaps.

Law enforcement agencies have used copper bullets in sizes 5.56mm and 9mm. Copper bullet ammunition is thought to have relatively low human toxicity, is corrosion resistant, requires no bullet jackets, and can equal lead bullet weights for 5.56mm and 9mm small arms. Copper is significantly (between three and five times) more expensive than lead ball ammunition. The use of copper bullets for all small arms training would dramatically increase the total copper loading on the SARs at Camp Edwards. Copper is known to have some toxic effects on humans and aquatic organisms[27]. The extent to which these effects would impact the natural resources at Camp Edwards is unknown.

The steel bullet ammunition that has undergone acceptance testing and is currently in the Army ammunition inventory are special armor piercing (AP) rounds. These rounds penetrate targets (as well as materials in front of and behind targets) much more efficiently and have a much larger effective range than lead-bullet counterparts. For example, the AP .50 cal round has a surface danger zone (SDZ) of approximately 9,000 meters while the SDZ for the lead-bullet .50 cal round is approximately 6,000 meters. These increases in SDZs would make impossible to fit all of the required small arms training at Camp Edwards on the current ranges and within the installation boundary. The use of individual ranges would be more likely to close down other ranges and training areas due to the overlap of SDZ with occupied areas; potentially impacting

[26] The Army Training and Doctrine Command is responsible for testing alternative ammunition to ensure it meets these requirements. To meet these rigorous standards, the Army conducts a multi-year testing process for each new alternative. If met, the alternative ammunition would undergo a procurement process, as outlined in Army Regulation 710-2-2. As of Fiscal Year 2007, no other alternative met or exceeded standards and was not procured for the Army ammunition inventory.

[27] Drinking water standards are generally set between 1.5 to 2 mg/L

range availability and training throughput. AP rounds also cause much greater wear and tear on targetry and other range equipments (e.g., bullet containment systems).

It is not recommended that Camp Edwards use commercially-available non-lead bullet alternatives that have not undergone acceptance testing by Army. It should be noted that, the Department of Defense (DoD) is actively pursuing alternate non-lead ammunition, but lead-bullet ammunition is currently the only ammunition available for all required small arms weapons systems and doctrinal training requirements[28].

As a BMP for range operations, Camp Edwards will use the standard issue lead-core ammunition because:

- Training with the same ammunition used in combat provides the most realistic training for the soldier. The skills of sight alignment, sight picture, trigger control, and follow-through are perishable skills that must be routinely practiced. Substituting ammunition that does not provide the same stimuli to the soldier during the firing process (i.e., M862 ammunition) will not allow the soldier to maintain proficiency.
- Use of standard ammunition will simplify the management of projectiles on ranges by reducing the types of chemicals and materials to a small and well understood few. Management of lead and copper on SARs presents well-known problems and issues with well-known and nationally accepted BMPs. Some non-standard ammunition contains chemicals whose impacts on human health and the environment are not as well known or understood.
- Use of standard ammunition is more cost effective to manage to protect human health and the environment. The characteristics and action levels for lead are well understood and can be monitored to ensure all BMPs are effective at preventing contamination of groundwater and surface waters. There are no viable alternatives known to be more protective of human health or that otherwise would require the same management controls that can be procured today.

Implementation of the Ammunition BMP is most applicable to SARs for which the primary training purpose is to train marksmanship. For ranges where the primary training purpose is to train tactical movement and communication of soldiers in a unit, it may not be necessary to train with ammunition with the ballistics of lead-core ammunition. The proposed Convoy Live Fire Range may be one example of a range where a significant portion of the training value can be obtained while employing plastic or blank ammunition. Some training value can also be realized from training on ISBC without lead-core ammunition. ISBC allows small units to develop proficiency in tactical maneuver to a series of objectives. However, to gain proficiency in the accurate employment of small arms weapons systems while conducting such a maneuver, it may be necessary to use lead-core ammunition.

6.1.2 Standard Operating Procedures Best Management Practices

[28] The MANG will continue to monitor the DoD's progress regarding potential use of non-lead ammunition as research and testing of non-lead bullet ammunition advances. Alternative ammunition that satisfies all marksmanship training and qualification requirements is not imminent.

As a BMP for range operations, Camp Edwards will develop, distribute, and enforce standard operating procedures (SOPs) to relevant personnel. The Camp Edwards range control officer will enforce the range operation SOPs. These SOPs are described in the following sections.

6.1.2.1 Unit Evaluation Standard Operating Procedure Best Management Practice

Each unit that uses a SAR at Camp Edwards will be provided a standardized questionnaire in which the unit can identify deficiencies in the design, operation, and maintenance of the range they have used. The intent of the Unit Evaluation SOP is to allow the ultimate users of the ranges the opportunity to provide input on those ranges. The using units may also be a first line of defense against rapid erosion events from storms that may not be identified during any other inspection or evaluation program scheduled at monthly or annual intervals.

Prior to occupation, or immediately thereafter, unit personnel will inspect the range and report any deficiencies immediately to Range Control. The unit environmental point of contact will complete and submit a Unit Evaluation Form to Camp Edwards Range Control. Range Control will review the forms, take appropriate action, and maintain the forms for 3 years.

An example of how the Unit Evaluation SOP would work is as follows: Soldiers from Fort Drum arrive at Camp Edwards for qualification training with the M16 rifle. Range Control schedules T Range for the unit to zero their rifles and briefs them on the proper procedures for the use of T Range. The environmental point of contact is given a Unit Evaluation SOP form and instructed to return the form to Range Control after the training evaluation. The soldiers arrive at T Range and begin training. The unit environmental point of contact notices a fallen tree on the backstop and three missing target holders. The soldier notes the tree and holders on the Unit Evaluation SOP form and provides the form to Range Control. Range Control contacts Facilities Engineers and requests assistance in removing the fallen tree. Range Control schedules maintenance on the missing target holders. The Unit Evaluation SOP form becomes a filed, permanent record at Range Control.

6.1.2.2 Range Residue and Expended Cartridge Casing Management Standard Operating Procedure Best Management Practice

Currently, using units are required to “police their brass.” In other words, at the end of the training day, using units remove expended cartridge casings from the range, visually inspect them to ensure that no live rounds are co-mingled with the expended casings, and then turn over the expended casings to the Ammunition Supply Point (ASP). The turnover is documented using DoD Form 1348. After turnover, ASP personnel conduct another 100% visual inspection of the expended cartridge casings to ensure no live rounds are co-mingled. The ASP segregates the expended cartridge casings and turns them over to the Defense Reutilization and Marketing Office for disposition.

Other range residue such as ammunition packaging, weapons cleaning materials, and trash are turned in to the ASP or disposed of in accordance with the Camp Edwards solid/hazardous waste management program requirements.

This management SOP will be documented and continued. The SOP will describe and require proper use and disposal of weapons cleaning materials and equipment (e.g., targetry) maintenance materials. The Draft Camp Edwards Integrated Solid Waste Management Plan may be a good location to document this SOP in addition to documenting it in range-specific design and O&M plans.

Implementation of the Range Residue and Expended Cartridge Casing Management SOP BMP will be implemented in a slightly different manner depending on the type of range in question. Policing brass on most SARs should be a relatively simple process, unassisted by instrumentation. A 25-m zero range, such as T Range, is an easier type of range for soldiers to remove expended cartridge casings and other munitions-related items. This is because the range has specific firing points, has specific impact areas in a berm, and is regularly maintained and groomed with mowing equipment. Detection and removal of brass using instrumentation over a greater area of movement may be necessary on a periodic basis. A range such as ISBC requires natural vegetative growth, which makes it much more difficult to see and remove munitions-related items. Also, a range like ISBC is used to train small unit tactics while navigating over terrain. This means that ammunition is fired from many different areas of the range, and these areas do not remain constant from unit to unit. Expended cartridge casings will not be found at specific firing points, rather they will be found across the range floor. Thus, the Range Residue and Expended Cartridge Casing Management SOP BMP will be more difficult to execute on certain ranges, such as ISBC.

6.1.2.3 Range Turn-in/Clearing Standard Operating Procedure Best Management Practice

Upon completion of training, and policing of the area(s), units will request a clearing party from Range Control to inspect their area. Once the area has been inspected and cleared (found to be in acceptable condition for turn-in) by Range Control personnel, the unit or organization representative will report to Range Control to return any range information packets or equipment issued and to close out the hand receipt prior to clearing the installation.

When firing is completed for the day, the using unit will provide Range Control with a report of the number of rounds of ammunition fired (by type) and number of personnel trained. All using units/organizations will complete a Training Facility Utilization Report (see Appendix G). A blank report will be provided to each unit/organization when drawing ranges and the completed report will be submitted upon turn-in.

6.1.3 pH Adjustment Best Management Practice

Metals transportation mechanisms through soil and groundwater are not as effective at higher pH values (i.e., 7.5 to 9). This is due to the solubility of most metals in acidic environments and their relative insolubility in neutral to basic environments. Camp Edwards may implement a soil pH adjustment program to monitor and adjust soil pH on the range floor, firing points, berms, and other related-range areas. Monitoring pH is a relatively low cost and technically simple process, as are the methods to increase pH. Lime addition to surface soils is standard practice for increasing pH and neutralizing soil, helping to reduce lead migration off the range.

The pH Adjustment BMP will be implemented in different ways depending on the range in question. For example, J Range is a relatively small, well-maintained, flat range with well-defined boundaries. Mechanical addition of lime or other alkaline substance will be relatively easy on such a range. However, a range like ISBC is much larger with more heavy vegetation and more dramatic changes in terrain. Mechanical application of lime will be more difficult at this range.

6.1.4 Metals Monitoring/Sampling Best Management Practice

Although the BMPs described in this section have broad and immediate applicability across many of the SARs at Camp Edwards, some of them, particularly the Bullet Containment System BMPs, require a significant investment of monetary and administrative resources. The selection and implementation of these BMPs, as well as identification and implementation of any lead removal requirements, will be undertaken when indicated by the characterization of the nature and extent of metals in environmental media on the range. As discussed in previous sections, metals may move as free metal particles, when absorbed to soil particles, or as dissolved metal. Erosion of surface soil, storm water runoff, and dissolution and vertical transport (percolation) can transport metals in the environment. To understand the nature and extent of these transport mechanisms, Camp Edwards will institute a metals monitoring program. Soil samples will be taken from locations where range use patterns indicate the likelihood of high metals concentrations. This Metals Monitoring/Sampling BMP will include groundwater sampling conducted at appropriate locations in proximity of the SARs. Lysimeters, underground devices used to gather soil-water samples, will be used to collect and analyze pore water in soil 2–4 ft below likely areas of bullet accumulation (e.g., toes of berms). Use of lysimeters will provide an early warning if dissolved metals are percolating toward groundwater. Camp Edwards will use widely accepted methods of sampling, sample preparation, and analytical techniques. Camp Edwards will work with EMC and EPA to identify the most appropriate methods and locations of monitoring and sampling. Camp Edwards will also work with EMC and EPA to determine appropriate action levels and triggers for implementation of periodic metals removal or range design BMPs. Triggers that such BMPs may be warranted could come from metal concentrations in soil, lysimeter readings, or groundwater monitoring. It may also be possible to correlate such sampling data with more easily tracked parameters such as numbers of rounds fired or number of training days on a particular range (see Section 6.1.5). Results of the metals monitoring program will be reported annually to EMC and EPA.

6.1.5 Periodic Metals Removal Best Management Practice

Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Planning and design of necessary removals will be coordinated with EMC and EPA prior to implementation. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used.

During periodic lead removal, an assessment of the effectiveness of bullet containment and removal can be undertaken. Currently, Camp Edwards range control tracks and records all ammunition expended on each SAR. The amount of lead within the projectile of each bullet is known by the U.S. Army and recorded for each ammunition type in the Munitions Item Demilitarization Action System (MIDAS). Camp Edwards will track the total mass of lead deposited on each range by multiplying the weight of lead in each bullet fired by the number of rounds expended on that range. Lead recovered from bullet containment systems will be weighed and the total mass divided by the calculated total mass of lead deposited on the range. This will yield a percentage of total mass recovered. The percentage of lead recovered indicates the level of containment and removal BMP effectiveness for each SAR. MANG will report the results from each periodic metals removal project to the EMC.

For example:

Total mass expended on X Range: 1,000 lb.
Total lead recovered on X Range: 900 lb.

900 / 1,000 = 0.9 x 100 = 90%

90% recovery of total mass on X Range.

Camp Edwards will create a standard reporting format to publish the results from each range lead recovery project in accordance with EPSs. Range Control and Environmental staff should report BMP effectiveness to EMC following a visual inspection or lead recovery project to ensure proper monitoring and maintenance of SAR BMPs.

During a phased approach, Camp Edwards will bring high priority SARs on-line. To decrease the total net metals loading for all SARs, Camp Edwards will initiate a metals removal on ranges not yet prioritized for modernization (i.e., those SARs not listed in the three identified phases). Metals removed will include small arms bullets, casings, and other munitions debris, such as munitions' bodies and fins. Metals removal will also include range-related debris, such as targetry, equipment, vehicles, and structures. When practicable, removed metals will be recycled. Those without recycling value will be disposed of in compliance with state and federal solid waste regulations.

6.1.6 Periodic Inspection of Range Conditions Best Management Practice

To ensure the BMPs employed on each SAR at Camp Edwards remain effective, Camp Edwards Range Control personnel and Environmental staff will conduct periodic visual inspections. Camp Edwards will develop an inspection form for each SAR, to be included in the SAR O&M Plan. Using this range-specific form for documenting observations, personnel will conduct visual inspections after a major storm or major training event[29] and after the annual training cycle (e.g.,

[29] A major storm event is defined as an accumulation over 2 in. in a 24-hour period; a major training event is defined as the range utilized during a 2-week training regime.

in the fall of each year). During these visual inspections, personnel will document the following conditions:

- Degree and type of erosion on the range floor and backstop slopes,
- Percentage of coverage and type of vegetation on the range floor and backstop slopes, and
- Condition of the bullet containment system installed (where applicable).

Personnel will use these range-specific inspection forms to track SAR maintenance requirements and their resolution. Additionally, field crews will take a baseline condition photo for each SAR. This baseline photo will help field crews evaluate observed conditions against the baseline and help document the rehabilitation of any reported range deterioration. Camp Edwards will create a photo log using the baseline condition photos and any inspection and rehabilitation photos. The photo log will include the date, time, direction, and any pertinent site notes associated with each picture.

6.2 Administrative Best Management Practices

6.2.1 Support Personnel and Training Best Management Practice

The operational tempo on the Camp Edwards SARs has been dramatically reduced in comparison to pre-1997 levels when training restrictions were applied to Camp Edwards. Many of the SARs have not been used in several years. One of the impacts of this lack of training is the reduction in personnel available to support training on the SARs. For example, Range Control currently has one or two personnel responsible for target maintenance. Historically, this number has been as high as seven personnel. Along with the decrease in numbers of personnel who operate and maintain the SARs comes a loss of institutional knowledge of how to operate and maintain those ranges. There are fewer personnel with knowledge about standard Army doctrine as well as site-specific issues at Camp Edwards.

As a BMP for range operations, Camp Edwards will employ the necessary number of personnel to effectively operate and maintain the SARs. MANG will provide these personnel with the appropriate training necessary to carry out their responsibilities. Both current and new personnel will be thoroughly trained in the details of the SAR P2 Overview and range-specific P2 design and O&M plans, and provided opportunity to continue their professional education and training by attending formal schools, seminars, and conferences. This continuing education will ensure they are knowledgeable about new and more effective processes and procedures for O&M of SARs. The Army Range Officer Professional Development curriculum, currently being developed at Headquarters Department of the Army (HQDA) and the Army Training Support Center, provides several training opportunities for range staff in the future.

Camp Edwards currently has a range officer who is responsible for ensuring that all ranges are in serviceable condition and are being used and managed n accordance with current policies. This responsibility includes issuing and clearing training facilities, range communications, coordination with using units, monitoring units on the ranges or in the training areas to ensure compliance with Camp Edward’s regulations, and resolution of conflicts. Camp Edwards will provide personnel to oversee training operations at the ranges and ensure use of the ranges complies with SOPs and BMPs established in the range-specific P2 Design and O&M plans.

6.2.2 Budgeting and Funding Best Management Practice

As part of the U.S. Army, Camp Edwards has a complex and formalized budgeting and funding process. Funding requirements are forecast years into the future and submitted through NGB, up the U.S. Army chain-of-command, and into the President's budget. Once requirements are funded, money is allocated to the Army, NGB, and the installations. Installation projects can be funded from a variety of sources, such as installation O&M accounts, Major Command accounts, or centrally from HQDA.

As a BMP for range operations, Camp Edwards will specifically assess the funding requirements for the SARs and incorporate them into the budgeting process. Projects related to the design, construction, operation, and maintenance of the SARs will be itemized, programmed, and tracked individually under the Army Range and Training Land Program. Funding for the sustainable O&M of ranges will be programmed under a number of U.S. Army programs to include Range Operations and Maintenance, Real Property Service, Sustainment, and Environmental Quality. Lead core ammunition will only be fired at Camp Edwards SARs as BMPs are funded and implemented.

6.2.3 Small Arms Range Supplement Update Best Management Practice

The purpose of the SAR P2 Overview is to identify BMPs that can be used to support the employment of small arms at Camp Edwards in a manner that meets training requirements and protects human health and the environment regardless of the type of ammunition used. As training requirements and environmental conditions change, this plan must also change.

As a BMP for range operations, Camp Edwards will review and update this plan on a regular basis. This plan only addresses a small number of the most critical SARs. Numerous other SARs are not addressed in this current plan. Camp Edwards may use additional ranges in the future. Prior to putting any other ranges to use, Camp Edwards will update this plan and coordinate the new plan with stakeholders. The plan will be reviewed and updated annually or as new ranges are brought on-line. Once a steady state of soldier training and environmental protection has been achieved, the review and update process may be required less frequently.

6.3 Range Design Best Management Practices

The designs of the SARs at Camp Edwards are critical to the effective training of soldiers as well as protection of the environment. Many BMPs can be incorporated into range designs that will support the high quality training that soldiers require while ensuring by-products from range use, such as spent casings and projectiles, do not harm human health or the environment. Subject to the availability of funding, Camp Edwards will implement the following BMPs on their SARs. Lead core ammunition will only be fired at Camp Edwards as BMPs are funded and implemented. Certain BMPs may not be suitable for all the SARs, so exceptions may occur on occasion.

6.3.1 Enhanced Soil Berm Design Best Management Practice

The earthen berm is the most widely implemented bullet containment method at military and civilian SARs. The primary purpose of soil berms on ranges is to reduce the distance traveled by rounds and reduce the effective SDZ for the weapons fired on the range. Soil berms also provide a media to contain and concentrate bullets while reducing the degree that precipitation and other weather forces interact with bullet materials. Soil berms are the containment system on which most SAR management guidance by the U.S. Army, EPA, and ITRC is based. Camp Edwards will implement enhancements to standard soil berm designs to minimize the transport of metals out of the berm.

This BMP includes several berm designs and berm design features recommended for use on Camp Edwards SARs. Each design represents a useful option for new berm construction, combining several of the suggested berm BMP features. Not all features are present in all drawings, allowing Camp Edwards the ability to choose exactly which combination of features is most appropriate for the designated range.

Berm design is of critical importance to minimize erosion and the transport of metals-containing soils, metal particles, and dissolved metals off the range. Metals can migrate due to the effects of both wind and water movement. Results of the site evaluations conducted in the development of this plan revealed that Camp Edwards' berms are of a standard contoured soil configuration with various levels of vegetation.

Each design includes several useful features for new berm construction. Camp Edwards, working with EMC and EPA, can choose exactly which combination of features is most appropriate for designated ranges. Figures 6-1, 6-2, 6-3, and 6-4 present conceptual designs of enhanced soil berms and different models of liquid movement. In general, the designs incorporate multiple features to minimize metal transport by:

- Limiting the interaction of liquid (precipitation) with berm soil and bullets (i.e., berm/berm-face covers),
- Retarding the vertical movement and direct movement of any dissolved metals toward the toe of the berm or storm water management swales (i.e., berm liners), and
- Reducing the erosion (and associated metal particle movement) caused by surface water flow (i.e., slopes, vegetation, and swales).

These designs allow:

- Timely identification (through focused soil and groundwater sampling) of metals movement in solution and
- Efficient metals (source) removal.

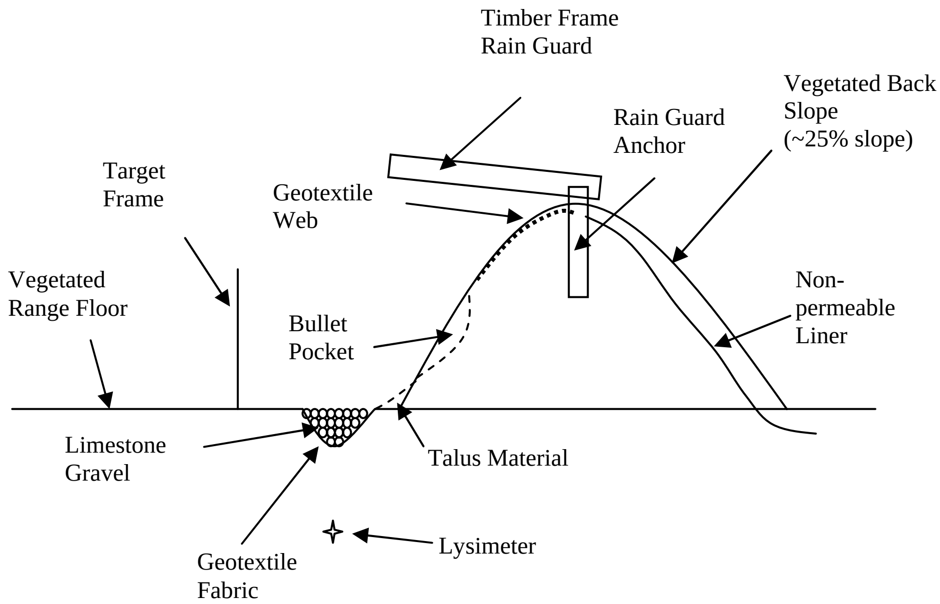


Figure 6-1. Conceptual Model of Soil Berm Design (Rain Guard)

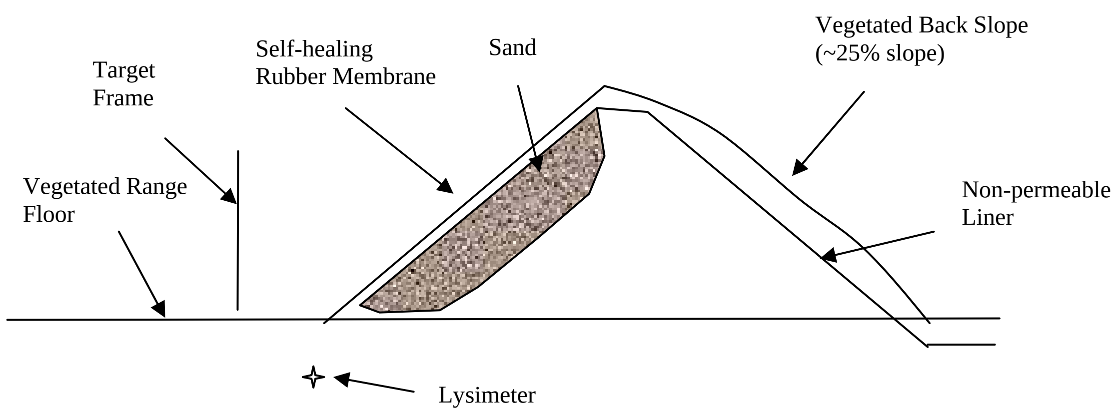


Figure 6-2. Conceptual Model of Soil Berm Design (Self-Healing Membrane)

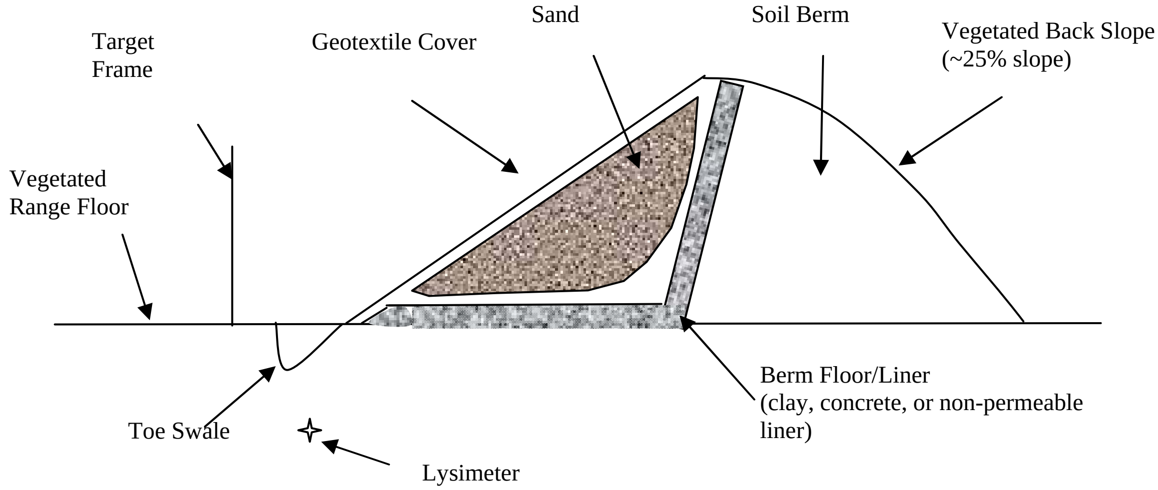
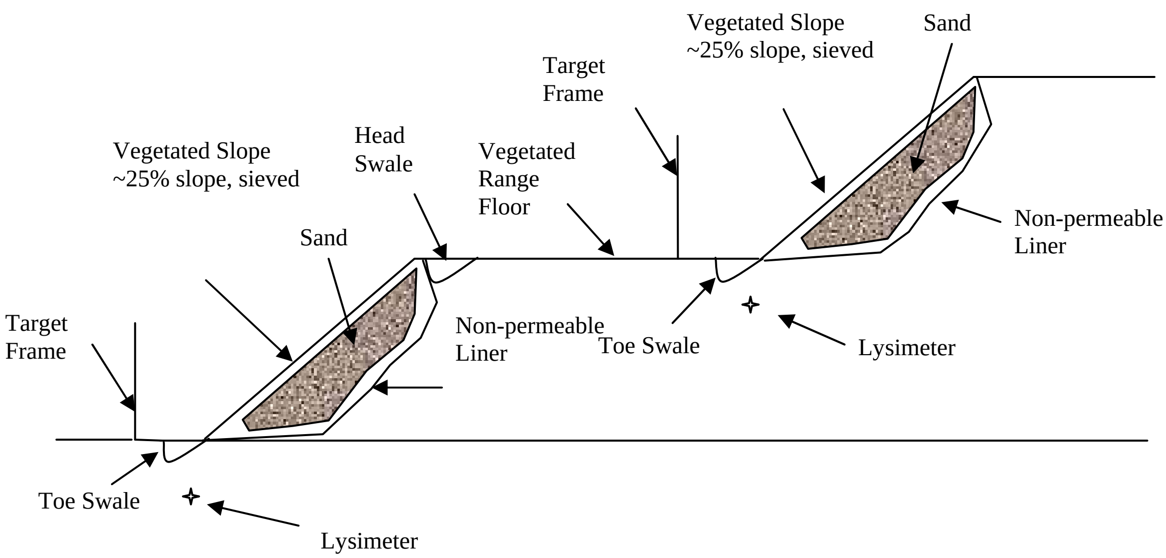


Figure 6-3. Conceptual Model of Soil Berm Design (Berm Floor/Liner)



Note: Swales will drain to off-range retention ponds

Figure 6-4. Conceptual Model of Soil Berm Design (Terraced and Lined)

The Improved Soil Berm Design BMP is most applicable to ranges where targets are arranged in a static array and where the positions of both shooter and target routinely result in a bullet trajectory that deposits projectiles into a static backstop. The Improved Soil Berm Design BMP is typically implemented on static fire ranges where soldiers fire from a fixed firing point and do not fire from oblique angles or while on the move. Of the prioritized ranges, this BMP is most applicable to:

- T Range
- J Range
- K Range
- A Range
- KD Range (Rifle/Machine Gun Zero)

Implementation of this BMP would be more complex at ranges where targets are distributed over a wide area and over long distances or multiple distances. These types of ranges tend to result in distribution of projectiles over an area wider than is feasible to cover with a bullet containment system. Soil berms installed on these types of ranges must be custom designed and placed in a manner to maximize capture of projectiles, while minimizing obstruction of line-of-sight from shooter to targets at greater distances. Of the prioritized ranges, these include:

- E Range
- S Complex
- ISBC
- (Proposed) Convoy Live Fire Range
- (Proposed) Sniper Field Fire Range

Several design factors associated with the soil berm design minimize impacts to human health and the environment from range use.

6.3.1.1 Enhanced Soil Berm Design Best Management Practice: Berm Face

During construction of the berm, soil will be prepared by sieving to remove rocks, roots, and other debris that may induce ricochet when impacted by fired bullets. It will not be necessary to sieve the entire volume of soil needed for the berm. Enough soil will be sieved to accommodate bullet pockets and the front slope of the berm at all firing positions. The front slope of the berm will measure approximately 25% to minimize the chance of slope failure and erosion. Employing sifted sand on the berm face also eases recovery and removal of bullets. This same feature can be incorporated into the design of range floors to ease bullet removal when projectiles are anticipated to be concentrated on the floors of ranges rather than in the berm.

The berm face may also be constructed with one of several covers. The self-healing rubber membrane shown in Figure 6-2 allows bullets to pass through its water-proof surface while limiting the creation of permanent holes in the cover material. This attribute is advantageous because it prevents precipitation from interacting with bullets and soil located within the berm. Because the self-healing rubber membrane is waterproof, erosion of the berm is controlled as well. A geotextile cover, as shown in Figure 6-3, also allows bullets to pass through its surface, but is not waterproof and does not self-seal holes. Geotextile covers on the berm face function to maintain slope and bullet pocket integrity, therefore preventing erosion caused by storm water runoff, and consequently preventing metal migration. Geotextiles also provide a matrix in which vegetation can take hold. The utilization of vegetation as ground cover, shown in Figure 6-4, stabilizes berm soil and, when used in conjunction with geotextiles, further hinders the effects of erosion. The geotextile web shown in Figure 6-1 is another option for berm slope covering. The geotextile web is a woven honeycomb pattern that functions similarly to a geotextile cover but with the ability to maintain berm integrity and prevent erosion at greater slopes. Berm face coverings should be selected with consideration given to the specific uses of the range and other features chosen in berm construction.

6.3.1.2 Enhanced Soil Berm Design Best Management Practice: Berm Back Slope

A non-permeable liner, as shown in Figures 6-1 and 6-2, will be emplaced below the ground surface on the top and backslope of the berm to help channel surface water and precipitation away from the berm. The liner will be placed deep enough so that vegetation root structure growth is not impeded and the liner is not affected by foot traffic and maintenance activities. Vegetation of the berm back slope, independent of non-permeable liner use, will prevent berm erosion. A textured liner may be necessary to ensure stability of the liner in the berm slope soil.

6.3.1.3 Enhanced Soil Berm Design Best Management Practice: Berm Floor/Liner

To prevent the percolation of water and dissolved metals from the berm surface to groundwater, a berm floor of clay, concrete, or non-permeable liner may be installed, as depicted in Figures 6-3 and 6-4. These materials will reduce vertical transportation of soluble metals to groundwater. The installation of the berm floor or liner could also be used in conjunction with a metal fixation chemical that has been mixed into the berm soil. This further reduces the likelihood that metals contaminated water will reach the groundwater aquifer.

Lysimeters will be installed beneath the berm floor to detect contaminated water that is percolating through soil. More discussion of metals monitoring can be found in Section 6.1.4.

6.3.1.4 Enhanced Soil Berm Design Best Management Practice: Rain Guard

A non-permeable liner will overhang the berm face to minimize precipitation onto the bullet pockets and talus material and resulting erosion and vertical metals transport in the water column. This liner will be supported on a frame and anchored into the berm. Various framing and anchoring methods are available. General requirements for this system include anchoring suitable for expected wind loads and resistant to subsurface deterioration. The frame will also need to resist wind loads and snow loads. Sloping the frame slightly will help ensure precipitation is transported to the berm backslope where it will be removed from the range area. The front face of the frame will need to resist damage from bullet impact or be easily and inexpensively maintained. Timber facing may be a suitable option for protecting the frame structure. Various vendors may be able to provide replaceable rubberized blocks specially designed to contain fired bullets. Vegetation will not grow well under the rain guard and must be replaced with another soil stabilization technique. Geotextile covers or geowebs, as discussed in Section 6.3.1.1, could be used in conjunction with the rain guard to ensure berm stability.

A self-healing rubber membrane, as mentioned in Section 6.3.1.1, is also a viable rain guard option. The membrane seals bullet holes created in its waterproof surface, preventing precipitation from reaching the earthen surface of the berm.

6.3.1.5 Enhanced Soil Berm Design Best Management Practice: Berm Swales

Where soldiers fire at stationary targets, bullet pockets will be formed in the berm. These pockets will contain many of the fired bullets. Wind and rain erosion typically occur in the area of the bullet pocket, and soil from that pocket can be deposited at the bottom of the berm near the range floor, also known as the "toe" of the berm. It is this soil at the toe of the berm that may contain some of the highest concentrations of metals anywhere on the range. It may also be some of the easiest to transport due to the lack of vegetation.

As a BMP for range operations, Camp Edwards will evaluate the need for stormwater management structures and may construct shallow swales the length of the berms at the toe. The swales may be lined first with geotextile fabric. Limestone gravel may be placed over top of the fabric. The limestone will assist in raising the pH of any soil that migrates down the face of the berm and into the toe swale. The geotextile fabric will help keep the limestone in place and prevent soil particle migration.

This berm toe swale will assist in ensuring that metals-containing soil that migrates out of the berm pocket does not migrate off the range and any metals in that soil do not dissolve into rainwater and percolate into the environment. This type of swale may also be used on other sections of the range, such as in a drainage swale leading to a retention pond.

6.3.2 Bullet Containment System Best Management Practice

Although the earthen berm is the most widely implemented bullet containment method at military and civilian SARs, advancements in materials and designs have made other bullet containment systems viable options on some ranges. Camp Edwards will implement bullet trap systems for some of its SARs. For example, Camp Edwards has already implemented the STAPP™ system on T Range. Figure 6-5 presents a conceptual model of the recommended bullet trap design. This particular bullet containment system is recommended based on the compilation of information about bullet containment systems and the draft results of an extensive evaluation of current bullet containment system technologies conducted by the National Defense Center for Environmental Excellence (see Appendix H). A bullet containment system applicable to pop-up targets has not been identified. The feasibility of using bullet containment systems on ranges with pop-up targets and other bullet containment systems will be evaluated on a case-by-case basis for applicability at specific ranges at Camp Edwards. Similar to the improved soil berm designs, the recommended bullet containment system incorporates multiple features to minimize metal transport by limiting:

- Interaction of precipitation with the containment matrix and bullets,

- Dissolved metals percolation toward groundwater, and
- Dissolved metals and metal fines migration via erosion or storm water.

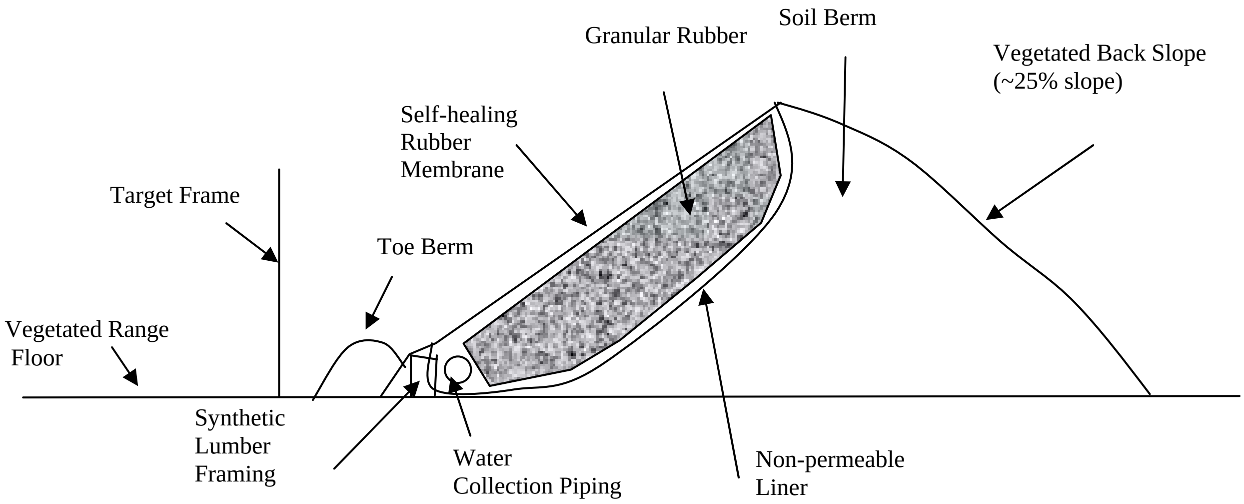


Figure 6-5. Conceptual Model of Bullet Trap Design

The Bullet Containment System BMP is most applicable to ranges where targets are arranged in a static array or where the positions of both shooter and target routinely result in a bullet trajectory that deposits projectiles into a static backstop. The Bullet Containment System BMP is applicable both where soldiers fire from a fixed firing point and on a move/shoot range where soldiers fire from oblique angles or while on the move. Of the prioritized ranges, this BMP would be most easily applied to:

- A Range
- J Range
- K Range
- KD Range (Rifle/Machine Gun Zero)
- T Range

Implementation of this BMP would be more complex at ranges where targets are distributed over a wide area and over long ranges. These types of ranges tend to result in distribution of projectiles over an area wider than is feasible to cover with a bullet containment system. Bullet containment systems installed on these types of ranges must be custom designed and placed in a manner to maximize capture of projectiles, while minimizing obstruction of line-of-sight from shooter to targets at greater distance. Of the prioritized range, these include:

- E Range
- SE/SW Range
- ISBC
- (Proposed) Convoy Live Fire Range
- (Proposed) Sniper Field Fire Range

Section 7 contains a detailed discussion of more range-specific design modifications for these ranges. Several design factors of the bullet containment system minimize impacts to human health and the environment from range use.

6.3.2.1 Bullet Containment System Best Management Practice: Granular Rubber Berm Face

The face of the berm will be filled with granular rubberized material. In many cases, automobile tires and floor mats can be recycled by shredding them to create the granular rubber. The granular material will be approximately the size of a small shotgun pellet. The granular material will serve to decelerate and stop bullets. The relatively slow deceleration will help the bullets stay intact and reduce fragmentation and creation of more mobile metal particles. The granular material matrix itself will help minimize transport of any metals dust created during bullet impact or bullets impacting other bullets already in the trap.

6.3.2.2 Bullet Containment System Best Management Practice: Self-Healing Rubber Membrane Cover

A layer of rubberized material or geotextile will be secured over top of the granular material. This liner will prevent precipitation from entering the trap. This berm face cover will be made of a material that is “self-healing,” meaning that bullet penetration will not cause a permanent hole in the material. This will reduce the amount of precipitation that can enter the trap, thus reducing the potential for dissolution and transport of metals. The “self-healing” nature of the material will also serve to deny oxygen to any fires that may occur within the granular rubber. Patches of this rubber membrane can also be cut to size and glued in place to repair areas where concentrated fire (e.g., areas immediately behind targets) damages the original cover.

6.3.2.3 Bullet Containment System Best Management Practice: Water Containment and Collection System

Small openings or holes will eventually appear in the top liner and some precipitation will enter the system. An impermeable liner will be installed under the granular rubber berm face, and a water collection reservoir will be installed at the toe of the trap to contain the water and any dissolved metals or metal particles. This reservoir will allow sampling of the collected material to help determine proper disposal techniques. This collection system will help eliminate transport of contaminated water out of the trap and onto the range floor or underlying soil berm.

6.3.3 Vegetation Best Management Practice

Vegetation is critical to minimizing erosion and the transport of metals-containing soils, particulate metals, and dissolved metals off the range. These metals can migrate due to the effects of both wind and water movement. Camp Edwards is maintaining high levels of vegetation on many of the SARs.

As a BMP for range operations, Camp Edwards will identify native, non-invasive vegetation suitable for use as a BMP for minimizing erosion and transport of metals. Vegetation will be grown on all berms, backstops, the range floor, and when possible, areas immediately surrounding the range. The vegetation will not be a species that will attract wildlife and will have a solid root structure to help fix soil particles in place. The vegetation will not have rapid growth characteristics to minimize maintenance costs in the form of mowing. The chosen vegetation will be suitable in soils with a neutral to alkaline pH. This is based on the assumption that the pH Adjustment BMP will be used. The health of the vegetation will be monitored and regular maintenance will occur, including mowing and reseeding.

While the Vegetation BMP will be suitable for most of the SARs at Camp Edwards, it may be implemented somewhat differently on a range such as ISBC. The intent of ISBC is to train soldiers on tactical movement to an objective. This requires that soldiers have access to trails, short grasses, shrubs, and possibly even trees in which to practice movement skills.

Implementation of the Vegetation BMP on ISBC may include reseeding or replanting of native shrubs or trees to reduce soil movement. Mowing and maintenance may not take place as frequently to ensure solders can practice their skills in a more natural environment. The future Convoy Live Fire Range may also require vegetation such as shrubs and trees. Such vegetation may allow soldiers the ability to become proficient in identifying camouflaged threats, hidden improvised explosive devices, and use of cover and concealment if they need to train in dismounted counter-ambush tactics.

6.3.4 Range Contours Best Management Practice

Topographic contouring of the range is critical to minimizing projectile ricochet, erosion, and transport of metals-containing soils, particulate metal, and dissolved metals off the range. These soils can migrate due to the effects of both wind and water movement. Camp Edwards is maintaining good topographic contouring on several SARs.

As a BMP for range operations, Camp Edwards will minimize soil gradients to minimize surface water flow velocities. These gradients will be different depending on the area of range in question. Slopes of 25% are typical of range berms because those berms must minimize erosion as well as minimize ricochets. Range floors can have virtually horizontal slopes to minimize surface water flow. A concern on range floors is the ponding of water, which can be minimized by consistent grades with mild slopes. Areas around the outer perimeter of the range will be sloped away from the range to minimize the amount of water that moves onto the range and thus has the opportunity to transport soil and metals off the range.

6.3.5 Wind Breaks Best Management Practice

Wind breaks are critical to minimizing erosion and the transport of metals-containing soils and particulate metals off the range. Camp Edwards is maintaining a healthy population of tall trees and shrubs, which act as effective wind breaks, around several SARs. Berms themselves also act as effective wind breaks at the SARs.

As a BMP for range operations, Camp Edwards will identify native, non-invasive trees and shrubs suitable for use as wind breaks in areas where such breaks do not exist. The wind breaks will be grown on or behind all berms, backstops, and when possible, areas immediately surrounding the range. The trees and shrubs used to build the breaks will not be a species that will attract wildlife and will have a solid root structure to resist toppling during high wind events. The chosen trees and shrubs will be suitable in soils with a neutral to alkaline pH. This is based on the assumption that the pH Adjustment BMP will be used. The health of the trees and shrubs will be monitored and regular maintenance will occur, including pruning and cutting of dead trees or shrubs.

While the Wind Breaks BMP will be suitable for most of the SARs at Camp Edwards, it may be implemented somewhat differently on a range such as ISBC or KD Range. ISBC and KD Ranges require much more acreage than a standard 25-m qualification range or a pistol range. This means that trees and shrubs may be located at longer distances away from berms or bullet impact areas. Winds may be more effective at transporting soil away from such ranges due to the nature of the range design.

6.3.6 Target Placement Best Management Practice

The location of targets relative to the berm can have a dramatic effect on the number of fired bullets that impact the berm. The closer the target is to the berm, the more fired bullets will be contained by the berm. This is because error in sight alignment and sight picture increases with distance from the shooter. If the shooter misses the center of the target by 1 ft at 100 m, that error will be approximately 2 ft at 200 m. Keeping the target close to the berm will focus the soldiers' sight alignment and picture on approximately the same location on the berm. This will result in a more concentrated bullet pocket that is easier to manage.

As a BMP for range operations, Camp Edwards will install target holders close to the berm. Enough space between the berm toe and target holders will exist to allow personnel and equipment to safely carry out maintenance and inspection responsibilities.

7. RANGE-SPECIFIC BEST MANAGEMENT PRACTICES

Although the final selection of BMPs implemented at each Camp Edwards SAR will be made in coordination with EMC, EPA, and other stakeholders, the SAR P2 Overview includes recommendations for the training use, configuration, and management of each of the priority SARs. Implementation of these BMPs is subject to the availability of funding for these purposes. Lead core ammunition will only be fired at Camp Edwards as BMPs are funded and implemented.

The most significant metals management challenges occur on ranges with multiple target emplacements at various distances. These ranges include E Range, S Complex, ISBC, and the proposed Sniper Field Fire Range and Convoy Live Fire Range (if standard ball ammunition is used). The following range-specific recommendations focus on required range design modifications and assume the appropriate implementation of other BMPs (operational and administrative BMPs) in Section 6 of this report. Particular attention is given to the conceptual design of range-specific enhanced soil berms and other bullet containment systems, as well as monitoring and periodic removal of metals.

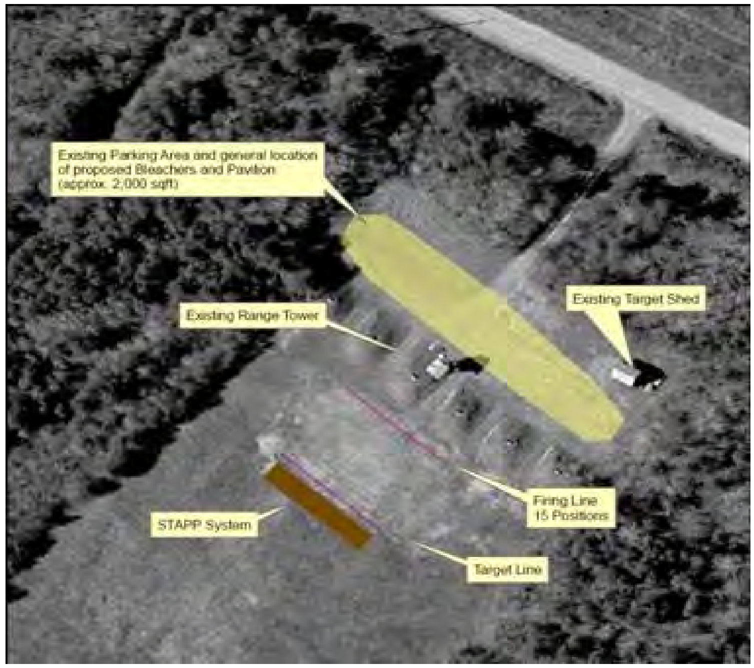


Figure 7-1. Aerial of Current T Range Configuration

7.1 Phase 1

7.1.1 T ("Tango") Range Best Management Practices

T Range represents the highest priority and first in the sequence of SARs that Camp Edwards will seek to bring on-line with lead small arms ammunition (see Figure 7-1). T Range is a standard 25-m Rifle/Machine Gun Zero Range (FCC 17801) for both M16 rifle and M249 and M240 machine guns (see Figure 7-2 and Appendix F). Zeroing is one of the most basic and universal training tasks for small arms marksmanship. T Range will be used primarily for zeroing the 5.56mm rifle and 7.62mm machine gun.

Figure 7-2. Bullet Containment System at T Range

T Range can also be used as an alternate range for M16 qualification using scaled targets. Scaled targets simulate firing at a longer range by using reduced image size and perspective. It is also possible that T Range will serve as an alternate range for training on all calibers (.22, .357, .38, .40, 9mm, .45, .44) of pistols. Law enforcement using T Range will most frequently fire .38, .40, 9mm, and .45 caliber pistols, while military pistol fire will likely be limited to 9mm.

Camp Edwards recently installed a granular rubber (i.e., STAPP ™) bullet containment system on T Range. The system is 100 × 30 ft and provides bullet containment for 15 firing lanes (see Figure 7-3). The system contains all the features recommended in the Bullet Containment System BMP described in Section 6, including an 18-in. granular rubber berm face, a self-healing rubber membrane cover, a synthetic lumber frame, an impermeable liner, and an internal water collection reservoir. Camp Edwards will periodically collect and sample the precipitation that accumulates in the reservoir within the STAPP™ system. Based on the results of this sampling, Camp Edwards will dispose of the water appropriately. The STAPP™ system is capable of accepting tracer rounds as long as its self-healing rubber membrane is maintained. Maintenance of the STAPP™ system may include periodic repair or replacement of sections of the rubber membrane cover that become perforated and ineffective.

Camp Edwards will implement each of the appropriate operational and administrative BMPs described within Section 6 on T Range. As part of the Metals Monitoring/Sampling BMP, Camp Edwards will install a groundwater monitoring well down gradient and lysimeters in soil under the toe of the bullet containment system. If lead from the ammunition is not contained by the system and dissolved lead begins to percolate through the pore water toward the aquifer, the lysimeters will provide an early warning. All sampling and analysis will be coordinated with EMC and EPA.

The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs conducted. Camp Edwards will develop a maintenance schedule for system repairs, removing water from the collection reservoir, and periodic separation of lead from the granular rubber matrix based on conditions observed over the first year of full-scale use. Periodic maintenance activities may be scheduled based on number of rounds fired, mass of rounds fired, number of days, or some other observable variable. System alterations, water collection and sampling, and lead removal actions will be coordinated with EMC and EPA.

Camp Edwards will plant and maintain appropriate vegetative cover on the soil berm areas around the bullet containment system, as well as the range floor, to reduce erosion. Camp Edwards placed target frames in positions to concentrate projectile impacts into the bullet containment system and to allow access to the system for maintenance. Camp Edwards plans to construct additional troop support facilities (i.e., bleachers and a pavilion for mess, ammunition issue, and weapon breakdown/cleaning) within the current parking areas of T Range. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

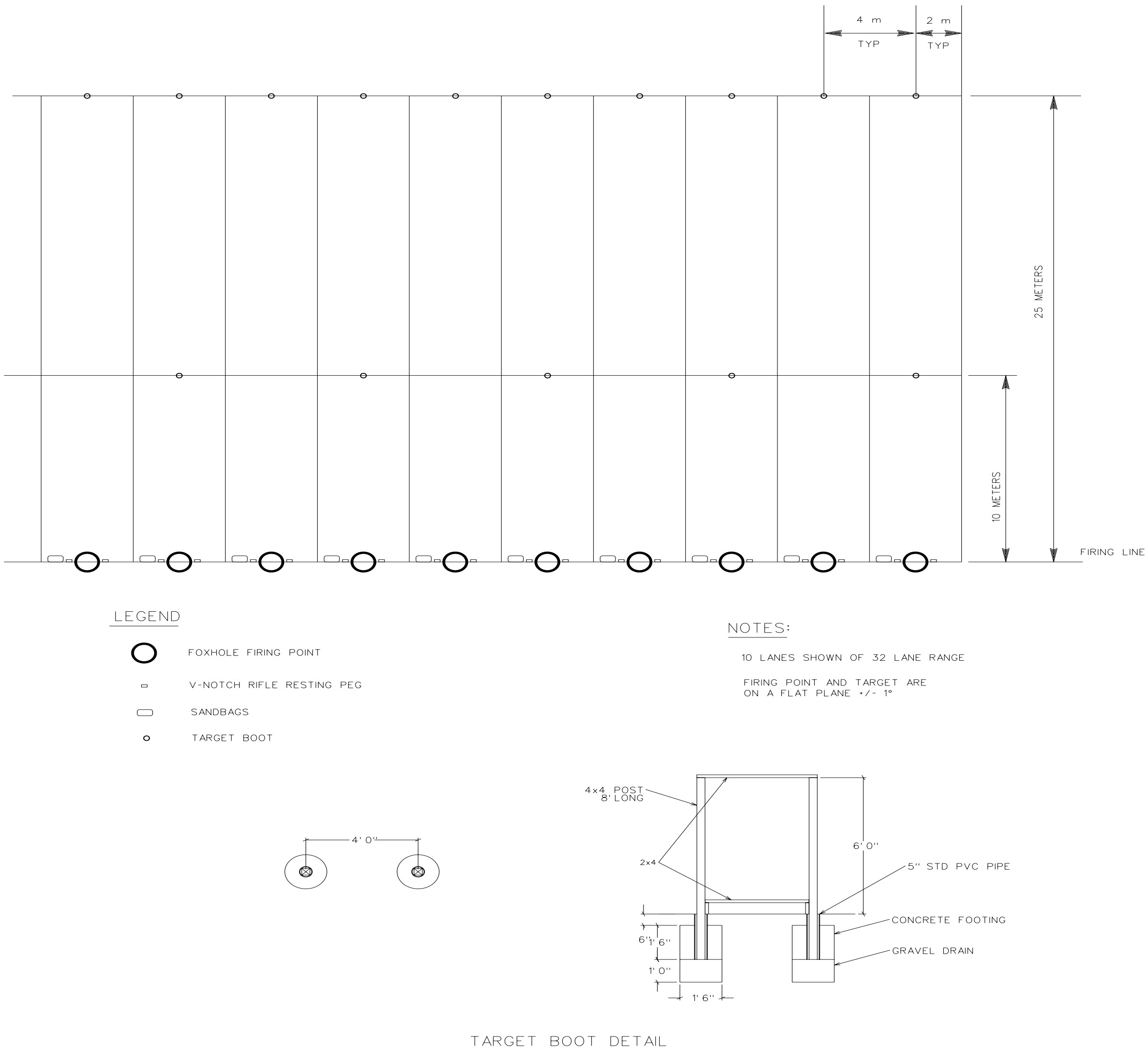


Figure 7-3. Standard Army Design for 25-m Zero Range

7.1.2 E ("Echo") Range Best Management Practices

E Range is designed to meet training and qualification requirements with all calibers of combat pistols (e.g., M9 and M11). The range is being modernized to satisfy the standard Army range design for a Combat Pistol/MP Firearms Qualification Course (FCC 17821) (see Figure 7-4). This range type is used to train and test soldiers on the skills necessary to identify and engage infantry targets with pistols at various distances. E Range has 15 firing lanes. Soldiers begin at the first firing line and engage pop-up targets in sequences triggered by the range operator.

The majority of the firing takes place at the static firing line at the front of the range, from which soldiers engage the pop-up targets within their lanes in variable sequences. This range can also support soldiers moving from the static firing line forward in their lanes about 10 m to a firing line in front of the first targets. As they move forward, soldiers engage targets as they "pop up" within their lane. When qualifying with pistols, soldiers have a set amount of time to engage

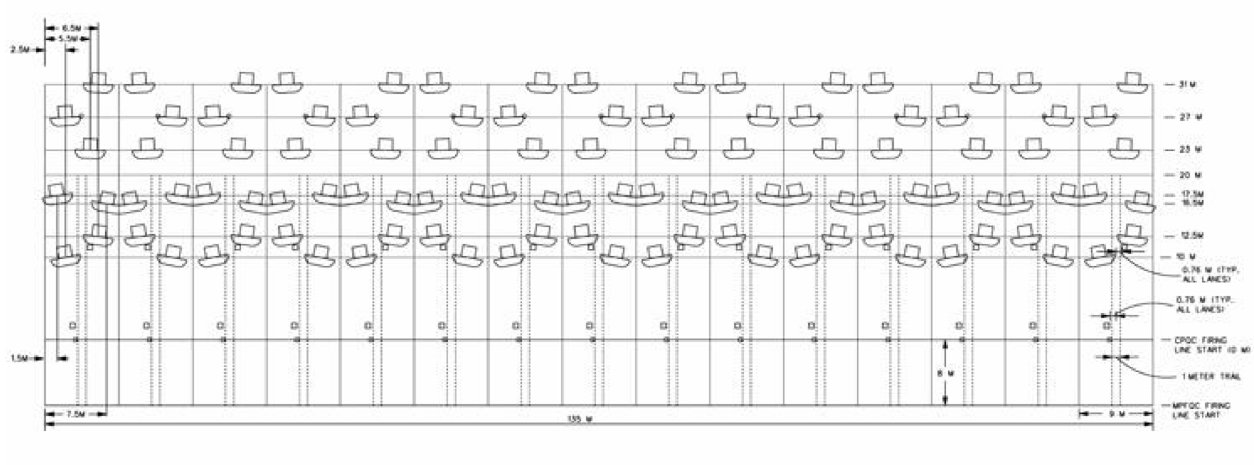


Figure 7-4. Standard Army Design for Combat Pistol/MP Firearms Qualification Course (FCC 17821)

each target and move through the entire progression of targets, while successfully hitting no less than the minimum required number of targets. Pistol fire is to the east. E Range is under construction and being outfitted with modern targetry and troop support facilities, including a covered bleacher/pavilion (see Figure 7-5). Current troop support structures include a range tower and maintenance shed.

Figure 7-5. Target Emplacements on E Range

The targetry on E Range is being installed at a slightly lower elevation than the firing lanes. As soldiers move down the firing lane engaging targets, they create a slightly negative angle of fire. The negative (downward) angle of fire causes the anticipated point of impact for rounds fired to be the range floor behind each of the targets. Because of this point of impact, Camp Edwards plans to manage the range floor in a manner consistent with the Improved Soil Berm Design BMP. The range floor may consist of 18 in. of sifted sand that will minimize bullet pulverization and will facilitate implementation of the Periodic Metals Removal BMP. Behind the last row of targets, Camp Edwards is considering a number of options to contain and manage metals from bullet impacts. One option under consideration involves constructing a 4-ft plywood wall that will provide support for a short (approximately 2-ft) sand berm. The berm will capture those rounds fired at the last targets and the additional 2 ft of plywood will indicate whether rounds are striking above the berm. Another option is to install a shot curtain or other similar barrier at the back of the range to limit the distribution of bullets beyond the last row of targets. Camp Edwards intends to "demonstrate" selected bullet containment designs on one or two firing lanes and select the most effective and feasible option for full implementation. All appropriate operational and administrative BMPs will also be implemented on E Range. Notably, these may include mixing soil additives (e.g., lime) into the range floor to maintain a neutral pH and minimize metal solubility.

Additional metals containment features can be designed into the range floor and berms on E Range. A layer of non-permeable clay or a geotextile layer may be installed under the sand range floor and berms. This will restrict dissolved metals from percolating through the sand toward groundwater. Also, a soil additive to fix metals can be added to the sand of the range floor. Products such as MAECTITE® Chemical Treatment Process bond with metals to form insoluble compounds.

Additional P2 BMP recommendations for E Range include implementation of the Metals Monitoring BMP. A groundwater monitoring well and the placement of lysimeters beneath the range at the depth of the frost line will allow for monitoring of potential lead migration and detection of such potential migration before it affects groundwater beneath Camp Edwards. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Camp Edwards will program for implementation of any required metals removal. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

7.2 Phase 2

7.2.1 J ("Juliet") Range and K ("Kilo") Range Best Management Practices

J and K Ranges (see Figures 7-6 and 7-7) are 25-m Rifle/Machine Gun Zero Ranges for both M16 rifles and M249 and M240 machine guns. Zeroing is one of the most basic and universal training tasks for small arms marksmanship. Both of these ranges can also be used as alternate ranges to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols. Camp Edwards intends to implement the Enhanced Soil Berm Design BMP on both of these ranges and evaluate, through the Metals Monitoring BMP, how lead can be managed in a soil berm at Camp Edwards. There is also a potential for Camp Edwards to acquire additional bullet containment system equipment from other military installations where the equipment was undergoing demonstration and validation. MANG has been in discussion with another U.S. Army installation to accept a

Figure 7-7. K Range Firing Points to Target Berm

deceleration-type bullet containment system. This type of system accepts small arms fire through a long steel plate assembly that funnels rounds toward a chamber that resembles the shell of a snail. Once bullets enter the chamber they revolve around in it until they lose energy and drop into a collection chamber below. These types of systems can support oblique fire and ammunition up to and including .50 caliber. If such equipment can be acquired, Camp Edwards may install it on either J or K Range. K Range has a larger footprint and a larger area between the firing line and the target berm. It may, therefore, lend itself to installation of such equipment. Final design features of the improved soil berms or other bullet containment systems on J and K Ranges will be selected in coordination with EMC, EPA, and other stakeholders. All other appropriate operational, administrative, and design BMPs may also be implemented on J and K Ranges to include, but not be limited to, land contouring, vegetation, SOPs, and pH adjustment.

7.2.2 S ("Sierra") Complex Best Management Practices

SE and SW Ranges (S Complex) have historically functioned as two separate machine gun transition ranges. Each had five firing lanes to engage infantry pop-up targets out to 800 m. Mounded firing points exist at both ranges: five at SE Range along the 280-ft-long firing line and five at SW Range along the 200-ft-long firing line. A series of targets are spaced between 100 and 800 m downrange from the firing points. Neither range has a backstop.

S Complex is currently being modernized into a standard Army Automated Record Fire Range (FCC 17805) to meet doctrinal training requirements for M16 qualification (see Figure 7-8.) This range, once modernized, will include 10 firing lanes and many automated pop-up targets arranged over a large area (approximately 300 × 100 m). This type of range does not lend itself as readily to management of lead using soil berms or bullet containment systems as do standard 25-m zero ranges.

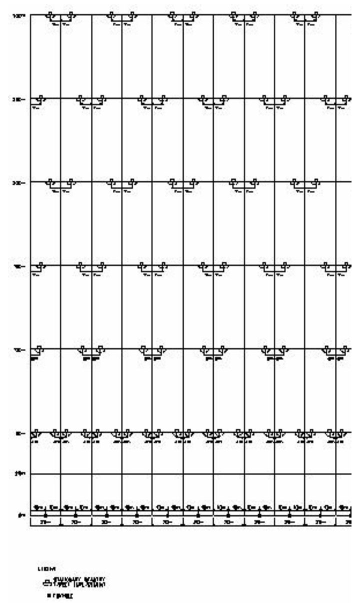


Figure 7-8. Standard Automated Record Fire Range (FCC 17805)

Camp Edwards intends to implement all appropriate generally applicable BMPs to include, where feasible, some variation of the improved soil berm BMP or the Bullet Containment System BMP. Camp Edwards will also implement metals monitoring. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

The complexity associated with installing soil berms or other bullet containment systems on a range such as S Complex stems from the need to engage multiple targets at different distances within one firing lane. Placement of bullet containment berms/structures behind these targets limits line-of-sight to subsequent targetry. One option for overcoming this challenge is to elevate the firing line on S Complex to allow soldiers to engage longer range targets over the tops of the bullet containment systems emplaced behind shorter range targets (see Figure 7-9). Another option is to widen the firing lanes on S Complex to allow the staggered placement of targets and minimize the overlaps in line-of-sight among shorter and longer range targets (see Figure 7-10). Detailed range design drawings (to include proposed bullet containment structures) and a line-of-sight analysis is necessary to select the optimal option or combination of options. Number and placement of targets and corresponding bullet containment devices should be optimized based on trade-offs between training requirements supported and line-of-sight constraints. The feasibility of construction or installing bullet containment devices will be evaluated based on range specific condition, training requirements, and the results of an appropriately designed metals monitoring program. Elevation of the firing line and of longer range target emplacements/bullet containment systems will offset some line-of-sight concerns.

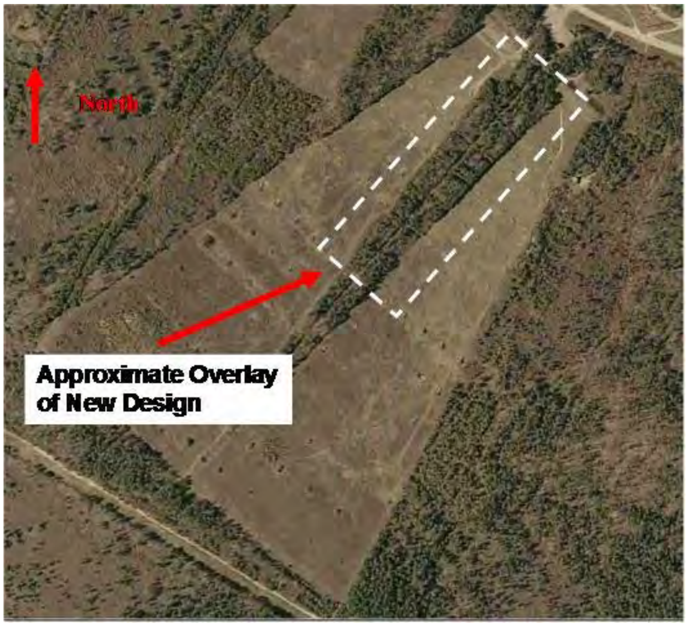


Figure 7-9. Former Sierra Range Complex (Overlay of Proposed New Design)

If a more detailed analysis indicates that the installation of bullet containment structures is infeasible, Camp Edwards may manage metals in surface soils of S Complex through the implementation of the operational BMPs contained in Section 6. Camp Edwards can periodically spread a pH-stabilizing soil additive to the range floor soils using standard agricultural equipment. Other soil management (e.g., fertilizing and over-seeding) can be conducted to maintain vegetation on the range and minimize horizontal movement of metals through erosion or storm water runoff. Camp Edwards can monitor lead concentrations in soil, soil water, and groundwater using soil sampling techniques, lysimeters, and groundwater monitoring wells. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Monitoring and removal will focus on areas where range use patterns and bullet impacts indicate the highest concentration of bullet deposition. During periodic metals removal,

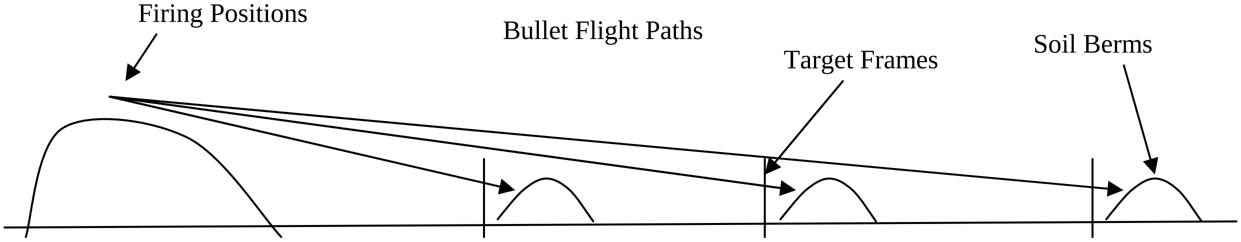


Figure 7-10. Elevated Firing Point and Line-of-Sight to Targets

areas of highest metals concentration can be confirmed and soils in these areas can be amended with a metals fixative such as MAECTITE® Chemical Treatment Process. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

7.2.3 A ("Alpha") Range Best Management Practices

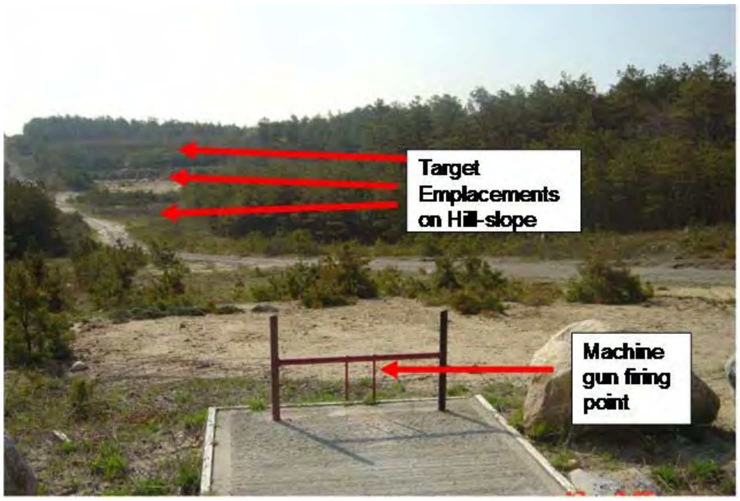


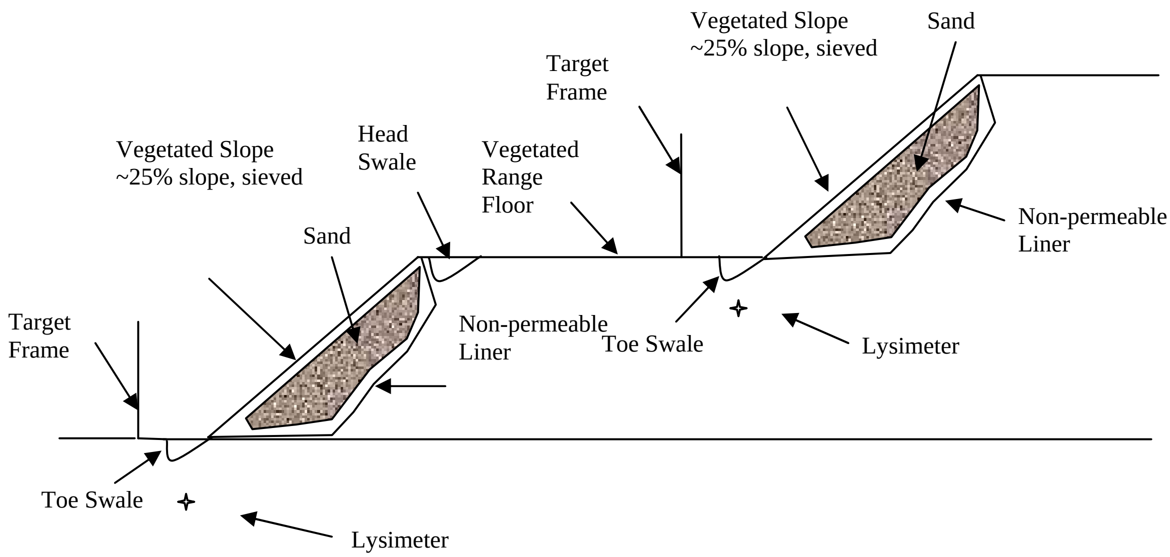
Figure 7-11. A Range from Elevated Firing Point

A Range is an approximately 300-m Machine Gun Field Fire Range that is currently used to support familiarization and basic marksmanship training with plastic bullets in .50 caliber (M2). This range is positioned in such a manner as to allow soldiers to engage targets emplaced on a hillside from raised firing positions, creating a negative angle of fire and reducing the effective SDZ of the weapons. The presence of restrictive metal "H" frames, through which the barrels of machine guns are placed to limit both elevation and traverse of fire, further reduces the effective SDZ of these weapons (see Figure 7-11). This reduced effective SDZ makes it possible to safely fire the .50 caliber M2 machine gun on A Range. For this reason, Camp Edwards may use A Range to conduct a large portion of its .50 caliber and 5.56mm (SAW) and 7.62mm (M240 and M60) machine gun training in the future.

Metals management on A Range will focus on two potential transport pathways, vertical percolation of dissolved metals toward groundwater and horizontal migration of fine metal particle through erosion and storm water transport. Although soils at A Range are slightly more loamy and less sandy than other range soils at Camp Edwards (see Section 5.3), soils, rates of precipitation and groundwater recharge, and presence of a sole-source drinking water aquifer under the entire Reserve/Training Area demand management of metals to prevent vertical transport toward groundwater. The presence of target areas on a hillside that already illustrates evidence of erosion and storm water runoff also indicates the need to manage these potential mechanisms for metals transport.

Notional designs of the target area on A Range to manage both vertical and horizontal transport of metals include contouring the current target emplacements on the hillside to create a series of terraced (i.e., stepped) soil berms (see Figure 7-12). The inherent negative angle of fire at A Range, combined with appropriate target placement on these terraces, lends itself to management of lead bullets using the Enhanced Soil Berm Design BMP. The enhanced soil berms recommended for A Range feature a vegetated sand face sloped at approximately 25% and swales to manage storm water runoff.

Additional metals containment features can be designed into the terraced berms on A Range. A layer of non-permeable material such as clay or geotextile may be installed behind the berm face. This will restrict dissolved metals from percolating through soil toward groundwater. Also, a soil additive to fix metals can be added to the sand of the berm face. Products such as the MAECTITE® Chemical Treatment Process bond with metals to form insoluble compounds.



Note: Swales will drain to off-range retention ponds

Figure 7-12. Terraced Enhanced Soil Berm Design

The use of vegetation, pH adjustment, and swales (for storm water management) will complement the features of the improved soil berm BMP. Camp Edwards will also implement other appropriate operational and administrative BMPs to include the placement of lysimeters in soil below the toes of the terraced berm faces. Camp Edwards will conduct periodic metals removal as indicated necessary after consideration of such factors as the results of metals monitoring or the number of rounds fired on the range.

Figure 7-13. KD Range Aerial Photo

7.3 Phase 3

7.3.1 KD ("Known Distance") Range Best Management Practices

Currently, KD Range is divided into two subparts with two distinct firing line/target configurations and two distinct training uses (see Figure 7-13). On the west side of the range, four stations are situated at the firing line. Each station, or firing point, engages infantry targets at 100 yards, 200 yards, and 300 yards (from the station). The east side of the range has 5 firing lines each with 25 firing positions. The five firing lines are located on firing position berms at known distances from a single set of targets. The firing lines are at 100 yards, 200 yards, 300 yards, 300 m, and 600 yards. Each firing line is intended to engage targets placed above a large soil berm located approximately 600 yards from the initial firing line. Target frames designed to raise and lower targets are still present behind the soil berm but are in disrepair.

In the future Camp Edwards intends to use KD Range to serve multiple purposes. The east side of KD Range will continue to be used as a Known Distance Range and will support 10- and 25-m zero for machine gun and rifle. It may also support, in a limited capacity, machine gun marksmanship (e.g., familiarization and practice marksmanship) for the SAW M249, M240, M60, and M2. There are no current plans to modernize and resume firing on the west side of KD Range.

For KD Range to support the desired training requirements in a manner that controls the migration of metals, many design features/modifications may be incorporated into the proposed range design.

- The position of the existing targets may be moved from the top to the base of the target berm. Continued use of the targets in their current position would encourage distribution of bullets over a relatively large area behind the target berm. Moving the targets to the base of the berm will concentrate fire and bullet impact into the berm face and lend itself to bullet containment and management.
- The firing lines may be elevated, either through the addition and grading of fill soil, or by the construction of elevated firing platforms. The firing lines should be raised to the degree necessary to direct the angle of fire to the new target locations at the base of the target berm while maintaining line-of-sight over subsequent firing stations.
- An enhanced soil berm or other bullet containment system may be installed in the current earthen berm, which will continue to serve as the backstop for the eastern portion of the modernized KD Range.

Camp Edwards will also implement other appropriate operational and administrative BMPs from Section 6. There is very little elevation change over the range floor of KD Range. This lends itself to soil stability and makes the application of fertilizer, seed, and other soil amendments relatively easy. Camp Edwards can maintain vegetative cover and a stable neutral pH on KD Range to control metals migration. Camp Edwards will also implement the Metals Monitoring BMP through the use of lysimeters, groundwater monitoring wells, and soil sampling. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M Plans.

7.3.2 ISBC ("Infantry Squad Battle Course") Best Management Practices

In response to training requirements identified by the locally stationed Brigade Combat Team, Camp Edwards wants to reinstate offensive and defensive tactical movement and live fire on ISBC. The current placement of the objectives on the tops of hills would make metals management complex. Their placement would likely result in the distribution of projectiles over a relative large area behind and around the objectives. To reconfigure the range for optimal metals management, the two objectives could be moved lower in elevation to the front of the hills upon which they are currently positioned. This would allow the hill slope to act as a backstop, concentrating and containing projectiles. Once the objectives are configured in locations that would allow management of projectiles through some manner of bullet containment, an enhanced soil berm or other bullet containment system technology could be installed within the hill slope behind the target emplacements. Because the primary training purpose of ISBC is to allow tactical movement and coordination of small units, it requires that the objectives be somewhat unobtrusive. The bullet containment system selected should be able to blend into the natural terrain. An enhanced soil berm managed to maintain vegetative cover and coupled with a non-permeable liner (e.g., clay or geotextile) under the berm face would meet these requirements (see Figure 7-14). The face of the berm must be monitored and managed to minimize erosion to prevent horizontal movement of metals beyond the area protected by the non-permeable liner. Each bullet containment system should include a lysimeter to monitor soil water moving away from the bullet pocket. Soils around the berm should be periodically sampled for metals to monitor for horizontal transport via erosion or storm water. Camp Edwards will work with EMC and EPA to identify requirements for the periodic removal of metals from SAR soils. Metals removal requirements will be based on such factors as, results of metals monitoring, numbers of rounds fired, the period in which they were fired, and the number of training days for which the range was used.

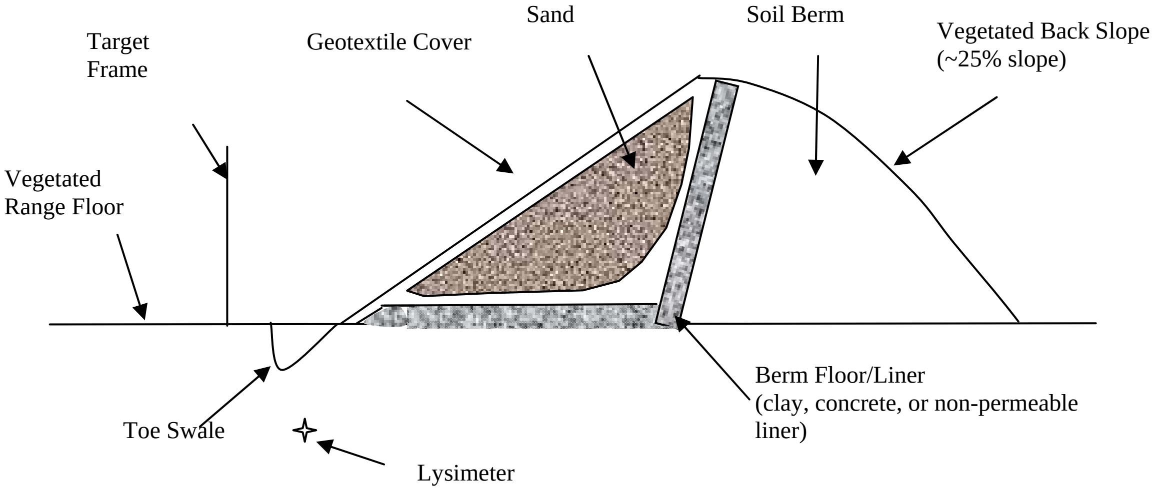


Figure 7-14. Recommended Enhanced Soil Berm Design (ISBC)

Also, to be more consistent with Army training standards for such a facility, ISBC should be expanded, additional objectives added, and automated targetry installed. Figure 7-15 is the standard Army design for an ISBC.[30] It shows five objectives and one range road with multiple

[30] Army Training Support Center 2004. *Training Ranges*, Training Circular 25-8.

engagement possibilities for diverse squad training. This would allow squads to maneuver in doctrinally sound formations and engage targets from appropriate distances. If the available footprint of ISBC or other constraints prevent this level of expansion, Camp Edwards should seek to match this design as closely as is feasible. Each target array should be configured with a bullet containment system and managed as described in the previous paragraph. Final BMP selection will be made in coordination with EMC, EPA, and other stakeholders and will be included in the range-specific design and O&M plans.

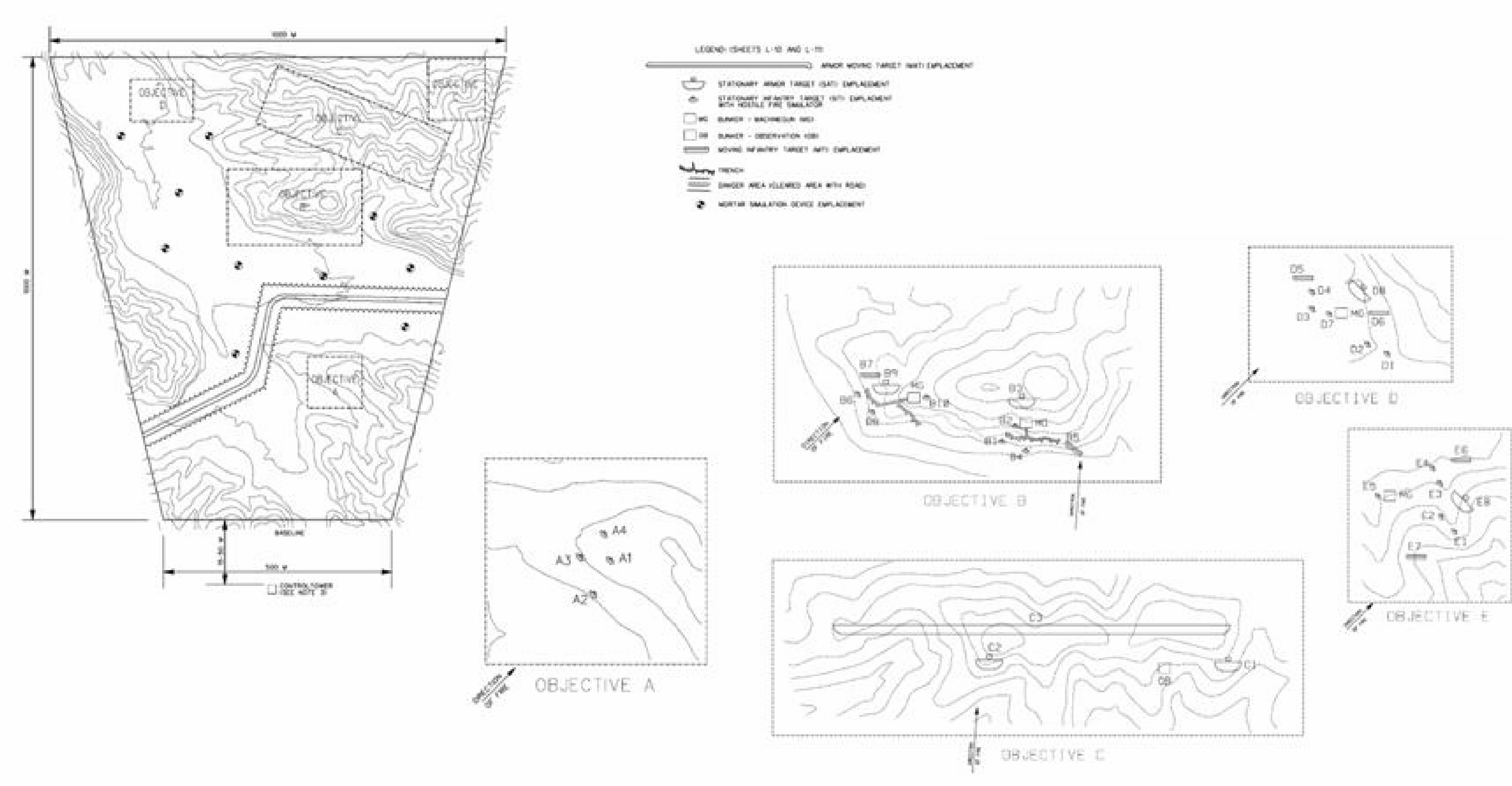


Figure 7-15. Standard Army Design for ISBC Including Objectives

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8. CONCLUSIONS AND IMPLEMENTATION

MANG and Camp Edwards identified a definite approach to implement sustainable operations that are protective of human health and the environment while supporting mission requirements for small arms and any Army standard or alternative training ammunition. To move forward, MANG will undertake the following steps to implement the SAR P2 Overview at specifically identified SARs as needed to meet Army live-fire training requirements:

- Continue seeking stakeholder input and obtain EMC, MassDEP, and EPA Region 1 oversight, concurrence, and approval for the process of modifying the EPS prohibiting the use of lead-bullet ammunition within the training area at Camp Edwards as identified in the 15 September 2006 Notice of Project Change.
- Formally petition EMC for modification of the lead prohibition EPS, under the process legislated by Chapter 47 of the Acts of 2002, explaining in detail all aspects, potential impacts, and proposed mitigations for changes.
- Seek approval from EMC and EPA of the range-specific BMPs and approval to return to live-fire training with standard lead small arms ammunition at the identified Phase 1 ranges.
- Implement range-specific BMPs for which funding is available, as approved by EMC, EPA, and other oversight organizations.
- Plan, program, and budget for implementation of other approved BMPs.
- Commence small arms live-fire training with standard lead-core ammunition in Spring/Summer 2007 at the critical Phase 1 SARs, for which all required BMPs have been implemented.
- Periodically update the SAR P2 Overview to reflect changes in SAR design and training requirements, as well as findings from monitoring and results from management of small arms ammunition used in training.
- Request that additional training with lead small arms ammunition be reinstated at specific SARs in a phased approach on a range-by-range basis, as necessitated by mission requirements.

The BMPs identified in the SAR P2 Overview will be customized for each prioritized SAR in Range-Specific O&M Plans and applied in consultation with EMC, EPA, and other oversight entities in a manner that will allow MANG to satisfy its federal and state missions while preserving the sole source drinking water aquifer.

MANG is committed to adhering to the triple bottom line of mission, community, and environment to maintain sustainable operations at Camp Edwards. Through implementation of the SAR P2 Overview elements, including EMC oversight and stakeholder involvement, MANG and Camp Edwards can meet doctrinal Army training requirements applicable to live fire with small arms in a manner that is consistent with environmental protection.

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Appendix A

POINTS OF CONTACT

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Appendix A
POINTS OF CONTACT

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Appendix B
ACRONYMS

Appendix B

ACRONYMS

AFCEE	Air Force Center for Environmental Excellence
ANGB	Air National Guard Base
AO	Administrative Order
ASP	Ammunition Supply Point
BMP	Best Management Practice
CAC	Community Advisory Council
CRREL	Cold Regional Research and Engineering Laboratory
CSM	Conceptual Site Model
DA	Department of the Army
DCR	Department of Conservation and Recreation
DoD	Department of Defense
DRMO	Defense Reutilization and Marketing Office
E&RC	Environmental & Readiness Center
EIR	Environmental Impact Report
EMC	Environmental Management Committee
EO	Environmental Officer
EPA	U.S. Environmental Protection Agency
EPS	Environmental Performance Standard
ERDC	Engineering Research and Design Center
FCC	Facility Category Code
HQDA	Headquarters Department of the Army
IAGWSP	Impact Area Groundwater Study Program
IRP	Installation Restoration Program
ISBC	Infantry Squad Battle Course
ITRC	Interstate Technology & Regulatory Council
KD	Known Distance
LAW	Light Anti-Armor Weapon
MAARNG	Massachusetts Army National Guard
MANG	Massachusetts National Guard
MassDEP	Massachusetts Department of Environmental Protection
Mass DFG	Massachusetts Division of Fish and Game
MCP	Massachusetts Contingency Plan
MEPA	Massachusetts Environmental Policy Act
MMR	Massachusetts Military Reservation
MOA	Memorandum of Agreement
NGB	National Guard Bureau
O&M	Operations and Maintenance
P2	Pollution Prevention
ppb	parts per billion
ppm	parts per million
RDP	Range and Training Land Program Development Plan
REST	Range Evaluation Software Tool

Appendix B

ACRONYMS (CONTINUED)

SAC	Science Advisory Council
SAR	Small Arms Range
SAW	Squad Automatic Weapon
SDZ	Surface Danger Zone
SOP	Standard Operating Procedure
TAG	The Adjutant General
TC	Training Circular
TCLP	Toxicity Characteristic Leaching Procedure
TOW	Tube-launched, Optically Tracked, Wire-guided
USACE	U.S. Army Corps of Engineers
USAEC	U.S. Army Environmental Center
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
XRF	X-Ray Florescence

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Appendix C

SMALL ARMS RANGE FACT SHEETS

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A Range Fact Sheet

Alpha Range

Located at Burgoyne/Wood Road

Proposed Use

The future intended use of A Range is to continue as a .50 caliber 300M Machine Gun Field Fire Range. Camp Edwards may use A Range to conduct a large portion of its .50 caliber and 5.56mm (SAW) and 7.62mm (M240 and M60) machine gun training in the future.

Authorized Weapon Systems	Ammunition
.50 caliber machine gun	.50 caliber plastic and lead

Historical Use

A Range has been used since the 1970s as an M2 (.50 caliber) 300M Machine Gun Field Fire Range. Currently, it is used to support familiarization and basic marksmanship training with plastic bullets in both 5.56mm (M16) and .50 caliber (M2). Soldiers engage paper targets on wooden frames along a 1,000-ft firing line toward the east from one of three firing points, two for dismounted and one for mounted machine gun firing. A maintenance road, Wood Road, runs through the range from the south side of the shooting lanes to the north side of the targets and backstop. This range is positioned in such a manner as to allow soldiers to engage targets emplaced on a hillside from raised firing positions, creating a negative angle of fire and reducing the effective surface danger zone of the weapons. The presence of restrictive metal “H” frames, through which the barrels of machine guns are placed to limit both elevation and traverse of fire, further reduces the effective surface danger zone of these weapons. This reduced effective surface danger zone makes it possible to safely fire the .50 caliber M2 machine gun on A Range. NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Historical Ammunition Use at A Range

Training Year	Training Days	.50 caliber Plastic	.50 caliber Lead
2004	3	8,400	0
2003	3	800	0
2002	2	5,297	0
2001	3	2,700	0
2000	2	6,900	0
1998	3	4,735	0
1997		11,800	0
1996		0	21,094
1995		0	31,473
1994		0	32,430
TOTAL		**40,632**	**84,997**
AVERAGE		4,063	8,500

A Range Fact Sheet

Environmental Setting

Although the soils at A Range are slightly more loamy and less sandy than other range soils at Camp Edwards, the soils, rates of precipitation and groundwater recharge, and the presence of a sole source drinking water aquifer under the entire Reserve/Training Area demand management of metals to prevent vertical transport toward groundwater. The presence of target areas on a hillside that already illustrates evidence of erosion and storm water runoff also indicates the need to manage these potential mechanisms for metals transport.

Erosion was also evident at the berm, and large rocks capable of causing bullet pulverization were found in the berm surface. The extensive erosion may be attributed the lack of vegetation on the range. Wind breaks are present around the range but do not appear to have a significant impact in preventing erosion. There are no drainage ditches or swales on the range; however, the shoulders of Wood Road act as swales for storm water runoff.

Recommended Best Management Practices

1. Notional designs of the target area on A Range to manage both vertical and horizontal transport of metals include contouring the current target emplacements on the hillside to create a series of terraced (i.e., stepped) soil berms. The inherent negative angle of fire at A Range, combined with appropriate target placement on these terraces, lends itself to management of lead bullets using the Enhanced Soil Berm Design BMP.

2. The enhanced soil berms recommended for A Range feature a vegetated sand face sloped at approximately 25% and swales to manage storm water runoff.

3. A layer of non-permeable material such as clay or geotextile may be installed behind the berm face. This will restrict dissolved metals from percolating through the soil toward groundwater. Also, a soil additive to fix metals can be added to the sand of the berm face. Products such as the MAECTITE® Chemical Treatment Process bonds with metals to form insoluble compounds.

4. Camp Edwards will also implement other appropriate operational and administrative BMPs to include the placement of lysimeters in the soil below the toes of the terraced berm faces and metals removal if indicated through the implementation of the Metals Monitoring BMP.

5. Applicable BMPs for A Range will be coordinated with EMC and other stakeholders as plans for that facility advance.

A Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)

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Aerial Photo: A Range

00June06

The Environmental & Readiness Center
Your Link For Information
www.eandrc.org

A Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)

Overview Photo: A Range

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E Range Fact Sheet

Echo Range

Located at West Range Area, Burgoyne Road

Proposed Use

Camp Edwards is upgrading E Range. Its future intended use is as a Combat Pistol Qualification Course. E Range is undergoing an upgrade as follows:

- Upgraded computer control system
- Upgraded targets and associated equipment and earthen berms
- New range control tower
- New covered canteen area

This range type is used to train and test soldiers on the skills necessary to identify and engage infantry targets with pistols at various distances. E Range has 15 firing lanes. Soldiers begin at the first firing line and engage pop-up targets in sequences triggered by the range operator. Soldiers move forward toward the back of the range continuing to engage targets as they "pop up" to either side of the maneuver lane.

Authorized Weapon Systems	Ammunition
Pistol	.38 caliber, .40 caliber, 9mm

Historical Use

E Range is designed to meet training and qualification requirements with all calibers of combat pistols (e.g., M9 and M11). This range type is used to train and test soldiers on the skills necessary to identify and engage infantry targets with pistols at various distances. E Range has 15 firing lanes. Soldiers begin at the first firing line and engage pop-up targets in sequences triggered by the range operator. Soldiers move forward toward the back of the range continuing to engage targets as they "pop up" to either side of the maneuver lane When qualifying with pistols, soldiers have a set amount of time to engage each target and move through the entire progression of targets, while successfully hitting no less than the minimum required number of targets. Pistol fire is to the east, with rounds impacting into the range floor or small manmade berms directly behind the targets. Between 1986 and 1989, E Range was relocated to its current site on Burgoyne Road. The range is capable of supporting training with all calibers of pistol ammunition. Troop support structures include a latrine, range tower, and maintenance shed.

Historical Ammunition Use at E Range

Training Year	Training Days	.45 caliber Frangible	.40 caliber	.38 caliber	9mm	12 gauge
2004	2	0	0	0	16,000	0
2003	0	0	0	0	0	0
2002	0	0	0	0	0	0
2001	0	0	0	0	0	0
2000	4	1,030	3,200	0	450	0
1998	0	0	0	0	0	0
1997	4	0	2,380	0	5,394	0
1996		0	9,380	11,406	12,783	0
1995		6,100	18,000	1,750	42,925	0
1994		7,867	240	3,981	47,100	400
TOTAL		**14,997**	**33,200**	**17,137**	**124,652**	**400**
AVG		1,500	3,320	1,714	12,465	40

E Range Fact Sheet

Environmental Setting

E Range abuts the D Range boundary; the two ranges share a berm. Both the berms and the backstop are covered in vegetation. The backstop on the north side contains a large boulder, which presents a safety hazard to those soldiers engaging targets from north firing lanes, lanes 1–5. Storm water flows off the range at three distinct areas: (1) from the range, through the parking lot, and down the driveway entrance to the road; (2) at the farthest north firing point corner into a swale that empties into a wooded area abutting D Range; and (3) on the opposite side of the range at the farthest south firing point, another swale empties into a wooded area.

Recommended Best Management Practices

1. The targetry on E Range is being installed at a slightly lower elevation than the firing lanes. As soldiers move down the firing lane engaging targets, they create a slightly negative angle of fire. The negative (downward) angle of fire causes the anticipated point of impact for rounds fired to be the range floor behind each of the targets. Because of this point of impact, Camp Edwards plans to manage the range floor in a manner consistent with the Improved Soil Berm Design BMP. The range floor may consist of 18 in. of sifted sand that will minimize bullet pulverization and will facilitate implementation of the Periodic Metals Removal BMP.

2. Behind the last row of targets, Camp Edwards plans to construct a 4-ft plywood wall that will provide support for a short (approximately 2-ft) sand berm. The berm will capture those rounds fired at the last targets and the additional 2 ft of plywood will indicate whether rounds are striking above the berm. Camp Edwards intends to “demonstrate” this bullet containment design on one target on one firing lane prior to full implementation.

3. All appropriate operational and administrative BMPs will also be implemented on E Range. Notably, these may include mixing soil additives (e.g., lime) into the range floor to maintain a neutral pH and minimize metal solubility.

4. A layer of non-permeable clay or a geotextile layer may be installed under the sand range floor and berms. This will restrict dissolved metals from percolating through the sand toward groundwater. Also, a soil additive to fix metals can be added to the sand of the range floor. Products such as the MAECTITE® Chemical Treatment Process bonds with metals to form insoluble compounds.

5. Camp Edwards may implement a metals monitoring BMP. A groundwater monitoring well and the placement of lysimeters beneath the range at the depth of the frost line will allow for monitoring of potential lead migration and detection of such potential migration before it impacts groundwater beneath Camp Edwards. As indicated by the results of this monitoring, Camp Edwards may program for implementation of the Periodic Metals Removal BMP.

E Range Fact Sheet

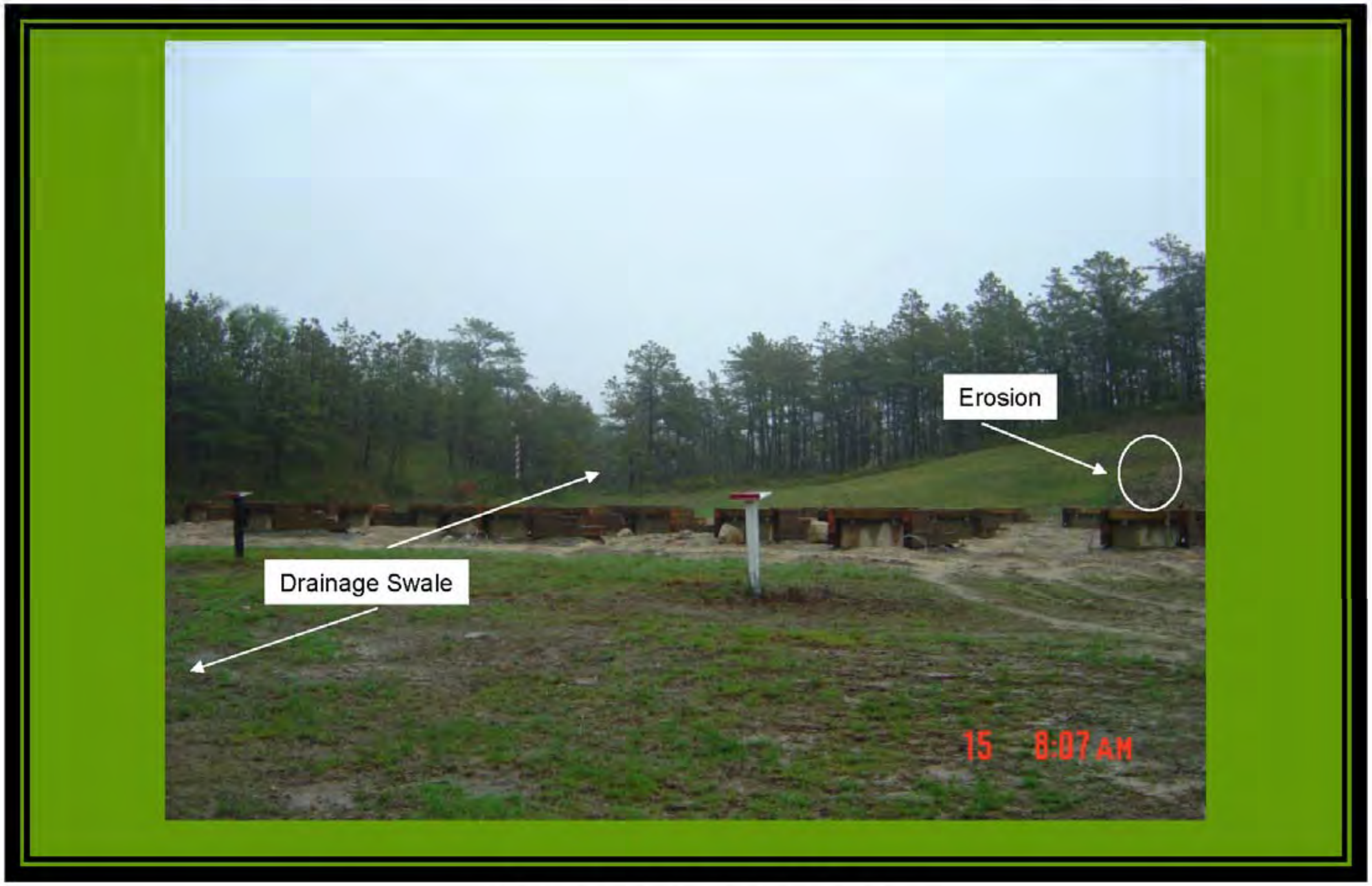
CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)

Aerial Photo: E Range

00June06

E Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Overview Photo: E Range

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ISBC Fact Sheet

Infantry Squad Battle Course

Located at North Range Area at Gibbs Road

Proposed Use

In response to training requirements identified by the locally stationed Brigade Combat Team, Camp Edwards wants to reinstate offensive and defensive tactical movement and live fire on ISBC. It shows five objectives and one range road with multiple engagement possibilities for diverse squad training. This would allow squad to maneuver in doctrinally sound formations and engage targets from appropriate distances. If the available footprint of ISBC or other constraints prevent this level of expansion, Camp Edwards should seek to match this design as closely as is feasible. Each target array should be configured with a bullet containment system and managed as described in the recommended BMP section below.

Authorized Weapon Systems	Ammunition
Pistol	.22 caliber; 5.56mm; 7.62mm, 40mm; 22mm
.50 Caliber Machine Gun	.50 caliber

Historical Use

Historically, ISBC has been used as a squad offensive and defensive tactical training course. The current ISBC is a maneuver and live fire range that is roughly 600 × 300 m; however, the area previously used for this purpose was much larger. ISBC has several maneuver lanes/trails through natural terrain that allow small units to close with and assault two separate objectives. The objectives are made up of sandbags arranged to resemble machine gun nests. Downrange from Objective 1 are two tactical vehicles that were used as targets when the ISBC was in a larger configuration. The current Army design standard for such a range is much larger that the current footprint of ISBC and contains five more robust target arrays as objectives.

Historical Ammunition Use at ISBC

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62mm Lead	9mm	40mm Training Grenade
2004	0	0	0	0	0	0	0
2003	5	18,685	0	0	0	0	0
2002	4	22,160	0	0	0	0	0
2001	3	500	500	0	0	0	0
2000	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1997		0	0	15,317	0	0	0
1996		0	0	21,792	22,400	0	75
1995		0	0	42,068	2,900	150	0
1994		0	0	40,748	1,798	0	647
TOTAL		**41,345**	**500**	**119,925**	**27,098**	**150**	**722**
AVG		4,135	50	11,993	2,710	15	72.2

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

ISBC Fact Sheet

Environmental Setting

The current placement of the objectives on tops of hills would make metals management complex. Bullets would be distributed over a relatively large area due to the lack of a backstop or bullet containment system. The requirement to maintain the range with natural terrain and vegetation does not lend itself to bullet management or bullet recovery in the range's current configuration. Range modernization and implementation of design BMPs could improve metals management on ISBC.

Recommended Best Management Practices

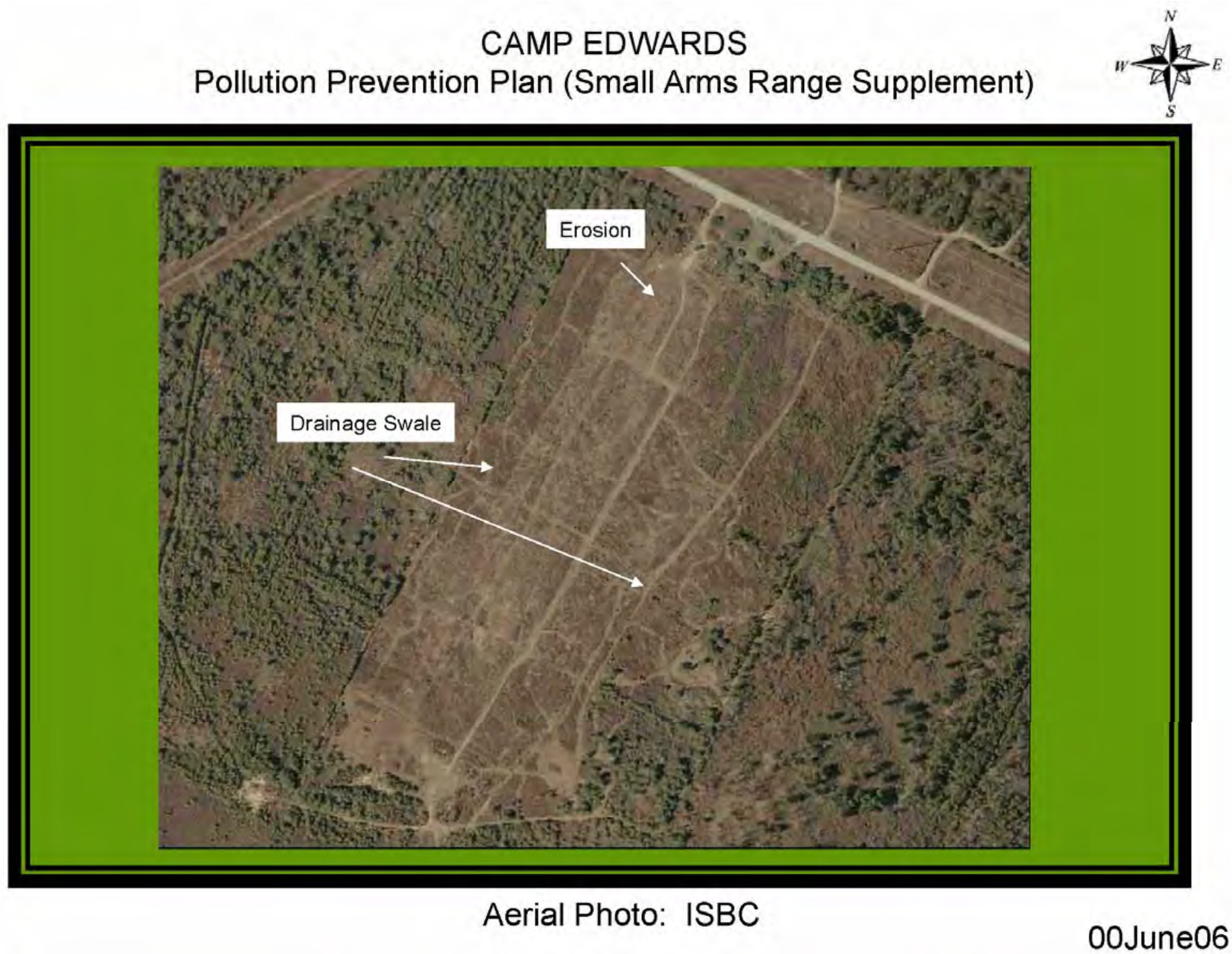
1. To reconfigure the range for optimal metals management, the two objectives could be moved lower in elevation to the front of the hills upon which they are currently positioned. This would allow the hill slope to act as a backstop, concentrating and containing projectiles. Once the objectives are configured in locations that would allow management of projectiles through some manner of bullet containment, an enhanced soil berm or other bullet containment system technology could be installed within the hill slope behind the target emplacements.

2. The bullet containment system selected should be able to blend into the natural terrain.

3. An enhanced soil berm managed to maintain vegetative cover and coupled with a non-permeable liner (e.g., clay or geotextile) under the berm face would meet these requirements.

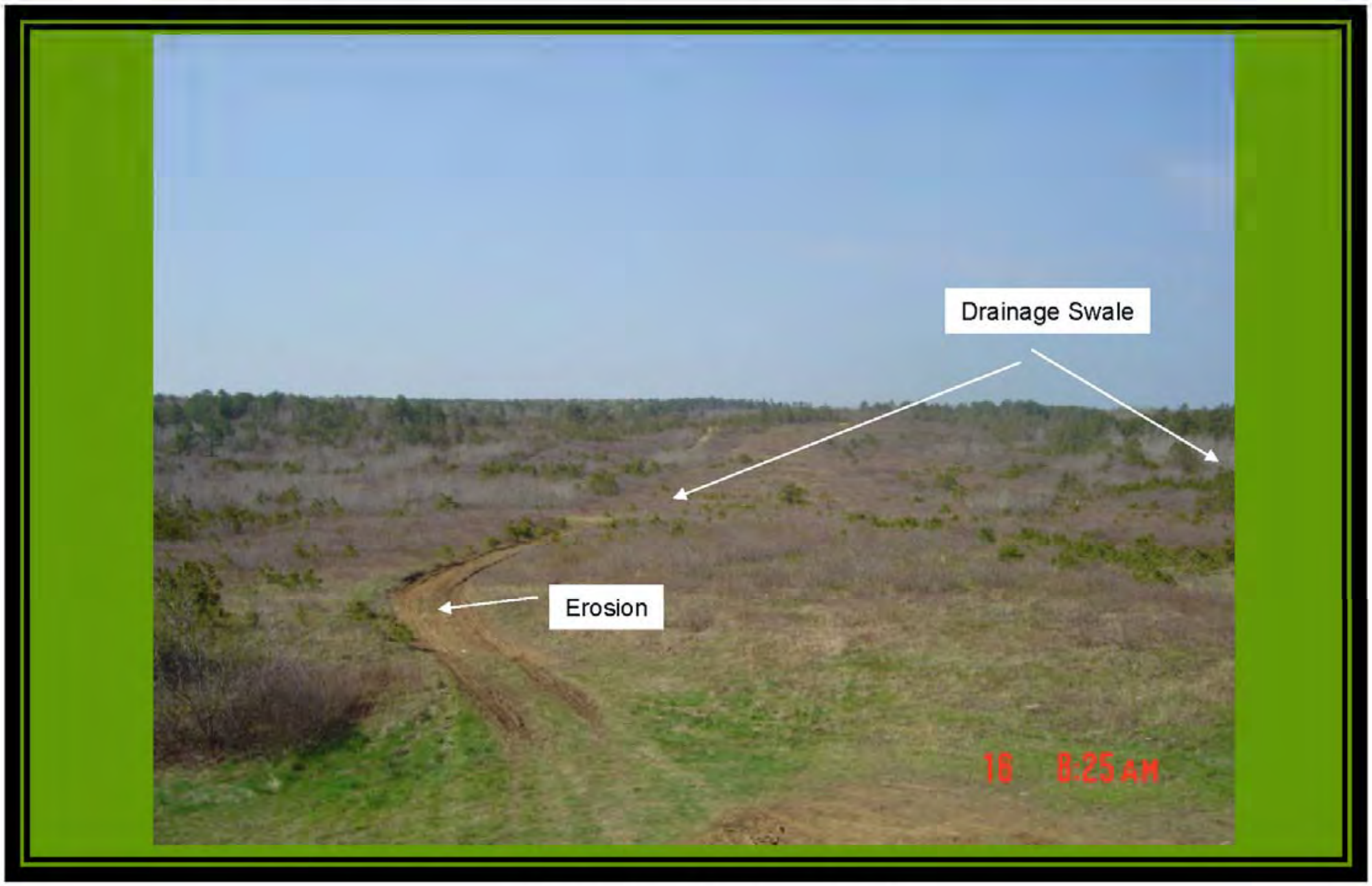
4. The face of the berm must be monitored and managed to minimize erosion to prevent horizontal movement of metals beyond the area protected by the non-permeable liner. Each bullet containment system should include a lysimeter to monitor soil water moving away from the bullet pocket. Soils around the berm should be periodically sampled for metals to monitor for horizontal transport via erosion or storm water. The Periodic Metals Removal BMP should be implemented if indicated necessary by metals monitoring.

ISBC Fact Sheet



ISBC Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Overview Photo: ISBC

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J Range Fact Sheet

Juliet Range

Located at Forrestdale/Pocasset Road

Proposed Use

The future intended use for J Range is to continue as a 25M Rifle and Machine Gun Zero Range for both M16 rifle and the M249 and M240 machine guns. Zeroing is one of the most basic and universal training tasks for small arms marksmanship. J Range may act as an alternate to K Range, as both of these ranges can also be used as alternate ranges to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols.

Weapon	Caliber
Pistol (all calibers)	5.56 Tungsten-Nylon
	5.56 Plastic
	5.56 Lead
	9mm
Machine Gun	.40 caliber
	.38 caliber
	.45 caliber Frangible
Shotgun	12 gauge

Historical Use

J Range is located directly north of Pocasset-Forestdale Road, west of K Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. J Range has been used as a 25 m pistol qualification range with 16 firing points spaced along the range floor width of 150 ft. Paper silhouette targets on wooden frames are located 25 m from the firing line and a berm backstop is located approximately 50 ft behind the targets. NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Historical Ammunition Use at J Range

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	.45 caliber Frangible	.40 caliber	.38 caliber	9mm	12 gauge
2004	2	4,064	0	0	0	0	0	0	0
2003	2	8,876	0	0	0	0	0	0	0
2002	3	7,520	2,600	0	0	0	0	4,200	0
2001	3	3,488	3,203	0	0	0	0	0	0
2000	4	1,100	8,800	0	0	0	0	3,000	0
1998	0	0	0	0	0	0	0	0	0
1997		0	0	0	0	0	10,250	11,020	620
1996		0	0	23,840	265	39,150	17,575	35,002	6,580
1995		0	0	19,676	0	0	16,575	95,775	1,555
1994		0	0	17,725	25,000	135	2,620	16,482	4,875
TOTAL		**25,048**	**12,003**	**61,241**	**25,265**	**39,285**	**47,020**	**165,479**	**13,630**
AVG		2,505	1,200	6,124	2,527	3,929	4,702	16,548	1,363

J Range Fact Sheet

Environmental Setting

Fired rounds were found evenly spread across the backstop with only slight evidence of erosion in and around bullet pockets. Inspection of the backside of the berm revealed projectile fragments, indicating the possibility of ricochet or overshot.

No storm water controls are in place on J Range. Wind breaks are present around the range along with a high percentage of vegetative cover on the range floor. There was no standing water or significant erosion visible on the floor or the berm. The range is located more than 15,000 ft south of water supply wells on the installation.

Recommended Best Management Practices

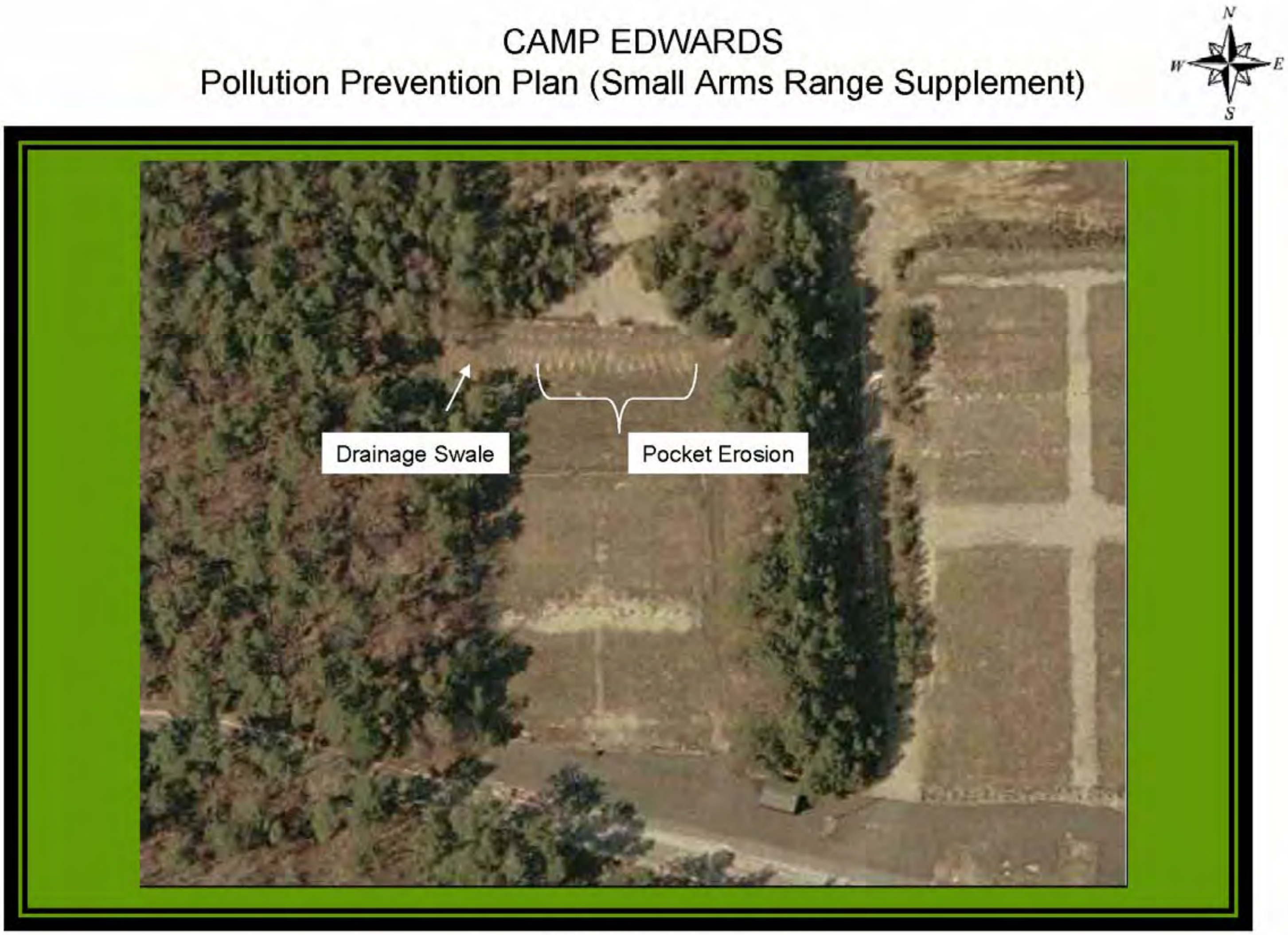
1. Camp Edwards intends to implement the Enhanced Soil Berm Design BMP and evaluate, through the Metals Monitoring BMP, how lead can be managed in a soil berm at Camp Edwards.

2. There is also a potential for Camp Edwards to acquire additional bullet containment system equipment from other military installations where the equipment was undergoing demonstration and validation. MANG has been in discussion with another U.S. Army installation to accept a deceleration-type bullet containment system. This type of system accepts small arms fire through a long steel plate assembly that funnels round toward a chamber that resembles the shell of a snail. Once bullets enter the chamber they revolve around in it until they lose energy and drop into collection chamber below. These types of systems can support oblique fire and ammunition up to and including .50 caliber. If acquired, Camp Edwards may install this bullet containment system at either J or K Range.

3. All other appropriate operational, administrative, and design BMPs may also be implemented on J Range, including, but not limited to, land contouring, vegetation, SOPs, and pH adjustment.

J Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Aerial Photo: J Range

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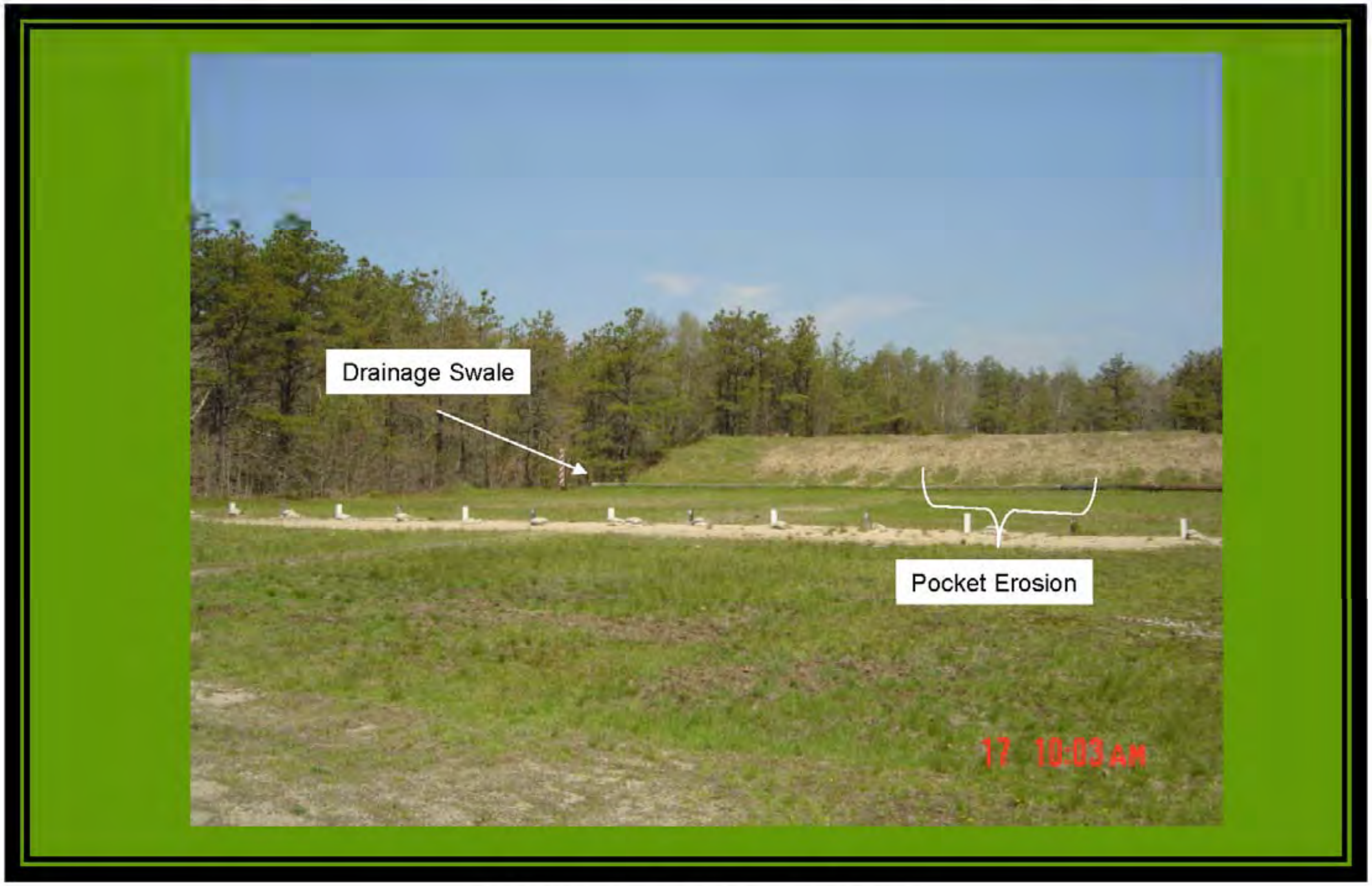
J Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Overview Photo: J Range

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K Range Fact Sheet

Kilo Range

Located at Forrestdale/Pocasset Road

Proposed Use

The future intended use for K Range is to continue as a 25M Rifle and Machine Gun Zero Range for both M16 rifle and the M249 and M240 machine guns. Zeroing is one of the most basic and universal training tasks for small arms marksmanship. K Range may act as an alternate to J Range, as both of these ranges can also be used as alternate ranges to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols.

Weapon	Caliber
Pistol (all calibers)	5.56 Tungsten-Nylon
	5.56 Plastic
	5.56 Lead
	9mm
Machine Gun	.40 caliber
	.38 caliber
	.45 caliber Frangible
Shotgun	12 gauge

Historical Use

K Range is located directly north of Pocasset-Forestdale Road, east of J Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. K Range has been used as a 25 m pistol qualification range with 16 firing points spaced along the range floor width of 200 ft. Paper silhouette targets on wooden frames are located 25 m from the firing line and a berm backstop is located approximately 60 ft behind the targets.

Historical Ammunition Use at K Range

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	.45 caliber Frangible	.40 caliber	.38 caliber	9mm	12 gauge
2004	3	2,320	0	0	0	2,150	0	2,000	0
2003	2	840	0	0	0	0	0	2,300	0
2002	5	12,240	0	0	0	0	0	4,200	0
2001	2	2,400	0	0	0	0	0	1,482	0
2000	2	1,100	9,500	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1997		0	0	9,960	0	21,792	0	21,250	1,846
1996		0	0	18,627	10,900	28,800	5,550	33,235	10,400
1995		0	0	17,564	560	38,600	17,800	24,780	2,050
1994		0	0	3,610	6,900	200	33,092	19,900	4,175
TOTAL		**18,900**	**9,500**	**49,761**	**18,360**	**91,452**	**56,442**	**109,147**	**18,471**
AVG		1,890	950	4,976	1,836	9,145	5,644	10,915	1,847

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

K Range Fact Sheet

Environmental Setting

Fired rounds were found evenly spread across the backstop with only slight evidence of erosion on the backslope of the berm. Inspection of the backside of the berm also revealed projectile fragments, indicating the possibility of ricochet or overshot. Some small rocks were located on the berm surface within and around the bullet pockets, which may be responsible for some of the bullet ricochet.

No storm water controls are in place on K Range. Wind breaks are present around the range along with a high percentage of vegetative cover on the range floor. There was no standing water or significant erosion visible on the floor and only slight erosion on the backslope of the berm. The range is located more than 15,000 ft south of water supply wells on the installation.

Recommended Best Management Practices

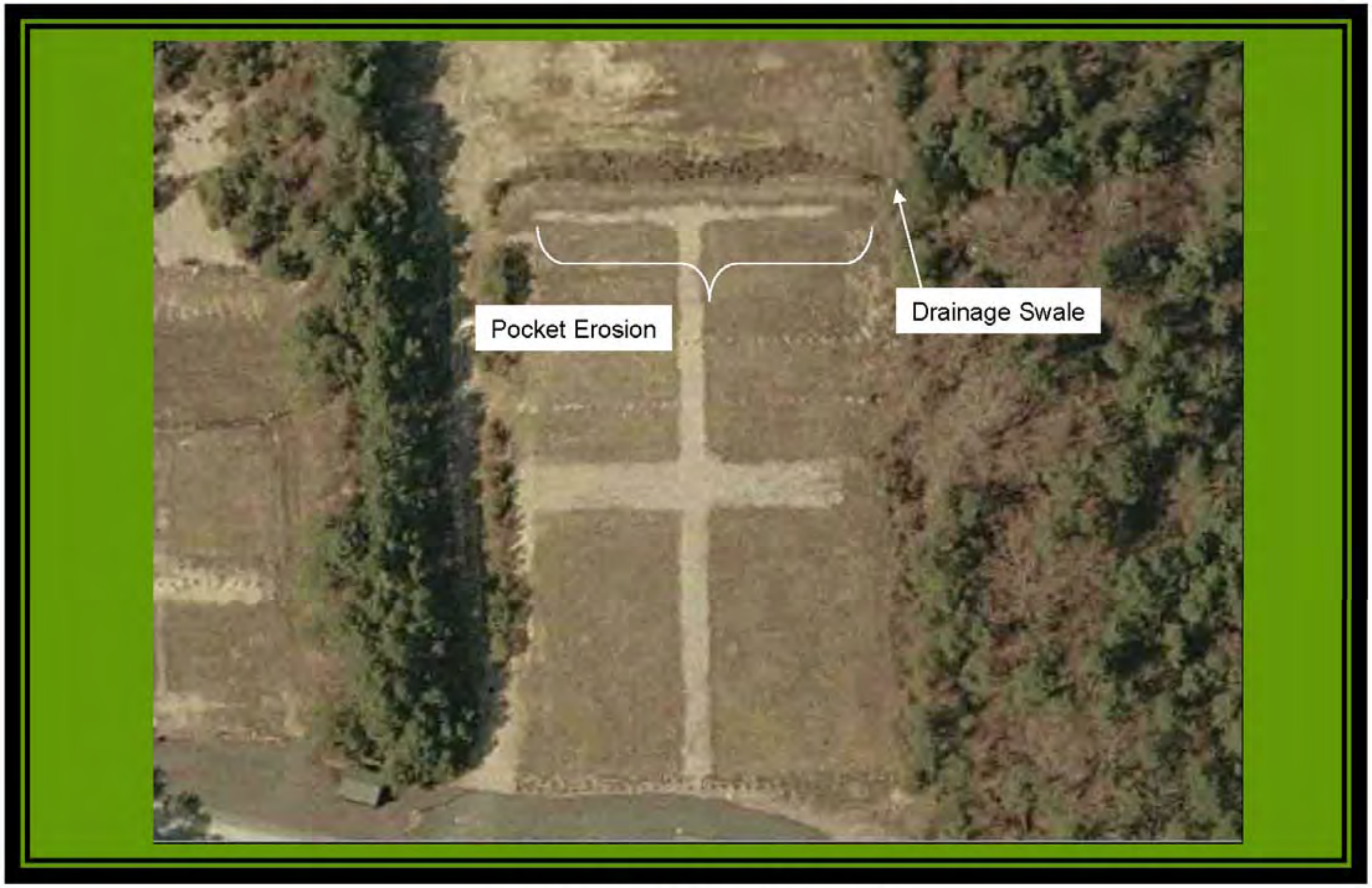
1. Camp Edwards intends to implement the Enhanced Soil Berm Design BMP and evaluate, through the Metals Monitoring BMP, how lead can be managed in a soil berm at Camp Edwards.

2. There is also a potential for Camp Edwards to acquire additional bullet containment system equipment from other military installations where the equipment was undergoing demonstration and validation. MANG has been in discussion with another U.S. Army installation to accept a deceleration-type bullet containment system. This type of system accepts small arms fire through a long steel plate assembly that funnels round toward a chamber that resembles the shell of a snail. Once bullets enter the chamber they revolve around in it until they lose energy and drop into collection chamber below. These types of systems can support oblique fire and ammunition up to and including .50 caliber. If acquired, Camp Edwards may install this bullet containment system at either J or K Range.

3. All other appropriate operational, administrative, and design BMPs may also be implemented on K Range, including, but not limited to, land contouring, vegetation, SOPs, and pH adjustment.

K Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Aerial Photo: K Range

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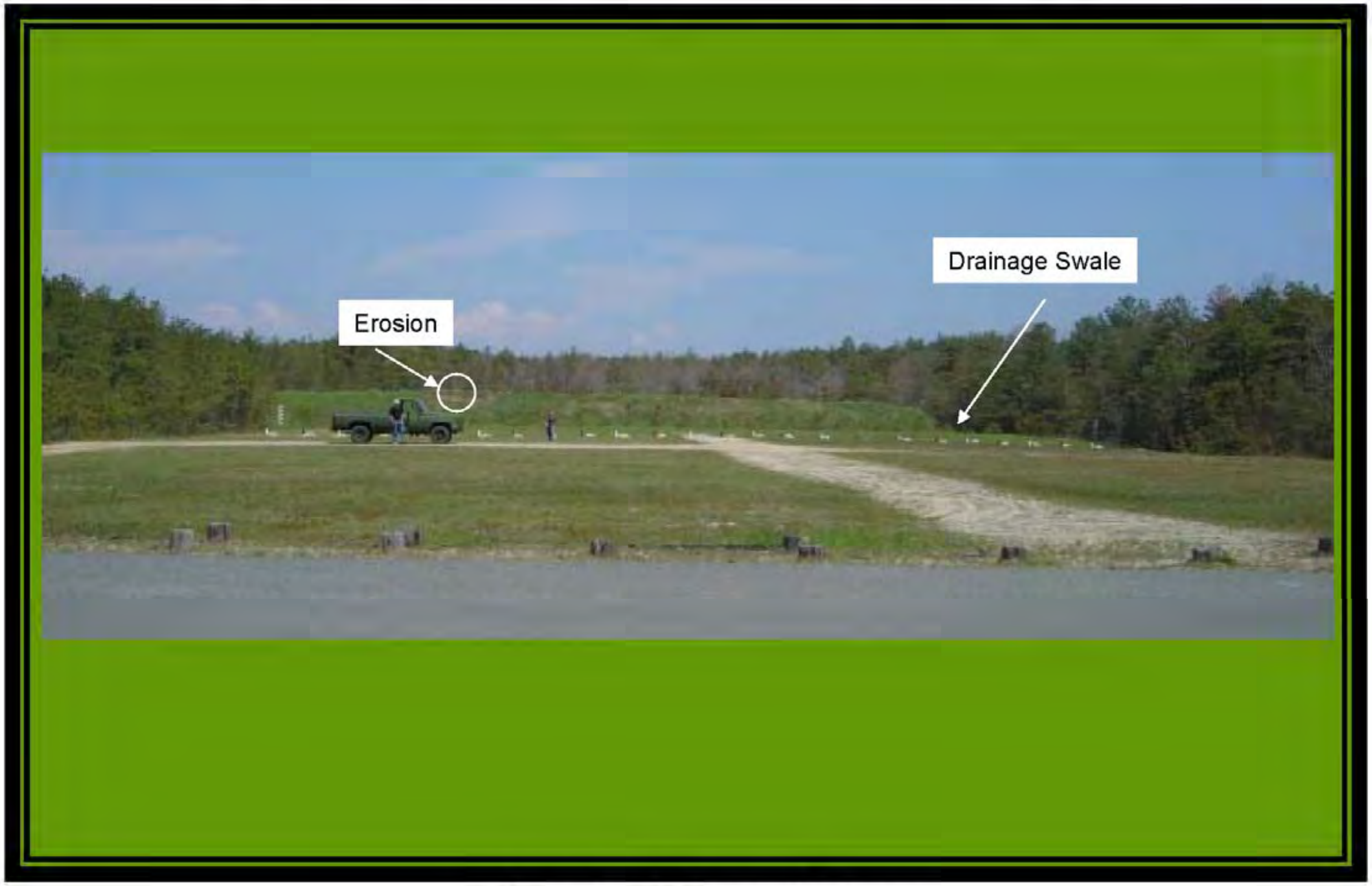
K Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Overview Photo: K Range

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KD Range Fact Sheet

Known Distance Range

Located in South Range Area at Forrestdale/Pocasset Road

Proposed Use

In the future Camp Edwards intends to use KD Range to serve multiple purposes. The east side of KD Range will continue to be used as a Known Distance Range and will support 10- and 25-m zero for machine gun and rifle. It may also support, in a limited capacity, machine gun marksmanship (e.g., familiarization and practice marksmanship) for the SAW M249, M240, M60, and M2. There are no current plans to modernize and resume firing on the west side of KD Range.

Authorized Weapon Systems	Ammunition
Pistol	All calibers
Machine Gun	.50 caliber, .45 caliber
Rifle	7.62mm
Shotgun	12 gauge

Historical Use

Historically, KD Range has been a multipurpose range for small arms marksmanship and firing of the Dragon missile, TOW missile, LAW rocket, 40mm grenade launchers, and 90mm recoilless rifle. Currently, KD Range is divided into two subparts with two distinct firing line/target configurations and two distinct training uses. On the west side of the range, four stations are situated at the firing line. Each station, or firing point, engages infantry targets at 100 yards, 200 yards, and 300 yards (from the station). The east side of the range has 5 firing lines each with 25 firing positions. The five firing lines are located on firing position berms at known distances from a single set of targets. The firing lines are at 100 yards, 200 yards, 300 yards, 300 m, and 600 yards. Each of the firing lines is intended to engage targets placed above a large soil berm located approximately 600 yards from the initial firing line. Target frames designed to raise and lower targets are still present behind the soil berm but are in disrepair. NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Historical Ammunition Use at KD Range

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62mm Lead	.50 caliber Plastic	.45 caliber Frangible	.38 caliber	9mm	40mm	12 gauge
2004	12	37,763	0	0	0	0	0	0	0	240	0
2003	9	12,655	100	0	0	200	0	0	0	0	0
2002	3	6,720	9,910	0	0	0	0	0	0	0	0
2001	1	1,000	0	0	0	0	0	0	0	0	0
2000	1	0	4,800	0	0	0	0	0	0	0	0
1998	4	0	15,210	0	0	0	0	0	0	0	0
1997		0	0	11,159	140	0	0	0	0	0	0
1996		0	0	44,642	5,292	0	0	1,425	0	0	0
1995		0	0	129,684	17,250	0	1,141	550	2,750	0	510
1994		0	0	123,587	24,119	0	0	0	2,300	0	0
TOTAL		**58,138**	**30,020**	**309,072**	**46,801**	**200**	**1,141**	**1,975**	**5,050**	**240**	**510**
AVG		5,814	3,002	30,907	4,680	20	114	198	505	24	51

KD Range Fact Sheet

Environmental Setting

On the west side of the range, all four stations are overgrown with pine trees that obstruct line-of-sight to the targets. Debris found in the vicinity of the infantry targets, bunkers, and mock building façade included expended 40mm target practice projectiles. Debris found in the vicinity of the tactical vehicle hulk included expended practice rockets, 40mm target practice projectiles, expended 40mm pyrotechnics rounds, and assorted scrap metal debris.

On the east side of the range, some of the firing position berms had expended 40mm target practice projectile fragments, expended small arms cartridge casings, rocks, overgrowth, and erosion. There is a single large earthen berm on the north end of the east side of KD Range, 600 yards from the initial firing line. Behind this berm is a set of target lifter mechanisms for raising and lowering target frames for engagement from each of the known distance firing lines. These lifters are in disrepair. The placement of these targets above the berm would lend itself to the distribution of bullets into the heavily vegetated areas behind the target berm.

Storm water swales are not evident on the range; this is a flat straight range. MANG placed the tungsten-contaminated soil removed from both B and C Ranges on the left side of KD Range. The soil was formed in the shape and configuration of a berm or elongated mound and covered on all sides with geotextile to prevent further potential leaching of tungsten into groundwater.

Recommended Best Management Practices

1. Design BMPs:

- The position of the existing targets may be moved from the top to the base of the target berm. Continued use of the targets in their current position would encourage distribution of bullets over a relatively large area behind the target berm. Moving the targets to the base of the berm will concentrate fire and bullet impact into the berm face and lend itself to bullet containment and management.
- The firing lines may be elevated either through the addition and grading of fill soil or by the construction of elevated firing platforms. The firing lines should be raised to the degree necessary to direct the angle of fire to the new target locations at the base of the target berm while maintaining line-of-sight over subsequent firing stations.
- An enhanced soil berm or other bullet containment system may be installed in the current earthen berm, which will continue to serve as the backstop for the eastern portion of the modernized KD Range.

2. Camp Edwards can maintain vegetative cover and a stable neutral pH on KD Range to control metals migration. Camp Edwards may also implement the Metals Monitoring BMP through the use of lysimeters, groundwater monitoring wells, and soil sampling. Based on the results, periodic metals removal may also be necessary on KD Range.

3. Camp Edwards will also implement other appropriate operational and administrative BMPs from the SAR P2 Overview Plan.

KD Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)

Aerial Photo: KD Range

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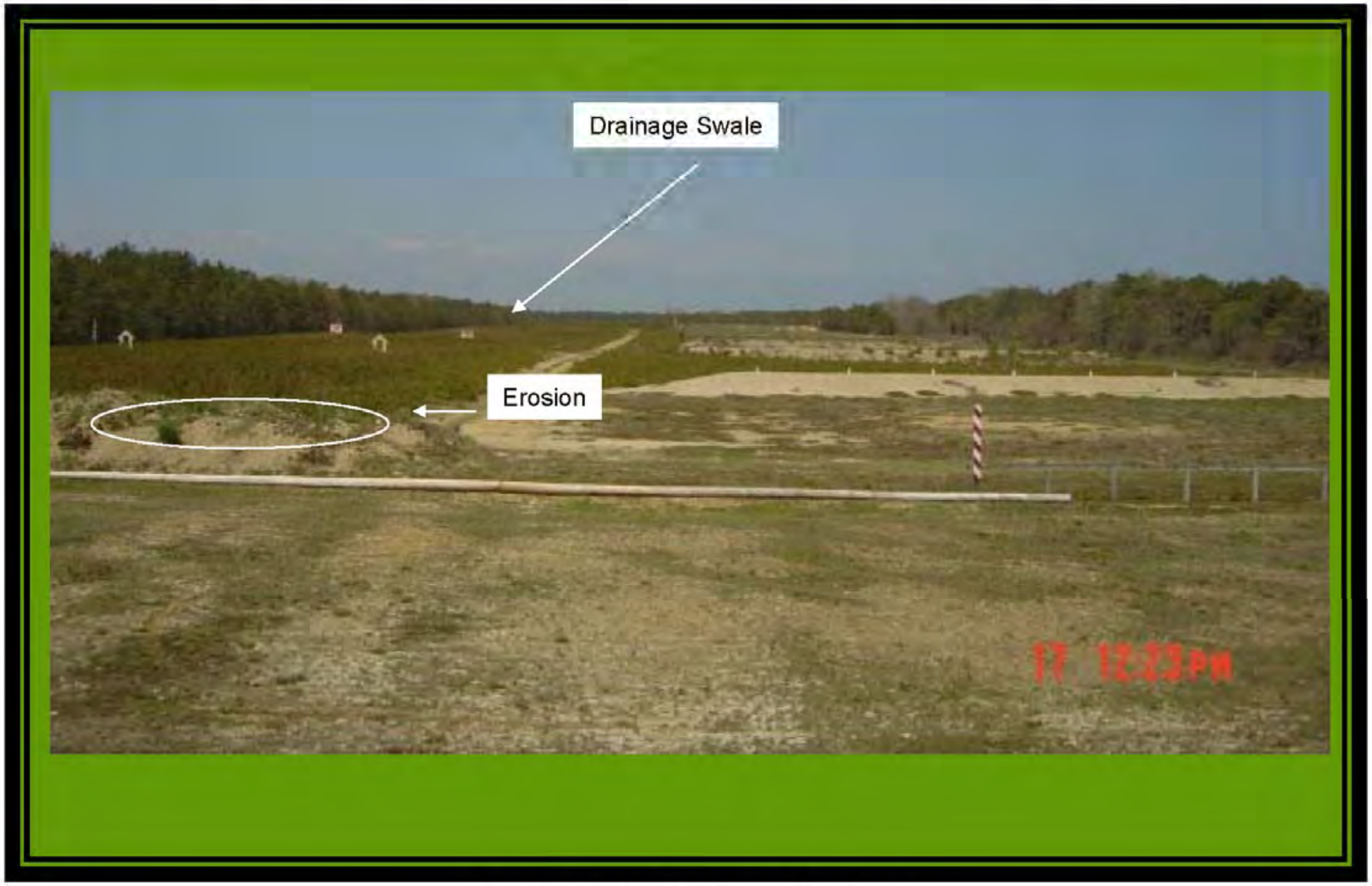
KD Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Overview Photo: KD Range

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S Complex Fact Sheet

Sierra Range Complex

Located at Gibbs Road

Proposed Use

Camp Edwards began a project to upgrade the existing computer system (both hardware and software) and replace targets on both of the five-lane ranges. The project evolved into combining the ranges into a single 10-lane range with a new computer system, new targets, a new tower, a set of bleachers, and a pavilion. The extensive upgrade is designed to create an Automated Record of Fire Range and to align the range with current U.S. Army small arms training standards. In its future intended use as a Modified Record of Fire Range, soldiers will engage new pop-up infantry targets for set time intervals at distances of 100, 125, 150, 200, 250, and 300 m from the firing lines.

Authorized Weapon Systems	Ammunition
Machine gun	.50 caliber lead
	7.62mm lead
	5.56mm Tungsten and lead
Pistol	9mm

Historical Use

Historically, S West and S East ("Sierra Range Complex") functioned as two separate machine gun transition ranges. Each had five firing lanes to engage infantry pop-up targets out to 800 m. Mounded firing points exist at both ranges: five at S East Range along the 280-ft long firing line and five at S West Range along the 200-ft long firing line. A series of targets are spaced between 100 and 800 m downrange from the firing points. Neither range has a backstop. To combine these separate ranges into one complex, construction started with removing and regrading a utility corridor that supported the two separate five-lane ranges. Additionally, new trench lines will be dug to support the electronics of the range. To ensure range construction meets the EPSs, all soil used for the project will come from within MMR; any reseeding will be a native seed mix; and the range will be monitored for invasive species and those species removed if found. NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Historical Ammunition Use at S Ranges

Sierra East

Training Year	Training Days	5.56mm Tungsten	5.56mm Lead	7.62mm Lead	.50 caliber Lead	9mm
2004	2	8,480	0	0	0	0
2003	2	10,800	0	0	0	0
2002	3	12,754	0	0	0	0
2001	1	600	0	0	0	0
2000	2	27,227	0	0	0	0
1998	0	0	0	0	0	0
1997		0	0	28,730	0	0
1996		0	0	3,360	75,765	0
1995		0	3,640	49,878	0	0
1994		0	33,370	87,087	0	250
TOTAL		59,861	37,010	169,055	75,765	250
AVERAGE		5,986	3,701	16,906	7,577	25

S Complex Fact Sheet

Sierra West

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62mm Lead	.50 caliber Lead
2004	6	27,260	0	0	0	0
2003	4	9,200	0	0	0	0
2002	3	13,554	0	0	0	0
2001	1	600	0	0	0	0
2000	0	0	0	0	0	0
1998	0	0	0	0	0	0
1997		0	0	0	0	0
1996		0	0	0	0	55,060
1995		0	0	4,720	34,550	0
1994		0	0	10,941	67,860	0
TOTAL		50,614	0	15,661	102,410	55,060
AVERAGE		5,061	0	1,566	10,241	5,506

Environmental Setting

At the time of the evaluation, this range complex was under construction; therefore, it was difficult to identify storm water swales and runoff. This large range does have tree breaks on all boundaries, but wind may redirect off-range those projectiles that reach beyond 200 m from the firing lines.

Recommended Best Management Practices

1. Camp Edwards intends to implement all appropriate generally applicable BMPs to include, where feasible, some variation of the Improved Soil Berm BMP or the Bullet Containment System BMP.

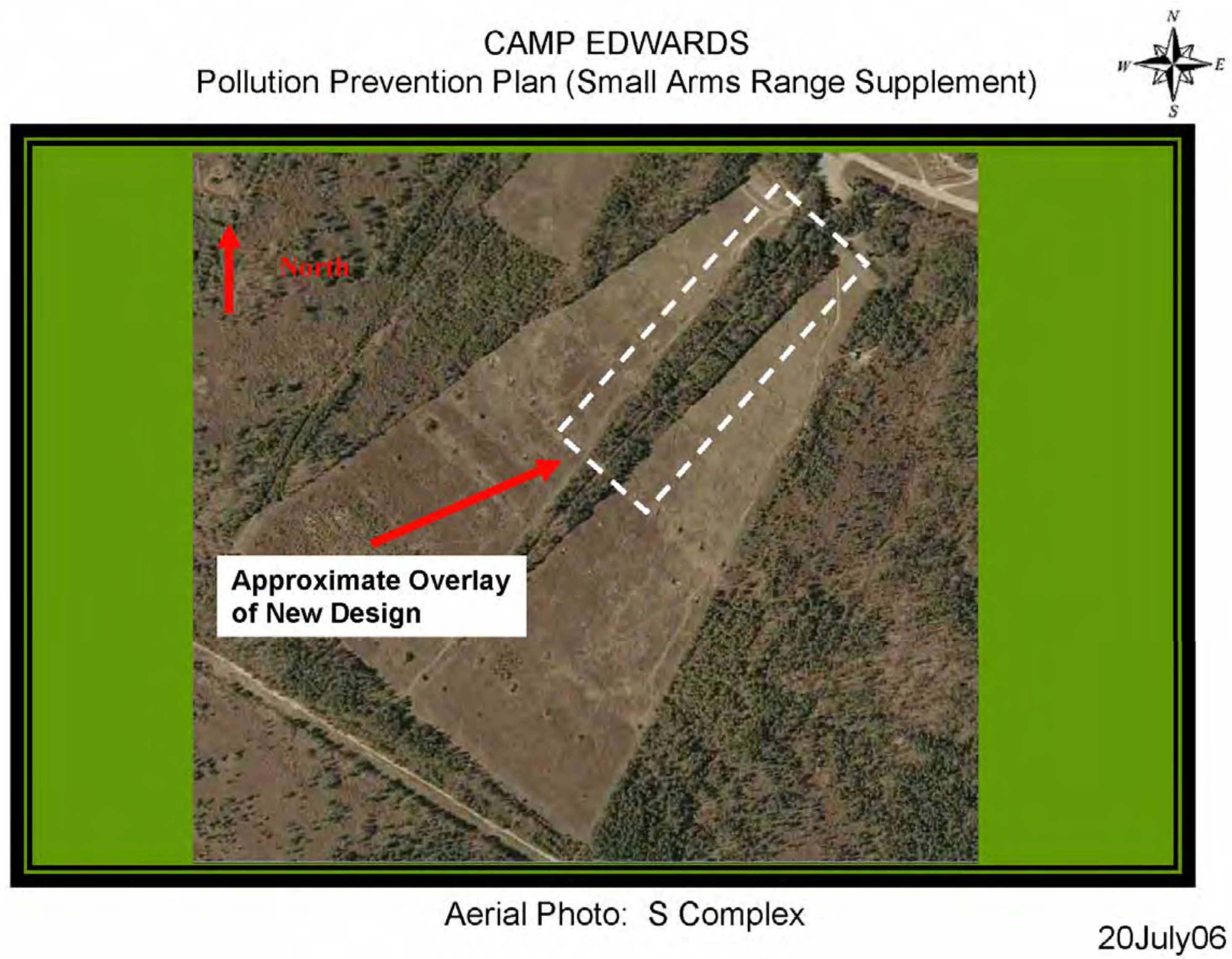
2. They should also implement metals monitoring and, based on these results, may conduct periodic metals removal. Final BMP selection will be made in coordination with EMC and other stakeholders.

3. Design BMPs: Placement of bullet containment berms/structures behind these targets limits line-of-sight to subsequent targetry.

- One option for overcoming this challenge is to elevate the firing line on the S Complex to allow soldiers to engage longer range targets over the tops of the bullet containment systems emplaced behind shorter range targets.
- Another option is to widen the firing lanes on S Complex to allow the staggered placement of targets and minimize the overlaps in line-of-sight among shorter and longer range targets.

Detailed range design drawings (to include proposed bullet containment structures) and a line-of-sight analysis are necessary to select the optimal option, or combination or options. Number and placement of targets and corresponding bullet containment devices should be optimized based on trade-offs between training requirements supported and line of sight constraints. Construction or installation of bullet containment devices will be undertaken based on the results of an appropriately designed metals monitoring program. Elevation of firing line and range target emplacements/bullet containment systems will offset some line of sight concerns.

S Complex Fact Sheet



S Complex Fact Sheet

CAMP EDWARDS

Pollution Prevention Plan (Small Arms Range Supplement)

Overview Photo: S Complex

00June06

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T Range Fact Sheet

Tango Range

Located in North Range Area at Gibbs Road

Proposed Use

Recently, Camp Edwards installed a granular rubber (i.e., STAPP ™) bullet containment system on T Range. The system is 100 × 30 ft and provides bullet containment for 15 firing lanes. T Range will be used primarily for zeroing the 5.56mm rifle and 7.62mm machine gun. T Range can also be used as an alternate range for M16 qualification using scaled targets. Scaled targets simulate firing at a longer range by using reduced image size and perspective. It is also possible that T Range will serve as an alternate range for training on all calibers (.22, .357, .38, .40, 9mm, .45, .44) of pistols. Law enforcement using T Range will most frequently fire .38, .40, 9mm, and .45 caliber pistols, while military pistol fire will likely be limited to 9mm. Camp Edwards plans to construct additional troop support facilities (i.e., bleachers and a pavilion for mess, ammunition issue, and weapon breakdown/cleaning) within the current parking areas of T Range.

Authorized Weapon Systems	**Ammunition**
Pistol	All calibers
Machine Gun	7.62mm, M16
Rifle	5.56mm

Historical Use

T Range is a standard 25M Rifle and Machine Gun Zero Range (FCC 17801) for both M16 rifle and the M249 and M240 machine guns. T Range can also be used as an alternate range to conduct many other training tasks with the M16 rifle, as well as all calibers of pistols. In the late 1980s, T Range was an assault course where only blank ammunition was used. In 1990 or 1991, MAARNG began firing the .50 caliber M2 machine gun on T Range. This range has two firing lines. The first firing line is 250 ft long and consists of 6 large (approximately 22 × 40 × 8 ft) mounds, on top of which are 2 foxholes each, totaling 12 elevated machine gun firing positions. In the middle of the six mounds, next to the range tower, Camp Edwards hardened a maintenance trail to allow for mounted machine gun firing. The second firing line is 144 ft long with 20 pistol firing positions and sits 50 ft in front of the machine gun firing positions. Recently, Camp Edwards installed a granular rubber (i.e., STAPP ™) bullet containment system on T Range. The system is 100 × 30 ft and provides bullet containment for 15 firing lanes. The system contains an 18-in. granular rubber berm face, a self-healing rubber membrane cover, a synthetic lumber frame, an impermeable liner, and an internal water collection reservoir. NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

T Range Fact Sheet

Historical Ammunition Use at T Range

Training Year	Training Days	5.56 mm Tungsten	.50 caliber Plastic	.45 caliber Frangible	.40 caliber	.38 caliber	9mm	12 gauge
2004	3	6,370	0	0	0	0	0	0
2003	4	10,057	200	0	0	0	0	0
2002	6	8,400	5,800	3,880	3,000	0	1,800	250
2001	12	3,200	4,000	3,351	34,847	0	12,201	0
2000	0	0	0	0	0	0	0	0
1998		0	18,520	0	0	0	0	0
1997		0	13,535	0	0	0	0	0
1996		0	2,025	0	0	0	0	0
1995		0	0	0	0	0	0	0
1994		0	6,400	0	0	0	1,080	0
TOTAL		**28,027**	**50,480**	**7,231**	**37,847**	**0**	**15,081**	**250**
AVG		2,803	5,048	723	3,785	0	1,508	25

Environmental Setting

Historically at T Range, soldiers engaged paper targets placed on wooden target holders placed 600 ft from the machine gun firing line. There is little visual evidence of tree damage beyond the old targets from the impact of projectiles occurring prior to installation of the current berm. Numerous plastic projectiles were found on the range floor. The range floor shows some signs of erosion with multiple swales that allow surface water flow from the east side of the firing points downrange toward the west side of the targets. Current target holders are placed 25 m downrange from the pistol firing positions.

Recommended Best Management Practices

1. Bullet Containment System BMP: The system contains all the features recommended in the bullet containment system BMP described in Section 6, including an 18–in. granular rubber berm face, a self-healing rubber membrane cover, a synthetic lumber frame, an impermeable liner, and an internal water collection reservoir. The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs conducted. Camp Edwards will develop a maintenance schedule for system repairs, removing water from the collection reservoir, and periodic separation of the lead from the granular rubber matrix based on conditions observed over the first year of full-scale use.

2. Camp Edwards will periodically collect and sample the precipitation that accumulates in the reservoir within the STAPP ™ system. Based on the results of this sampling, Camp Edwards will dispose of the water appropriately. Maintenance of the STAPP system may include periodic repair or replacement of sections of the rubber membrane cover that become perforated and ineffective.

3. Camp Edwards will implement each of the appropriate operational and administrative BMPs.

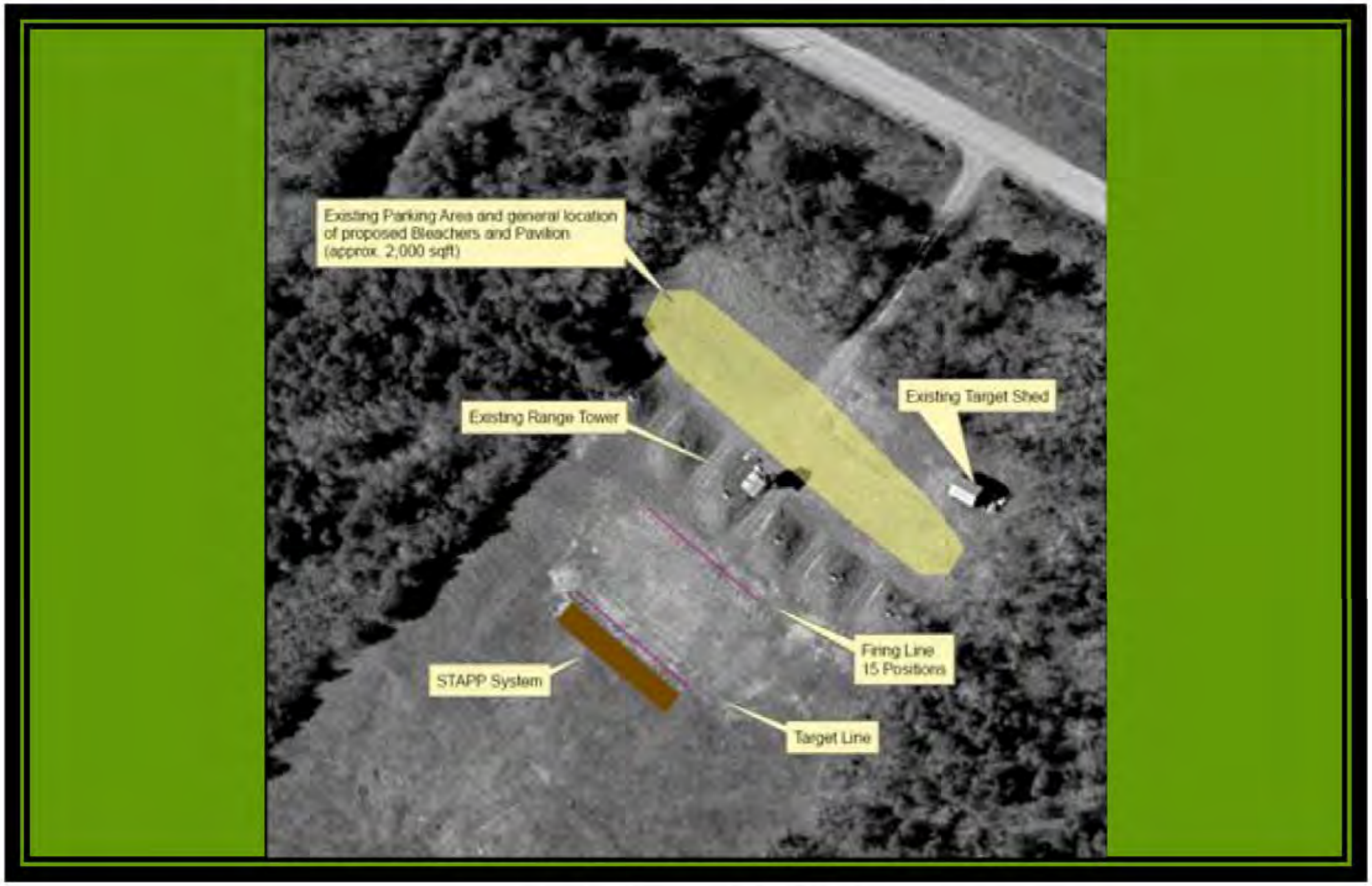
4. As part of the Metals Monitoring BMP, Camp Edwards will install a groundwater monitoring well downgradient and lysimeters in soil under the toe of the bullet containment system. If lead from the ammunition is not contained by the system and dissolved lead begins to percolate through the pore water toward the aquifer, the lysimeters provide an early warning. All sampling and analysis will be coordinated with EMC.

5. Camp Edwards will plant and maintain appropriate vegetative cover on the soil berm areas around the bullet containment system as well as the range floor to reduce erosion.

6. Camp Edwards has placed target frames in positions to concentrate projectile impacts into the bullet containment system and to allow access to the system for maintenance.

T Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)



Aerial Photo: T Range

00June06

T Range Fact Sheet

CAMP EDWARDS
Pollution Prevention Plan (Small Arms Range Supplement)

Overview Photo: T Range

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Appendix D

OPERATIONAL AND ENVIRONMENTAL ASSESSMENTS

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CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Alpha **Assessment Date:** 18May06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☐

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☐ No ☒
   Note: No drawings existed for A Range.

2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☐ Deterioration ☐ Note: No drawings existed for A Range.

Berm Design

1. Are berm lengths greater than lengths of total shooting positions? Yes ☒ No ☐
   This range allows for firing of vehicle-mounted .50 cal machine guns, which can fire outside the area of the berm.

2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☒ No ☐
   This range allows for firing of vehicle-mounted .50 cal machine guns, which can fire outside the area of the berm.

3. Do fired rounds impact into berms while standing and while prone? Yes ☒ No ☐
   Firing is done from vehicle-mounted machine guns or prone. Gun barrels are physically constrained when firing prone by metal bars that inhibit both elevation and traverse to help ensure rounds impact the berm.

4. Do fired rounds impact berms at top, center, or bottom? Top ☒ Center ☒ Bottom ☒

5. Are distances between berms and targets short enough to prevent overshot? Yes ☐ No ☒

6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☒ No ☐

7. Are berms built into hillsides? Yes ☒ No ☐

8. What are berm slope angles? Front angle = 30–40 degrees Back angle = 0 degrees

9. Are slope angles uniform or variable? Uniform ☐ Variable ☒

10. Are slope angles in high use areas similar to those angles in low use areas? Yes ☐ No ☒

11. Berm Face Length = 30 feet

12. Berm Height = 20 feet

13. Berm Width = 165–200 feet

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe:
   Copper jackets were found on top of the berm. Plastic bullets were found all over the range floor.

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe:
   Significant erosion is evident at the berm. Several trees are falling onto the range due to erosion of the soil beneath them. Other trees have exposed root balls due to erosion.

3. Are many fired rounds visible on berm backslopes? Yes ☒ No ☐

4. Is there ample room in front of berms to extend slope forward? Yes ☒ No ☐

5. How many feet of space are available (without crowding target areas)? Feet = ≥20

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☒ Even Spread ☐

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒
   The visible bullets were plastic.

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒
   The visible bullets were plastic.

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs, and describe:
   Large rocks (larger than a human fist) were evident all over the berm. Several trees were falling into the berm area due to erosion.

Floor Design

1. Floor length from shooting position to toe of berm = 1,025–1,050 feet

2. Floor width = 80–200 feet

3. Do floors slope away from firing points? Yes ☒ No ☐

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool? Yes ☒ No ☐
   If "Yes", note location on range sketch and take photographs.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
   Yes ☐ No ☒
   If "No", indicate location on range sketch, take photographs, and describe:
   Large rocks (larger than a human fist) were evident throughout the range floor area. Trees and shrubs are also located on the range floor, as well as a packed earth road.

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☐ No ☐ N/A ☒

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or nonflowing streambeds? Distance = 3,300 feet

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   A Range was constructed in the mid-1970s and has been used since that time for as an M2 (.50 cal) machine gun range. Both .50 cal ball and plastic rounds have been fired at this range. Firing lead ammunition was suspended in the late 1990s.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, A Range was used to train soldiers. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at A Range.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☒ No ☐

5. Identify the historic use of the range using the tables below.

Weapon	Caliber	Total Rounds	Years in Use
.50 cal machine gun	.50 cal Plastic	14,497	2002–2004

Training Year	Training Days	.50 cal Plastic	.50 cal Lead
2004	3	8,400	0
2003	3	800	0
2002	2	5,297	0
2001	3	2,700	0
2000	2	6,900	0
1998	3	4,735	0
1997		11,800	0
1996		0	21,094
1995		0	31,473
1994		0	32,430
		40,632	**84,997**
AVG		4,063	8,500

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, A Range is used to train soldiers using bullets that fire plastic projectiles.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March
4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Identify the current use of the range using the table below.

Weapon	Caliber	Rounds/Year	Days in Use/Week
.50 cal machine gun	.50 cal Plastic	0	0

6. Are alternate ranges available to accomplish similar missions? Yes ☒ No ☒

7. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

8. Which lanes are used most often? Lane Numbers:
   There are only three firing points: two for dismounted and one for mounted machine guns.

9. What type of targets are used?
   Targets used on A Range include paper targets on wooden frames.

Future Use

1. What is the future anticipated use of the range?
   As of Spring 2006, Camp Edwards is considering a convoy training range to start at A Range's northern maintenance road that runs alongside the targets and backstops.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☐ Decrease ☐ NA ☒

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☐ No ☒

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.
   If A Range becomes a convoy training range, the use of machine guns may be limited, if used at all.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Is the range slated for reconfiguration? Yes ☐ No ☒

8. Are footprints likely to change? Yes ☐ No ☒

9. Is the range slated for modernization? Yes ☐ No ☒

If "Yes", describe the modernization.
If A Range becomes a convoy training range, its modernization may include removable pop-up targetry in accordance with the range designs in TC 25-8. The TC 25-8 standard design will be modified to fit the current footprint and train Guard and Reserve units accordingly.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of observation towers, sheds, target holders, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush are also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? <u>As needed.</u>

3. What major repairs have been completed to maintain the range?
   A Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

4. Has lead been recovered from the range? Yes ☒ No ☐ When?
   A Range was part of the 1998 MMR Berm Maintenance Program in which recyclable metals were removed.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   A Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazards and dispositioned through Defense Reutilization and Marketing Office (DRMO).

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = approximately 100 feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet   Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? Approximately northwest.

Surfacewater/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range. Wood Road is a gravel road that runs the length of the range from firing points to the berm area. Contours of the road's shoulders act as swales for storm water runoff.

2. What are the drainage patterns/characteristics?
   Soil on A Range has a high sand content and high permeability, which allows rapid surface water and storm water infiltration. Significant erosion was visible on the range floor alongside Wood Road and at the range berm.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☒ No ☐

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   A wetland is located approximately 5,900 ft to the northwest of the A Range berm.

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 6,600 feet

9. Are there man-made structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? Approximately 10–25 %

2. What percentage of the berm surface is vegetated? Approximately 0 %

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☒ No ☐

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☐ No ☒ NA ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
    If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Plymouth-Barnstable complex, rolling, very bouldery

2. What is the soil pH? ______

3. What are background lead concentrations? ______ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☒ No ☐
   If "Yes", take photographs, locate range sketch and describe below.
   Significant erosion was visible on the range floor alongside Wood Road and at the range berm.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒
4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐
2. Are high wind speeds and gusts common? Yes ☒ No ☐
3. Do trees or natural features block wind from ranges? Yes ☒ No ☐
4. What is mean annual snowfall? Approximately 33.9 inches
5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches
6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 1	Date: 5/17/06
Direction Photo Taken: N/A	
Description: Ammunition found on backstop	

Photo No. 2	Date: 5/17/06
Direction Photo Taken: Targetry to Firing Point	
Description: Back view of the targets	

PHOTOGRAPHIC LOG		
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 3	**Date:** 5/17/06
Direction Photo Taken: N/A	
Description: Backstop	

Photo No. 4	**Date:** 5/17/06
Direction Photo Taken: Backstop, left	
Description: Backstop slope erosion	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
5	5/17/06

Direction Photo Taken:
Backstop, middle

Description:

Backstop slope erosion

Photo No.	Date:
6	5/17/06

Direction Photo Taken:
Backstop, right

Description:

Backstop slope erosion

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
7	5/17/06

Direction Photo Taken:
Backstop to firing points

Description:

Barren field in front of backstop

Photo No.	Date:
8	5/17/06

Direction Photo Taken:
Backstop to firing points

Description:

Barren vegetation in front of berms

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 9 | **Date:** 5/17/06

Direction Photo Taken:
Firing points

Description:

Concrete pad for mounted machine gun fire

Photo No. 10 | **Date:** 5/17/06

Direction Photo Taken:
Maintenance road to firing points

Description:

Erosion from parking lot and firing points

URS		PHOTOGRAPHIC LOG
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 11	**Date:** 5/17/06
Direction Photo Taken: Firing points	
Description: Firing points with gun mount	

Photo No. 12	**Date:** 5/17/06
Direction Photo Taken: Berms to firing points	
Description: Version 1	

URS	**PHOTOGRAPHIC LOG**

Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 13	**Date:** 5/17/06

Direction Photo Taken:
Berms to firing points

Description:

Version 2

Photo No. 14	**Date:** 5/17/06

Direction Photo Taken:
Parking lot

Description:

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 15	Date: 5/17/06
Direction Photo Taken: Maintenance Road	
Description: Erosion	

Photo No. 16	Date: 5/17/06
Direction Photo Taken: Second backstop	
Description: Left	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
17	5/17/06

Direction Photo Taken:
Second Backstop

Description:

Right

Photo No.	Date:
18	5/17/06

Direction Photo Taken:
Second Backstop

Description:

Erosion

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 19	Date: 5/17/06

Direction Photo Taken:
Targets to backstop

Description:

Targets

Photo No. 20	Date: 5/17/06

Direction Photo Taken:
Top of backstop

Description:

Top of backstop to the right

PHOTOGRAPHIC LOG		
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 21	**Date:** 5/17/06
Direction Photo Taken: Targets to backstop	
Description: Vegetation behind the targets	

CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Echo **Assessment Date:** May 17, 2006

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☐

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐
2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☒ Deterioration ☐

Berm Design

1. Are berm lengths greater than lengths of total shooting positions? Yes ☐ No ☒
   There is no berm constructed on the northernmost firing positions. The range is currently undergoing modernization. It is assumed that a berm will be constructed for all firing positions.
2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☐ No ☒
   There is no berm constructed on the northernmost firing positions. The range is currently undergoing modernization. It is assumed that a berm will be constructed for all firing positions.
3. Do fired rounds impact into berms while standing and while prone? Yes ☒ No ☐
4. Do fired rounds impact berms at top, center, or bottom? Top ☐ Center ☒ Bottom ☒
5. Are distances between berms and targets short enough to prevent overshot? Yes ☐ No ☒
6. Are distances between berms and targets great enough to accommodate mowers? Yes ☒ No ☐
7. Are distances between berms and targets great enough to accommodate and earthmoving equipment? Yes ☐ No ☒

8. Are berms built into hillsides? Yes ☒ No ☐

9. What are berm slope angles? Front angle = 21 degrees Back angle = _____ degrees

10. Are slope angles uniform or variable? Uniform ☒ Variable ☐

11. Are slope angles in high use areas similar to those angles in low use areas? Yes ☐ No ☒

12. Berm Face Length = 15 feet

13. Berm Height = 16 feet

14. Berm Width = 400 feet

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Yes ☐ No ☒

4. Is there ample room in front of berms to extend slope forward? Yes ☐ No ☒

5. How many feet of space are available (without crowding target areas)?
   It is difficult to determine available space because the range is under construction.

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☐ Even Spread ☐ NA ☒
   No rounds are visible because the range is under construction.

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs, and describe:

Floor Design

1. Floor length from shooting position to toe of berm = _____ feet.
   Not applicable; under construction.

2. Floor width = 400 feet.

3. Do floors slope away from firing points? Yes ☐ No ☒
   This is a move and shoot range, so there are no fixed firing points.

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒
   Not applicable; under construction.

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool?
   If “Yes”, note location on range sketch and take photographs.
   Not applicable; under construction.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
   Yes ☒ No ☐
   If “No”, indicate location on range sketch, take photographs, and describe:

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☒ No ☐ N/A ☐

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or nonflowing streambeds? Distance = <u>3,300</u> feet

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   E Range was built between 1986 and 1989. It is located on Burgoyne Road and has historically been used to train soldiers in the use of pistols and shotguns. An Administrative Order suspended the firing of lead ammunition. Plastic bullets have been used as a replacement for lead.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, E Range was used to train soldiers in the use of pistols. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at E Range.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☒ No ☐

5. Identify the historic use of the range using the table below.

Training Year	Training Days	.45 cal Frangible	.40 cal	.38 cal	9mm Frangible	12 gauge
2004	2	0	0	0	16,000	0
2003	0	0	0	0	0	0
2002	0	0	0	0	0	0
2001	0	0	0	0	0	0
2000	4	1,030	3,200	0	450	0
1998	0	0	0	0	0	0
1997	4	0	2,380	0	5,394	0
1996		0	9,380	11,406	12,783	0
1995		6,100	18,000	1,750	42,925	0
1994		7,867	240	3,981	47,100	400
		14,997	33,200	17,137	124,652	400
AVERAGE		1,500	3,320	1,714	12,465	40

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   E Range is currently undergoing modernization for use as a combat pistol qualification range. The range is being reconstructed with new targets, upgraded berms, an after action reviewing area, a covered canteen, and new target controlling equipment.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = <u>November through March</u>

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Identify the current use of the range using the table below. E Range is currently undergoing a modernization project and is not being used.

6. Are alternate ranges available to accomplish similar missions? Yes ☐ No ☒

7. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

8. Which lanes are used most often? Lane Numbers: <u>Unable to identify most often used lanes because the range is under construction.</u>

9. What type of targets are used?
   Targets used on E Range will include pop-up infantry targets.

Future Use

1. What is the future anticipated use of the range?
   According to the 2006 RTLP, E Range is being upgraded to a Combat Pistol Qualification Course. At the time of the site visit, E Range was under construction, with new targets being installed along with range facilities, including a canteen area and after action review area.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☒ No ☐

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.

E Range is currently undergoing modernization for use as a combat pistol qualification range. The range is being reconstructed with new targets, upgraded berms, an after action reviewing area, a covered canteen, and new target controlling equipment.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance will include upkeep of the observation tower, shed, target holders, the covered canteen, and range boundary markers. Targets will be replenished when needed. Mowing of grass and cutting of brush will be conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? As needed.

3. What major repairs have been completed to maintain the range? None

4. Has lead been recovered from the range? Yes ☒ No ☐
   When? E Range was part of the 1998 MMR Berm Maintenance Program.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   E Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated. In situ processing was not required at E Range based upon pre-excavation and post-excavation sample data meeting the established project performance criteria.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = <u>approximately 100</u> feet

2. How deep is groundwater below the concentrated areas? Depth = <u>100 </u>feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet   Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? <u>Northwest</u>

Surface Water/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. Because of the construction, many areas were eroded and swale drainage patterns were evident. Swales direct water from the top of the backstop and berms onto the range floor. Water flows from the range floor to the parking lot along berms and at multiple firing points.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☒ No ☐

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range. But under these construction conditions, the site drains from the backstop, along the berms into the parking lot, and down to the range entrance.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas? Distance = 4,300 feet The western boundary is approximately 4,300 ft east of Little Halfway Pond.

7. Are training missions or maintenance efforts altered due to wet or muddy conditions? Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 5,300 feet

9. Are there manmade structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? Approximately 0 % This is due to the current construction efforts at E Range.

2. What percentage of the berm surface is vegetated? Approximately 0 % This is due to the current construction efforts at E Range.

3. Is vegetation sufficiently abundant to provide realistic training conditions? No. This is due to the current construction efforts at E Range.

4. Is vegetation mowed sufficiently to promote target visibility? No. This is due to the current construction efforts at E Range.

5. Is vegetation native or imported? Not applicable.

6. Are storm water channels and swales vegetated? Yes ☒ No ☐

7. Are down-gradient areas well vegetated? Yes ☐ No ☒

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
    If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Sandy

2. What is the soil pH? ______

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☒ No ☐
   If "Yes", take photographs, locate range sketch and describe below.
   At the time of the site visit, range construction and recent heavy rainfall significantly eroded the range backstop, berms, and floor.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately <u>33.9</u> inches

5. What is the average 2 year 24 hour storm event? Approximately <u>1.29</u> inches

6. What is the monthly rainfall average? Approximately <u>4.0</u> inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 1	Date: 5/22/06	
Direction Photo Taken:		
Description: Toe of backstop		

Photo No. 2	Date: 5/22/06	
Direction Photo Taken:		
Description: Left side of range, along backstop		

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 7	Date: 5/22/06

Direction Photo Taken:

Description:

Top of backstop to parking lot

Photo No. 8	Date: 5/22/06

Direction Photo Taken:
Top of backstop to toe

Description:

Pockets

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CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: ISBC **Assessment Date:** 16 May 06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☐

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes No ☒
   Camp Edwards was not able to locate design or construction drawings for ISBC.

2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☐ Deterioration ☐
   The lack of drawings makes it difficult to determine whether changes are due to modification or deterioration.

Berm Design

This range does not have a standard berm. It has a hill upon which two sandbagged bunkers are used as training objectives. Some of the following questions are not applicable to ISBC.

1. Are berm lengths greater than lengths of total shooting positions? Not applicable.

2. Do rounds fired from the outside shooting lanes impact the berms? Not applicable.

3. Do fired rounds impact into berms while standing and while prone? Yes ☐ No ☐
   Not applicable.

4. Do fired rounds impact berms at top, center, or bottom? Top ☐ Center ☐ Bottom ☐
   Not applicable.

5. Are distances between berms and targets short enough to prevent overshot? Not applicable because objectives are at the top of a hill.

6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☐ No ☐
   Not applicable.

7. Are berms built into hillsides? Yes ☐ No ☐
   Not applicable.

8. What are berm slope angles? Front angle = _degrees Back angle = _degrees
   Not applicable.

9. Are slope angles uniform or variable? Uniform ☐ Variable ☒
   The angle of the objective hill is variable.

10. Are slope angles in high use areas similar to those angles in low use areas? Not applicable

11. Berm Face Length = Not applicable.

12. Berm Height = Not applicable.

13. Berm Width = Not applicable.

Berm Operations

This range does not have a standard berm. It has a hill upon which two sandbagged bunkers are used as training objectives. Some of the following questions are not applicable to ISBC.

1. Is there evidence of undershot? Yes ☐ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe:
   There was visual evidence of superficial damage to trees and shrubs by projectile impact.

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☐No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Yes ☐ No ☒

4. Is there ample room in front of berms to extend slope forward? Yes ☒ No ☐

5. How many feet of space are available (without crowding target areas)? The toe of the objective hill could be moved dozens of feet without impacting the stability of the hill or the quality of the training.

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Not applicable.

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒ Plastic bullets.

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒ Plastic bullets.

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☒ No ☐
   If "Yes", indicate location on map, take photographs and describe below:
   Rocks, trees, and shrubs are located throughout the range and objective hill area. Some of the larger rocks were spray painted orange presumably to warn soldiers not to fire into the rocks to minimize ricochet.

Floor Design

1. Floor length from shooting position to toe of berm. Not applicable. This is a move and shoot range.

2. Floor width = 500–800 feet

3. Do floors slope away from firing points? Not applicable.

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Not applicable.

6. Are low spots evident where water is likely to pool? Yes ☒ No ☐
   If "Yes", note location on range sketch and take photographs.
   The range floor is sandy soil, and despite the heavy rain event before the site visit, there were no pools on the range floor.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
   Yes ☐ No ☒
   If "No", indicate location on range sketch, take photographs, and describe:
   Rocks, trees, and shrubs are located throughout the range and objective hill area. Some of the larger rocks were spray painted orange presumably to warn soldiers not to fire into the rocks to minimize ricochet.

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☐ No ☐ N/A ☒

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or nonflowing streambeds? Distance = 3,200 feet The objectives on ISBC are approximately 3,200 ft southeast of Gibbs Pond.

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   ISBC was established around 1980 to train small unit tactics. It was also used for various assault training, rifle training, grenade launcher training, and as a machine gun transition range.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, ISBC was used to train soldiers in small unit tactics such as assaulting and defending an objective. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at ISBC. Since the suspension of lead ammunition, plastic and tungsten-nylon ammunition have been used at ISBC.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☐ No ☒

5. Identify the historic use of the range using the table below.

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62mm Lead	9mm	40mm Target Practice
2004	0	0	0	0	0	0	0
2003	5	18,685	0	0	0	0	0
2002	4	22,160	0	0	0	0	0
2001	3	500	500	0	0	0	0
2000	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0
1997		0	0	15,317	0	0	0
1996		0	0	21,792	22,400	0	75
1995		0	0	42,068	2,900	150	0
1994		0	0	40,748	1,798	0	647
		41,345	500	119,925	27,098	150	722
AVERAGE		4,135	50	11,993	2,710	15	72.2

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, ISBC is used to train soldiers in small unit tactics such as assaulting and defending dug-in emplacements. Since the Administrative Order suspending firing of lead ammunition, plastic and tungsten-nylon ammunition is used.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Are alternate ranges available to accomplish similar missions? Yes ☐ No ☒

6. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

7. Which lanes are used most often? Not applicable because this is a move and shoot range.

8. What type of targets are used? Sandbagged fighting positions are used as targets on ISBC.

Future Use

1. What is the future anticipated use of the range?
   According to the 2006 RTLP, Camp Edwards wants to upgrade ISBC to a squad and platoon combined arms offensive/defensive live fire range.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐ NA ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☒ No ☐

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of the observation tower, trails, and sangbagged objectives. Mowing of grass and cutting of brush are also conducted on an as needed basis. ISBC requires natural vegetation to facilitate training of small unit movement and communication techniques, so mowing and brush clearing are kept to a minimum.

2. How often is routine maintenance completed? As needed.

3. What major repairs have been completed to maintain the range? None.

4. Has lead been recovered from the range? Yes ☐ No ☒

5. Has berm footprint changed? No berm.

6. How are removed berm soils managed? Not applicable.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = <u>approximately 100</u> feet

2. How deep is groundwater below the concentrated areas? Depth = <u>100</u> feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet   Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? <u>Northwest</u>

Surface Water/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The range floor is well vegetated, and natural drainage swales were observed all over the floor, flowing from the objective down toward the floor of the range. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. No standing water was visible on the range, although some standing water was observed in tire ruts on a maintenance road that runs along the eastern border of ISBC. Erosion was observed along the swales.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☒ No ☐

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas? Distance = 3,200 feet The objectives on ISBC are approximately 3,200 ft southeast of Gibbs Pond.

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 11,200 feet

9. Are there manmade structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? 100%

2. What percentage of the berm surface is vegetated? 95%

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Not applicable as this is a move and shoot range.

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☒ No ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities?
Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Sandy

2. What is the soil pH? _____

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☐ No ☒
   If "Yes", take photographs, locate range sketch and describe below.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately <u>33.9</u> inches

5. What is the average 2 year 24 hour storm event? Approximately <u>1.29</u> inches

6. What is the monthly rainfall average? Approximately <u>4.0</u> inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 61	Date: 5/22/06
Direction Photo Taken:	
Description: Mid range to Objective 1	

Photo No. 62	Date: 5/22/06
Direction Photo Taken:	
Description: North facing slope from Objective 1	

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
65	5/22/06

Direction Photo Taken:
Objective 1 slope

Description:

Orange paint on rocks

Photo No.	Date:
66	5/22/06

Direction Photo Taken:
Parking lot

Description:

Standing water from recent rain event

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 67	Date: 5/22/06
Direction Photo Taken:	
Description: Slope to Objective 1	

Photo No. 68	Date: 5/22/06
Direction Photo Taken:	
Description: Storm water gulley along slope from Objective 1	

CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Juliet **Assessment Date:** 18May06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☒

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐

2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☐ Deterioration ☒

Berm Design

1. Are berm lengths greater than lengths of total shooting positions? Yes ☒ No ☐

2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☒ No ☐

3. Do fired rounds impact into berms while standing and while prone? Yes ☒ No ☐

4. Do fired rounds impact berms at top, center, or bottom? Top ☒ Center ☒ Bottom ☒

5. Are distances between berms and targets short enough to prevent overshot? Yes ☒ No ☐

6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☒ No ☐

7. Are berms built into hillsides? Yes ☐ No ☒

8. What are berm slope angles? Front angle = 20–25 degrees

9. Are slope angles uniform or variable? Uniform ☒ Variable ☐

10. Are slope angles in high use areas similar to those angles in low use areas? Yes ☐ No ☒

11. Berm Face Length = 130 feet

12. Berm Height = 8 feet

13. Berm Width = 130 feet

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe: Inspection of the backside of the backstop revealed projectile fragments.

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Yes ☒ No ☐
   Inspection of the backside of the backstop revealed projectile fragments.

4. Is there ample room in front of berms to extend slope forward? Yes ☐ No ☒

5. How many feet of space are available (without crowding target areas)? Feet = 0

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☐ Evenly Spread ☒

7. Are visible bullets fragmented? Yes ☒ No ☐

8. Are visible bullets oxidized? Yes ☒ No ☐

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs, and describe:

Floor Design

1. Floor length from shooting position to toe of berm = 130 feet

2. Floor width = 150 feet

3. Do floors slope away from firing points? Yes ☐ No ☒

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool? Yes ☐ No ☒
   If "Yes", note location on range sketch and take photographs.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet? Yes ☒ No ☐
   If "No", indicate location on range sketch, take photographs, and describe:

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☐ No ☐ N/A ☒

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or non-flowing streambeds?
    Distance = Approximately 3,000 feet northwest.

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   J Range was constructed in the late 1980s and used as a pistol range. The range is located on Pocasset-Forestdale Road.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, J Range was used to train soldiers pistol marksmanship. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at J Range. Currently, plastic or tungsten-nylon projectiles are used for training.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☒ No ☐

5. Identify the historic use of the range using the table below.

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	.45 cal Frangible	.40 cal	.38 cal	9mm	12 gauge
2004	2	4,064	0	0	0	0	0	0	0
2003	2	8,876	0	0	0	0	0	0	0
2002	3	7,520	2,600	0	0	0	0	0	0
2001	2	2,400	0	0	0	0	0	1,482	0
2000	2	1,100	9,500	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0
1997		0	0	9,960	0	21,792	0	21,250	1,846
1996		0	0	18,627	10,900	28,800	5,550	33,235	10,400
1995		0	0	17,564	560	38,600	17,800	24,780	2,050
1994		0	0	3,610	6,900	200	33,092	19,900	4,175
		23,960	12,100	49,761	18,360	89,392	56,442	100,647	18,471
AVG		2,396	1,210	4,976	1,836	8,939	5,644	10,065	1,847

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, J Range is used as a 25-m pistol qualification range with 16 firing points. Due to restrictions on firing lead ammunition, plastic and tungsten-nylon bullets are used for training.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March
4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Identify the current use of the range using the table below.

Weapon	Caliber	Rounds/Year	Days in Use/Week
Pistol (all calibers)	5.56 Tungsten Nylon	0	0
	5.56 Plastic	0	0
	5.56 Lead	0	0
	9mm	0	0
Machine Gun	.40 cal	0	0
	.38 cal	0	0
	.45 cal Frangible	0	0
Shotgun	12 gauge	0	0

6. Are alternate ranges available to accomplish similar missions? Yes ☒ No ☐

7. Do training loads necessitate use of entire range during typical sessions? Yes ☐ No ☒

8. Which lanes are used most often? Lane Numbers: 3–15

9. What type of targets are used?
   Targets used on J Range include paper silhouette targets on wooden frames.

Future Use

1. What is the future anticipated use of the range?
   According to the RTLP, in FY 2006, J Range will be upgraded as a 25-m familiarization and qualification range.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☐ No ☒

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.
   According to the RTLP, in FY 2006, J Range will be upgraded as a 25-m familiarization and qualification range.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of the observation tower, shed, target holders, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush is also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? <u>As needed.</u>

3. What major repairs have been completed to maintain the range?
   J Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

4. Has lead been recovered from the range? Yes ☒ No ☐ When?
   J Range was part of the 1998 MMR Berm Maintenance Program in which recyclable metals were removed.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   J Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = approximately 100 feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? Southwest

Surfacewater/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no storm water controls on J Range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. No standing water or significant erosion was visible on the range or range berms.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☐ No ☒

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the contours of the berms and terracing, as well as the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   Distance = approximately 4,600 feet

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = <u>approximately 15,200</u> feet

9. Are there man-made structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? Approximately <u>90</u> %

2. What percentage of the berm surface is vegetated? Approximately <u>20–30</u> %

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☒ No ☐

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☒ No ☐ NA ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
    If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? <u>Plymouth-Barnstable complex, rolling, very bouldery</u>

2. What is the soil pH? ______

3. What are background lead concentrations? ______ ppm

Soil Erosion

1. Is erosion evident on range berms? Yes ☒ No ☐
   If "Yes", take photographs, locate range sketch and describe below.
   There is no erosion evident on the range floor; however, there is slight evidence of erosion in and around the bullet pockets.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately 33.9 inches

5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches

6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
1	5/23/06

Direction Photo Taken:
Backstop back slope

Description:

Erosion

Photo No.	Date:
2	5/23/06

Direction Photo Taken:
Backstop back slope

Description:

Swale

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
3	5/23/06

Direction Photo Taken:
Backstop

Description:

Erosion

Photo No.	Date:
4	5/23/06

Direction Photo Taken:
Top of backstop to toe

Description:

Slope and pocket erosion

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 5	Date: 5/23/06

Direction Photo Taken:
Toe to slope of backstop

Description:

Slope and pocket erosion

Photo No. 6	Date: 5/23/06

Direction Photo Taken:
Parking lot to backstop

Description:

Firing points and left berm

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
7	5/23/06

Direction Photo Taken:
Right firing points to left

Description:

Firing points and left berm

Photo No.	Date:
8	5/23/06

Direction Photo Taken:
Range marker

Description:

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
9	5/23/06

Direction Photo Taken:
Range markers

Description:

Photo No.	Date:
10	5/23/06

Direction Photo Taken:
Parking lot to backstop

Description:

Right berm

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
11	5/23/06

Direction Photo Taken:
Right berm erosion

Description:

Photo No.	Date:
12	5/23/06

Direction Photo Taken:
Right berm erosion

Description:

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 13	Date: 5/23/06

Direction Photo Taken:
Toe of slope to left berm

Description:

CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Kilo **Assessment Date:** 18May06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☒

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐
2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☐ Deterioration ☒

Berm Design

1. Are berm lengths greater than lengths of total shooting positions? Yes ☒ No ☐
2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☒ No ☐
3. Do fired rounds impact into berms while standing and while prone? Yes ☒ No ☐
4. Do fired rounds impact berms at top, center, or bottom? Top ☒ Center ☐ Bottom ☐
5. Are distances between berms and targets short enough to prevent overshot? Yes ☐ No ☒
6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☒ No ☐
7. Are berms built into hillsides? Yes ☐ No ☒
8. What are berm slope angles? Front angle = 25 degrees
9. Are slope angles uniform or variable? Uniform ☒ Variable ☐
10. Are slope angles in high use areas similar to those angles in low use areas? Yes ☐ No ☒

11. Berm Face Length = 250 feet

12. Berm Height = 8 feet

13. Berm Width = 250 feet

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe: Inspection of the backside of the backstop revealed projectile fragments.

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Yes ☒ No ☐
   Inspection of the backside of the backstop revealed projectile fragments.

4. Is there ample room in front of berms to extend slope forward? Yes ☒ No ☐

5. How many feet of space are available (without crowding target areas)? Feet = 50

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☐ Evenly Spread ☒

7. Are visible bullets fragmented? Yes ☒ No ☐

8. Are visible bullets oxidized? Yes ☒ No ☐

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs, and describe: There are some small rocks on the berm surface within and around bullet pockets that may cause ricochet.

Floor Design

1. Floor length from shooting position to toe of berm = 250 feet

2. Floor width = 200 feet

3. Do floors slope away from firing points? Yes ☐ No ☒

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool? Yes ☐ No ☒
   If “Yes”, note location on range sketch and take photographs.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet? Yes ☒ No ☐
   If “No”, indicate location on range sketch, take photographs, and describe:

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☐ No ☐ N/A ☒

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or non-flowing streambeds?
    Distance = <u>Approximately 950 </u>feet southwest.

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   K Range was constructed in the late 1980s and used as a pistol range. The range is located on Pocasset-Forestdale Road.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, K Range was used to train soldiers in pistol marksmanship. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at K Range. Currently, plastic or tungsten-nylon projectiles are used for training.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☒ No ☐

5. Identify the historic use of the range using the table below.

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	.45 cal Frangible	.40 cal	.38 cal	9mm	12 gauge
2004	3	2,230	0	0	0	2,150	0	2,000	0
2003	2	840	0	0	0	0	0	2,300	0
2002	5	12,240	0	0	0	0	0	4,200	0
2001	3	3,488	3,203	0	0	0	0	0	0
2000	4	1,100	8,800	0	0	0	0	3,000	0
1998	0	0	0	0	0	0	0	0	0
1997		0	0	0	0	0	10,250	11,020	620
1996		0	0	23,840	265	39,150	17,575	35,002	6,580
1995		0	0	19,676	0	0	16,575	95,775	1,555
1994		0	0	17,725	25,000	135	2,620	16,482	4,875
		19,898	12,003	61,241	25,265	41,435	47,020	169,779	13,630
AVERAGE		1,990	1,200	6,124	2,527	4,144	4,702	16,978	1,363

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, K Range is used as a 25-m pistol qualification range with 16 firing points. Due to restrictions on firing lead ammunition, plastic and tungsten-nylon bullets are used for training.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Identify the current use of the range using the table below.

Weapon	**Caliber**	**Rounds/Year**	**Days in Use/Week**
Pistol (all calibers)	5.56 Tungsten Nylon	0	0
	5.56 Plastic	0	0
	5.56 Lead	0	0
	9mm	0	0
Machine Gun	.40 cal	0	0
	.38 cal	0	0
	.45 cal Frangible	0	0
Shotgun	12 gauge	0	0

6. Are alternate ranges available to accomplish similar missions? Yes ☒ No ☐

7. Do training loads necessitate use of entire range during typical sessions? Yes ☐ No ☒

8. Which lanes are used most often? Lane Numbers: Unable to tell due to range disuse.

9. What type of targets are used?
   Targets used on K Range include paper silhouette targets on wooden frames.

Future Use

1. What is the future anticipated use of the range?
   According to the RTLP, in FY 2006, K Range will be upgraded as a 25-m familiarization and qualification range.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☐ No ☒

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.
   According to the RTLP, in FY 2006, K Range will be upgraded as a 25-m familiarization and qualification range.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of the observation tower, shed, target holders, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush are also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? <u>As needed.</u>

3. What major repairs have been completed to maintain the range?
   K Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

4. Has lead been recovered from the range? Yes ☒ No ☐ When?
   K Range was part of the 1998 MMR Berm Maintenance Program in which recyclable metals were removed.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   K Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated in situ and ex situ with MAECTITE to chemically bond leachable lead to a stable mineral crystal form.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = approximately 100 feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? Southwest

Surfacewater/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no storm water controls on K Range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. No standing water or significant erosion was visible on the range or range berms.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☐ No ☒

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the contours of the berms and terracing, as well as the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   Distance = approximately 4,600 feet.

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = approximately 15,200 feet

9. Are there man-made structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? Approximately 80–90 %

2. What percentage of the berm surface is vegetated? Approximately 20–30 %

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☐ No ☒

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☐ No ☐ NA ☒

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
    If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Plymouth-Barnstable complex, rolling, very bouldery

2. What is the soil pH? _____

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range berms? Yes ☒ No ☐
   If "Yes", take photographs, locate range sketch and describe below.
   There is no erosion evident on the range floor; however, there is slight evidence of erosion on the backslope of the backstop.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately 33.9 inches

5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches

6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

	PHOTOGRAPHIC LOG	
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 1	**Date:** 5/23/06
Direction Photo Taken: Parking to range	
Description:	

Photo No. 2	**Date:** 5/23/06
Direction Photo Taken: Right to left of backstop toe	
Description:	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 3	Date: 5/23/06
Direction Photo Taken: Firing points to left berm	
Description:	

Photo No. 4	Date: 5/23/06
Direction Photo Taken: Right berm and marker	
Description:	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 5	**Date:** 5/23/06
Direction Photo Taken: Target holders	
Description:	

Photo No. 6	**Date:** 5/23/06
Direction Photo Taken: Target line	
Description:	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 7	Date: 5/23/06

Direction Photo Taken:
Top of backstop to parking lot

Description:

Photo No. 8	Date: 5/23/06

Direction Photo Taken:
Slope of backstop to toe

Description:

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 9 | **Date:** 5/23/06

Direction Photo Taken:
Behind target line to backstop

Description:

Tree damage

Photo No. 10 | **Date:** 5/23/06

Direction Photo Taken:
Behind target line to backstop

Description:

Tree damage

URS		PHOTOGRAPHIC LOG
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 11	**Date:** 5/23/06
Direction Photo Taken: Behind target line to backstop	
Description: Tree damage	

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CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: KD Range **Assessment Date:** 18 May 06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☐

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐
2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☐ Deterioration ☒

Berm Design

1. Are berm lengths greater than lengths of total shooting positions? Yes ☒ No ☐
2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☒ No ☐
3. Do fired rounds impact into berms while standing and while prone? Yes ☒ No ☐
4. Do fired rounds impact berms at top, center, or bottom? Top ☐ Center ☐ Bottom ☐
5. Are distances between berms and targets short enough to prevent overshot? Yes ☐ No ☒
6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☒ No ☐
7. Are berms built into hillsides? Yes ☐ No ☒
8. What are berm slope angles? Front angle = 20–25 degrees
9. Are slope angles uniform or variable? Uniform ☐ Variable ☒
10. Are slope angles in high use areas similar to those angles in low use areas? Yes ☐ No ☒

11. Berm Face Length = 24 feet

12. Berm Height = 10 feet

13. Berm Width = 180 feet

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☒ No ☐
   If “Yes”, indicate location on range sketch, take photographs and describe:
   There is no berm behind the targets at KD Range that would capture any fired rounds from the KD Range firing berms. The targets are located at the top of a constructed berm in a standard “target butt” configuration. None of the fired rounds that impact the target are stopped by a berm. KD Range is also used as a 25-m qualification range where the shooting position is the 600-m firing line. The target butt berm acts as a backstop for soldiers shooting 25-m qualification. With a berm that far away from the firing line, there is a high probability of overshot and undershot.

2. Are there indications of slope failures (like extensive soil on toes)? Yes ☐ No ☒
   If “Yes”, indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Yes ☒ No ☐

4. Is there ample room in front of berms to extend slope forward? Yes ☒ No ☐

5. How many feet of space are available (without crowding target areas)? Feet =
   Not applicable. Targets are positioned on top of the backstop in a “target butt” configuration. The targets are not located at the foot of the backstop.

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☐ Even Spread ☒

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☒ No ☐
   If “Yes”, indicate location on range sketch, take photographs, and describe:
   Rocks litter the tops of each berm on the right side of the range. The backstop on which the targets sit has multiple rocks on the slope.

Floor Design

1. Floor length from shooting position to toe of berm = 250–1,750 feet
   Floor width varied among each berm on the right side of the range.

2. Do floors slope away from firing points? Yes ☐ No ☒

3. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

4. Do floor gradients facilitate target visibility? Yes ☒ No ☐

5. Are low spots evident where water is likely to pool? Yes ☐ No ☒
   If "Yes", note location on range sketch and take photographs.

6. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
   Yes ☒ No ☐
   If "No", indicate location on range sketch, take photographs, and describe:

7. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☒ No ☐ N/A ☐

8. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

9. How far is the impact area from flowing or nonflowing streambeds? Distance = <u>3,100</u> feet

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   KD Range was built in the 1970s and has been used for training various weapons systems, including rifles, machine guns, the Dragon missile, TOW missile, LAW rocket, and 90mm recoilless rifle. An Administrative Order suspended the use of lead ammunition in the late 1970s. Ammunition used on KD Range after that date has been limited to plastic and tungsten-nylon small arms ammunition.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, KD Range was used to train soldiers to employ various weapons such as small arms and shoulder-fired rockets and missiles. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at KD Range. Currently, KD Range is used for small arms training using plastic and tungsten-nylon projectiles.

3. Has the range configurations changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☐ No ☒

5. Identify the historic use of the range using the table below.

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62m Lead	.50 cal Plastic	.45 cal Frangible	.38 cal	9mm	40mm	12 gauge
2004	12	37,763	0	0	0	0	0	0	0	240	0
2003	9	12,655	100	0	0	200	0	0	0	0	0
2002	3	6,720	9,910	0	0	0	0	0	0	0	0
2001	1	1,000	0	0	0	0	0	0	0	0	0
2000	1	0	4,800	0	0	0	0	0	0	0	0
1998	4	0	15,210	0	0	0	0	0	0	0	0
1997		0	0	11,159	140	0	0	0	0	0	0
1996		0	0	44,642	5,292	0	0	1,425	0	0	0
1995		0	0	129,684	17,250	0	1,141	550	2,750	0	510
1994		0	0	123,587	24,119	0	0	0	2,300	0	0
		58,138	30,020	309,072	46,801	200	1,141	1,975	5,050	240	510
AVERAGE		5,814	3,002	30,907	4,680	20	114	198	505	24	51

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, KD Range is used to train soldiers using bullets that fire plastic projectiles.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Are alternate ranges available to accomplish similar missions? Yes ☐ No ☒

6. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

7. Which lanes are used most often? Unknown because of disuse.

8. What type of targets are used?
   Targets on the west side of Range KD include stationary infantry silhouettes, mock building facades, gun emplacements with overhead protection, and a tactical vehicle hulk. Targets on the east side of KD Range include standard paper and cardboard stationary targets. Several large items including a U.S. Coast Guard boat, trailers, and a bus were observed behind the target butts on the east side of the range. It is possible that these items were intended for use as targets on the west side of the range.

Future Use

1. What is the future anticipated use of the range?
   According to the 2006 RTLP and discussion with Camp Edwards staff, there is a desire to reconfigure KD Range into a multi-purpose range that supports training for the M2 .50 cal machine gun, .50 cal heavy sniper rifle, and standard KD rifle and machine gun training.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐ NA ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☒ No ☐

8. Are footprints likely to change? Yes ☒ No ☐
   Addition of the capability to train with the .50 cal heavy sniper rifle will significantly increase the footprint of KD Range to accommodate the extreme range of the weapon system.

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of observation towers, sheds, target holders, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush are also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? As needed.

3. What major repairs have been completed to maintain the range? None.

4. Has lead been recovered from the range? Yes ☒ No ☐
   When? KD Range was part of the 1998 MMR Berm Maintenance Program.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   KD Range was part of the 1998 MMR Berm Maintenance Program during which berm material was removed and screened, recyclable metal segregated, and soil fines treated. In situ processing was not required at KD Range based upon pre-excavation and post-excavation sample data meeting the established project performance criteria.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = 100 feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet   Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? Southwest

Surface Water/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. No standing water or significant erosion was visible on the range or range berms.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☐ No ☒

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   Distance = 3,200 feet

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 15,200 feet

9. Are there manmade structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated?
   a. On the right side of the range are five berms leading up to the backstop on which the targets sit.
      i. Between Berms 1 and 2: Approximately 25%
      ii. Between Berms 2 and 3: Approximately 25%
      iii. Between Berms 3 and 4: Approximately 50%
      iv. Between Berms 4 and 5: Approximately 100%
      v. Between Berms 5 and the backstop: Approximately 100%

2. What percentage of the berm surface is vegetated?
   a. On the right side of the range are five berms leading up to the backstop on which the targets sit.
      i. Berm 1: Approximately 0%
      ii. Berm 2: Approximately 20%
      iii. Berm 3: Approximately 100%
      iv. Berm 4: Approximately 20%
      v. Berm 5: Approximately 100%
      vi. Backstop Approximately 20%

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☐ No ☒

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☒ No ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☒ No ☐

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
    If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Sandy

2. What is the soil pH? _____

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☒ No ☐
   If "Yes", take photographs, locate range sketch and describe below.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately 33.9 inches

5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches

6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 76	**Date:** 5/23/06
Direction Photo Taken: On Berm 4	
Description: Ammunition fragment	

Photo No. 77	**Date:** 5/23/06
Direction Photo Taken: Near tank on left side of range	
Description: Ammunition debris	

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 92 | **Date:** 5/23/06

Direction Photo Taken:
Left range

Description:

Station 1
Firing Point

Photo No. 93 | **Date:** 5/23/06

Direction Photo Taken:
Left range

Description:

Station 2
Firing Point

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 96	Date: 5/23/06
Direction Photo Taken: Left range	
Description: Tactical vehicle target	

Photo No. 97	Date: 5/23/06
Direction Photo Taken: Left range	
Description: Tactical vehicle target detail	

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No.	Date:
102	5/23/06

Direction Photo Taken:
Backstop back

Description:

Overgrown target lifters

Photo No.	Date:
103	5/23/06

Direction Photo Taken:
Backside of backstop

Description:

Overgrown target lifters

URS

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 112 | **Date:** 5/23/06

Direction Photo Taken:
Behind backstop

Description:

Trailer

Photo No. 113 | **Date:** 5/23/06

Direction Photo Taken:
Behind backstop

Description:

USCG boat

CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Sierra Complex **Assessment Date:** 17 May 2006

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☒

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐

2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☒ Deterioration ☐

Berm Design

There is no berm associated with the targets on either SE Range or SW Range. This is true for the historic range configuration, as well as the range design drawings used for the current range modernization project currently underway.

1. Are berm lengths greater than lengths of total shooting positions? Yes ☐ No ☒

2. Do rounds fired from the outside shooting lanes impact the berm? Yes ☐ No ☒

3. Do fired rounds impact into berms while standing and while prone? No berm.

4. Do fired rounds impact berms at top, center, or bottom? No berm.

5. Are distances between berms and targets short enough to prevent overshot? No berm.

6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? No berm.

7. Are berms built into hillsides? No berm.

8. What are berm slope angles? No berm.

9. Are slope angles uniform or variable? No berm.

10. Are slope angles in high use areas similar to those angles in low use areas? No berm.

11. Berm Face Length. No berm.

12. Berm Height. No berm.

13. Berm Width. No berm.

Berm Operations

1. Is there evidence of overshot, undershot, or ricochets? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs and describe:
   At the end of the constructed range, overshot was evident in the tree damage along the range boundary.

2. Are there indications of slope failures (like extensive soil on toes)? No berm.
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? No berm.

4. Is there ample room in front of berms to extend slope forward? No berm.

5. How many feet of space are available (without crowding target areas)? No berm.

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   No berm.

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Yes ☒ No ☐
   If "Yes", indicate location on range sketch, take photographs, and describe:
   Each target sits atop a berm. Those targets and berms farther back from the firing line, toward the range boundary, are made up of large rocks and soil. Some of these berms contained tree/shrub growth.

Floor Design

1. Floor length from shooting position to toe of berm. No berm.

2. Floor width = <u>150–900</u> feet

3. Do floors slope away from firing points? Yes ☐ No ☒

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool? Yes ☒ No ☐
If "Yes", note location on range sketch and take photographs.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
Yes ☒ No ☒
If "No", indicate location on range sketch, take photographs, and describe:
Less than 800 ft, there are rocks on the range floor. More than 800 ft from the firing points, the floor is covered in grass.

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
Yes ☒ No ☐ N/A ☐

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or nonflowing streambeds? Distance = 1,650 feet

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   Prior to the suspension of firing lead ammunition in the late 1990s, S Complex was used for rifle and machine gun training sites. The two ranges were constructed sometime between 1986 and 1989 at their current locations. Since then, both have been used as automatic rifle and machine gun transition ranges. Ammunition authorized for use at these ranges includes 5.56mm and 7.62mm ball tracer rounds. Mounded firing points exist at both ranges: five along SE Range along the 280 ft long firing line and six at SW Range along the 200 ft long firing line. A series of target berms are spaced between 100 and 800 m downrange from the firing points. No backstop berm exists at either range.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, S Complex was used to train soldiers. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at S Complex. This range is under construction.

3. Has the range configurations changed over time? Yes ☒ No ☐
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☒ No ☐

5. Identify the historic use of the range using the table below.

Sierra East

Training Year	Training Days	5.56mm Tungsten	5.56mm Lead	7.62mm Lead	.50 cal Lead	9mm
2004	2	8,480	0	0	0	0
2003	2	10,800	0	0	0	0
2002	3	12,754	0	0	0	0
2001	1	600	0	0	0	0
2000	2	27,227	0	0	0	0
1998	0	0	0	0	0	0
1997		0	0	28,730	0	0
1996		0	0	3,360	75,765	0
1995		0	3,640	49,878	0	0
1994		0	33,370	87,087	0	250
		59,861	37,010	169,055	75,765	250
AVERAGE		5,986	3,701	16,906	7,577	25

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Sierra West

Training Year	Training Days	5.56mm Tungsten	5.56mm Plastic	5.56mm Lead	7.62mm Lead	.50 cal Lead
2004	6	27,260	0	0	0	0
2003	4	9,200	0	0	0	0
2002	3	13,554	0	0	0	0
2001	1	600	0	0	0	0
2000	0	0	0	0	0	0
1998	0	0	0	0	0	0
1997		0	0	0	0	0
1996		0	0	0	0	55,060
1995		0	0	4,720	34,550	0
1994		0	0	10,941	67,860	0
		50,614	0	15,661	102,410	55,060
AVERAGE		5,061	0	1,566	10,241	5,506

NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Current Use

1. What is the current use of the range?
   Currently, S Complex is under construction.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Are alternate ranges available to accomplish similar missions? Yes ☒ No ☐

6. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

7. Which lanes are used most often? Not applicable; under construction.

8. What type of targets are used?
   Infantry pop-up targets will be used on the newly constructed S Complex.

Future Use

1. What is the future anticipated use of the range?
   According to the 2006 RTLP, S Complex is being upgraded for an Automated Record Fire Range, creating 10 firing lanes with electronic pop-up infantry targets.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☒ No ☐

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.
   S Complex is being upgraded to an Automated Record Fire Range, creating 10 firing lanes with electronic pop-up infantry targets.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of observation towers, sheds, target holders, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush are also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? As needed.

3. What major repairs have been completed to maintain the range? None.

4. Has lead been recovered from the range? Yes ☒ No ☐
   When? S Complex was part of the 1998 MMR Berm Maintenance Program.

5. Has berm footprint changed? Yes ☐ No ☒

6. How are removed berm soils managed?
   Berms that protect the targets' pop-up mechanisms were treated during the 1998 MMR Berm Maintenance Program, during which berm material was removed and screened, recyclable metal segregated, and soil fines treated. In situ processing was not required at S Complex based upon pre-excavation and post-excavation sample data meeting the established project performance criteria.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = _____ feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? North

Surface Water/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The site is under construction. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. Due to range construction, there were pools of standing water and erosion on the range.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range? No berm.

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   Distance = 5,300 feet

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 11,600 feet

9. Are there manmade structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? Approximately 100%

2. What percentage of the berm surface is vegetated? Target berms vegetation varied.

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☒ No ☐

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☒ No ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☒ No ☐
    If "Yes", take photographs and draw on range sketch.
    At the range boundary, multiple trees contain bullets and/or bullet damage.

Soil Characteristics

1. What is the soil type? Sandy

2. What is the soil pH? _____

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☐ No ☒
   If "Yes", take photographs, locate range sketch and describe below.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐

2. Are high wind speeds and gusts common? Yes ☒ No ☐

3. Do trees or natural features block wind from ranges? Yes ☒ No ☐

4. What is mean annual snowfall? Approximately 33.9 inches

5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches

6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 117	**Date:** 5/22/06
Direction Photo Taken:	
Description: Firing points	

Photo No. 118	**Date:** 5/22/06
Direction Photo Taken:	
Description: Firing points (right)	

PHOTOGRAPHIC LOG		
Client Name: MAARNG	**Site Location: Camp Edwards, Massachusetts**	**Project No.** 39455585

Photo No. 123	**Date:** 5/22/06
Direction Photo Taken:	
Description: Tree damage along range boundary	

Photo No. 124	**Date:** 5/22/06
Direction Photo Taken:	
Description: Tree damage detail	

CAMP EDWARDS POLLUTION PREVENTION PLAN
SMALL ARMS RANGE SUPPLEMENT
OPERATIONAL AND ENVIRONMENTAL ASSESSMENT

Range Name: Tango Range **Assessment Date:** 17 May 06

DESIGN ASSESSMENT

Available Maps (checkmark applicable types of maps)

Floodplain ☐ Watershed ☐ Topographic ☒ Final Construction ☐

Soil Type ☒ Shotfall ☐

Other ☒ underground plumes, roads, vegetation, groundwater contours, wetlands, monitoring plots, and wells.

Design Drawing Review

1. Does actual range construction closely resemble design drawings? Yes ☒ No ☐

2. Do differences between design and construction appear to result from design modifications or deterioration? Modification ☒ Deterioration ☐

Berm Design
There is no berm behind the targets at T Range.

1. Are berm lengths greater than lengths of total shooting positions?
   There is no berm at T Range.

2. Do rounds fired from the outside shooting lanes impact the berms? Yes ☐ No ☒
   There is no berm at T Range.

3. Do fired rounds impact into berm while standing and while prone? Yes ☐ No ☒
   There is no berm at T Range.

4. Do fired rounds impact berms at top, center, or bottom? Not applicable. There is no berm at T Range.

5. Are distances between berms and targets short enough to prevent overshot? Not applicable.

6. Are distances between berms and targets great enough to accommodate mowers and earthmoving equipment? Yes ☐ No ☒ There is no berm at T Range.

7. Are berms built into hillsides? Not applicable.

8. What are berm slope angles? Not applicable.

9. Are slope angles uniform or variable? Not applicable.

10. Are slope angles in high use areas similar to those angles in low use areas? Not applicable.

11. Berm Face Length = <u>No berm</u>

12. Berm Height = <u>No berm</u>

13. Berm Width = <u>No berm</u>

Berm Operations

1. Is there evidence of undershot? Yes ☐ No ☒
   If "Yes", indicate location on range sketch, take photographs and describe:
   Trees behind the targets are not protected by a berm. Some minor tree damage was evident.

2. Are there indications of slope failures (like extensive soil on toes)? Not applicable.
   If "Yes", indicate location on range sketch, take photographs and describe:

3. Are many fired rounds visible on berm backslopes? Not applicable.

4. Is there ample room in front of berms to extend slope forward? Not applicable.

5. How many feet of space are available (without crowding target areas)? Not applicable.

6. Are fired rounds concentrated in pockets or spread evenly across the backstop?
   Pockets ☐ Evenly Spread ☒

7. Are visible bullets fragmented? Yes ☐ No ☐ NA ☒

8. Are visible bullets oxidized? Yes ☐ No ☐ NA ☒

9. Do berm surfaces contain rocks/trees/debris that cause bullet pulverization? Not applicable.

Floor Design

1. Floor length from shooting position to toe of berm. Not applicable.

2. Floor width = <u> 330 </u>feet

3. Do floors slope away from firing points? Yes ☐ No ☒

4. Do floor gradients promote thorough drainage to off-range areas? Yes ☐ No ☒

5. Do floor gradients facilitate target visibility? Yes ☒ No ☐

6. Are low spots evident where water is likely to pool? Yes ☒ No ☐
   If "Yes", note location on range sketch and take photographs.
   The range floor is uneven, and small pockets were observed that may allow water to pool.

7. Are floors free of large rocks and debris that could cause bullet splatter or ricochet?
   Yes ☒ No ☐
   If "No", indicate location on range sketch, take photographs, and describe:

8. Do soil mounds and railroad ties sufficiently guard against bullet-to-concrete contact?
   Yes ☐ No ☐ N/A ☒

9. Is the impact area in a surface water body or wetland? Yes ☐ No ☒

10. How far is the impact area from flowing or nonflowing streambeds? Distance = <u>1,500</u> feet
    T Range is 1,500 ft to the west of Grassy Pond.

OPERATIONAL ASSESSMENT

Historical Use

1. What was the historic use of the range?
   Prior to the suspension of firing lead ammunition in the late 1990s, T Range was an active combination .50 cal machine gun and pistol range located on the southern side of Gibbs Road, just west of SE and SW Ranges. T Range was constructed sometime between 1986 and 1989 at what was formerly Papa Range. Former Papa Range was used first in 1967 as a night defense course (where only blank ammunition was used) and continued to be used as such until the mid-1970s when it was converted to a squad and platoon attack course. At that time, no ammunition was used. In the later 1980s, the name was changed to T Range and continued to be used as an assault course. Only blank ammunition was used during this period as well. In 1990 or 1991, current T Range was converted to a .50 cal machine gun range. Since that time, ammunition use has been limited to .50 cal ammunition.

2. Do past operations differ significantly from current? Yes ☒ No ☐
   If "Yes", describe:
   Prior to the late 1990s, T Range was used to train soldiers. An Administrative Order suspended the use of lead ammunition at Camp Edwards, which severely decreased the amount of training conducted on-post, including at T Range. Due to the suspension, only tungsten-nylon and plastic ammunition is currently used.

3. Has the range configuration changed over time? Yes ☐ No ☒
   If "Yes", describe:

4. Have areas adjacent to range been used for firearm training in the past? Yes ☐ No ☒

5. Identify the historic use of the range using the table below.

   NOTE: Lead was used through 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber. Frangible was used after 1997 for .38 caliber, 9mm, 12 gauge, and .40 caliber.

Training Year	Training Days	5.56mm Tungsten	.50 cal Plastic	.50 cal Lead	.45 cal Frangible	.40 cal	.38 cal	9mm	12 gauge
2004	3	6,370	0	0	0	0	0	0	0
2003	4	10,057	200	0	0	0	0	0	0
2002	6	8,400	5,800	0	3,880	3,000	0	1,800	250
2001	12	3,200	4,000	0	3,351	34,847	0	12,201	0
2000	0	0	0	0	0	0	0	0	0
1998		0	18,520	0	0	0	0	0	0
1997		0	13,535	0	0	0	0	0	0
1996		0	2,025	0	0	0	0	0	0
1995		0	0	0	0	0	0	0	0
1994		0	0	6,400	0	0	0	1,080	0
		28,027	44,080	6,400	7,231	37,847	0	15,081	250
AVERAGE		2,803	4,408	640	723	3,785	0	1,508	25

Current Use

1. What is the current use of the range?
   Currently, T Range is used for small arms familiarization and marksmanship.

2. During which months is training heaviest? Months = April through October

3. During which months is training lightest? Months = November through March

4. Does range support required through-put, even during peak usage? Yes ☒ No ☐

5. Are alternate ranges available to accomplish similar missions? Yes ☐ No ☒

6. Do training loads necessitate use of entire range during typical sessions? Yes ☒ No ☐

7. Which lanes are used most often? Due to the lack of a berm, it is difficult to determine the lanes most often used at T Range.

8. What type of targets are used?
   Paper targets are used on T Range.

Future Use

1. What is the future anticipated use of the range?
   According to the 2006 RTLP, Camp Edwards wants to upgrade T Range into a 25-m familiarization and qualification range. At the time of the site visit, the STAPP bullet contaminant system was delivered but not installed for range use.

2. Are training loads (frequency, duration, and intensity) expected to remain stable, increase, or decrease? Stable ☐ Increase ☒ Decrease ☐

3. Is civilian use (e.g. local police training) likely to remain stable, increase, or decrease?
   Stable ☐ Increase ☒ Decrease ☐ NA ☐

4. Are new ranges being built on the installation (or old ranges revitalized) that could reallocate existing training missions? Yes ☒ No ☐

5. Will future training missions be modified? Yes ☐ No ☒
   If "Yes", please describe.

6. Is extensive maintenance, such as lead recovery, scheduled? Yes ☐ No ☒

7. Are ranges slated for reconfiguration? Yes ☒ No ☐

8. Are footprints likely to change? Yes ☐ No ☒

9. Are ranges slated for modernization? Yes ☒ No ☐
   If "Yes", describe the modernization.

Current/Historical Maintenance

1. What do routine maintenance efforts typically entail?
   Routine maintenance includes upkeep of the observation tower, shed, target holders, firing position mounds, and range boundary markers. Targets are replenished when needed. Mowing of grass and cutting of brush are also conducted on a regular basis to ensure visibility of targets and access to range areas.

2. How often is routine maintenance completed? As needed.

3. What major repairs have been completed to maintain the range? None.

4. Has lead been recovered from the range? Yes ☐ No ☒

5. Has berm footprint changed? There is no berm on T Range.

6. How are removed berm soils managed? Not applicable.

7. How is range residue managed? Targets? Brass? Trash?
   Target material and trash are disposed of as solid waste. Expended cartridge casings are policed by the using unit and given to the ASP where it is inspected and certified as free of explosive hazard and dispositioned through DRMO.

ENVIRONMENTAL ASSESSMENT

Groundwater

1. What is the depth to groundwater? Depth = approximately 100 feet

2. How deep is groundwater below the concentrated areas? Depth = 100 feet

3. What is the aquifer thickness and aerial extent?
   Thickness = _____ feet Extent = _____ square miles

4. What is the aquifer productivity? Productivity = _____ gallons/day

5. What is the aquifer regulatory classification? Sole source aquifer

6. What is the direction of groundwater movement? _____

Surface Water/Storm Water

1. What are the storm water controls? *Please list and take photographs.*
   There are no engineered storm water controls such as drainage ditches or swales on the range.

2. What are the drainage patterns/characteristics?
   There is little opportunity for surface water to flow across the floor of the range due to the high sand content and permeability of the soil. The range floor is well vegetated, and drainage swales were observed all over the floor, flowing from the second firing line to the left corner of the targets. The site visit was conducted after a major rain event that lasted several days at Camp Edwards. No standing water was observed on the range. Erosion was observed along the swales.

3. Are berms adjacent to hills that potentially increase storm water flow onto the range?
   Yes ☐ No ☒

4. What is the flood potential and frequency?
   There is very little flooding potential on the range due to the high sand content and permeability of the soil on the range. The range is not located in a 100-year floodplain, which also indicates a low flooding potential.

5. Where does storm water go after leaving ranges?
   In general, storm water does not have the opportunity to leave the range area due to the high sand content and permeability of the soil on the range.

6. What are distances to nearest downgradient surface waters, wetlands, or other sensitive areas?
   Distance = 3,600 feet

7. Are training missions or maintenance efforts altered due to wet or muddy conditions?
   Yes ☐ No ☒

8. What are distances to nearest installation boundaries, and nearest *downgradient* installation boundaries? Distance = 7,300 feet

9. Are there manmade structures between impact location and surface water that may affect storm water flow paths or erosion? Yes ☐ No ☒

Vegetation

1. What percentage of floor surface is vegetated? 95%

2. What percentage of the berm surface is vegetated? Not applicable.

3. Is vegetation sufficiently abundant to provide realistic training conditions? Yes ☒ No ☐

4. Is vegetation mowed sufficiently to promote target visibility? Yes ☒ No ☐

5. Is vegetation native or imported? Native ☒ Imported ☐

6. Are storm water channels and swales vegetated? Yes ☒ No ☐

7. Are down-gradient areas well vegetated? Yes ☒ No ☐

8. Do trees near ranges obscure visibility or inhibit access with equipment? Yes ☐ No ☒

9. Was vegetation engineered to include phytoextracting or phytostabilizing qualities? Yes ☐ No ☒

10. Are there any areas of stressed vegetation? Yes ☐ No ☒
If "Yes", take photographs and draw on range sketch.

Soil Characteristics

1. What is the soil type? Sandy

2. What is the soil pH? _____

3. What are background lead concentrations? _____ ppm

Soil Erosion

1. Is erosion evident on range floors and berms? Yes ☒ No ☐
If "Yes", take photographs, locate range sketch and describe below.

2. Is an erosion and sediment control plan in place? Yes ☐ No ☒

3. Is dust generated on the range? Yes ☐ No ☒

4. Does wind or water erosion occur near impact areas? Yes ☐ No ☒

Weather

1. Do storm events often include periods of intense downpour? Yes ☒ No ☐
2. Are high wind speeds and gusts common? Yes ☒ No ☐
3. Do trees or natural features block wind from ranges? Yes ☒ No ☐
4. What is mean annual snowfall? Approximately 33.9 inches
5. What is the average 2 year 24 hour storm event? Approximately 1.29 inches
6. What is the monthly rainfall average? Approximately 4.0 inches

Other

1. Are there migratory birds and wildlife on/near the range? Yes ☐ No ☒

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 126 | **Date:** 5/22/06

Direction Photo Taken:
Right side of firing point mounds across firing points

Description:

Mounds and firing points

Photo No. 127 | **Date:** 5/22/06

Direction Photo Taken:

Description:

Firing point

PHOTOGRAPHIC LOG

Client Name: MAARNG	Site Location: Camp Edwards, Massachusetts	Project No. 39455585

Photo No. 128	Date: 5/22/06

Direction Photo Taken:
Firing point mounds and tower back toward the parking lot and entrance

Description:

Firing mound and range control tower

Photo No. 129	Date: 5/22/06

Direction Photo Taken:

Description:

Access road for vehicle mounted machine gun training

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Appendix E

USACE RANGE EVALUATION SOFTWARE TOOL

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Appendix E

USACE RANGE EVALUATION SOFTWARE TOOL

REST is an Army-developed screening tool that analyzes several parameters to identify the potential for metals to migrate off-range. Those parameters include:

- Corrosion of expended small arms projectiles
- Groundwater transport
- Aerial transport
- Ammunition mass
- Surface water transport

REST assigns a number to a range of values for each parameter and sums these numbers to determine a risk for each parameter. The risk calculated for each parameter is then entered into an equation to determine the overall risk for metals migration. The charts that follow show the calculations and assignment of values for each parameter.

The REST program computes the overall score from the following equation:

$$\boxed{\text{Overall Risk} = \text{Mass Risk} \times \frac{\text{Corrosion Risk} + 5}{10} \times \frac{\text{Surface Water} + \text{Ground Water} + \text{Air Risk} + 15}{30}}$$

Corrosion Risk

Equation: T1(soiltype)+T2(brackish)+T3(DepthtoWater)+T4(PH)+T5(soilclay)+T6(rain)

Tables

SoilType: x	T1
=0	1
between 1 and 10	x

Brackish	T2
No	0
Yes	2

DepthToWater	T3
<2	2
between 2 and 10	1
> 10	0

pH	T4
<3	-1
between 3 and 6	0
between 6 and 9	1
> 9	2

Soilclay	T5
<25	0
>=25	1

Rain	T4
<7	0
between 7 and 15	-1
between 15 and 40	0
Between 40 and 70	1
> 70	2

Default Example: CorrosionRisk= 2(LoamySand) +0(not adjacent to brackish water) +2(Depth to water =0) -1 (pH=2) +0 (soilclay=13%) +0 (rain=2) =3	

Groundwater Risk

Equation: T1(DepthtoWater)+T2(PotableRisk)+T3(soiltype)+T4(Rain)+T5(CEC)+T6(pH)+ T7(organic)+T8(NearestWater)+T9(NearestBoundary)+T10(NearestSensitive)

DepthToWater	T1
<5	10
Between 5 and 10	9
Between 10 and 20	8
Between 20 and 30	7
Between 30 and 50	6
Between 50 and 75	5
Between 75 and 100	4
Between 100 and 200	3
Between 200 and 300	2
Between 300 and 500	1
> 500	0

Rain	T4
<7	-2
between 7 and 15	-1
between 15 and 40	0
Between 40 and 70	1
> 70	2

SoilType: x	T3
Gravel, Sand	2
Loamy Sand, Loamy Soil	1
Sandy Loam Silt Loam Loam	0
Sandy Clay Loam Clay Loam	-1
Sandy Clay Silty Clay Clay	-2

DepthtoWater*1.5	T2
<=DepthtoPotable	-1
>DepthtoPotable	0

CEC	T5
<10	+1
Between 10 and 50	0
>50	-1

pH	T6
<5	+1
Between 5 and 9	0
>9	-1

Organic	T7
<0.5	+1
Between 0.5 and 2	0
>2	-1

Distance	T8,T9,T10
<1500	1
between 1500 and 5000	0
>5000	-1

Default Example:
GroundwaterRisk=
10(DepthtoWater=0)
-1(Potable factor)
+1(Loamy Soil)
-2 (rain=2)
+1 (CEC=2)
+1 (pH=2)
+0 (organic=2)
+1 (nearestWater=0)
+1 (nearestBoundary=0)
+1 (nearestSensitive=0)
=13

Modified Example (DepthtoWater=400):
GroundwaterRisk=
+1(DepthtoWater=0)
+0(Potable factor)
+1(Loamy Soil)
-2 (rain=2)
+1 (CEC=2)
+1 (pH=2)
+0 (organic=2)
+1 (nearestWater=0)
+1 (nearestBoundary=0)
+1 (nearestSensitive=0)
=5

AirRisk

Equation:

Rainfall_erosivity * Erode + T1(CEC) + T2(F_Veg) + T3(Windbreaks) + T4(Gusts) + T5(Fragments) + T6(NearestBoundary) + T7(NearestSensitive) + T8(Peak Gust)

Rainfall_erosivity = Max(1 - rain / 150 , 0.1)

Berm (VegDrainCover, VegFace)	**noBerm (TotalVeg)**	**T2**
Both >=30		-2
Only one >=30	>=150	-1
Both <30	Between 50 and 150	0
	<50	+1

SoilType: x	**Erode**
Gravel	1
Sand	3
Loamy Sand	5
Loamy Soil	7
Sandy Loam	9
Silt Loam	10
Loam	9
Sandy Clay Loam	7
Clay Loam	5
Sandy Clay	3
Silty Clay	1
Clay	?

Peak Gust	**T8**
<40	0
>40	2

Distance	**T6,T7**
<1500	1
between 1500 and 5000	0
>5000	-1

CEC	**T1**
<50	0
>50	-1

Windbreaks	**T3**
True	-1
False	0

Gusts	**T4**
True	1
False	0

Fragments	**T5**
True	1
False	0

Default Example:

AirRisk=
4.9(Loamy Sand)* 0.98(Rain=2)
+0 (CEC=2)
+0 (VefCover=0,0)
+0 (windbreaks=F)
+0 (Gusts=F)
+0 (Fragments=F)
+1 (nearestBoundary=0)
+1 (nearestSensitive=0)
+0 (Peak Gust=2)
=6.9

MassRisk

AmmoDensity = Average * Time / 15.4 / 1000 / (Volume * 1800 / 35.3)

Average = annual average weighted ammunition use
Bermed Volume = BermLength * BermHeight * 0.5
Non-Bermed Volume = NoBermLength*(1.1*NoBermFar-0.9*NoBermNear)/2
If a dimension is set to zero the default Volume is Volume = 300*10*0.5

AmmoDensity	MassRisk
0	0
Between 0 and 0.1	1
Between 0.1 and 0.5	2
Between 0.5 and 1	3
Between 1 and 10	4
Between 10 and 25	5
Between 25 and 100	6
Between 100 and 250	7
Between 250 and 500	8
Between 500 and 1000	9
>1000	10

Ammunition Type	Weighting Factor
.22 caliber	22.5
5.56 mm	36.33
7.62 mm	105.6
9 mm	101
.38 caliber	109
.45 caliber	56.5
.50 caliber	197
Skeet	10
Other	92

Modified Example: Ammunition Use= 1.0E8/year (.22 caliber) Average= 2.25E9 Time=1 Volume=1500 (default) AmmoDensity= 2.25E9/15.4/1000/ (1500*1800/35.3) = 1.91 MassRisk=4	

SurfaceWaterRisk

Equation: T1(SoilLoss)+T2(CEC)+T3(WingWalls)+T4(Vegetation) +T5(Gullies)+T6(ConnectedGullies)+T7(Fragments)+T8(NearestWater) +T9(NearestBoundary)+T10(NearestSensitive)+T11(WaterPresent)+T12(BermHillside)

SoilLoss = 0.244*Erode*rain*Gradient
Gradient=(0.43+0.3*BermSlope+0.043*BermSlope^2)/6.613 [Min of 0.2; If >0.8 then set to 1]

SoilType: x	**Erode**
Gravel	.05
Sand	.12
Loamy Sand	.27
Loamy Soil	.48
Sandy Loam	.38
Silt Loam	.27
Loam	.37
Sandy Clay Loam	.28
Clay Loam	.14
Sandy Clay	.25
Silty Clay	.13
Clay	?

SoilLoss	**T1**
<2	1
Between 2 and 3	2
Between 3 and 4	3
Between 4 and 5	4
Between 5 and 6	5
Between 6 and 7	6
Between 7 and 8	7
Between 8 and 9	8
Between 9 and 10	9
>10	10

Berm (VegDrainCover, VegFace)	**noBerm (TotalVeg)**	**T2**
Both >=30		-2
Only one >=30	>=150	-1
Both <30	Between 50 and 150	0
	<50	+1

Distance	**T8,T9,T10**
<1500	1
between 1500 and 5000	0
>5000	-1

WingWalls	**T3**
True	0
False	1

CEC	**T2**
<50	0
>50	-1

Gullies,Fragments,WaterPresent, ConnectedGullies, , BermHillside	**T5,T6,T7,T11, T12**
True	1
False	0

Default Example: Erode=.27 (Loamy Sand) Rain=2 Gradient=0 SoilLoss= 0	=1 (SoilLoss=0) +0 (CEC=2) +1 (wingwalls=F) +0 (vegetation=0) +0 (Gullies=F) +0 (ConnectedGullies=F) +0 (Fragments=F) +3 (all 3 Distances=0) +0 (Waterpresent=F +0 (BermHillside=F) =5

Appendix F

STANDARD ARMY RANGE DESIGNS

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Appendix F

STANDARD ARMY RANGE DESIGNS

This appendix contains range designs and their subsequent training requirements for the following range types:

- Automated Combat Pistol/MP Firearms Qualification Range
- Known Distance Range
- 25 Meter Range
- Automated Field Fire (AFF) Range
- Automated Record Fire (ARF) Range
- Modified Record Fire (MRF) Range
- Qualified Training Range (QTR)
- Infantry Squad Battle Course (ISBC)
- Sniper Field Fire Range
- Heavy Sniper Range
- Convoy Training Range

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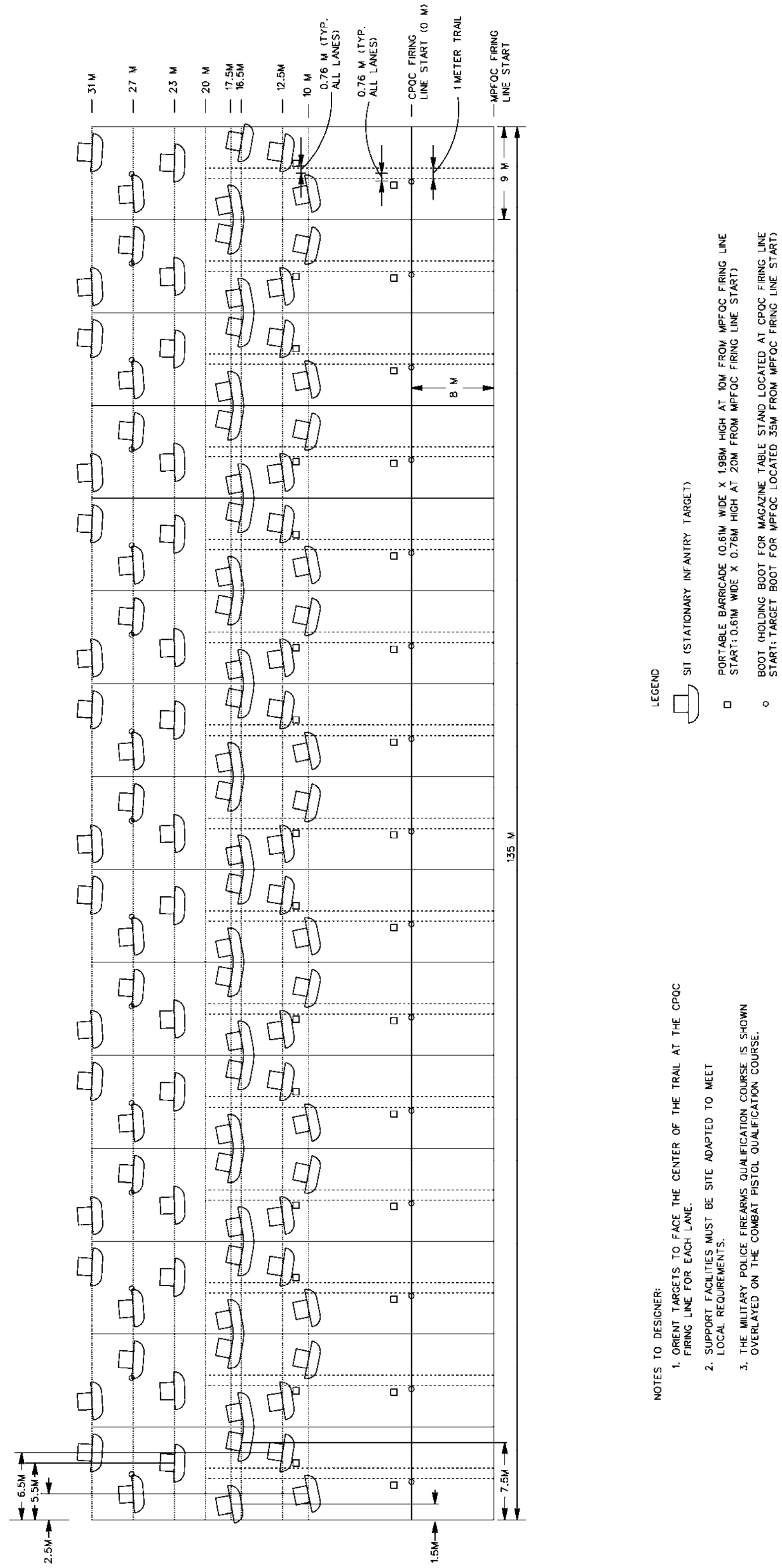
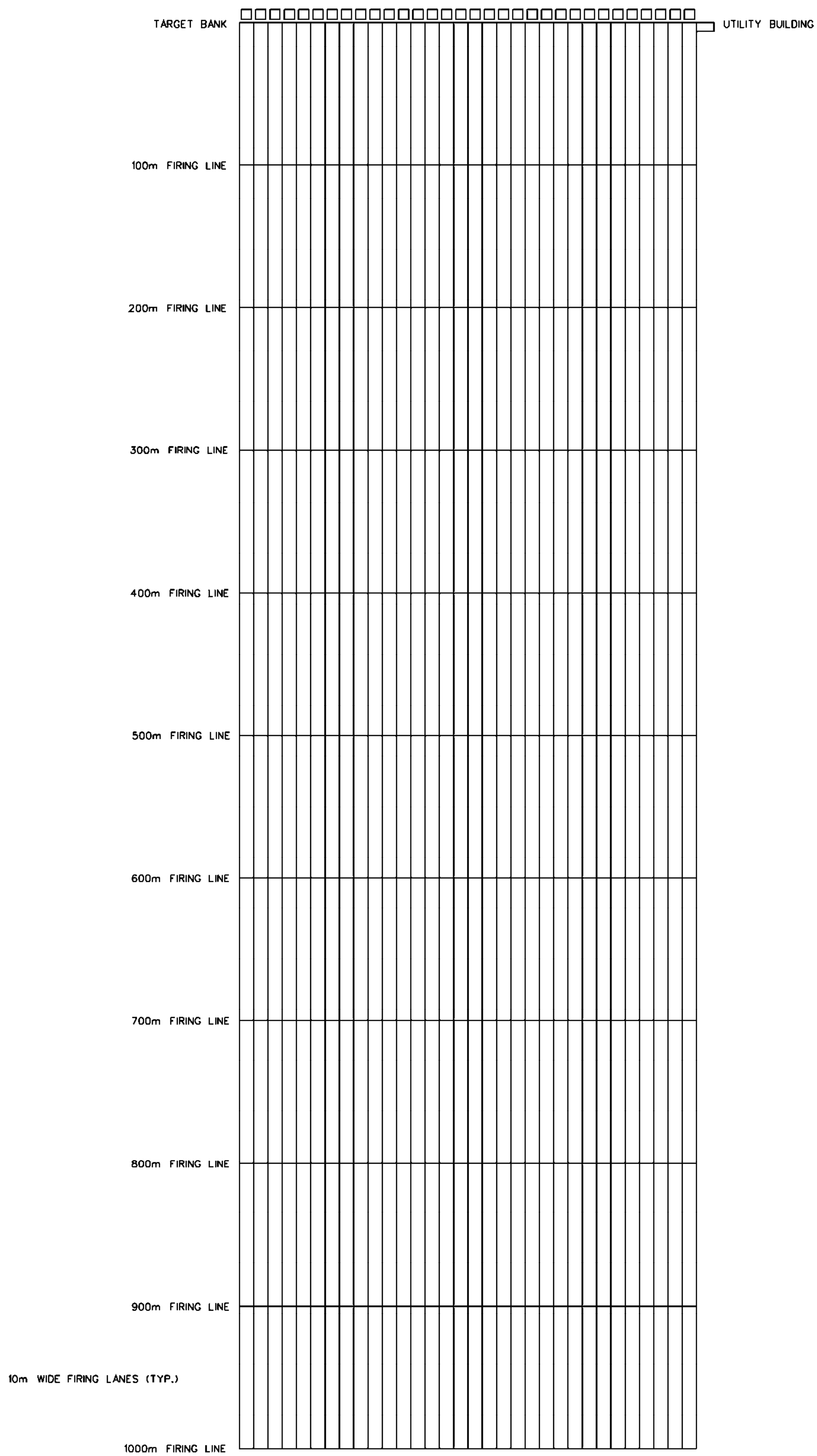
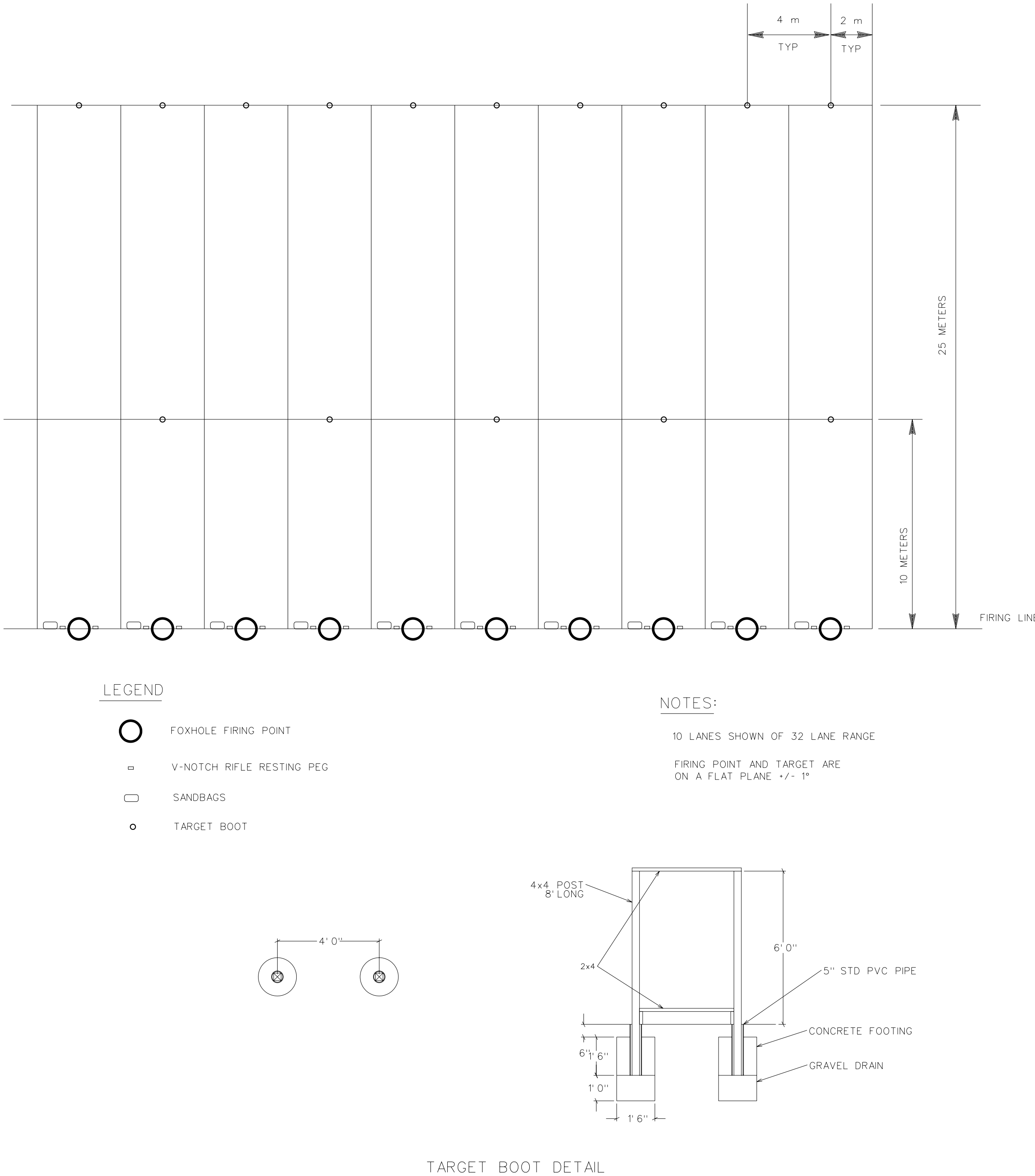


Automated Combat Pistol/MP Firearms Qualification Range
(Source: TC 25-8 DRAFT 2006)

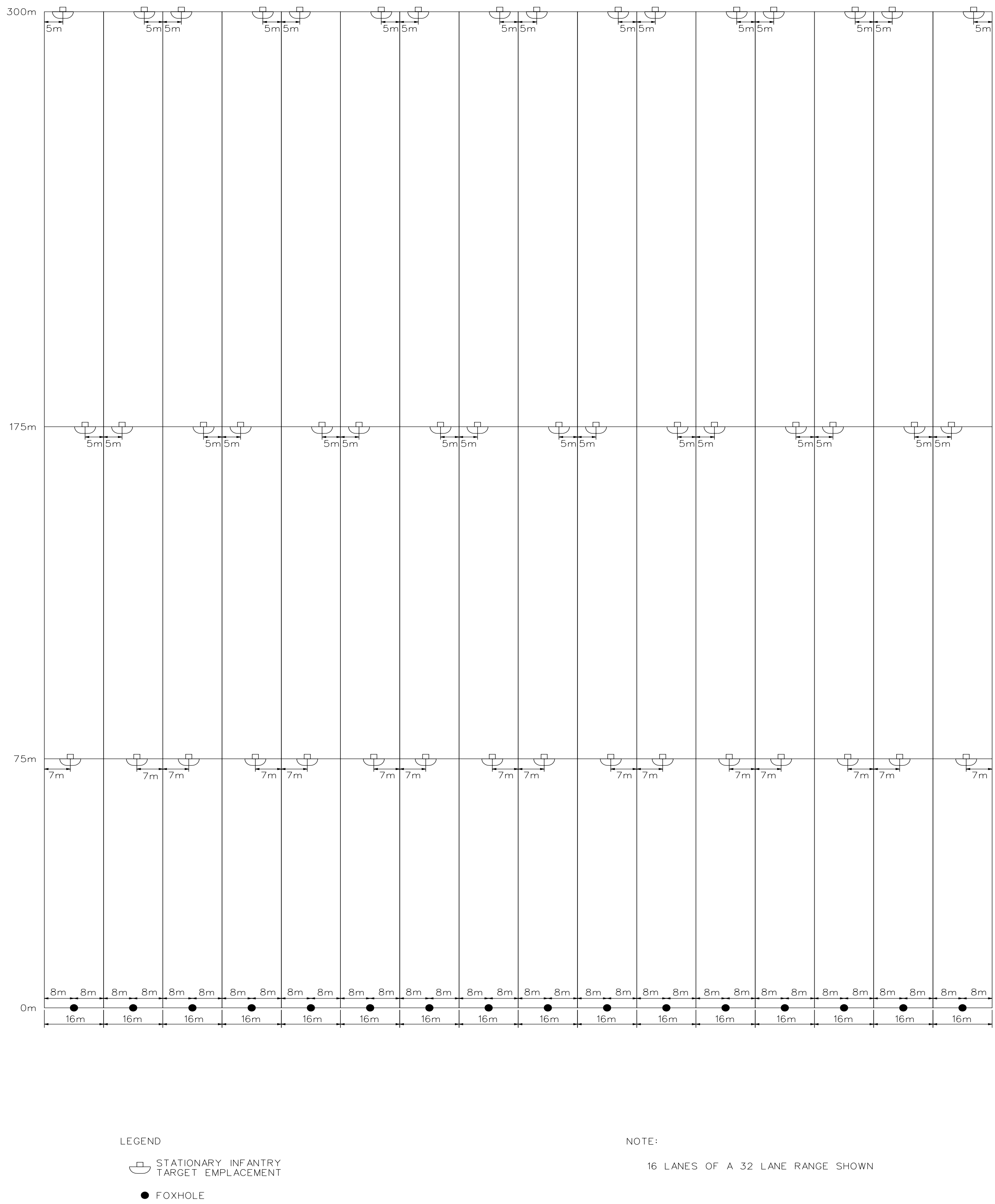
AUTOMATED COMBAT PISTOL/MP FIREARMS QUALIFICATION RANGE REQUIREMENTS (SOURCE: FM 3-23.35 June03)						
Training	**Target Type**	**Exposures**	**Distance**	**Rounds**	**Misc.**	**Applicable Ranges**
Combat Pistol Qualification (Table I)	E-type with optional aggressor figures	5 targets 3 seconds each	None specified	7		
Combat Pistol Qualification (Table II)	E-type with optional aggressor figures	5 targets 3 seconds each 1 target 5 seconds	None specified	8		
Combat Pistol Qualification (Table III)	E-type with optional aggressor figures	3 targets 3 seconds each 2 targets 5 seconds each	None specified	7		
Combat Pistol Qualification (Table IV)	E-type with optional aggressor figures	2 targets 2 seconds each 2 targets 4 seconds each	None specified	5		
Combat Pistol Qualification (Table V)	E-type with optional aggressor figures	4 targets 2 seconds each 6 targets 4 seconds each	None specified	13		
Alternate Pistol Qualification Course (Table I)	APQC	21 seconds	25m	7	stand	
Alternate Pistol Qualification Course (Table II)	APQC	45 seconds	25m	13	kneel	
Alternate Pistol Qualification Course (Table III)	APQC	35 seconds	25m	10	crouch	
Alternate Pistol Qualification Course (Table IV)	APQC	35 seconds	25m	10	prone	
Alternate Pistol Qualification Course (Table IV Night Conditions)	E-type	10 seconds each round	25m	30	night	
Alternate Pistol Qualification Course (Table IV NBC Conditions)	E-type	10 seconds each round	25m	20	NBC gear	



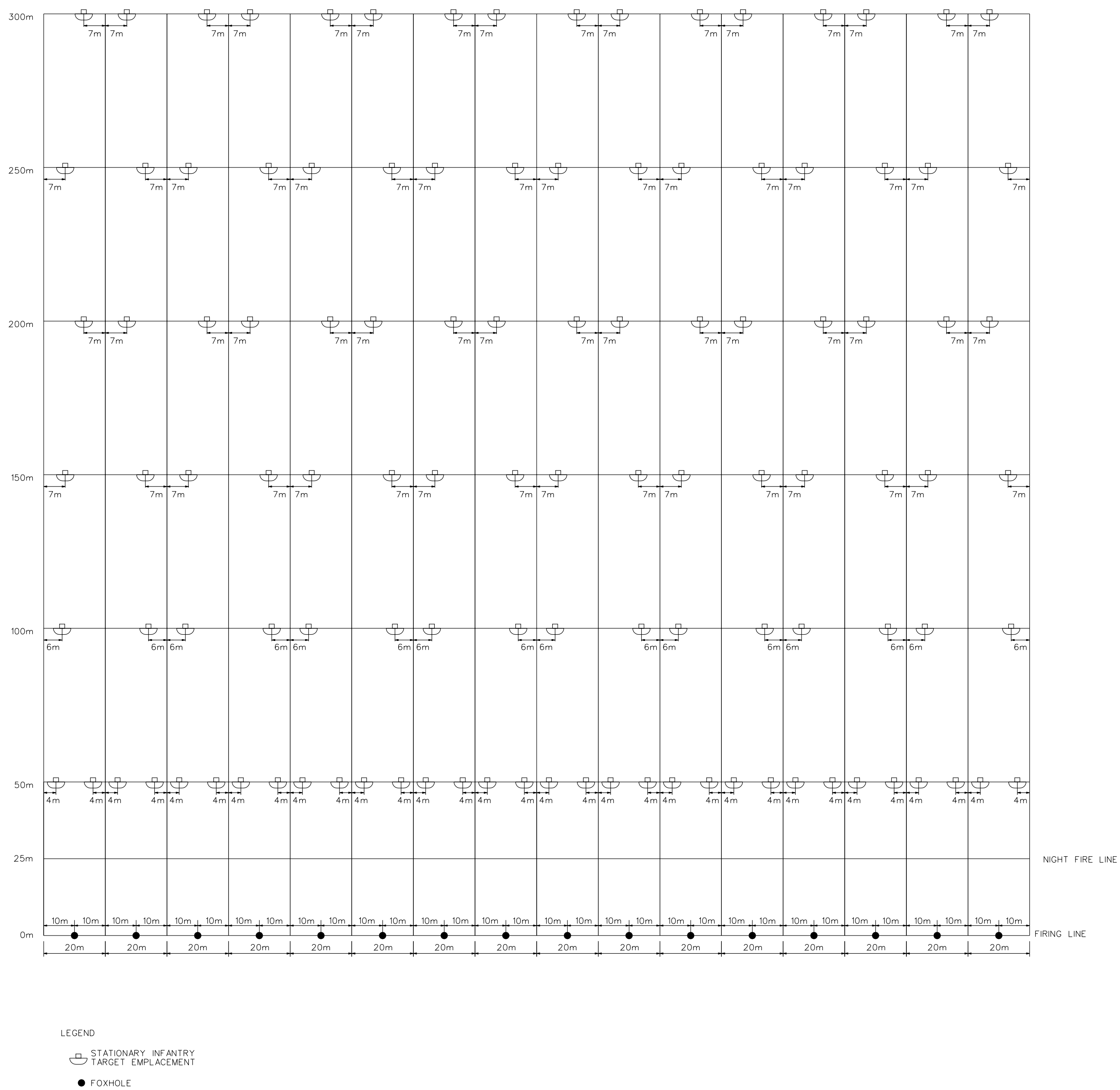
Known Distance Range (Source: TC 25-8 DRAFT 2006)



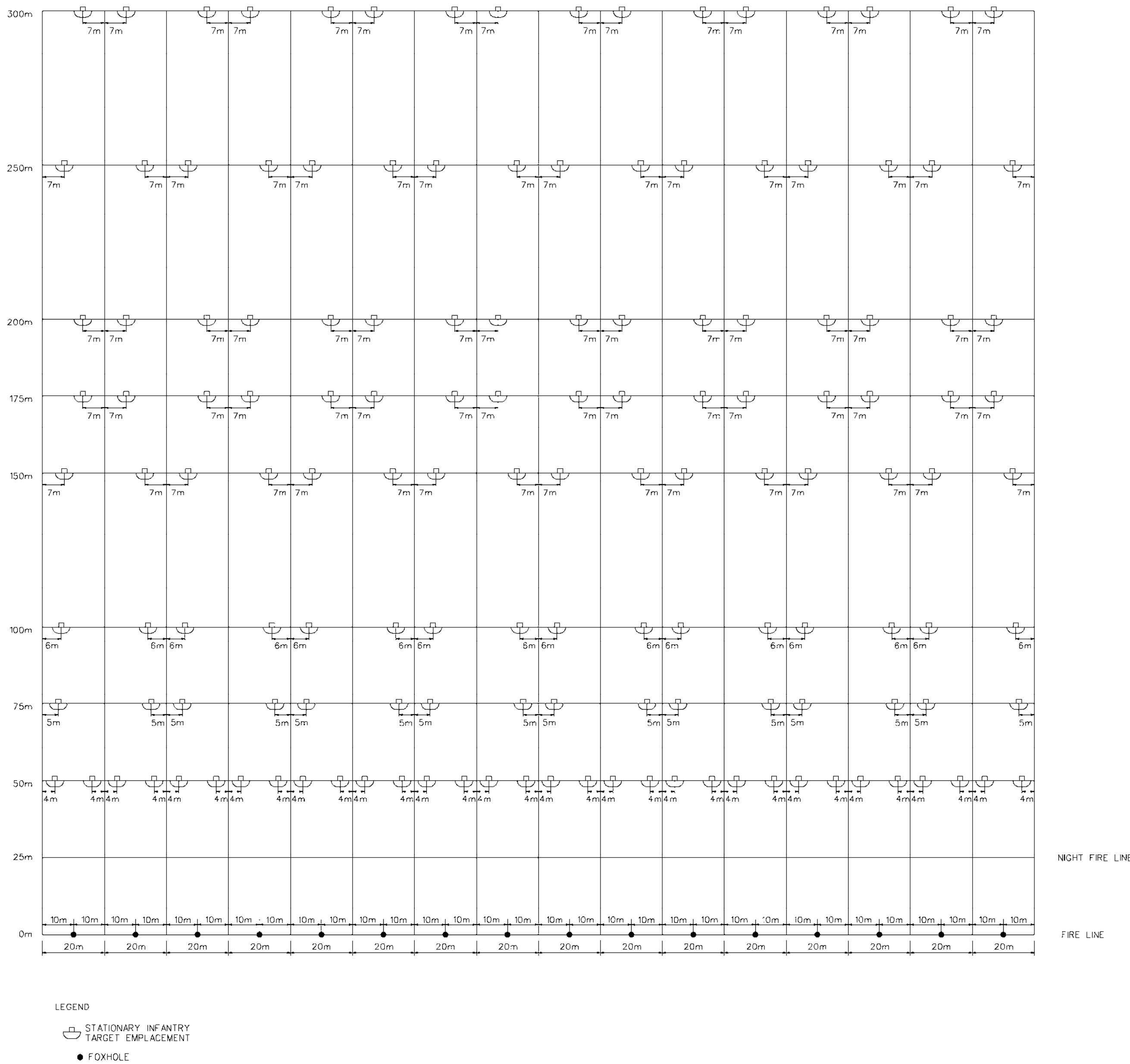
25 Meter Range (Source: TC 25-8 DRAFT 2006)



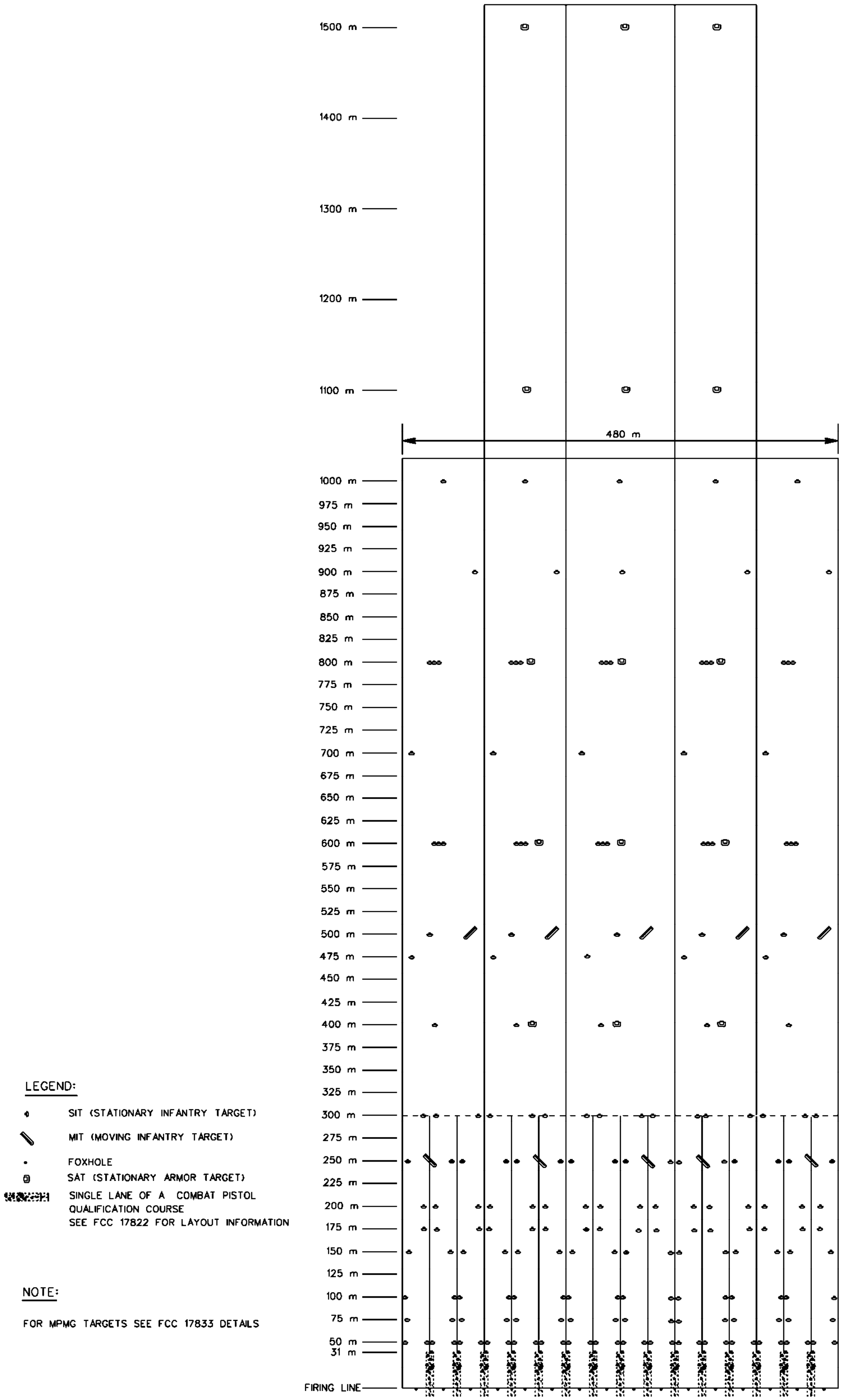
Automated Field Fire (AFF) Range (Source: TC 25-8 DRAFT 2006)



Automated Record Fire (ARF) Range (Source: TC 25-8 DRAFT 2006)



Modified Record Fire (MRF) Range (Source: TC 25-8 DRAFT 2006)

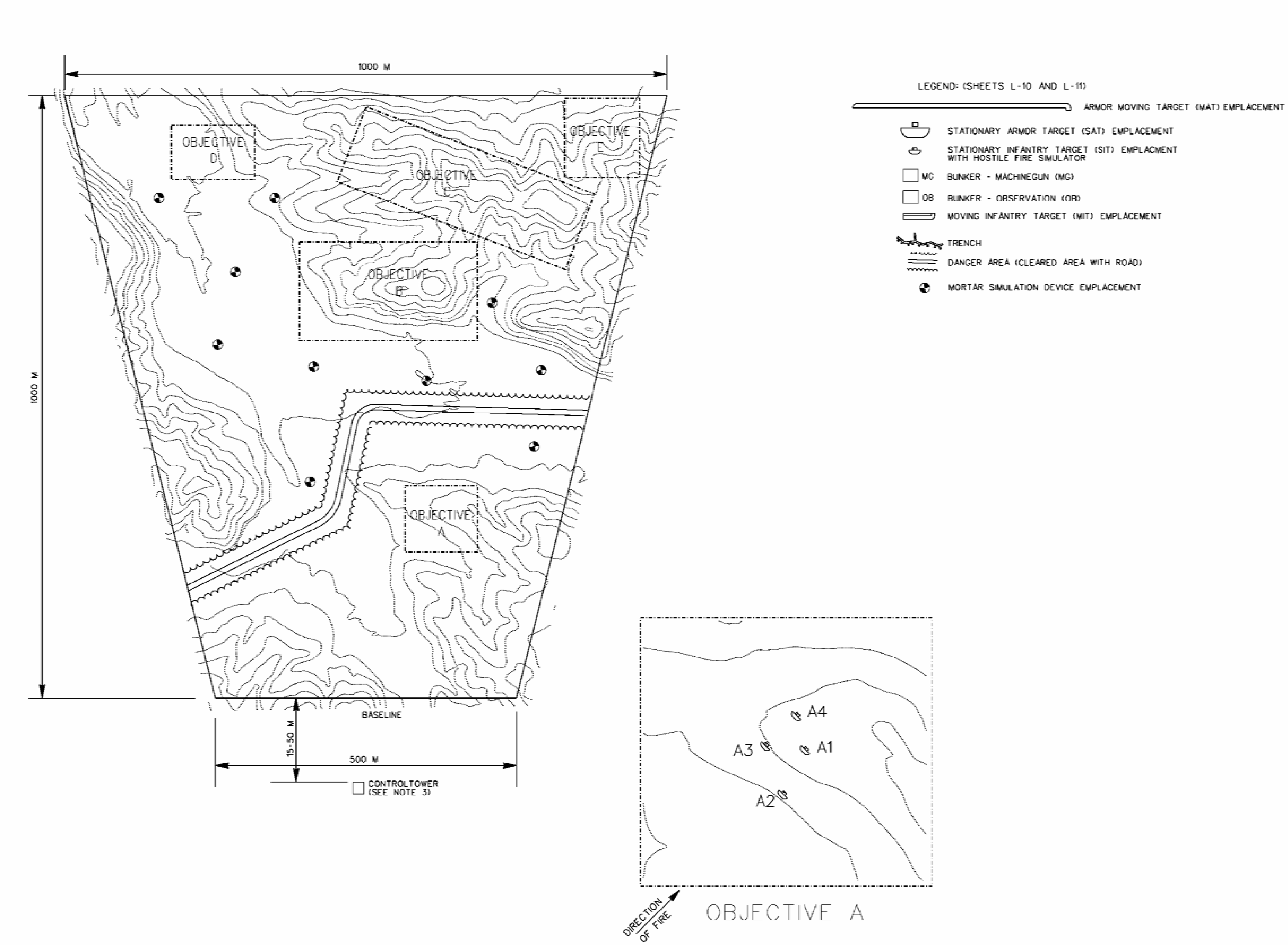


Qualified Training Range (QTR) (Source: TC 25-8 DRAFT 2006)

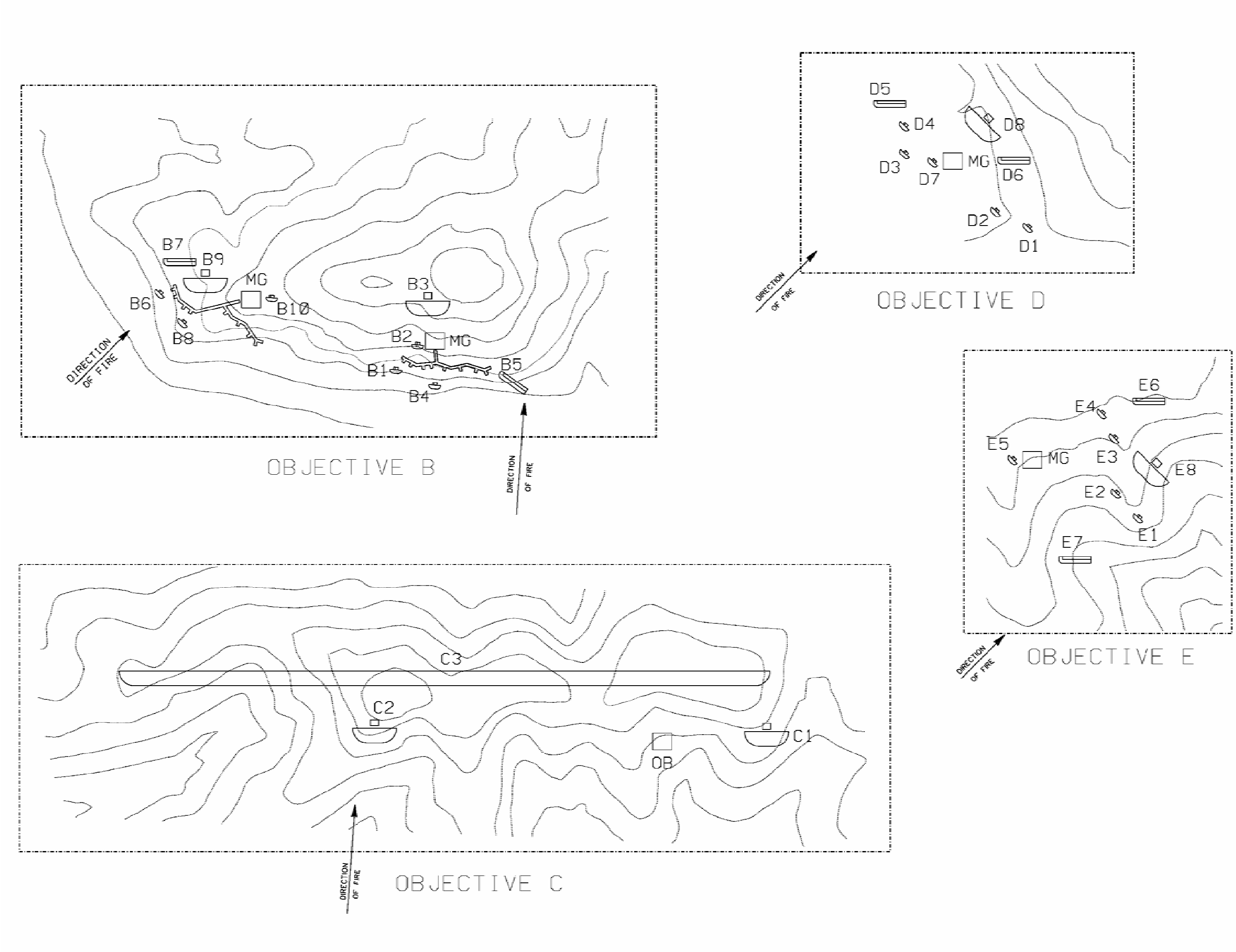
QUALIFIED TRAINING RANGE (QTR) BASIC RIFLE TRAINING AND QUALIFICATION REQUIREMENTS (SOURCE: FM 3-22.9 APR03)					
Training	**Target Type**	**Exposures**	**Distance**	**Misc.**	**Applicable Ranges**
Grouping	E-silhouette	NA	25m		
Zero	E-silhouette	NA	25m		
KD	E and F silhouette	NA	75m		
	E and F silhouette	NA	175m		
	E and F silhouette	NA	300m		
Field Fire I	None specified	36 single timed	75m (5 targets)		
Field Fire I	None specified		175m (7 targets)		
Field Fire I	None specified		300m (6 targets)		
Field Fire II	None specified	44 multiple timed	75m (3 practice targets) (16 scored targets)		
Field Fire II	None specified		175m (4 practice targets) (17 scored targets)		
Field Fire II	None specified		300m (3 practice targets) (11 scored targets)		
Practice Record Fire	None specified	40 single or multiple	50m (5 targets) 100m (9 targets) 150m (10 targets) 200m (8 targets) 250m (5 targets) 300m (3 targets)	Fighting Hole	
Record Fire ("Qualification")	None specified	40 single or multiple	50m (5 targets) 100m (9 targets) 150m (10 targets) 200m (8 targets) 250m (5 targets) 300m (3 targets)	Fighting Hole	

Other training activities exist for M68 Close Combat Optic, Night Vision Goggles, Infra-red Aiming Laser, Burst Fire, Suppressive Fire, Quick Fire, NBC firing, Night Fire, Designated Marksman (500m)

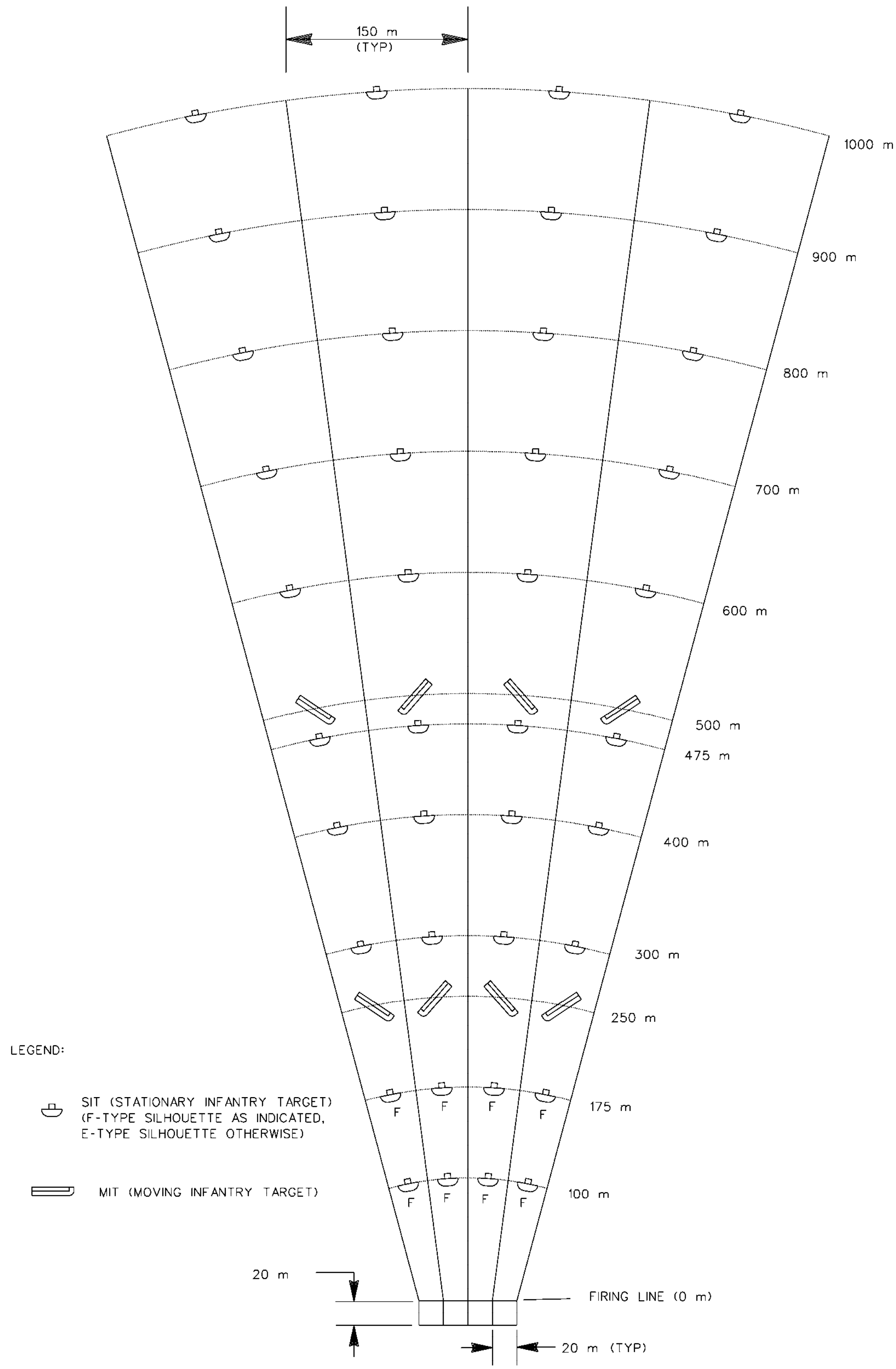
QUALIFIED TRAINING RANGE (QTR) M60/M240/M249 MACHINE GUN TRAINING AND QUALIFICATION REQUIREMENTS (SOURCE: FM 3-22.68 JAN03)				
Training	**Target Type**	**Exposures**	**Distance**	**Applicable Ranges**
10m Zero	None Specified	None specified	10m	
Field Zero	None Specified	None specified	500m (recommended)	
10m Firing (Practice)	Pasters A1 and A2	None specified	10m	
10m Firing (Practice)	Pasters A3 and A4	None specified	10m	
10m Firing (Practice)	Pasters A5 and A6	None specified	10m	
10m Firing (Practice)	Pasters A7 and A8	None specified	10m	
10m Firing (Practice)	Pasters B1 and B2	None specified	10m	
10m Firing (Practice)	Pasters B1 through B4	None specified	10m	
10m Firing (Practice)	Pasters B7 through B8	None specified	10m	
10m Firing (Practice)	Pasters B5 through B6	None specified	10m	
10m Firing (Qualification)	Pasters C5 through C6	None specified	10m	
10m Firing (Qualification)	Pasters C7 through C8	None specified	10m	
Transition Fire (Field Zero) Task 1	Double E-type	None specified	500m	
Transition Fire Task 2 (Qualification)	Double E-type	10 seconds	400m	
Transition Fire Task 3 (Qualification)	Double E-type	10 seconds	500m	
Transition Fire Task 4 (Qualification)	Single E-type	20 seconds	600m	
Transition Fire Task 5 (Qualification)	Single E-type	20 seconds	800m (6 targets)	
Transition Fire Task 6 (Qualification)	Single and Double E-type	30 seconds	400m (1 Single E-type) 600m (1 Double E-type)	
Transition Fire Task 7 (Qualification)	Single and Double E-type	45 seconds	700m (2 Double E-type) 800m (3 Double E-type)	
Transition Fire Task 8 (Qualification)	Single and Double E-type	45 seconds	400m (1 Single E-type) 500m (2 Double E-type) 600m (3 Double E-type)	



Infantry Squad Battle Course (ISBC) (1) (Source: TC 25-8 DRAFT 2006)

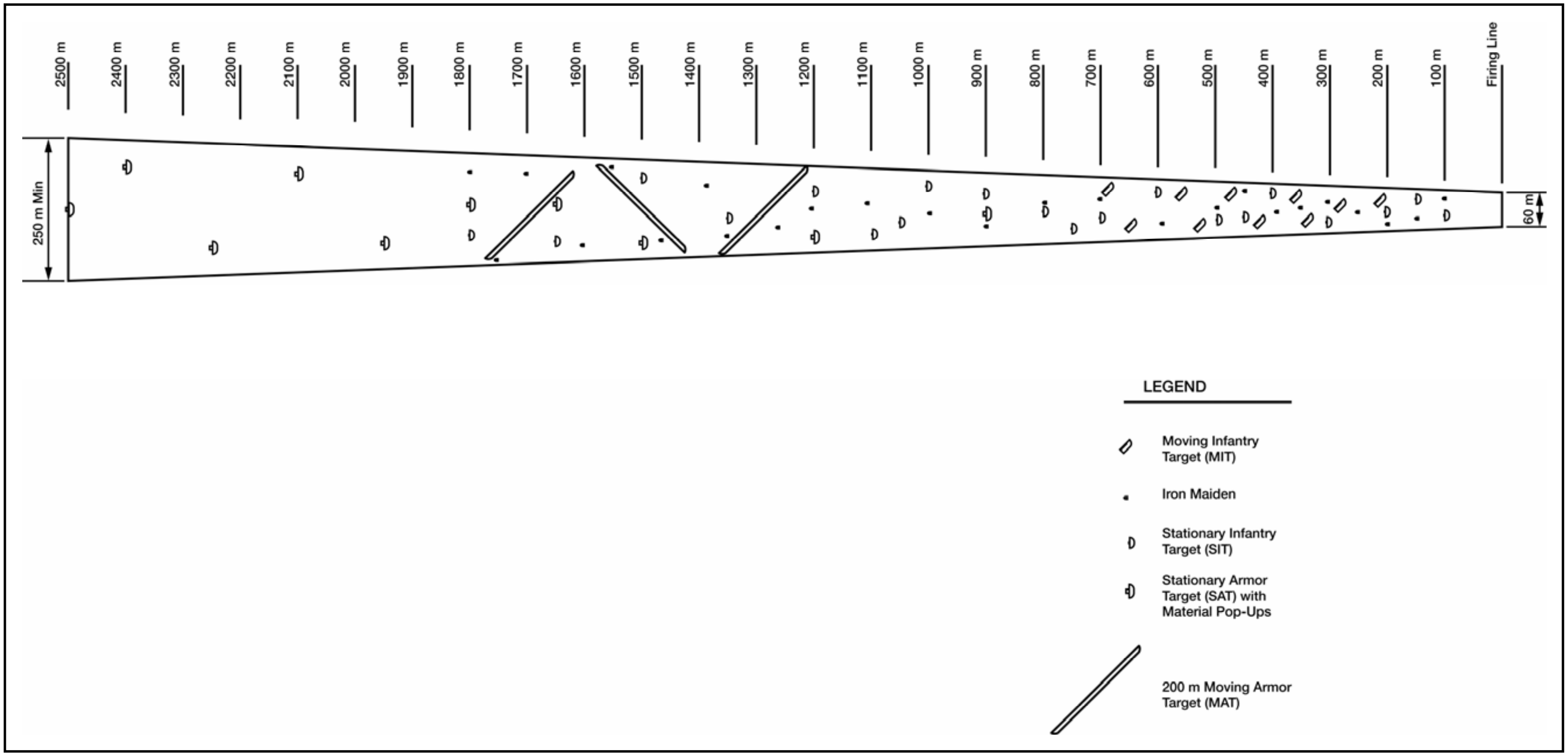


Infantry Squad Battle Course (ISBC) (2) (Source: TC 25-8 DRAFT 2006)



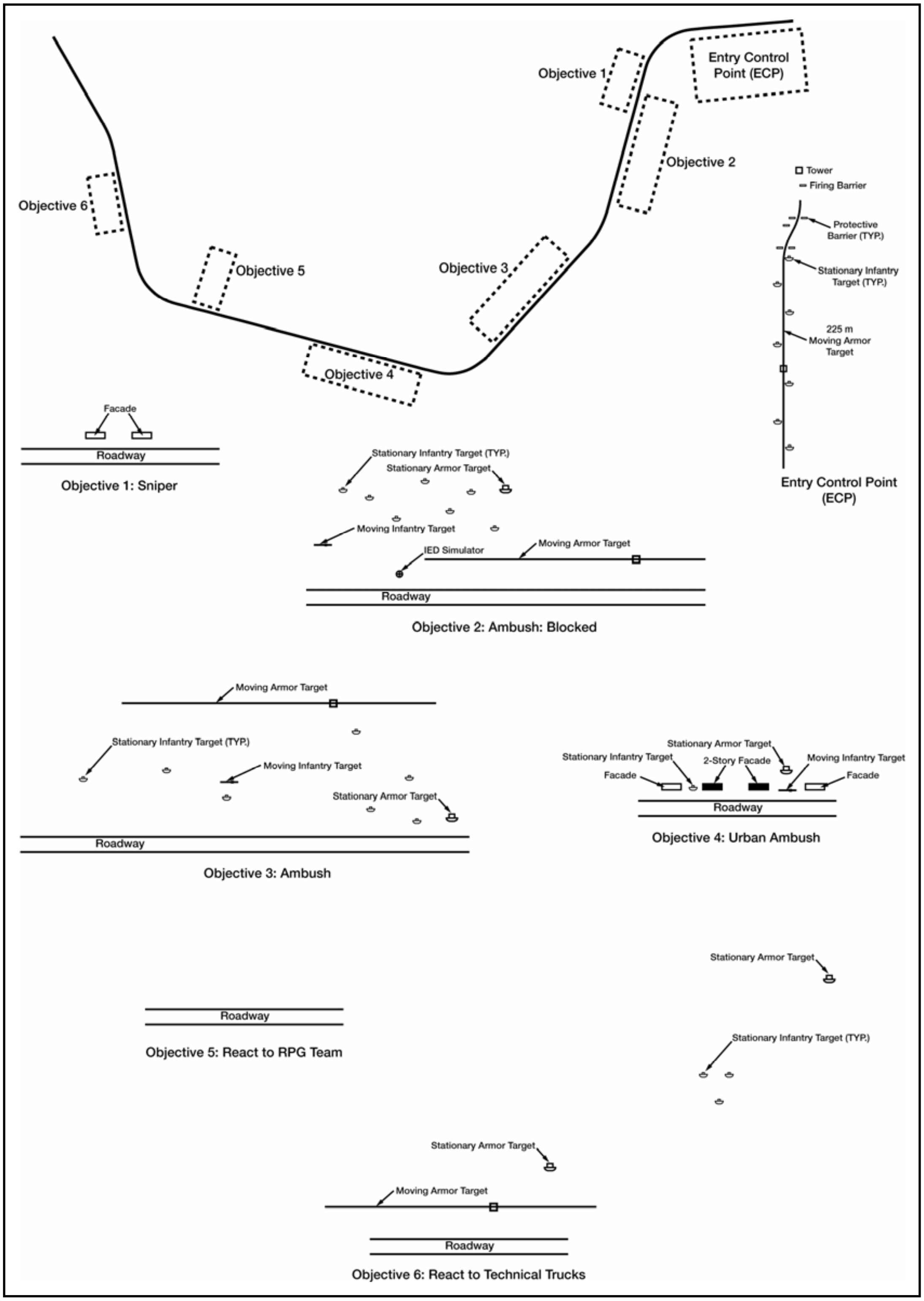
Sniper Field Fire Range (Source: TC 25-8 DRAFT 2006)

SNIPER FIELD FIRE RANGE REQUIREMENTS (Source: FM 22-10 AUG06 DRAFT)				
Target Type	**Exposures**	**Distance**	**Rounds**	**Applicable Ranges**
E-type, hit kill	NA	200m	None specified	
Iron Maiden, E-type, Hit Kill, Moving	NA	300m	None specified	
E-type, Hit Kill	NA	325m	None specified	
E-type, Hit Kill, Window	NA	375m	None specified	
E-type, Hit Kill, Bunker	NA	400m	None specified	
Iron Maiden Moving Tracked Vehicle w/Hit Kill	NA	50m	None specified	
Iron Maiden	NA	600m	None specified	
Iron Maiden	NA	700m	None specified	
Iron Maiden	NA	800m	None specified	
Iron Maiden	NA	900m	None specified	
Iron Maiden	NA	1,000m	None specified	



Heavy Sniper Range (Source: TC 25-8 DRAFT 2006)

HEAVY SNIPER RANGE REQUIREMENTS					
Training	**Target Type**	**Exposures**	**Distance**	**Rounds**	**Applicable Ranges**
Zero	E-type	None specified	400-600m	2	
Zero Confirmation	E-type	None specified	500m	3	
Record Fire	E-type	None specified	325m	2	
Record Fire	E-type	None specified	410m	2	
Record Fire	E-type	None specified	590m	2	
Record Fire	Stationary	None specified	590m	2	
Record Fire	Stationary	None specified	845m	2	
Record Fire	Stationary	None specified	915m	2	
Record Fire	Stationary	None specified	960m	2	
Record Fire	Missile	None specified	1000m	2	
Record Fire	Stationary	None specified	1115m	2	
Record Fire	Stationary	None specified	1290m	2	
Record Fire	Truck size mover	None specified	1200m	2	
Record Fire	Stationary	None specified	1380m	2	
Record Fire	Stationary	None specified	1560m	2	
Record Fire	Truck flank mover	None specified	1600m	2	
Record Fire	Stationary	None specified	1775m	2	
Record Fire	Stationary	None specified	1550m	2	
Record Fire	Stationary	None specified	1030m	2	
Record Fire	Missile	None specified	1000m	2	
Record Fire	Stationary	None specified	1660m	2	



Convoy Training Range (Source: TC 25-8 DRAFT 2006)

FCC 179XX CONVOY LIVE FIRE RANGE/ENTRY CONTROL POINT (CLF/ECP)

This complex is used to train and test soldiers, crews, platoons, and companies on the skills necessary to employ convoy-mounted weapon systems and detect, identify, engage, and defeat stationary and moving armor and infantry targets presented individually or as part of a tactical array in an open or urban environment.

Primary features include:
5 stationary armor targets
6 moving armor targets
53 stationary infantry targets
4 moving infantry targets
6 facades
1 course road
The ECP targets are fully automated and scored from the range operations center-tower. They are fully capable of providing immediate performance feedback to the using participants. All other targets are reconfigurable/RF and controlled with a hand-held device.

Associated Range Operations and Control facilities:
All facilities are located with the entry control point
Range operations center, tower (17971)
Latrine (73075)
Ammo breakdown building (17129)

Requirement Document: TC 63-1, FM 3-22.9, FM 3-22.68, FM 3-22.65, FM 3-22.27, FM 5-34, TC 55-25(Draft), TSP-Convoy Survivability

Additional Information:
Gunnery tasks requiring the use of dud-producing ammunition cannot be fired on this range.

Convoy Training Range Target Requirements (Source: TC 25-8 DRAFT 2006

Appendix G

TRAINING FACILITY UTILIZATION REPORT

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Appendix G

TRAINING FACILITY UTILIZATION REPORT

TRAINING FACILITY UTILIZATION REPORT		
UNIT:	UIC:	COMPONENT
DATES(S) OF TRAINING:		
NUMBER OF PERSONNEL ON SITE:		
SITE USED: (Specify which Training Area, Range, or Facility used)		
NUMBER OF NIGHT(S) BIVOUAC:		
NUMBER OF PERSONNEL BIVOUAC:		
NUMBER OF DAY(S) IN ADVANCE:		
NUMBER OF PERSONNEL ON ADVANCE:		
REMARKS: This form will be completed by all units/organizations conducting training at Camp Edwards, and returned to Range Control or Training Aids Support Center (or both if applicable) at the completion of training.		

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Appendix H

EVALUATION OF BULLET CONTAINMENT SYSTEMS

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Appendix H

EVALUATION OF BULLET CONTAINMENT SYSTEMS

Overview

Historically, outdoor small arms firing ranges used earthen berms to safely capture fired small arms projectiles. Berms were constructed of locally available soil and little thought was given to the environmental impacts of the metals in the fired projectiles or propellants used at the range. The primary intent of the berm was to safely capture fired projectiles. Over time, concerns arose over the impacts to the environment from metals, particularly lead, that have accumulated in soil berms over the years that many ranges have been in operation. Berms became engineered, designed, and constructed facilities with attention paid to soil type, slope angles, construction methods, and mitigation of environmental impacts. The latest improvement to SAR design has been the bullet containment system, or “bullet trap.” Bullet containment systems are totally engineered systems using concrete, steel, rubber, and other material(s) to capture fired projectiles safely and minimize transport of metal particulates and metals-containing soil, groundwater, and surface water that may be present in earthen berms.

Several types of bullet traps are available commercially. Most are based on the goal of safely containing the fired projectiles and protecting them from the effects of wind and water to minimize impacts to the environment. The methods used to achieve that goal vary greatly, from encapsulation in a concrete matrix to deceleration and containment in a steel drum. This appendix presents an evaluation of the wide variety of bullet traps in use currently.

Survey of Bullet Containment Systems in Use

Table H-1 lists the various types of bullet traps and the locations in which they are currently used. The list attempts to represent the wide variety of traps currently available and the various types of organizations using the systems. The survey indicates that use of bullet containment systems is accepted among all four Military Services as well as the law enforcement community, both in the United States and overseas. It should be noted that the study focused on the use of bullet containment systems in the military community and not the civilian outdoor shooting range community. This may be due to the cost associated with installation of a containment system and the difference in regulatory and stakeholder pressure on military versus civilian ranges.

Table H-1. List of Bullet Traps and Locations of Use

Type of Trap	Installations/Facilities
Inclined Steel Plate	Goodfellow Air Force Base (AFB) Ellsworth AFB Wright-Patterson AFB Bangor Coast Guard Armory
Rubber Berm	Brunswick Naval Air Station Naval Air Support Newport

Type of Trap	Installations/Facilities
Reclining Rubber Berm	Fort Drum Training Support Center Vivenza, Italy Training Support Center Wiesbaden, Germany Groton Naval Submarine Base F.E. Warren AFB Coast Guard Station Sandy Hook
Rubber Blocks	Fort Bragg
Deceleration Traps	Kirtland AFB U.S. Secret Service, Fort Gillem Crime Lab Whiteman AFB Barksdale AFB Minot AFB Shaw AFB Mississippi Army National Guard New Jersey Air National Guard
Shock Absorbing Concrete	Fort Bragg Marine Corps Base Camp Lejeune, NC Marine Corps Air Ground Combat Center 29 Palms, CA

The primary purpose of any bullet containment system is to support the intended use of the system. That requires all containment system designers to be aware of the small arms training doctrine. Numerous variations to small arms training must be considered. Typical questions faced by containment system designers include:

- What caliber ammunition will be used?
- What type of ammunition will be used (i.e., tracer, armor piercing, frangible)?
- How many rounds of ammunition will be fired annually?
- Will the user be firing perpendicular to the system or at oblique angles?
- How will fired projectiles be managed?

These questions, and many more, must be addressed during the design of a bullet containment system for any specific range application. In many cases, the designers are aware of these issues and can identify how their systems do or do not meet training and doctrine requirements. This makes analysis and comparison of various systems more simple and straightforward.

The following bullet containment system descriptions detail the operation and maintenance of each design and use.

Soil Backstops/Berms

Design and Function

The soil berm is the oldest and most basic way to stop and contain bullets. In its simplest form, this type of backstop is a properly sized and positioned soil mound placed behind the targets (see Figure H-1). Bullets pass through the target, strike the soil backstop, and remain embedded in the soil until removed. Ideal backstop slopes vary based on soil types but most are optimized at approximately 26 degrees to minimize erosion and bullet ricochet. Vegetation, mostly grasses, is

Figure H-1. Soil Backstop with Target Frames and Holders

placed on the backstops and berms to reduce erosion. Typically, shooting patterns concentrate lead firing into specific spots on the berm, creating pockets, or "hot spots," behind the targets. An unintended consequence of creating this bullet pocket is the fact that bullets will impact each other and cause pulverization. Pulverized lead is more mobile, both by water and wind, and increases the relative amount of lead surface area available for dissolution by water. Bullet-on-bullet impacts may also cause projectiles to ricochet. Other situations that may cause ricochet include rocks or debris in the berm or frozen soil.

Operations and Maintenance

Routine operations and maintenance of a soil backstop include vegetation mowing and clearing to ensure adequate target visibility. Re-seeding of grasses is also conducted to minimize soil erosion and transport of lead containing soil and lead particles. Management and maintenance of wind breaks is also conducted to ensure wind erosion is minimized and damage to trees from accidental bullet impact does not degrade wind break effectiveness. Drainage swales are monitored and, if needed, re-contoured to ensure effective movement of surface water.

Less regular, but more complex range maintenance activities include lead recovery. During lead recovery activities, heavy equipment is used to "mine" the projectiles from the berm face for purposes of recycling or disposal. The mining efforts are typically concentrated in the areas of the bullet pockets since the pockets contain the highest density of projectiles. A certain amount of the berm soil will be contaminated and must be disposed of and replenished. This large-scale maintenance activity is time consuming, costly, and can result in significant downtime for the range.

Costs

The benefits of a native soil backstop or berm include low cost, relatively low maintenance, and the ability to use any kind of ammunition. A recent upgrade to a Fort Jackson SAR included the following costs:

Soil Amendment Plan: $9,000
Construction Costs: $31,000
Annual Operations Costs: $2,000
Fertilizer and Lime Costs: $1,500
Soil Testing: $50

Inclined Steel Plate

Design and Function

Inclined steel plate systems use steel or armor plate set at an angle to the bullet trajectory. Bullets strike the plate and are redirected downward into a sand or water-filled basin. The basin contains the bullets and bullet fragments. Since bullets impact the plate at high velocity, lead dust may be generated, which requires air pollution control equipment to be installed. This is typical of an indoor range that uses inclined plate containment systems. Outdoor systems may include an overhead roof structure that minimizes the amount of rain and snow that may collect in the sand/water basin. The type and thickness of plating depends on the ammunition used. Steel plates can be fabricated to support training with small arms ammunition up to and including .50 cal. The use of armor piercing ammunition is not typically feasible.

Operations and Maintenance

Operations and maintenance of an inclined steel trap includes removal of bullets and bullet fragments from the trough or basin. The bullets may be recycled, and the sand or water may need to be replenished on a regular basis. Water-filled traps may need to have antimicrobial agents added on a regular basis. At some point, water in a basin may need to be disposed of. The trap must be cleaned frequently by mining the lead from the sand/water and disposing of or recycling the metal.

Costs

Capital costs for inclined plate systems are approximately $2,500–$4,500 per linear foot. This price includes materials, shipping, and installation.

Granular Rubber

Design and Function

Granular rubber containment systems are similar to typical dirt berms with the exception that, instead of stopping projectiles using soil, recycled rubber material is used. Most granular rubber designs employ vehicle tires that have been chipped to about the size of a large marble. These rubber chips are applied in a thick layer over a foundation or support structure and play a role similar to that of soil in a dirt berm. The depth of the granular rubber is 15–18 in. at the bottom and top of the angled support structure, and 28–30 in. in the center of the trap where most of the projectiles will be fired. Some containment system designs include roofs that help keep water from running down the rubber and transporting lead into the environment. Some designs include a rubber blanket that covers the granular material (see Figure H-2). The blanket further minimizes transport of dust or debris and minimizes infiltration of water or snow that may cause migration of metals into the environment. Some designs include a liquid collection system at the bottom of the trap to control and manage any water that may be collected in the trap.

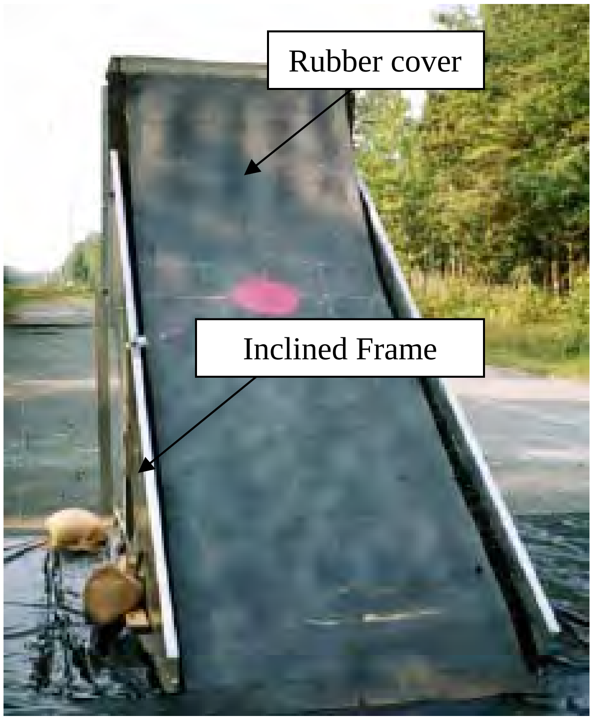

Figure H-2. Granular Rubber Containment System

Bullets fired into the rubber are captured safely and are left virtually intact, with minimum deformation and almost no fragmentation. Rounds can be shot from any distance with no ricochet or back splatter. Granular rubber can sustain projectiles, including armor-piercing, jacketed, semi-jacketed, and non-jacketed shot and slug. Tracer ammunition is not recommended due to potential fire hazard. There is little to no dust created from the impact of the bullet with the rubber material.

Operations and Maintenance

Typical maintenance of granular rubber traps includes regular inspections and removal of projectiles from the trap. Cleaning should occur after approximately 40,000–60,000 rounds per lane. The process of separating the lead from the rubber is very specialized and time consuming, increasing maintenance costs and decreasing the range's availability for training. A modified/heavy duty vacuum may be used to extract bullets from the rubber. Management of the projectiles typically includes recycling or disposal. A small amount of rubber media will be lost during cleaning and must be replaced. If the system includes a water collection system, this water may need to be tested to identify its hazardous or non-hazardous characteristics, and management may include release to the environment or disposal.

Costs

Table H-2 presents startup costs for several types of granular rubber containment systems.

Table H-2. Rubber Bullet Trap Cost Comparison

Cost Type	Model LE 7512 ($)	Model LE 7500 ($)	STAPP™ ($)
Equipment (per linear foot)	950	750	400
Freight	175	100	100
Installation	325	250	75
Maintenance	7–10/lane (after 70,000 rounds)	7–10/lane (after 50,000 rounds)	7–10/lane (after 10,000-15,000 rounds)

Deceleration Chamber Traps

Design and Function

This bullet trap is a system in which fired bullets are deflected off of a lower and/or upper steel plate and into a circular declaration chamber. The chamber resembles the shell of a snail and bullets revolve in it until they lose energy and drop into the collection chamber below (see Figures H-3 and H-4). These types of systems can support oblique fire and ammunition up to and including .50 cal.

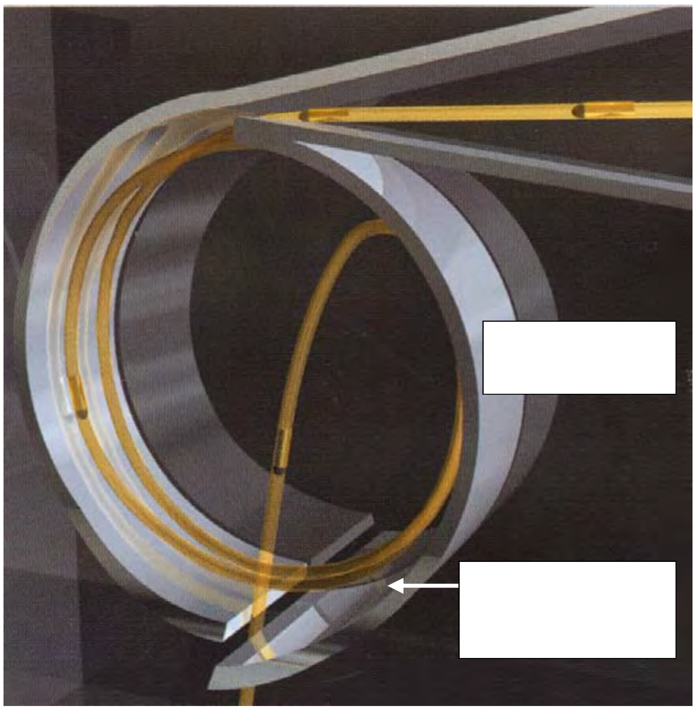

Figure H-3. Cross-Section of Deceleration Chamber

Some designs include roofs that keep water and snow from entering the trap and possibly transporting lead into the environment. Some designs include automated bullet collection systems under the deceleration chamber that simplify the collection and recycling or disposal of the fired projectiles. Some systems are "dry," meaning that no fluids are used to assist the operation of the trap. Other systems are "wet." This means that fluid is allowed to flow over the surface of the lower steel plate. The purpose of the fluid is to capture any dust or debris generated by the impact of the bullet with the steel plate.

Operations and Maintenance

Routine maintenance includes inspection of the trap system. Components that require inspection include the inclined plate, wet system pumps, filters, piping, and any associated conveyors equipment like augers and collection buckets. Wet systems will also need to have fluids replenished and possibly replaced if it becomes contaminated.

Typical operations and maintenance requires 2–8 hours/month depending on the number of rounds fired and whether automated bullet collection systems are included.

Costs

Capital cost for this type of system is on the order of $2,400 per 50 linear feet.

Shock Absorbing Concrete

Design and Function

Shock Absorbing Concrete (SACON) is a low-density, fiber-reinforced, foamed concrete developed by Structures Laboratory at the U.S. Army Engineer Research and Development

Figure H-4. Back View of Deceleration Chamber System

Center (ERDC).[1] SACON is typically fabricated into a block form that is used to capture fired projectiles. It is possible to add a self-healing rubber blanket to the front of the block to increase the life of the block itself. The blocks are typically placed on a concrete foundation (see Figure H-5). Using a sand foundation is possible but not recommended.

Figure H-5. Sacon Backstops Behind 25-m Range Targets

[1] http://aec.army.mil/usaec/technology/rangexxi03a.html.

SACON blocks can be used to safely stop up to and including .50 cal ammunition, though the size of the block needed is over 2 ft in depth. Once the block is saturated with fired projectiles, the entire block can be disposed of.

Operations and Maintenance

SACON can accept up to 7,100 rounds before requiring rotation or disposal. Blocks can be patched or repaired to minimize disposal costs. A damaged area can be cut out and replaced with SACON cores, which returns the block to a serviceable condition. Debris from SACON ranges is classified as non-hazardous and may be disposed of as solid waste. Some bullet fragments may not penetrate the SACON and will fall in front of the trap. These fragments may be carried by water and wind and increase the relative amount of lead surface area available for dissolution by water. Surrounding the trap, the range should be contoured to promote storm water runoff away from the bullet pockets, minimizing the likelihood of lead transport.

Costs

Based on the measured durability of the SACON bullet trap design tested and its resultant maintenance frequency for an assumed 30,000 5.56mm rounds per lane throughput, ERDC estimates an annual recurring cost of $3,800 per lane. ERDC confirmed that recycling SACON blocks is approximately 100 times the cost of purchasing new aggregate material. Instead, ERDC recommend disposal of the used SACON as a solid waste coupled with the purchase of new aggregate materials; this would be approximately 75% cheaper than recovering the aggregate material.

Rubber Block Traps

Design and Function

Rubber block traps are similar to SACON traps and consist of sets of large blocks molded from shredded tires and bound by an adhesive mixture. Fired projectiles are retained within the rubber block. Block rotation or replacement is required when the fired rounds begin to penetrate the back of the blocks. These blocks may be installed with a rubber-coasted steel back plate behind the blocks to capture rounds that penetrate the blocks. A support structure is recommended to firmly hold the blocks in place. This structure consists of a concrete pad and wooden/steel framing around the block. Rubber block traps can be used with ammunition up to and including 7.62mm. Limitations and hazards associated with rubber blocks include freezing temperatures and bullet buildup that may cause ricochet.

Operations and Maintenance

Typical maintenance for this type of containment system includes monthly block inspection. Hot spots in the rubber block may form after 3,000 rounds, causing the center of the block to protrude outward, as seen in Figure H-6.

Costs

Each block measures 24 in. wide by 9 in. tall by 11.5 in. deep and costs $79.95. One lane requires a set of blocks 4 ft high by 4 ft wide and contains two columns with each column containing five blocks. The total cost per lane is $799.50.

Figure H-6. Bullet Protrusion at Rear of Sacon Block

Costs Comparisons

Due to limited resources, a more in-depth cost analysis was conducted of various types of bullet containment systems. Table H-3 presents a cost comparison for a 20-lane, 25-m range with an annual throughput of 600,000 M855 bullets.[2]

Table H-3. Cost Comparison Summary

Technology	Startup Costs	Annual Operation and Maintenance	Annual Environmental Costs	Disposal Costs
SACON	$33,000	$74,000	$4,000	$18,000
Soil Berm	$59,000	$3,000	$500	$1,176,000
Deceleration	$316,000	No estimate	No estimate	$341,000
Block Rubber	$133,000	$31,000	$4,000	$30,000
Granular Rubber	$229,000	$18,000[a]	$3,000	$50,000

[a]Excluding metals recovery.

There is a large variability in the startup costs for the various types of bullet containment systems. As expected, the simple systems such as soil berms are of much lower startup costs than a highly designed, engineered, and constructed system such as a granular rubber or deceleration chamber system. Operations and maintenance costs are also quite variable with the simple soil berms being of much lower cost than the more complex systems. Due to the complexities at Camp Edwards, the operations and maintenance costs for a soil berm may be higher than suggested in Table H-3 due to more frequent inspection, monitoring, or lead removal that may be required. These higher costs may not hold true for the more complex systems

[2] Fabian, Gene 1999. *Shock-Absorbing Concrete (SACON) Bullet Traps for Small Arms Ranges Cost and Performance Report*, Army Test Center, November.

Bullet Containment System Analysis

The National Defense Center for Environmental Excellence (NDCEE) conducted an extensive demonstration/validation study of various bullet containment systems for use at military installations. The study attempted to collect data related to the technology's applications (indoor/outdoor), stopping media, ammunition accommodations, safety data, lead and water containment, required utilities, cost, and other pertinent data. The NDCEE team collaborated with government stakeholders to determine which criteria, characteristics, and capabilities an optimum system should or should not possess. Capabilities, environmental and health hazards, and involved costs are the basic criteria categories. Data related to these criteria were gathered from vendor supplied information or from field tests of the bullet containment systems at various military installations across the country. A catalog of all data and information gathered was used as a basis for the following bullet containment system analysis for Camp Edwards.

From the NDCEE study, nine promising containment technologies were evaluated for implementation at Camp Edwards. Of those nine, two were discounted. The soil berm technology was discounted because the purpose of the Camp Edwards evaluation was to identify non-soil berm solutions. Another promising technology was eliminated because it was a completely enclosed trailer mounted system unsuitable for outdoor ranges, such as those at Camp Edwards. Thus, a total of seven systems were evaluated for use at Camp Edwards.

The wide variety of criteria used during the NDCEE study were analyzed and the most applicable criteria were identified for use during the Camp Edwards analysis. Camp Edwards is a unique military facility with a complex history of environmental issues and stakeholder concerns. Thus, some of the NDCEE criteria were more applicable for Camp Edwards while others were not.

Table H-4 presents an evaluation of the bullet containment systems used in the NDCEE study that is tailored for the site-specific conditions at Camp Edwards. The criteria used during the evaluation were divided into three topics: capabilities, environmental and health hazards, and cost. Only those questions relevant to the range conditions at Camp Edwards were used for analysis, resulting in 1–6 questions per category. Due to stakeholder concerns at Camp Edwards, many of the criteria used during the evaluation were in the environmental and health hazards topic area.

Only one capabilities question was relevant to the range conditions at Camp Edwards. The capabilities topic area criteria were used to determine whether the containment system technology provided virtually complete capture of fired rounds without bullet splatter or ricochet. All seven ranges scored 5 out of 5 because they all provided total containment of fired rounds.

Six questions were asked in the environmental and health topic area, including:

- Has lead containment testing been performed? If yes, did the results pass Toxicity Characteristic Leachate Procedure (TCLP) requirements?
- Does the bullet trap include a system to eliminate precipitation from entering the trap?

Table H-4. NDCEE Comparison Summary

Bullet Containment Systems	STAPP™ Bullet Catcher	Action Total Containment	AABC	GranTrap	ELIxIR	STAPP™ Gel-Cor	Law Granular Trap
Capabilities							
Is there a system that eliminates environmental and health and safety concerns due to ricochets, fragmentation, and/or splattering? YES-5 points NO-0 points	5	5	5	5	5	5	5
Capabilities Subtotal	**5**	**5**	**5**	**5**	**5**	**5**	**5**
Environmental and Health Hazards							
Has lead containment testing been performed? If yes, did the results pass TCLP requirements? YES Tested, Passed TCLP-10 points, NOT Tested - 5 points YES Tested, Failed TCLP - 0 points	5	5	5	10	10	10	5
Does the bullet trap include a system to eliminate precipitation from entering the trap? YES-5 point, Design not completed - 2 points, Design done NO System-0 points	5	5	2	0	0	0	5
Does the bullet trap have a system to contain precipitation once it enters the trap? YES-5 point, Design not completed - 2 points, Design done, NO System-0 points	5	0	2	0	0	0	5
Does the bullet trap contain the bullet, all fragments, and debris? A) Bullet -5 point, B) Fragments - 5 points, C) Debris - 5 points D) NO-0 points	15	15	15	15	15	15	15
Will lead dust be 100% controlled (no lead dust released to the surrounding environment)? YES-5 points, Need more testing - 3 points, NO-0 points	3	0	3	5	5	5	3
Will lead leach out of the bullet trap over time? NO-10 points, Not Tested/proven - 8 points, YES-0 points	10	10	8	8	10	8	10
Environment and Health Subtotal	**43**	**35**	**35**	**38**	**40**	**38**	**43**
Cost							
What is the cost per linear foot for an outdoor 25-m range? Low-3 point, Medium-2 points High-1 points	3	1	2	3	3	3	3
What is the average amount of maintenance required per year? Low (once a year) -10 points, Medium (2-3 x year) -5 points, High (>3 x year) -1 point	10	10	10	5	5	10	1
Cost Subtotal	**13**	**11**	**12**	**8**	**8**	**13**	**4**
TOTAL	**61**	**51**	**52**	**51**	**53**	**56**	**52**

- Does the bullet trap have a system to contain precipitation once it enters the trap?
- Does the bullet trap contain the bullet, all fragments, and debris?
- Will lead dust be 100% controlled (no lead dust released to the surrounding environment)?
- Will lead leach out of the bullet trap over time?

The scores for the various systems ranged from 35 to 43. This is not a large difference in scores and indicated that many of the systems provided a similar level of environmental and health protection.

Two cost questions were relevant to the range conditions at Camp Edwards. The cost topic area scores ranged from 4 to 13. This is a larger difference in scores in comparison to the environmental and health topic area, indicating a larger difference in costs for the various systems.

When comparing the overall scores of the seven systems, including the capabilities, environmental and health hazard, and cost topic areas, the scores range from 51 to 61. Several of the systems scored 51, 52, and 53 points. One scored 56. The STAPP™ granular rubber trap scored the highest at 61 points. This scoring pattern separates the systems, with five systems at the bottom of the scoring range and only two at the top.

From the evaluation of the NDCEE data, it appears that the granular rubber STAPP™ system may be the most appropriate bullet containment system for Camp Edwards. In 2006, Camp Edwards installed the STAPP™ at T Range. This system supports a high volume of firing in each lane, with cleanup after 40,000–60,000 rounds. STAPP™ captures bullets and leaves them virtually intact, providing a safe shooting environment for users and preventing lead migration via water or wind. In Camp Edwards' high precipitation environment and on those ranges without wind breaks, this is an ideal BMP to implement. It should be noted that this bullet containment system BMP is not applicable on all Camp Edwards ranges due to its limitations on ammunition use and maintenance considerations. This system provides Camp Edwards with a BMP that supports training at small arms ranges while, if managed properly, protecting human health and the environment.