Revised Draft

J RANGE
BEST MANAGEMENT PRACTICES:
OPERATIONS, MAINTENANCE, AND MONITORING PLAN

CAMP EDWARDS, MASSACHUSETTS

prepared for:

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ACRONYMS & ABBREVIATIONS

AO	Administrative Order
ASP	Ammunition Supply Point
BMP	Best Management Practice
CM	Centimeter
CSM	Conceptual Site Model
DoD	Department of Defense
DODIC	Department of Defense Identification Code
DPT	Director of Plans and Training
EMC	Environmental Management Commission
EPA	US Environmental Protection Agency
E&RC	Environmental and Readiness Center
FCC	Facility Category Code
FE	Facilities Engineering
HEPA	High-Efficiency Particulate Air
HMWMP	Hazardous Material and Waste Management Plan
IAGWSP	Impact Area Groundwater Study Program
Kg	Kilogram
L	Liter
m	Meter
MANG	Massachusetts National Guard
MassDEP	Massachusetts Department of Environmental Protection
Mg	Milligram
MIS	multi-increment sample
MMR	Massachusetts Military Reservation
NGB	National Guard Bureau
OMM	Operations, Maintenance and Monitoring
P2	Pollution Prevention
RFMSS	Range Facility Management Support System
RSO	Range Safety Officer
SACON	Shock Absorbing Concrete
SAR	Small Arms Range
TCLP	Toxicity Characteristic Leaching Procedure
ug	Microgram
USAEC	US Army Environmental Command
XRF	X-ray Fluorescent (Sampling Device)

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1.0 INTRODUCTION

Camp Edwards is an important training center for National Guard, Reserve Components, US Coast Guard, and law enforcement agencies throughout the northeastern United States. Located on Cape Cod, an environmentally sensitive region, Camp Edwards contains threatened and endangered wildlife species, prime wildlife habitat, archeological sites, and culturally sensitive areas. Moreover, the Camp sits on top of the Sagamore lens, a sole-source drinking water aquifer for Cape Cod. The northern 15,000 acres of Camp Edwards, the Reserve/Training Area, are located within the recharge area of the aquifer. Camp Edwards is committed to excellence in environmental protection, training, readiness, and management of training sites. Training facilities available at Camp Edwards include small arms ranges (SARs), training areas, battle positions, observation posts, and maneuver roads and trails. These facilities 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. The Massachusetts National Guard (MANG) will seek to constantly improve upon training practices that protect the future of the surrounding ecosystem and the aquifer, and maintain a viable ready force.

1.1 Purpose

The purpose of this range Best Management Practice (BMP): Operations, Maintenance, and Monitoring (OMM) Plan is to identify the operations and management practices that MANG will implement to return "J" ("Juliet") Range to service in support of small arms weapons marksmanship training. This plan identifies BMPs that allow the employment of small arms at Juliet Range in a manner that:

- Meets current and future training requirements and
- Employs maximum feasible use of pollution prevention (P2) to protect the Upper Cape Water Supply Reserve, managed as a Massachusetts Department of Environmental Protection (MassDEP) Zone II for public water supplies.

This plan, along with other range-specific plans, is in support of the Camp Edwards *Pollution Prevention Overview (Small Arms Range Supplement)* (SAR P2 Overview) (MANG 2007). Per the phased approach outlined in the SAR P2 Overview, MANG is developing BMP OMM plans for each SAR that will support marksmanship training (see Figure 1-1). The phases in Figure 1-1 indicate the initial priorities of the MANG to support mission requirements; however, the ranges listed in these phases do not imply that they will remain in that order. Based on mission requirements the MANG will request approval of additional ranges during the T (Tango) Range trial period. Due to revised mission requirements to support a greater number of soldiers, Juliet and K (Kilo) ranges are the priority for the next ranges for approval to fire after Tango range. However, efforts for the E (Echo) Range and Sierra East and Sierra West Range will continue with the intent to bring these ranges on-line as quickly as practical to sustain current and future military training while protecting the environment.

The Juliet small arms range is a 25-meter (m) bermed range and is very similar to Tango Range, in that Tango is also a 25-meter SAR. Based on their similarities, the SAR P2 Overview

document, and the success of STAPP™ system as an effective containment system for managing small arms training as demonstrated on Tango Range, the MANG, in discussion with the environmental agencies, selected the STAPP™ system as the major management system for Juliet Range.

Prior to the employment of lead-bullet ammunition on any SAR, Camp Edwards will present the corresponding range-specific BMP OMM plan to the environmental agencies, the Environmental Management Commission (EMC) and US Environmental Protection Agency (EPA) for review and approval. The range-specific BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR Working Group; however, state approval would be through the EMC. MANG will program for funding requirements to implement the BMPs on an annual basis. Lead-bullet ammunition will only be fired at Camp Edwards on ranges with approved BMP OMM plans and as BMPs are funded and implemented. At Camp Edwards, Range Control will coordinate with all clean up programs using or working within the training area of Camp Edwards so that unnecessary loss of clean up or training time is avoided.

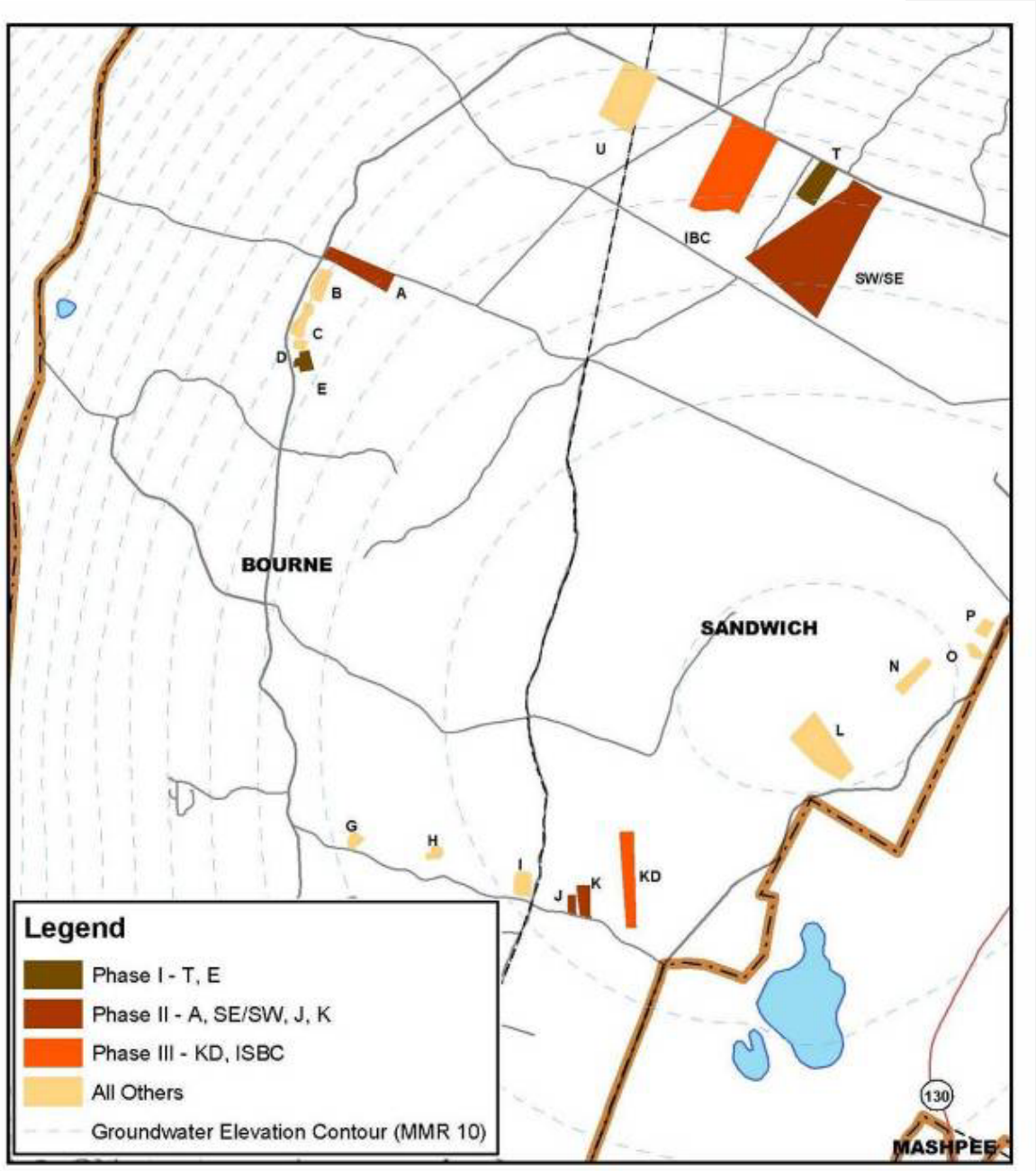


Figure 1-1. Small Arms Ranges and Initial Phases (June 2007) for Return to Live Fire

1.2 Scope

This BMP OMM plan is limited to the operation and use of Juliet Range. It supports the use of Juliet Range as a fully operational 25-m Rifle/Machine Gun Zero Range (Facility Category Code [FCC] 17801) to meet current and anticipated requirements for small arms training exercises at Camp Edwards. Although this plan identifies specific BMPs for the management of metals to sustain operations at Juliet Range, the scope of the BMPs addressed is not limited to typical environmental management options. It also includes BMPs for safe and efficient administration, use, management, and maintenance. The analysis of alternative approaches for sustainable operation of Juliet Range and the BMPs recommended in this plan are based on range-specific conditions and are not intended to apply to other SARs at Camp Edwards or on other Army or Department of Defense (DoD) installations or ranges.

1.3 Background

Juliet Range represents a high-priority range in the sequence of SARs that Camp Edwards seeks to bring on-line to support small arms marksmanship training. Although it has historically supported many training requirements, in the future it will be used as a standard 25-m Rifle/Machine Gun Zero Range primarily in support of training with M16 and M4 rifles, M249 and M240 pistols, and M60 machine guns.[1]

1.3.1 Historical Use

Juliet Range is located directly north of Pocasset-Forestdale Road, west of Kilo Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. It was established in the late 1980s at the site of the former Air Force A pistol range. Records indicate it continued to be used as a pistol range after the name was changed from Air Force A to Juliet Range (IAGWSP 2007). Juliet Range has been used primarily as a 25-m pistol qualification range with 17 firing points spaced along a 32-m firing line.

Paper silhouette targets on wooden frames are located 25 m from the firing line and a berm backstop is located approximately 50 feet behind the targets. Lead-bullet ammunition for 5.56mm, .38 caliber, 9mm, .40 caliber, .45 caliber, and 12 gauge was fired on Juliet Range through 1997. After 1997, military and civilian law enforcement personnel fired tungsten-nylon and plastic 5.56mm ammunition and frangible (copper and/or tungsten powder composite) 9mm ammunition on Juliet Range. The military fired tungsten-nylon rounds on Juliet Range between October 1999 and December 2005. The backstop berm was treated for lead during the 1998 Berm Maintenance Program (IAGWSP 2007). Training with lead-bullet ammunition has not occurred since 1997, except for one unapproved firing event with lead on Juliet Range in October 2005 (Clausen, et al 2007). The event occurred on 16 October 2005 and 1,940 rounds were expended on Juliet Range by an Army Reserve unit. (Mauk 2007)

[1] FCC 17801, 25-m Rifle/Machine Gun Zero Range, can also be used to support pistol marksmanship and as an alternate qualification course for M16.

1.3.2 Environmental Drivers

For MANG to resume effective small arms training, two significant legal drivers define the path forward; they are EPA Region 1 Administrative Order 2 (AO2) issued to MANG in 1997 and the revised Massachusetts Environmental Performance Standards for Camp Edwards, Massachusetts, dated 11 July 2007.[2]

Appendix A, Section II.E of AO2 states the following conditions and requirements for the resumption of prohibited training activities. "If…EPA approves resumption of Respondents' activities at the Training Range and Impact Area, Respondents shall ensure maximum feasible use at such time of pollution prevention technologies in any training activities. Specific measures to be evaluated by Respondents include the following:

- Use of non-toxic lead-free combat ammunition;
- Use of bullet traps at all small arms ranges;
- Use of munitions-capturing material, such as 'SACON';
- Use of non-exploding artillery and mortar rounds; and
- Development of guidance for the operation and maintenance of the ranges consistent with the pollution prevention strategies."

With regard to the resumption of small arms marksmanship training, the Environmental Performance Standards require the MANG to develop small arms range specific operations, maintenance and monitoring plans and have those plans approved through the Environmental Management Commission. Once the plans are approved the small arms ranges will be operated in compliance with EPS 19.0 Range Performance Standard and other applicable EPSs.

In its endeavor to meet the requirements of these two legal drivers, MANG is following the tenants of the Army's Strategy for the Environment—Mission, Environment, and Community. Development of a SAR P2 Overview provided the management strategy and prioritization of Camp Edwards SARs. The development of range-specific BMP OMM plans to prevent the migration of pollution to the water supply and sensitive natural resources fulfills the requirements of both of the drivers.

As such, this range-specific BMP OMM plan identifies potential pathways for migration of, and potential exposure to, contaminants from Juliet Range. Environmental management and P2 BMPs are analyzed and selected based on their ability to disrupt the pathways to potential receptors. The selected BMPs for Juliet Range are described in this plan. Prior to beginning

[2] AO2 was issued in April 1997 following AO1, issued in February of that year. AO1 required the National Guard Bureau (NGB) to investigate sources of contamination potentially from the training ranges and Central Impact Area. AO2 required that Camp Edwards cease certain training activities (e.g., firing lead small arms ammunition, artillery fire, and mortar fire) pending environmental investigations. These activities are still prohibited.
Chapter 47 of the Acts of 2002 codified a Memorandum of Agreement, ensuring permanent protection of the drinking water supply and wildlife habitats in the Reserve/Training Area, while allowing compatible military training. It created the EMC, to oversee compliance with and enforcement of, and modifications to the Environmental Performance Standards; and, environmental laws and regulations within the Reserve/Training Area.

marksmanship training on Juliet Range, Camp Edwards will present this BMP OMM plan to EMC and EPA for review and approval. The Juliet Range OMM plan is a document that the MANG will use to comply with applicable federal, state, and local regulations on operational small arms ranges. The BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR Working Group; however, state approval would be through the EMC.

1.4 Roles and Responsibilities

To implement this BMP OMM plan, Camp Edwards will involve a team of experts to manage training operations, facility maintenance, and environmental protection functions.

1.4.1 Training Site Commander

The Training Site Commander is responsible for the overall operation of Camp Edwards to include the immediate supervision, control, coordination, and safety of all Camp Edwards facilities and promotion of mission compatible and environmentally sustainable uses of Camp Edwards resources.

1.4.2 Director of Plans and Training

The Director of Plans and Training (DPT) is the primary advisor to the Training Site Commander on all matters concerning the safe, efficient utilization of Camp Edwards training facilities. Within the overall responsibility for Range Control operations, the DPT will:

- Provide review, comments, and approval of the SAR P2 Overview and individual range BMP OMM plans;
- Identify and program for range modernization, operations, and maintenance requirements based on training load and doctrine; and
- Include requirements within the SAR P2 Overview and individual range BMP OMM plans for planning and budgeting actions as appropriate for sustainable OMM of ranges.

1.4.3 Range Control Officer

The Range Control Officer is the primary representative of the Training Site Commander at Range Control and, as such, will:

- Coordinate the generation of range modernization requirements and oversee range modernization projects;
- Control access to ranges;
- Schedule and issue ranges to using units and clear/close out units upon completion of range use;
- Coordinate operation of ranges and oversee using units while training on Camp Edwards ranges;
- Enforce applicable guidance and regulations, range standard operating procedures, and safety requirements;

- Conduct periodic inspections of range conditions and identify requirements for repair and maintenance;
- Coordinate the repair of damage to range facilities (e.g., bullet containment systems);
- Collect Training Facility Utilization Reports from using units; and,
- Maintain range utilization, inspection, repair, and maintenance records.

1.4.4 Director of Facilities Engineering

The Director of Facilities Engineering (FE) is the primary representative of the Training Site Command for accomplishment of facility sustainment, restoration, and modernization and, as such, will:

- Coordinate necessary maintenance on SARs to include:
  - Periodic lead removal from SAR berm and other bullet containment systems that are integral to the range facility;
  - Repair of damaged range facilities (e.g., bullet containment systems); and,
  - Repair of erosion damage to firing points, target areas, berm, and other range areas;
- Coordinate necessary maintenance on all training support facilities on ranges (e.g., bleachers, parking areas, buildings).

1.4.5 Environmental and Readiness Center

The Environmental and Readiness Center (E&RC) is the primary representative for the Training Site Commander for accomplishment of sustainable environmental management requirements. To support the return and sustainment of small arms training at Camp Edwards in accordance with environmental agreements, orders, and regulatory and legal requirements, the E&RC will:

- Make adequate professional personnel resources available to the DPT and Range Control Officer to oversee or review implementation of P2 or pollution control BMPs;
- Coordinate with the Range Control Officer and FE to support the recovery, management, recycling, or disposal of metals from ranges in accordance with DoD guidance and federal and state solid waste regulations, as applicable;
- Conduct periodic reviews of range BMP OMM plans;
- Coordinate with MANG Environmental personnel, both full-time and part-time, to conduct periodic inspections of Juliet Range to ensure compliance with the BMPs;
- Coordinate required environmental sampling and monitoring on ranges; and
- Ensure coordination with the EMC, EPA, MassDEP, and other appropriate federal, state, and local environmental resource protection agencies to monitor concerns with SAR operations.

2.0 TRAINING DESCRIPTION

Small arms training conducted at Camp Edwards may vary per using unit depending on the unit's mission and the types and amounts of training required to maintain proficiency in mission essential tasks. This section describes training types and amounts anticipated on Juliet Range. It also describes range use procedures and restrictions that support safety and protection of human health and the environment.

2.1 Training Capabilities

Camp Edwards' current training requirements include the need for small arms familiarization, zeroing sights, marksmanship practice, weapons qualification, and small unit tactics. Table 2-1 provides basic descriptions of various types of small arms weapons training. The Army specifies certain range types to conduct these tasks for different weapons systems. The Army also specifies the number of repetitions needed to become proficient in each task. Camp Edwards must have a sufficient number of ranges to accommodate the throughput requirements for all soldiers, weapons systems, and training types.

Table 2-1. Small Arms Weapon Training Terms

Term	Description
Weapons 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 for a given ammunition load.
Practice/Marksmanship	Marksmanship training by which soldiers learn to accurately fire a given weapons 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 short range firing at fixed targets to field firing at various target types and longer ranges. Transition firing can include moving down the range floor towards the target and engaging the target at different firing lines/points along the range floor. It can also include transitioning from firing a rifle to a pistol during the same training event. 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 requires a gunner to complete several phases of firing tasks to qualify to operate a particular weapon. Record fire is scored to provide the gunner with feedback and to record the gunner's qualification.

As a 25-m Rifle/Machine Gun Zero Range with 17 firing lanes, Juliet Range is designed for training shot-grouping and zeroing exercises with pistols, rifles, and machine guns. Training tasks will include weapons familiarization, zeroing, practice marksmanship, and alternate qualification (see Section 2.1.1). In some scenarios, in order to train to standard, personnel will need to move down the firing lane towards the target and engage the target at different distances from the target. Soldiers will develop the skills necessary to align the sights and practice basic marksmanship techniques against stationary targets (Headquarters Department of the Army 2006).

As shown in Figure 2-1, Juliet Range is a south to north oriented firing range. The line of fire is south to north, the firers are at the southern end of the range and the target line and berm backstop are at the northern end. The firing line at Juliet Range is 32 m long with 17 firing positions spaced along the range floor width of 150 feet. The first firing line from the vehicle parking area, the southernmost firing line, is also the 25-m line and is at the maximum distance from the target line. The northernmost firing line, which is 3 yards from the target line, is the minimum distance from which weapons will be fired to safely engage targets. While STAPP™ can handle point blank firing it is not intended at this time to be used for training in this manner. The distance between the 25-m firing line and the 3-yard firing line is part of the range floor; in some scenarios for personnel to train to standard, the firers will move within their designated firing lane between the 25-m and the 3-yard line to engage targets on the target line. There are 17 wooden framed target holders placed 25 m downrange from the southernmost (maximum distance) firing line also known as the 25-m firing line. Soldiers will expend all ammunition from the designated firing positions (prone, kneeling, standing) along the firing lines and or lanes downrange to the targets. No weapons will be discharged forward of the northernmost (minimum distance) 3 yard firing line, across firing lanes, or at an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems (MANG 2006). In addition to the requirements of this plan, all firing on Juliet Range will be managed in accordance with Camp Edwards Regulation 385-63, which is summarized below in Section 2.1.3. Figure 2-1 depicts the bullet path from the maximum firing line on Juliet Range.

The multiple firing lines within the range floor between the maximum distance of 25 m and the minimum distance of 3 yards from the target line allows personnel to zero and conduct marksmanship training with rifles, pistols and machine guns authorized for use on Juliet Range.

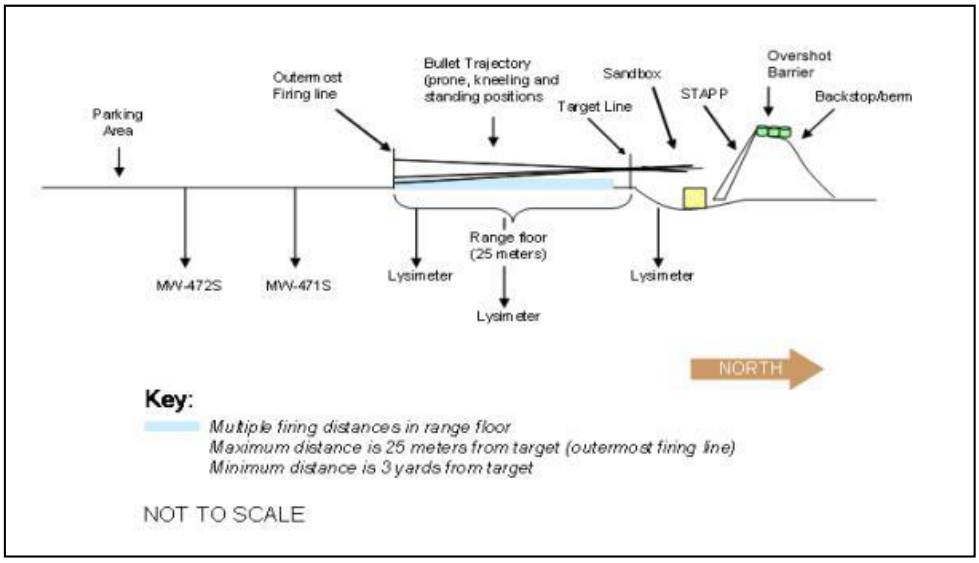


Figure 2-1. Basic Lateral View of Juliet Range

Range personnel can zero rifles and machine guns and conduct marksmanship training with these weapons systems in three different positions: prone, kneeling, and standing. Users may also zero and practice pistol marksmanship at the firing line.

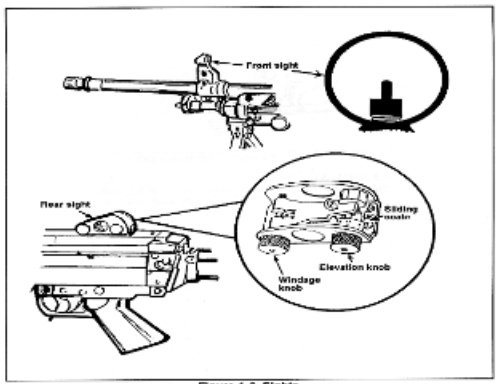
Juliet Range can also be used as an alternate range for M16 and M4 qualification using scaled targets although the use of this range for qualification is suboptimal. Scaled targets simulate firing at longer ranges by using reduced image size and perspective (see Figure 2-2).

Figure 2-2. Scaled Target

2.1.1 Training Types/Exercises

During a training exercise, a unit occupies the range for one to five days. The length of the unit's occupation depends on the training goals for that exercise. After checking out the range from Range Control, the designated Range Safety Officer (RSO) delivers any requisite safety and/or environmental announcements (see Section 4.1.2). The unit erects a small covered space with a folding table that acts as a desk for the records (e.g., ammunition log). The safety officer distributes ammunition to each soldier, notating rations in the records log.[3] No training is permitted forward of the firing line.

Familiarization exercises include a review of the weapon's basic components, applicable ammunition, and any firing attachments. Soldiers learn safe operating procedures for clearing ammunition from the chambers, function check, and inspection. Maintenance lessons include cleaning, lubrication, and preventive procedures to keep the weapon in combat-ready operation. Soldiers learn how to load and unload ammunition, adhering to safety procedures. Familiarization can be conducted at the firing line or in the assembly area.



Zeroing is one of the most basic and universal training tasks for small arms marksmanship. During zeroing, one soldier occupies each of the 17 positions along the 10-m or 25-m firing line, depending on the weapon system. To set the sights, soldiers learn the turns required of the windage knob or peep sight for accuracy. Having mastered those basics, soldiers move onto the adjustments required to engage targets at various ranges (elevation) (i.e.,

[3] At the end of the exercise, soldiers return unused ammunition. The safety officer subtracts the number of rounds returned from the amount distributed to record the munitions expenditure. The unit turns in this record to Range Control upon checkout proceedings.

25 m, 100 m, etc.). Rotation of the elevation knob toward the muzzle (front of the weapon) increases the range, whereas rotation toward the butt stock (back of the weapon) decreases the range (see Figure 2-3). Fine adjustments for zeroing are made by adjusting the peep sight. Juliet Range is a 25-m range, so units use scaled targets to depict targets beyond 25 m (see Figure 2-2). These scaled targets have smaller silhouettes to represent targets that are farther away.

Marksmanship training is divided into three phases: preliminary, basic, and advanced. Skills trained in the preliminary phase include the practice of steady position, aim, breath control, and trigger control. For example, breath control is practiced when the user inhales, places his/her finger on the trigger while holding the breath, and then releases that breath when shooting. This basic skill controls the shooter's firing rate and promotes accuracy. The basic phase applies these fundamentals in day and night cover conditions. The advanced phase trains the soldier in combat techniques of fire and techniques of employment.

The objectives of marksmanship training are:

- Accurate initial burst. Obtaining initial burst of fire on the target is essential to good marksmanship. This requires the rifleman to estimate range to the target, set the sights, and apply the fundamentals of marksmanship while engaging targets.
- Adjustment of fire. The rifleman must observe the strike of the rounds when the initial burst is fired. If not on target, the soldier must manipulate the weapon for accuracy.
- Speed. Speed is essential and is an acquired skill gained through extensive training. Speed should not be stressed to the detriment of accuracy (Headquarters Department of the Army 1985).

2.1.2 Weapons Systems and Ammunition Types

Juliet Range will be used primarily for zeroing the 5.56mm rifle (M16 and M4) and machine gun (M249) and 7.62mm machine gun (M240 and M60). Juliet Range may also serve as an alternate range for training on all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols. The most frequently fired pistol caliber on Juliet Range, by both law enforcement and military, is the 9mm (M9).

2.1.3 Use Procedures and Restrictions

Camp Edwards Regulation 385-63 outlines extensive rules and procedures for the ranges and training lands on Camp Edwards (MANG 2006). It notes that, "Users are to minimize environmental disturbance to protect the ecosystem as well as preserve the long-term value of our training site." Applicable subsections of this manual that apply to Juliet Range are:

- Section 2-3, Safety and Environmental Briefing
- Section 2-5, Ammunition, Demolition, and Pyrotechnics Restrictions
- Chapter 3, Environmental Considerations
- General Training and Environmental Protection Approvals and Conditions

Range Control personnel are well-versed with this regulation and educate RSOs during the scheduling and issuance of ranges to using units. Camp Edwards personnel oversee and assist the training conducted on Juliet Range and evaluate whether training is conducted in accordance with operational, safety and environmental requirements. See Section 4 for additional OMM procedures relevant to environmental BMPs. Camp Edwards will update Regulation 385-63 to resolve any inconsistencies with the requirements of this BMP OMM plan. All such inconsistencies will be identified prior to range use.

Before occupying Juliet Range, the unit must designate an RSO who will receive a safety briefing. The briefing informs units of the installation's restricted areas (impact area, forward of the firing line at any range), prohibitions of mortar and artillery munitions and pyrotechnics, misfire and malfunction procedures, communication procedures, and environmental considerations. Procedures directly related to environmental protection include:

- Weapons maintenance, cleaning, and lubrication will be conducted in a manner that minimizes the potential for release of solvents or lubricants to the environment.
- Cleaning/lubricating/preservative compound (CLP) and other weapons maintenance, cleaning, and lubricants will be conducted in a manner that minimizes the potential for release to the environment. Personnel will sparingly use these products when maintaining their weapons. When CLP containers are not in use, dependent upon their size, will be kept on the soldier's person; or, when not in use and where practical these containers will have their lids on and should be placed in a box, plastic bag or container like a 5-gallon bucket. If cleaning materials are used on the range-rags, patches, and other cleaning material- they will be thrown away into a separate plastic trash bag; this bag will then be disposed of in an enclosed container at the designated Range Control collection point. It will be inspected weekly by MANG staff; and, when appropriate by the MANG environmental staff to determine the disposition of the waste and then dispose of it in accordance with applicable federal, state, and local regulations.
- Units will use portable latrines.
- Units will avoid wildlife and damage to wildlife habitat.
- Units should take precautions for ticks.
- Soldiers will expend all ammunition from the designated firing positions along the firing line (between the maximum distance of 25 m and minimum distance 3 yards) within the firing lanes downrange to the targets. No weapons will be discharged:
  - Without permission from the Range Safety Officer; or,
  - Forward of the firing line or across firing lanes; or,
  - At an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems.
- Units must get approval from Range Control prior to employment of tracer and hollow point ammunition on Juliet Range (see 4.2.1.5 **Holes in the cover**).
  - The delinking of tracer rounds is not authorized (MANG 2006).
  - All fire (particularly tracer and hollow point fire) will be observed by the Range Control Officer (or authorized designee) to evaluate that bullet flight through target holders proceeds into the bullet containment system
  - Inspect the top cover immediately following training events where hollow points are employed and initiate repairs in accordance with section 4.2.1.5.

- Ensure that training is conducted in accordance with applicable procedures.

- After training with Automatic Weapons (e.g. 7.62mm, M4) the Range Control Officer (or authorized designee) will inspect the surface of STAPP to assess whether irregularities have formed at the surface due too rearrangement of rubber filler material from automatic firing. If it is determined that there has been a seam failure or significant reduction in rubber filler (15 inches or less) the appropriate repairs will be initiated in accordance with section 4.2.1.5.

2.2 Training Capacity

For planning purposes, MANG has estimated the throughput capacity of Juliet Range. The throughput capacity of a range is the maximum number of soldiers or units that it can accommodate in a given period of time. The calculations provided below represent the maximum number of soldiers that could be trained on Juliet Range given the stated assumptions and default values. Calculation of throughput capacity is based on the type of training, the time required for a single individual or unit to complete a training event or series of events, and the period of time (day, week, month, year) that applies. Throughput calculations for some types of ranges may also include the number of soldiers or units that can train simultaneously.

The daily throughput capacity of Juliet Range (25-m Rifle/Machine Gun Zero Range) with 17 lanes is estimated as follows[4]:

Number of lanes: 17

Time required for one soldier to complete firing: 30 minutes or 2 soldiers/hour

Time available for training: 8 hours/day

Number of soldiers per hour: 17 lanes x 2 soldiers/lane/hour: 34 soldiers/hour

Maximum throughput capacity: 34 soldiers/hour x 8 hours/day: 272 soldiers/day

To obtain the annual capacity, multiply the daily capacity by the number of days available for training:

Maximum daily throughput capacity: 272 soldiers/day

Days available for training: 280 (estimated)

Maximum annual throughput capacity: 272 soldiers/day x 280 days/year:
72,160 soldiers/year

The calculation above represents a theoretical maximum of 72,160 soldiers per year using Juliet Range. MANG does not foresee this level of training usage on Juliet Range because MANG has approximately 6,000 soldiers, of which some are deployed or training elsewhere. The following

[4] The calculation of throughput capacity is an estimate for planning purposes only. It is not intended to establish a limit on the utilization of Juliet Range. Adjusting any assumed value (e.g., hours of training/day, number of training days/year) will increase the throughput on Juliet Range.

sections provide a conservative estimate of the number of soldiers trained and related munitions expenditures for a year on Juliet Range.

Assuming each of MANG's 6,000 soldiers would train and qualify with the standard issue M16 or M4 rifle, each soldier would require 98 rounds of 5.56mm ammunition per year. If all of these soldiers were to train and qualify at Camp Edwards, the training load could be estimated as follows:

Estimated number of soldiers: 6,000 soldiers/year

Ammunition issued: 98 rounds of 5.56mm ammunition per soldier allocation per year

Estimated ammunition load at Camp Edwards: 6,000 soldiers/year x 98 rounds of 5.56mm ammunition: 588,000 5.56mm rounds/year

Estimated ammunition load at Juliet Range: Estimated ammunition load at Camp Edwards/2 ranges available to support training (Tango Range and Juliet Range): 294,000 5.56mm rounds/year

This is a conservatively high estimate of munitions firing level because MANG estimates that at any given time 1,500 soldiers are deployed and not training and 1,000 soldiers are qualifying at other installations. Although this calculation does not account for variations in the types and calibers of weapons systems and ammunitions that could be fired on Juliet Range, it does provide insight into the total firing load that Juliet Range could experience.

Table 2-2 contains ammunition expenditures from 1994 to 2007 on all Camp Edwards SARs where 5.56mm (M16 and M4) rifle and (M249) machine gun, 7.62mm (M60 and M240) machine gun, and pistols were fired. The table includes expenditures (for relevant calibers) from B, C, D, E, G, H, I, J, K, N, O, P, and T Ranges.

Table 2-2. Historical Ammunition Usage on All Relevant Ranges at Camp Edwards

Training Year[5]	Training Days	5.56mm Tung	5.56mm Plastic	5.5mm6 Lead	7.62mm Lead	.45 Lead/ Frang[6]	.40 Lead/ Frang	.38 Lead/ Frang	9mm Lead/ Frang
2007	20	0	0	8,547	0	0	0	0	100
2006	97	77,703	0	0	0	0	0	0	1,989
2005	52	124,331	0	0	0	0	0	0	5,552
2004	98	204,293	11,242	0	0	2,700	6,900	2,150	22,320
2003	93	286,920	100	0	0	3,900	2,900	0	10,750
2002	80	223,241	30,662	0	0	3,880	3,000	0	6,000
2001	49	75,217	26,210	0	0	6,651	38,747	0	16,233
2000	42	69,473	46,250	0	0	6,630	8,650	0	5,550
1998	36	0	131,056	0	0	0	0	0	0
1997		0	44,757	215,461	34,894	0	24,172	21,031	202,660
1996		0	0	365,836	64,207	11,165	79,557	62,279	388,956
1995		0	0	531,665	64,541	7,860	66,850	85,003	488,920
1994		0	0	532,900	99,118	68,224	5,915	65,983	454,220
TOTAL	**567**	**1,061,178**	**290,277**	**1,654,409**	**262,760**	**111,010**	**236,691**	**236,446**	**1,603,250**

Note: 1997 was the last training year that training with lead-bullet ammunition was permitted on Camp Edwards

MANG will track and report the actual amount of ammunition fired on Juliet Range annually. The following information will be collected each time Juliet Range is in use: total number of personnel trained, the weapon systems used, the type of ammunition, and the number of rounds expended will be collected each time (See Appendix A, Training Facility Utilization Report).

[5] Training year is a fiscal year, October to September.
[6] Pistol fire prior to 1998 used lead-core ammunition. After 1998 pistol fire was conducted primarily using frangible bullets.

3.0 RANGE LAYOUT

The purpose of this section is to provide visual/pictorial representations of the physical design modifications to Juliet Range to support the P2 BMPs described in Section 4. The primary P2 design feature on Juliet Range is the STAPP™ bullet containment system on the existing soil berm, Figure 3-1.

3.1 Range Plan

Juliet Range is located north of Pocasset-Forestdale Road, west of and directly adjacent to Kilo Range. The two ranges are separated by a soil berm covered with trees. Juliet Range has generally flat topography, with the exception of an existing soil berm/backstop previously used for bullet containment on the north side of the range. Two other soil berms covered with trees are located on either side of the range floor to the west and east, bordering the 150-foot-wide range floor. The berm on the eastern side of range floor separates Juliet and Kilo Ranges. Distinct features of Juliet Range include a parking lot, a storage shed for target frames shared with Kilo Range, a firing line, the range floor, and a soil berm.

Juliet Range is surrounded by trees, which buffer noise and act as a windbreak. The parking area is open to and accessed from Pocasset-Forestdale Road. The firing line at Juliet Range is 32 m long with 17 firing positions. The STAPP™ system is installed in such a way as to allow proper trajectory of fired rounds through targets and into the STAPP™ system from standing, kneeling, and prone positions. The existing soil berm/backstop was treated with Maectite™ during the berm maintenance project in 1998. MANG installed a STAPP™ bullet containment system on the existing soil berm in 2008. Juliet Range was surveyed and the target frames placed approximately 12 feet from the toe of the berm. The maximum firing line is 25 m from the range targets and the minimum firing line is 3 yards from the target line, as shown in Figure 2-1 on page 2-3.

The STAPP™ system is described in detail below in Section 3.2. Other proposed Juliet Range construction includes a range tower, bleachers, and a pavilion. These support facilities will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located adjacent to the current parking area of Juliet Range. The bleachers will provide seating for training announcements and will be situated behind the firing line in order to safely observe firing.

The Juliet Range plan incorporates several elements selected to disrupt migration pathways identified in the SAR P2 Overview and currently in use on Tango Range as shown in Figure 3-1. The STAPP™ system limits the interaction of precipitation with bullets and retards the vertical movement of metals into soil and the transport of dissolved and particulate metals toward the toe of the berm. Vegetation on the sides and back slope of the berm will prevent erosion of berm soil caused by surface water flow. The entire range floor is buffered by trees to prevent wind erosion and the migration of small arms firing residue off-range through wind entrainment. One pan lysimeter is located at the toe of the berm; a second pan lysimeter is located two yards in front of the maximum firing line. A third pan lysimeter is located on the range floor midway between the toe of the berm and the maximum firing line. A fourth lysimeter will be paced under the

infiltration area of the stormwater drainage system. The three lysimeters on the range floor of Juliet Range are located in the center firing lane, 2 feet below ground surface. The lysimeters are used to monitor soil-pore water for dissolved metals as an early indication of contaminant migration from the ground surface towards the water table. Because groundwater flows from northeast to southwest across the range, the existing groundwater monitoring wells are located appropriately to monitor for the presence of munitions constituents in groundwater.

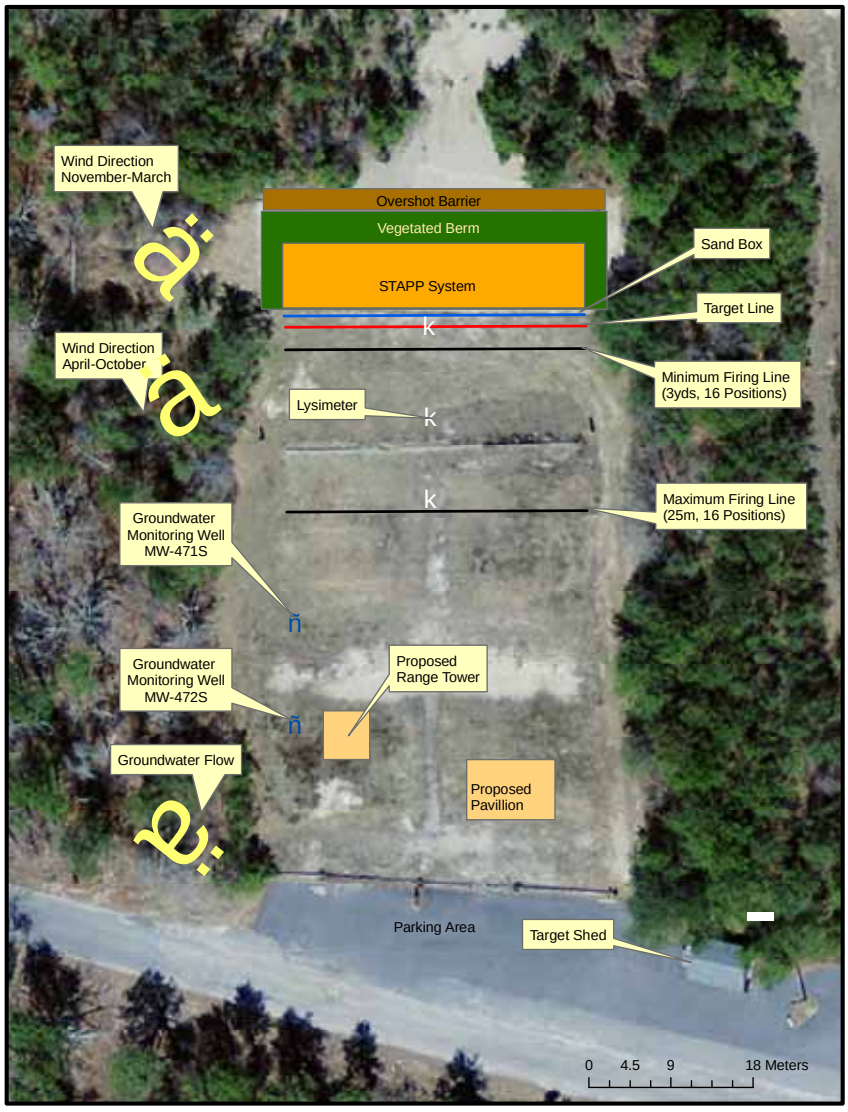


Figure 3-1. Aerial View of Juliet Range Plan

3.2 Details and Specifications of Bullet Containment System

Juliet Range employs several features that collectively sever pathways of metals migration; they include the STAPP™ system, an overshot barrier, the vegetated back slope, the vegetated range floor, and the two vegetated earthen berms on the east and west side of the range floor. The most significant feature is the STAPP™ system itself, which will contain the majority of the fired bullets. The STAPP™ system is a rubber sandwich framed by synthetic lumber; the system consists of a bottom rubber membrane, a matrix of rubber granules, and a cover that is a self-closing membrane that permits bullets to pass through but prevents precipitation from getting inside the system. Figure 3-2 shows the STAPP™ system on Juliet Range installed on an earthen berm.

Figure 3-2. Juliet Range Installed with STAPP™

The impermeable liner (see Figure 3-3a and 3-3b) prevents bullets in the granular rubber from interacting with berm soil. Additionally, the liner will collect condensation or water that has passed through perforations in the self-closing cover and will direct it toward the water collection piping for removal and disposal in accordance with local, state and federal law.

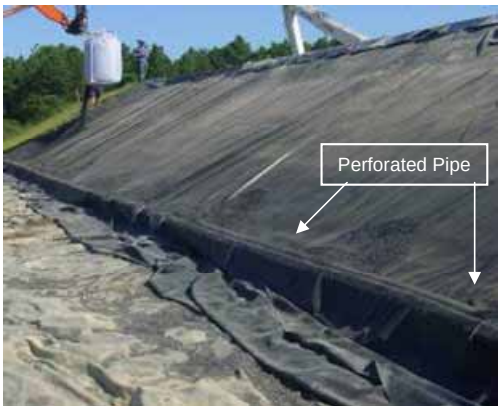


Figure 3-3a. Liner with Perforated Pipe

Figure 3-3b. Perforated Pipe & Rubber Granules

On the top of the berm at Juliet Range an overshot barrier will be installed to capture potential overshot (Figure 3-5). The barrier will be constructed to an appropriate height to contain most overshot.

To protect the base of the STAPP™ system from undershot a series of sand-filled timber framed boxes will be placed. behind the target frames. The 8' long sand boxes are constructed with 6" x 6" pressure treated timbers, 2" x 4"s and plywood. The boxes are fastened using nails, spikes, and wood dowels; the use of spikes was minimized to help prevent ricochet hazards with wood dowels providing most of the fastening strength. The boxes are filled with clean/washed sand. A heavy duty vinyl geotextile fabric (Thoroshield 4050) is secured to the box to allow it to shed rain water. The sand box placement is illustrated in Figures 3-5 and 3-6.

In addition to the sand boxes placed to protect the base of the STAPP™ system, the ground surface between the target line and the berm with STAPP™ will be graded in such a fashion that the base of STAPP™ is below the target line. This grade/elevation difference will provide additional protection to the base of STAPP™. Figure 3-5 provides an exaggerated view of the grade difference between the target line and STAPP™. This area will be appropriately graded to reduce erosion and manage surface water runoff. On Juliet Range, the elevation between the

target line and STAPP™ will be maintained at the current gradual slope to the west. The site will be graded and maintained to minimize the potential of any long-term standing water, see Section 4.2.1.4 for further discussion on storm water management.

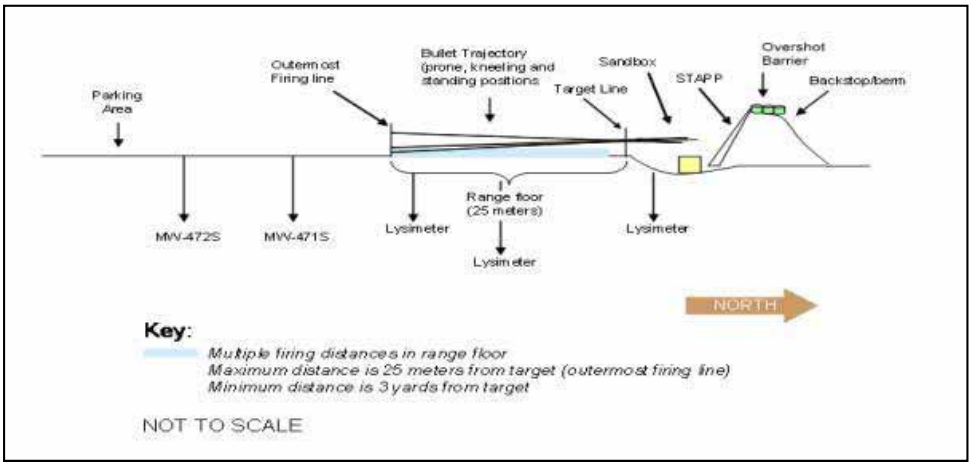


Figure 3-5. STAPP System and Grade Change between Target Line and Berm, Juliet Range

Figure 3-6 on the following page depicts the features associated with the target line and the STAPP™ system. The lysimeters shown in the figure represent the approximate location of the lysimeters to be installed. The 10º ground surface slope shown in the "Detail A" box is an approximate slope and is used to demonstrate the elevation difference between the target line and the base of the STAPP™ system.

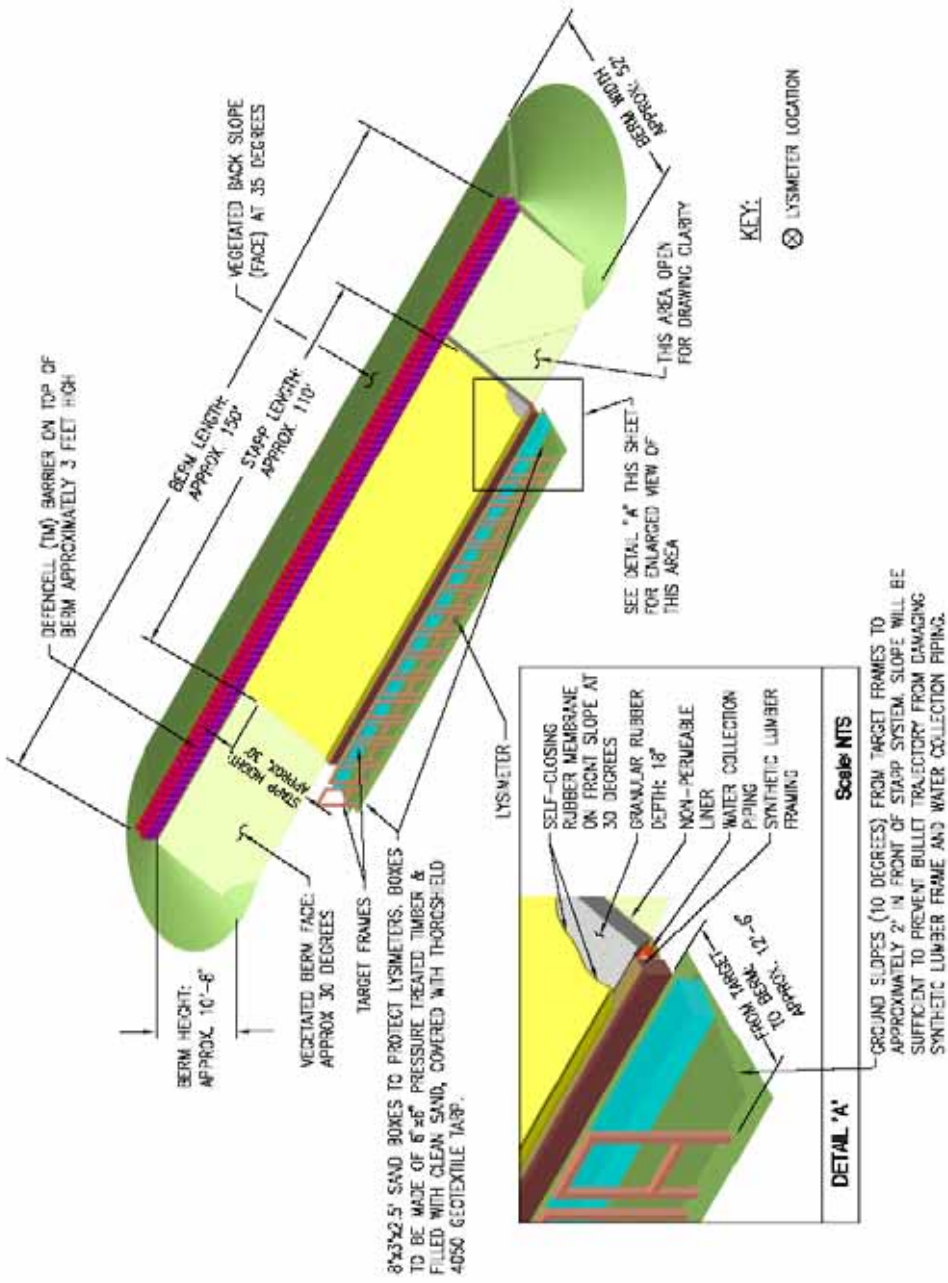


Figure 3-6. Drawing of STAPP™ Bullet Containment System

3.3 Details of Monitoring Features

Two groundwater monitoring wells are located on the west side of Juliet Range (MW-471S and MW-472S). The locations are appropriate to monitor impacts from firing on Juliet Range; groundwater flows to the south. Depth to groundwater at Juliet Range is approximately 27 m, and the installed wells will sample groundwater to a depth of 30 m below. Specifications of the groundwater monitoring wells installed on Juliet Range are shown below on Figure 3-7.

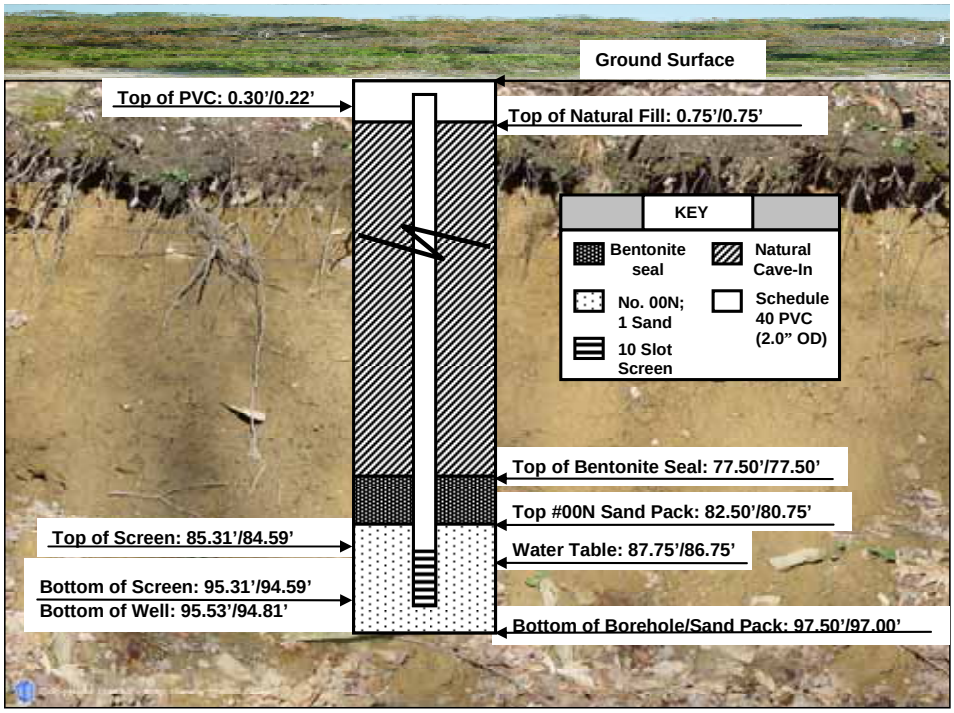


Figure 3-7. Groundwater Monitoring Well Construction Details for MW-472S and MW-471S, respectively

Lysimeters will also allow MANG to monitor for dissolved munitions constituents in soil-pore water on Juliet Range. The lysimeters will function as an early warning sign of lead migration within the first 2 feet of surface soil at the toe of the berm, at the firing line, and on the range floor. The lysimeter at the toe of the berm will detect whether metals from fired ammunition are contained by the STAPP^{TM} system. The lysimeters on the range floor and between the toe of the berm and the maximum firing line will detect the migration of any metals or propellants from the muzzle blast of fired weapons. Lysimeter sampling will characterize contaminant migration through the soil-pore water toward the aquifer.

Pan lysimeters (Figure 3-8) will be used on Juliet Range and are constructed with an open-faced container filled with washed quartz sand or other inert material. The container, or pan, is placed horizontally in the soil and is equipped with a drain port connected to a collection bottle by tubing. Water percolating through the soil above the pan is collected via gravity, and then pumped to the surface for sampling.

Figure 3-8. Example of a Pan Lysimeter

MANG installed pan lysimeters on Juliet and Kilo Ranges. The benefits of pan lysimeters include: the ability to collect larger volumes of water, a more reliable method to collect soil-pore water, fewer steps in sample collection, and an easier installation process.

The pan lysimeters are made of HDPE and 10" x 13" in size. Teflon-lined poly tubing (3/8" O.D.) is connected to the pan lysimeter and run to a 2 L HDPE container placed below the lysimeter. A fine screen mesh is placed at the inlet port to keep soil from entering the influent tubing. Washed sand is placed over the mesh and fills the lysimeter pan. Poly tubing (¼" O.D.) will run from the bottom of the 2 L container through a protective sleeve to the ground surface; soil-pore water is extracted through this tubing with a peristaltic pump. A protective cap placed at the end of the sleeve allows the tubing to be kept slightly below ground surface, but still accessible for sampling.

By monitoring weather conditions, attempts to sample soil-pore water will occur after rain events; 100mL of water is required for collection of a sample. The water will be analyzed for the required analytes listed in Section 4.2.2.3. Actual precipitation amounts will be recorded using a weather website with ties to meteorological equipment on base and precipitation data will presented in a log sheet.

4.0 RANGE OPERATIONS AND MAINTENANCE

This section provides guidance for the OMM of Juliet Range that is consistent with, and complimentary to, the P2 strategies evaluated and selected in the SAR P2 Overview and duplicates the strategies adopted for Tango Range. The following guidance satisfies the criteria identified by MANG for the "maximum feasible use of P2." As such, guidance was developed to be implementable, protective of human health and the environment, and to be cost effective.

If the MANG determines or anticipates that it may not be able to comply with any requirement of the OMMP, it will notify EPA and EMC within 24 hours of this determination in writing. Within an additional 48 hours, the MANG will provide a plan for EPA and EMC approval for addressing the potential deviation.

By the tenth day of each month, the MANG will prepare and submit to EPA and EMC a monthly report that includes: 1) the actions that have been taken toward maintaining compliance with the Administrative Order and the OMMP during the previous month, 2) a summary of all sampling results and tests and all other data during the previous month, 3) all work plans, reports, and other deliverables required by the Order, and 4) all actions scheduled for the next 6 weeks including percentages of work completed to date on ongoing tasks, delays encountered, and a description of efforts made to mitigate any delays.

By December 15, MANG will submit an annual report containing all data collected during the year. Any issues that were encountered should also be described.

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4.1 General Range Operations

4.1.1 Range Access

"During legally established hunting seasons in Massachusetts, licensed hunters with legally registered firearms may be permitted in select portions of Camp Edwards. Use of any portion of Camp Edwards for hunting is at the sole discretion of the Massachusetts National Guard. (MANG 2003)" Both Juliet and Kilo Ranges will be secure sites; trespassers are prohibited and hunting activities are not authorized on either of these ranges.

4.1.2 Range Scheduling

Juliet Range may be used for weekend training, inactive duty training, or during the two week-long annual training periods of MANG units. Deploying and Annual Training units have the first priority for scheduling training areas and ranges over Individual Duty Training and civilian requests. Per Camp Edwards Regulation 385-63, Range Control schedules Juliet Range usage based upon written input received from using units. Units forward a written request to "Commander Camp Edwards, ATTN: Range Control" or use the Range Facility Management Support System (RFMSS) Program stating the dates and facility desired. The written request must include the anticipated number of soldiers or other users occupying and using the range, the types of weapons to be used, the types of ammunition to be used (by DoD Identification Code [DODIC]), and estimated amounts of ammunition to be expended. A master schedule is available

for viewing electronically via the RFMSS Program. To avoid conflicts, co-use of a previously scheduled area will be confirmed only after Camp Edwards Operations and Range Control receive a written consent from the originally scheduled unit.

4.1.3 Issuing and Clearing the Range

A unit representative will sign out Juliet Range from Range Control prior to occupation or use. Units must confirm the information provided at the time the range was scheduled (e.g., numbers of users, weapons, and ammunition). Each unit will receive a Juliet Range usage packet, which will include a Weekly Range Bulletin. This bulletin indicates training facilities scheduled, airspace requirements, local restrictions, and other information pertinent to units training at Camp Edwards. Commanders are responsible for distribution to subordinate units and appropriate personnel. Prior to occupation, or immediately thereafter, unit personnel will inspect the range and report any deficiencies immediately to Range Control (see Section 4.2.1). Camp Edwards personnel will conduct safety and environmental awareness briefings to designated Officers in Charge and RSOs prior to issuing the range. The briefing will cover the requirements of this document as well as requirements of Camp Edwards Regulation 385-63, *Range Safety and Trainers Guide*, and safety requirements from applicable weapons manuals, field manuals, and technical manuals.

Upon completion of training, units shall police their brass and ammunition containers and packaging. Using units remove expended cartridge casings from the range, visually inspect them to remove any live rounds, and turn over the expended casings to the temporary Ammunition Supply Point (ASP). Other range residue such as weapons-cleaning materials and trash generated on the range will be collected on-site in a waste receptacle issued by Range Control upon check-in. The waste receptacle will be returned to Range Control upon checkout. Range control will establish a satellite accumulation point for wastes generated from weapons cleaning. Upon accumulation of 55 gallons of such waste, it will be disposed of per the Camp Edwards HMWMP and in compliance with state and federal solid and hazardous waste management regulations.

All units/organizations using Juliet Range will complete a Training Facility Utilization Report (see Appendix A[7]). This report summarizes the training activities conducted on the range and includes: the weapons systems used, the type and amount of ammunition used, the firing lanes that were used, and the types of vehicles present on the range. After policing their brass and related range residue, the unit/organization will inspect the range using the Juliet Range Inspection Form (see Appendix C). This form includes a review of the general order and condition of the facility, a visual check of erosion and vegetation on the range, and a visual inspection of the STAPP™ system. Blank copies of both of these reports will be included in the check-in packet distributed at Range Control. Upon clearing Juliet Range, each unit/organization will submit the completed reports to Range Control. The Range Control Officer or authorized designee will be available to answer any questions that arise during the visual inspection, but it is the unit/organization's responsibility to complete the range inspection. Once Juliet Range is inspected and cleared by Range Control personnel, via signature on the inspection forms, the unit

[7] The range inspection report in the Appendix is being continually improved for use on Juliet Range.

or organization representative will report to Range Control returning any Juliet Range packets or equipment issued and to close out the hand receipt prior to clearing the range.

4.1.4 Oversight of Training Operations

Per Section 1.4, the Range Control Officer is responsible for oversight of Juliet Range operations. The Range Control Officer issues and clears Juliet Range; he/she is the main point of contact for using units for range communications, usage requirements, and conflict resolution. The Range Control Officer will monitor units on Juliet Range to support compliance with this plan and Camp Edwards Regulation 385-63. The Range Control Officer will schedule all required monitoring described in Section 4.2 and all maintenance described in Section 4.3 with the appropriate Camp Edwards staff.

In coordination with Range Control, E&RC will have the MANG environmental personnel conduct site inspections of the range. Inspections can be conducted in conjunction with Range Control personnel or separately. In addition, the various environmental agencies will also inspect the range and/or units for compliance with the established Juliet Range OMM plans. If the range is operational, the environmental agency representatives will identify themselves to the Officer or Non-Commissioned Officer in Charge, who is responsible for the overall conduct of the range that day.

4.2 Range Monitoring

In addition to routine compliance monitoring, Range Control coordinates the general and environmental inspections and requisite rehabilitation on Juliet Range. Small arms training with lead-bullet ammunition will leave metals within the bullet containment system and possibly munitions constituents elsewhere on Juliet Range. In order to monitor the nature and extent of munitions constituents on Juliet Range, Camp Edwards instituted a monitoring program for soil, soil-pore water, and groundwater. MANG will also implement a number of other inspection and monitoring BMPs to ensure the conditions on Juliet Range that limit metals mobility are maintained. These BMPs include monitoring the condition of the bullet containment system, vegetation cover, and soil pH to minimize corrosion/dissolution of metals into subsurface soil or groundwater.

4.2.1 Range Inspections

Each time the range is used range inspections will be conducted by Range Control and accompanied by units or other users NCOIC or person in charge. This will provide with time a functional familiarity in how the range is cared for and its proper use. . Range Control will inspect the range on a regularly scheduled bi-weekly (every two weeks) basis, as the weather permits. Furthermore, Range Control will conduct detailed inspections three times during the peak training period and internal inspections of the STAPP™ system during periodic lead removal. There are three levels of inspections at Juliet Range: visual inspections, detailed inspections, and internal inspections. The requirements of each type of inspection are presented on the Juliet Range Inspection Form (see Appendix C). Each type of inspection is described in detail below and summarized in Table 4-4 at the end of Section 4.

As the MANG is currently regulated by the EMC under Chapter 47 and EPA Administrative Order II, in regards to small arms ranges and other aspects of live fire training on Camp Edwards, the EMC and EPA will conduct inspections of Juliet range.

Metric: When *the EPA or EMC provides an inspection report to the MANG the MANG will reply within 5 business days in writing, email, or other documentable form of communication.*

Most MANG training occurs between April and October. During this peak training period, the Range Control Officer will conduct a bi-weekly visual inspection of Juliet Range using the Juliet Range Inspection Form in Appendix C and compare his/her observations with the recently completed inspection forms of using units. The Range Control Officer will also conduct a visual inspection within 72 hours after major storm events[8].

Range Control will also conduct a detailed inspection of Juliet Range at the start, midpoint, and the completion of the peak training period. The detailed inspections will be conducted three times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October at the end of the peak training period. This detailed inspection will include features described in the Juliet Range Inspection Form Sections A-E (see Appendix C) as well as photo documentation of range conditions.

During the initial detailed inspection of Juliet Range conducted each year in March, Range Control will take baseline condition photos of the firing line, range floor, soil berm, and bullet containment system while standing at firing positions 4 and 13. These baseline photos will help field crews evaluate future observed conditions against the baseline and help document the rehabilitation of any reported range deterioration. Range Control 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. The following sections contain guidance for conducting range inspections.

MANG will also conduct an internal inspection of the components of the STAPP™ system each time MANG removes the cover and sifts the granular rubber material to remove and recover captured projectiles. Regularly scheduled internal inspections will occur after 500,000 rounds have been fired on Juliet Range or every three years, whichever occurs first. The internal inspection will include features described in the Juliet Range Inspection Form Section F (see Appendix C).

Range Control collects the Kilo Range Inspection Forms and schedules any required maintenance with either Facilities Engineering (FE) or the Environmental Office accordingly. Range Control files the inspection forms for administrative record keeping.

4.2.1.1 General Conditions and Order of Facility

[8] A major storm event is defined as an accumulation of more than 5 centimeters (cm) in a 24-hour period.

Distinct features of Juliet Range include a parking lot, a target shed shared with Kilo Range, a firing line, the range floor, an existing soil berm/backstop, STAPP™ bullet containment system, and 17 target frames. Proposed Juliet Range future construction includes troop support facilities and a range tower. The support facilities will include bleachers and a pavilion that will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located adjacent to the current parking area of Juliet Range. The bleachers will provide seating for training announcements and will be situated behind the firing lanes in order to safely observe firing. The parking area will be inspected for general condition and any petroleum, oil, and lubricant stains from vehicles. The target frames/holders, firing positions, shed, and proposed range tower must be in adequate condition to support unit training use. The protective timber "sand boxes" behind the target frames will be evaluated to identify deterioration, damage or excessive amounts of undershot. Units will note the condition of each of these features and any specific deficiencies in need of repair.

4.2.1.2 Erosion

Erosion is the displacement of soil by wind or water or by downward or downslope movement in response to gravity or human activity. Juliet Range is generally flat, with the exception of three sloped areas: the existing berm/backstop, which will support the STAPP™ system, and the two soil berms covered with trees on the east and west side of the range floor. The potential causes of erosion on Juliet Range are lack of vegetation, and human activity/disturbance, such as staff climbing the vegetated berm to inspect the top of the berm and the STAPP™ system.

4.2.1.3 Vegetation

Camp Edwards will plant and maintain Massachusetts Highway (MassHighway) seed mix to provide a vegetative cover on the berm areas around the bullet containment system and the range floor to reduce erosion (Ciaranca 2006).

4.2.1.4 Stormwater Management

On Juliet Range (Figure 4-1), there is a gently sloping drainage swale at the toe of the berm, which slopes to the west. Surface water flows from east to west, then through a drainage pipe under the maintenance road to a drainage basin near the southwest corner of the berm. The drainage basin is lined with limestone riprap. This system will need periodic maintenance to keep it in working condition. The drainage swale lined with riprap will be kept free of vegetation and the proper grade will be maintained to conduct surface water flow away from the range.

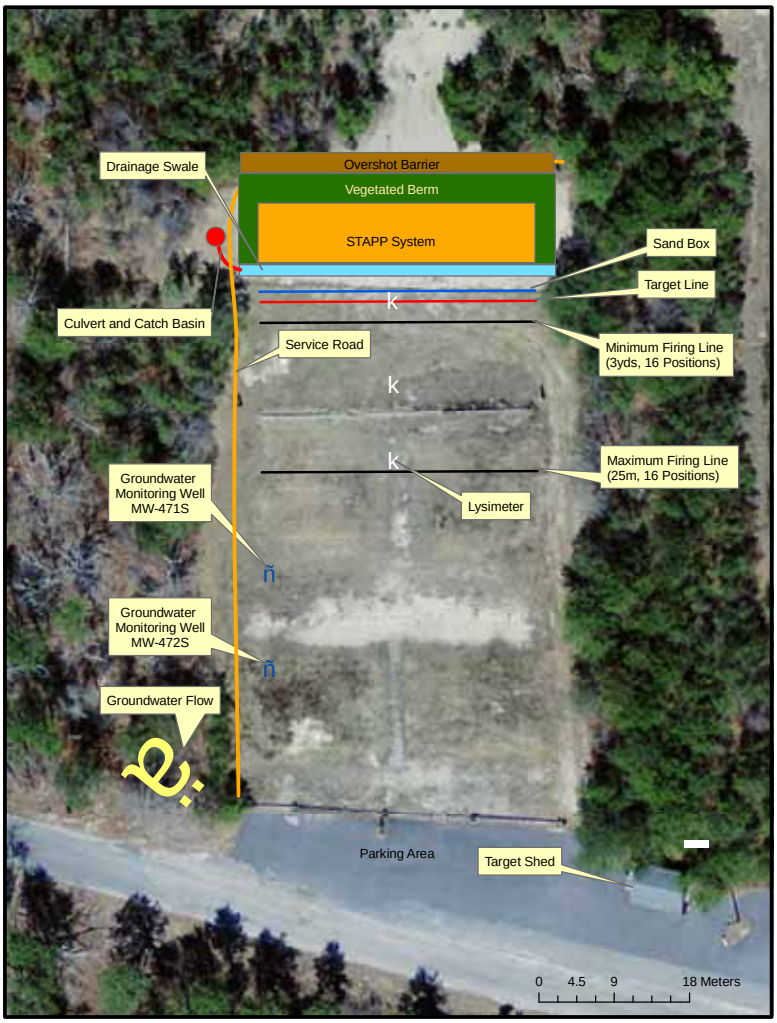

Figure 4-1. Stormwater Flow on Juliet Range

4.2.1.5 Bullet Containment System

The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs will be conducted in accordance with the metrics outlined below. A number of features of the STAPP™ bullet containment system will be monitored to contain metals and sever potential migration pathways. These features include:

- the self-closing rubber membrane cover (faces and seams),
- the rubber filler material,
- the impermeable liner,

- the internal water reservoir, and
- the synthetic lumber support structure.

General Metric: *If repairs cannot be scheduled or initiated within 72hours then all appropriate MANG leadership and appropriate federal and state environmental agencies will be notified in writing (email, letter or other documentable form of communication) within 72 hours of this detremination.*

General Metric: *If it is determined that repairs needed preclude the use of any lane or the range in total Range Control will shut down part or all of the range, providing for safety and environmental protection.*

Self-closing rubber membrane (faces and seams)

The self-closing cover is the top layer of the STAPP™ system. Although the rubber membrane that covers the granular rubber is "self-closing" it can become worn and perforated to the point where significant amounts of precipitation can accumulate within the system. The wear and perforation of the rubber membrane is heavily dependent upon range use. Both the frequency of operations at the range and the caliber of projectiles used in training will affect the useful life of the rubber membrane. Figure 4-2 depicts the progression of wear and perforation on a heavily used STAPP™ system over a number of years.

Figure 4-2. Examples of Wear and Deterioration of the Self-Closing Rubber Membrane on the STAPP™ System (photo not taken at Camp Edwards)

Holes in the cover. MANG will inspect the rubber membrane in accordance with the range inspections outlined in Section 6.2.1. If granular rubber media is exposed the cover is not preventing exposure of bullets to air and water. As such repairs should be scheduled to occur within 72 hours. This applies to all holes created by firing as well as any other occurrence that may cause holes, tears, seam failures or the like. No tracer fire will be conducted when such holes are present.

METRIC: *When underlying rubber media is visible, repairs will be scheduled to occur within 72 hours.*

Failed seams. Seam failure is most problematic in the bottom one foot of the STAPP™ system, near the base. In this area, the cover gradient is less steep than throughout the rest of the system and at times water may pond on the top of the self-closing cover. If the self-closing cover has a seam failure in the lower portion of the STAPP™, ponding water could penetrate the cover and accumulate in the water collection system. Larger seam failures can also be problematic in the upper portions of the STAPP™ system as they will also allow precipitation to leak into the system and will allow air-flow, thus supporting continued combustion of tracer rounds.

METRIC: *Failed seams occurring above the bottom one foot of self-closing cover (where water is not likely to pond on the membrane) require repair if the seam failure exceeds 6 inches. Failed seams occurring at/near the toe (within the bottom one foot) require repair if greater than one inch in size. Repairs will be initiated 72 hours of inspection, weather permitting.*

Ponding on the surface of the cover. A slight leveling of the self-closing cover may occur. If this leveling becomes a depression, water ponds on the top of the self-closing cover in this area. Ponding water may seep into the STAPP™ system through failed seams or holes in the cover.

METRIC: *Each time the top membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media appropriately to prevent any ponding of water on top of the self-closing cover.*

Rubber filler material

The rubber filler material is approximately 18 inches of loose, granular rubber fill situated below the self-closing cover. Irregularities in the surface of the STAPP™ system may be indicative of two different problems: (1) irregular distribution or settling of the granular rubber media, causing "thin-spots" and poor bullet-stopping capacity; or (2) erosion or irregular settling of soil beneath the STAPP™ system causing stretching or other stresses that may damage the impermeable liner.

METRIC: *A bulge or depression that exceeds 4 inches in height/depth over a length of 4 feet will be considered "significant" and will be repaired. Irregular settling will be measured using a 4-foot-long straight edge placed on the surface of the self-closing cover. Separation of 4 inches between the straight edge and the cover of the STAPP™ will indicate a need to "re-grade" or "rake" the rubber filler material to an even-level distribution across the STAPP™. Repairs will be initiated within 72 hours of inspection, weather permitting. Furthermore, each time the top membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media to a minimum depth of 15 inches.*

Impermeable liner

The impermeable liner is situated below the rubber filler material in the STAPP™ system and lies directly on the surface of the earthen berm. Figure 4-3 shows punctures in the impermeable liner beneath a STAPP™ system caused by.50 caliber projectiles that were not intended for this STAPP system. MANG will inspect the impermeable liner for punctures and tears each time the granular material is sifted to remove and recover captured projectiles (i.e., after the first year of training operations and subsequently after 500,000 rounds have been fired on Juliet Range or every three years, whichever occurs first).

METRIC: *Any perforations, holes, rips, or seam failures in the impermeable liner will be repaired. Repairs will be initiated within five working days of inspection, weather permitting.*

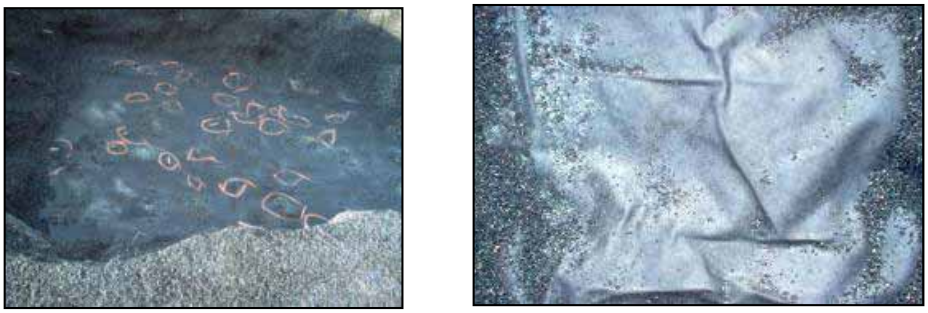

Figure 4-3. Examples of Perforated (left) and Intact (right) Liners (photos not taken at Camp Edwards)

Internal water reservoir system

External Visual Inspection. Units and Range Control will conduct a visual inspection of the ground surrounding the STAPP™ water reservoir at the bottom of the berm to check for any leaking.

METRIC: Any leaking will be immediately contained. Repairs will be initiated 72 hours of inspection, weather permitting.

Internal Visual Inspection. The internal water reservoir system is situated at the base of the STAPP™ system. It allows water to accumulate and be removed (Figure 4-4) The water reservoir system will be checked for excess water, punctures or cracks. Proper inspection of the impermeable liner and the internal water reservoir requires removal of the self-closing cover and displacement of some of the granular rubber material. This process will also require redistribution of the granular rubber across the system and resealing the self-closing cover around the edges of the STAPP™ system. MANG will inspect the internal reservoir system for punctures and cracks each time the granular material is sifted to remove and recover captured projectiles (i.e., after 500,000 rounds have been fired on Juliet Range or every three years, whichever occurs first).

Figure 4-4. Internal Water Reservoir System

METRIC: *All cracks or punctures in the reservoir will be repaired. Repairs will be initiated within 72 hours of inspection, weather permitting. Camp Edwards will sample, collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm of water accumulates in the reservoir. Water removal from the internal reservoir will be scheduled to occur within 72 hours, weather permitting.*

Synthetic lumber support structure

The synthetic lumber support structure makes up the frame surrounding the rubber granular material and holds the impermeable liner and self-closing cover in place. Figure 4-5 at right illustrates damage to the support frame for the installed bullet containment system.


Figure 4-5. Example of Damage to STAPP™ Support Frame
(photo not taken at Camp Edwards)

METRIC: *Conditions that affect the distribution of granular material or integrity of the cover or liner will be noted on the Range Inspection Form. Units and Range Control will also note the firing lanes in which they occur. Range Control will capture the initial damage with a photo and Camp Edwards will make repairs in accordance with the process and schedule outlined in Section 4.3.1. Repairs will be initiated within 72 hours of inspection, weather permitting.*

4.2.2 Environmental Sampling and Analysis

As part of the Monitoring/Sampling BMP, Camp Edwards will sample a number of environmental media on Juliet Range, including the water collected in the reservoir of the bullet containment system, groundwater, soil-pore water, and surface soils. Camp Edwards will sample the existing groundwater monitoring well. Also, Camp Edwards will install lysimeters (Figure 3-1) in soil under the toe of the bullet containment system, in the range floor between the minimum and maximum firing lines, and at the maximum firing line. If chemical constituents from the ammunition are not contained by the system and begin to percolate through the soil-pore water toward the aquifer, the lysimeters will provide an early warning. Sampling and analysis will be coordinated with EMC, EPA, and MassDEP. All monitoring and field work conducted at the range will be conducted in accordance with a health and safety plan that specifically addresses the potential risks associated with lead exposure at the range. The goal of the monitoring is to initiate routine range maintenance activities as needed to promote range sustainability. The following sections provide guidance for sampling and analysis of environmental media on Juliet Range.

4.2.2.1 Water from Bullet Containment System

Comment [p4]: Changes in this section made in response to EPA item a)

Experience has shown that the STAPP bullet collection systems accumulate water over time. It seems that precipitation makes its way through or under the upper membrane and collects at the bottom of the STAPP systems between the rubber membranes. Condensation within the system may also be a factor. Water has been emptied from all of the STAPP systems multiple times. The STAPP system on T Range collects the most water and has been emptied most often. Samples of the accumulated water have been collected several times to characterize the water in the STAPP system. Several metals have been consistently detected with antimony and zinc commonly detected at concentrations above drinking water standards. Therefore the water is pumped from the STAPP systems and disposed of off-site and not simply dumped out onto the range floor. The receiving facility specified a suite of analyses needed to characterize the water for disposal. Samples have also been collected from water that accumulated in the J and K Range STAPP systems in 2009 and 2011 to determine if the water in those systems shares the same characteristics. Metals concentrations have been similar in all three systems. The most recent samples were collected in from T Range in March 2011 and from J and K Range STAPP systems in April 2011. Results show similar concentrations to previous sampling events. Hence, process knowledge has been obtained and further sampling is not routinely needed. The disposal facility has agreed that the water is adequately characterized for disposal. Camp Edwards will continue to sample the water as needed to maintain compliance with the disposal facility's requirements.

Figure 4-6. Port Access for Water Inspection and Removal

To access the water, MANG personnel will access the STAPP™ system through the drain port as shown in Figure 4-6. The STAPP system will be inspected for the accumulation of water after

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significant precipitation events and in the spring after the water that accumulates over the winter thaws. The MANG will collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm or more of water accumulates in the reservoir. Camp Edwards will dispose of the water in accordance with all applicable state and federal laws and regulations. In no cases will water from the STAPP™ system reservoir be discharged onto the ground at the range.

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Deleted: <sp>The E&RC will sample, collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 or more cm of water accumulates in the reservoir or at least once every 6 months.. The water level will be inspected after all significant precipitation events. Camp Edwards will identify and coordinate with the receiving treatment-and-disposal facility to determine the appropriate analytical methods for testing the water. Based on the results of this sampling, Camp Edwards will dispose of the water in accordance with all applicable state and federal laws and regulations. In no cases will water from the STAPP™ system reservoir be discharged onto the ground on Juliet Range.¶
¶
<sp>After a series of consistent sampling results, Camp Edwards may employ "process knowledge" rather than sampling and analysis as a means of characterizing the water. To collect the water, Camp Edwards personnel will access the STAPP™ system through the drain port as shown in Figure 4-6.

4.2.2.2 Groundwater

Figure 3-1 indicates the location of the two down gradient groundwater monitoring wells (MW-471S and MW-472S). MANG will sample these wells annually in October for propellants and metals. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples. The groundwater samples will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerin (using method 8330) (US EPA 2007). As per the request of EPA, all analyses will be conducted using unfiltered samples. This will provide a total concentration of both solid and dissolved metals. The MANG may, at its option, also collect and analyze a filtered sample to determine dissolved metals concentrations.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-3. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt.

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4.2.2.3 Lysimeters

Camp Edwards installed lysimeters at a depth of 2 feet at the maximum firing line, between the minimum and maximum firing lines, and along the toe of the STAPP™ system. (see Figure 3-1). Soil between the minimum and maximum firing lines is a potential hotspot for metals accumulation. Muzzle blast from small arms may deposit metals and energetic materials onto surface soils. Lysimeters will provide an early indication if dissolved metals are migrating through soil-pore water toward groundwater Camp Edwards will sample the lysimeters twice annually, once before and once after the peak training season. Lysimeter sampling is inherently dependent on recent precipitation so some flexibility in sampling schedules should be anticipated. The MANG will notify EPA and EMC of upcoming sampling events at least 48

The soil-pore water samples will be analyzed for lead, copper, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerin (using method 8330) (US EPA 2007). As per the request of EPA, all analyses will be conducted using unfiltered

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samples. This will provide a total concentration of both solid and dissolved metals. The MANG may, at its option, also collect and analyze a filtered sample to determine dissolved metals concentrations.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-2. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt.

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4.2.2.4 Surface Soil

Camp Edwards will sample surface soil on Juliet Range between the maximum firing line and the toe of the berm. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples. The range floor will be divided up into six sample areas that are each 5 meters wide and the full length of the range. The first sample area (Area 1) will begin at the firing line and subsequent 5 meter wide areas will progress downrange to the berm (Area 6). Figure 4-7 shows the locations of the proposed sampling areas on Juliet Range.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-1. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt. Resampling may not be needed to confirm exceedences of soil interim action levels where previous sampling events have also detected the same analyte. In this case, the accuracy of the result would not be in question so there would be no value in resampling. MANG will provide a comparison of the data over time to determine if there are any apparent trends but resampling would be optional.

In addition, where multiple replicate samples are collected from a single area, the relative percent differences (RPD) of lead and nitroglycerine concentrations between the replicate samples will be calculated to determine the repeatability of the sampling procedure. RPD is defined as the standard deviation of the data set divided by the average value of the data set expressed as a percentage. For example the RPD of the values 15, 20, and 25 is 16 %.

The average of the RPDs for lead and the average of the RPDs for nitroglycerine will be calculated. If the average of the RPDs for either analyte is greater than 25%, and if this variation

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affects the usability of the data set for making range maintenance decisions, the sampling plan will be modified in an attempt to obtain better quality (i.e. more repeatable) data. The sample areas might be sub-divided into smaller areas or a greater number of incremental sub-samples might be collected within a given sample area. A plan for improving the data quality, if it is decided that the available data is not adequate for decision making, will be provided within 14 days of deciding that improvement is needed. The plan will include a schedule for re-sampling. Note that in case where the detected concentrations in a sample area are all either well below the interim action levels or well above them, the data can be compared to the interim action levels and sample repeatability is not a significant issue. In those cases, re-sampling would not be beneficial.

Where multiple replicate samples are collected from a sample area, all replicates will be compared to the interim action levels.

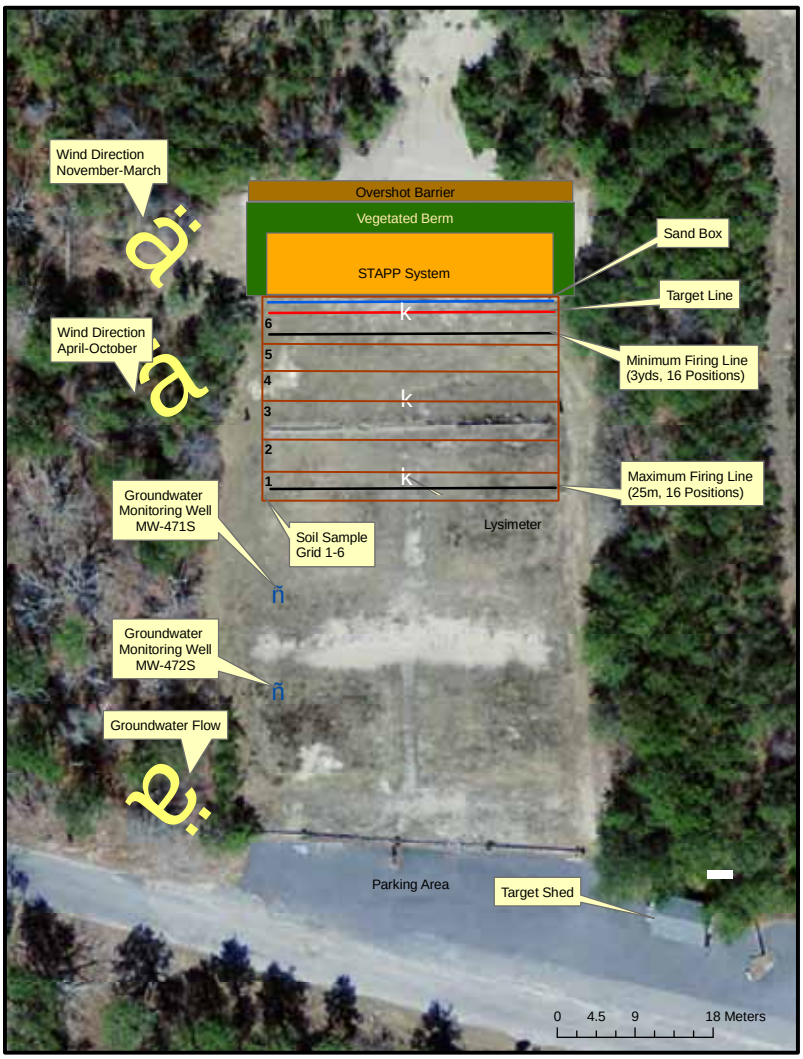

Figure 4-7 Surface Soil Sampling Areas

Once a year, in October, MANG will sample the surface soil in the sampling areas as outlined below:

Areas 1, 3 & 5 – Each area gets a 100-point multi-increment samples (MIS) sample collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the sample will be ground to a fine powder

following Cold Regions Research & Engineering Laboratory (CRREL) recommendations for firing-point samples. The ground sample will be used for analyses of nitroglycerin using method 8330b, and additional tests for lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). Each of these areas will also get two replicate samples. These will be 100-point MIS samples, ground according to CRREL and analyzed for nitroglycerin, lead, copper, zinc, antimony, and tungsten, in similar fashion to the primary samples listed above.

Areas 2 & 4 – Each area gets a 100-point MIS sample collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the composite sample will be ground to a fine powder following CRREL recommendations for firing-point samples. The ground sample will be used for analyses of nitroglycerin (using method 8330b), and additional tests for lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). No replicates for these areas.

Area 6 – One 100-point MIS sample will be collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the composite sample will be ground to a fine powder following CRREL recommendations for firing-point samples. The ground sample will be used for analyses of lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). No replicates for this area.

All samples are to be collected by a systematic random sampling method. As per CRREL recommendations, this requires dividing the sample area into exactly as many sub-areas as the number of increments required for the sample. One increment is collected from each sub-area. The location within the sub-area is irrelevant, but the same relative location should be used for each sub area. For example, if the center of the first sub-area is used to collect the first soil increment, the center of each following sub-area should also be used until the sample is complete. Replicate samples should be collected in the same way, but from a different location within the sub-areas. Replicates can be collected at the same time if practical. Decontamination between replicates or between sub-areas is not necessary since all three samples are characterizing the same sample area. Decontamination is required before beginning to sample a different area.

In addition to the laboratory analysis, on-site soil sampling may occur using the X-ray fluorescent (XRF) device. The XRF is design to detect metals and can be used to sample soil as well as the STAPP™ membrane. This sampling can occur randomly through time.

These sampling, processing, and analytical methods will be re-evaluated after the first year of monitoring and thereafter for validation and refinement. Camp Edwards staff will use a plug extractor to systematically collect representative samples from each grid and will not concentrate samples in one portion of the sampling grid.

4.2.2.5 pH

A neutral pH in soil will help reduce metals migration on the range. Lead is least mobile between a pH of 6.5 and 8.5. Within this range, lead binds more easily to clay and organic matter in the soil. Therefore, it is important to keep the pH of the soil as close to neutral (pH of 7) as possible to stabilize the lead in the soil. A neutral pH will inhibit corrosion and allow the lead in the soil to bind to clay and organic particles (ATSC 1998). Camp Edwards will manage the soil pH through soil amendment with lime with the goal of maintaining neutral soil pH (see Section 4.3.5).

Camp Edwards will test soil pH twice annually – once before and once after peak training season. Samples will be collected at the firing line and at the toe of the berm. To determine the average soil pH of each area, 6 to 12 soil samples will be collected at a depth of 6 inches along the firing line and along the toe of the berm. The soil samples will be mixed thoroughly too accurately represent soil from the sampling locations (Clemson 2007b). The soil samples will then be tested for pH.

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Limestone (lime) addition to surface soils is standard practice for increasing pH and neutralizing soils. A pulverized variety of lime will be applied before peak training season to increase its effectiveness. When the optimum pH is reached, pH should be checked once a year and lime applied as needed to promote vegetative growth and prevent vertical migration of lead (ATSC 1998).

4.3 Range Maintenance

Camp Edwards will conduct periodic maintenance on Juliet Range to ensure it remains in adequate condition to support training requirements and design features, and BMPs function as intended. To the maximum extent possible, maintenance will be conducted during off-peak training periods (between October and April). This preventative maintenance will be conducted as needed, regardless of other maintenance schedules. Maintenance and repairs at Juliet Range will be documented in a maintenance log and summarized in an Annual Range Maintenance Report. All maintenance and field work conducted at the range will be conducted in accordance with a health and safety plan that specifically addresses the potential risks associated with lead exposure at the range.

4.3.1 Bullet Containment System

The bullet containment system on Juliet Range consists of a soil berm and the STAPP™ system. Repairs will be initiated within five working days of inspection, weather permitting.

Based on the unit observations reported on Juliet Range Inspection Forms and Range Control's visual inspections, the following steps will be taken to repair holes or tears to the self-closing rubber membrane cover of the STAPP™ when granular rubber filler material is clearly visible through external inspection.

1. Sand the perimeter of the damaged area.

2. Wipe area clean using rubbing alcohol.
3. Cut a repair patch of the self-closing rubber membrane that is slightly larger than the damaged area to allow a 2.5–5 cm overlap. (The overlap provides a sound surface to which the repair patch adheres.)
4. Sand and wipe clean the underside of the repair patch.
5. Place a bead of the STAPP™-supplied glue on both the perimeter of the damaged area as well as the coordinating under side of the patch.
6. Lay the patch on top of the damaged area and apply hand-pressure.

The glue provided is made of cyanogeneacrylate; therefore, the manufacturer recommends breathing protection for large repairs (STAPP 2006). The same procedures will be conducted to repair any perforations in the impermeable liner material using appropriately matched materials and adhesives. Damage to the STAPP™ support frame will be repaired on an as-needed basis. The time required to complete minor repairs is generally less than 10 minutes. Larger repairs may require up to 30 minutes. During use the glue container will be handle such that there is no release of material to the environment. The container will be put in secondary containment whne not in use during seam repair.

After either 15 cm of liquid in the reservoir, Camp Edwards personnel will sample, remove, and dispose of the water in the internal reservoir system per the guidelines outlined in Section 4.2.2.1.

4.3.2 Periodic Metals Removal

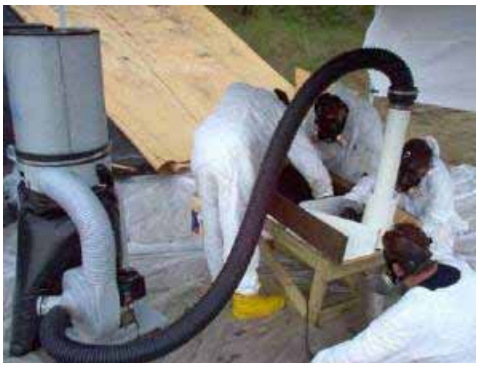

Figure 4-8. STAPP™ Sifter

MANG will periodically remove bullets from the STAPP™ system; bullets will be removed after 500,000 rounds have been fired on Juliet Range or every three years, whichever occurs first. MANG will use either the specially designed STAPP™ sifter, or a compatible system, for removing metals from the STAPP™ system. This unit consists of a table positioned at a defined slope with a small vibrator positioned on the underside of the table. The granular rubber and bullet mixture is placed onto the table, and due to the vibration slowly moves down the slope of the table. A piece of piping at the end of the table is connected to a cyclone vacuum with a high-efficiency particulate air (HEPA) filter. The vacuum has enough suction to remove the granular rubber but not the bullets. The granular rubber is sucked up via the cyclone and the air is filtered with a HEPA filter (see Figure 4-8). Total mass of metals removed from the bullet containment system will be compared with the total computed mass loading of bullets fired on Juliet Range from the Training Facility Utilization Reports (see Appendix A). This comparison is indicative of the efficiency with which the STAPP™ system eliminates the source of metals on Juliet Range. This process must be conducted with appropriate environmental protections as required. At a minimum secondary containment must be placed in all active work areas where metal removal will occur. Prior to work beginning, contractors or in house personnel conducting this work will coordinate with Range Control and the MAARNG Environmental Office to ensure that the proper environmental protections are in place. Also, this process must not be conducted during precipitation events or high winds.

4.3.3 Interim Triggers for Focused Assessments and Maintenance Actions for the Initial Year of Fire Operations on Juliet Range

Based on the results of soil, lysimeter and groundwater sampling described in Section 4.2.2, Camp Edwards will initiate range characterization and maintenance actions to prevent pollution, in coordination with the EMC, EPA, and MassDEP. The need for maintenance actions will be indicated by comparing monitoring results to a series of action levels. The type of action necessary will be dependent on the media being sampled / analyzed and the action level triggered (see action levels presented in Tables 4-1, 4-2, and 4-3). The action levels in the tables below are the same interim numbers currently in use for the time period of July 2007 to December 2008 for operations on Tango Range. They are subject to change as more information is developed on the leaching potential of these compounds and the effectiveness of the P2 Plan as a whole. These action levels will be periodically reviewed (per Section 5.3) in coordination with the EMC, EPA, and MassDEP.

The surface soil action Level 2 numbers are based on modeled potential for leaching to groundwater calculated using proposed sampling areas and a sample depth of 3 inches. Level 1 numbers are derived by taking 50% of the Level 2 numbers and are established to ensure close monitoring of elevated analyte concentrations in surface soils. The action levels for surface soil are provided in Table 4-1.

Table 4-1. Interim Surface Soil Action Levels for the Initial Year of Fire Operations on Juliet Range

Analyte	Level 1 Resampling and Validation[1]	Level 2 Focused Reassessment[2]
Lead	4,535 mg/Kg	9,070 mg/Kg
Antimony	1,750 mg/Kg	3,500 mg/Kg
Nitroglycerin	5 mg/Kg	10 mg/Kg

Notes: mg/kg= milligrams per kilograms

1. Results exceeding Level 1 will be validated through resampling and analysis.
2. The purpose of the Focused Reassessment will be to evaluate the cause, and assess the hazards. Results will be reviewed with stakeholders and may result in modification of the Conceptual Site Model. If reassessment verifies sampling results, MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., soil removal). Actions may include temporary suspension of the use of the range.

Soil-pore water action level numbers are based on a relevant drinking water standard (or similar risk-based concentration) for the respective compound. Level 1 numbers are based on one-third the drinking water standard and require resampling and validation of results. Level 2 numbers are based on one-half the drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the drinking water standard for the respective compound and will require some form of range maintenance activity to address the risks to human health and the environment. Action levels for soil-pore water are provided in Table 4-2.

Table 4-2. Interim Soil-Pore Water Action Levels for the Initial Year of Fire Operations on Juliet Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Range Maintenance[3]
Lead	10 ug/L	15 ug/L	30 ug/L
Copper	867 ug/L	1,300 ug/L	2,600 ug/L
Antimony	4.0 ug/L	6.0 ug/L	12 ug/L
Nitroglycerin	3.2 ug/L	4.8 ug/L	9.6 ug/L

Notes: ug/L+micrograms per liter

1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause or need for action and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow-on action could result. MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., dust control, pH control, soil removal).
3. Range Maintenance may include soil removal, resampling, or temporary suspension of firing on the range. The range will be reconstructed once favorable results from the post excavation sampling are received. Soil removal may not be required if a removal action has already been conducted based on soil monitoring results.

With proper BMP implementation, surface soil and soil-pore water monitoring, and appropriate maintenance actions, MANG does not anticipate significant detections of target analytes in groundwater samples. Therefore, detection at Level 3 concentrations provided in Table 4-3 reflects a potentially serious condition that could require significant actions, such as a cease-fire at the Juliet Range. Level 1 numbers are based on one-third the relevant drinking water standard (or equivalent risk number) and require resampling and validation of results. Level 2 numbers are based on one-half the relevant drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the relevant drinking water standard and require significant corrective actions such as cease-fire and reassessment of the P2 program.

Table 4-3. Interim Groundwater Action Levels for the Initial Year of Fire Operations on Juliet Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Cease Fire and Maintenance Action[3]
Lead	5.0 ug/L	7.5 ug/L	15 ug/L
Copper	434 ug/L	650 ug/L	1,300 ug/L
Antimony	2.0 ug/L	3.0 ug/L	6.0 ug/L
Nitroglycerin	1.6 ug/L	2.4 ug/L	4.8 ug/L

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow-on action could result.
3. Groundwater concentrations at or above Level 2 concentrations require significant actions including cease fire at the range, a complete reassessment of the pollution prevention program, and follow-on assessment and possible remediation.

Nitroglycerin has been detected in soil samples taken on the range floor on Juliet Range in concentrations up to 73 mg/kg. MANG may need to conduct periodic soil removal maintenance every three to five years, depending on the volume of training and the results of surface soil sampling outlined in Section 4.2.2.4. During this periodic soil removal, Camp Edwards anticipates removing 3 inches of surface soil from the firing line (the depth of past nitroglycerin detections). The removed soil will be placed in drums, characterized through a complete toxicity characteristic leaching procedure (TCLP) metals series, and disposed of at an approved and permitted facility, in accordance with state and federal solid and hazardous waste regulations. MANG will replace the removed soil with clean fill and revegetate the area.

4.3.4 Vegetative Cover and Windbreaks

At the beginning (March) and conclusion (October) of the training year, Camp Edwards Range Control will coordinate the spread of MassHighway seed mix, as required, on areas of the Juliet Range floor, and areas of the existing berm/backstop supporting the STAPP™ that have less that 50% vegetative cover. If during the course of the training year, the Juliet Range Inspection Forms identify areas of low vegetative cover, Range Control shall coordinate and schedule range maintenance as soon as growing conditions allow. Maintenance activities will be timed and conducted as to not interfere with scheduled training and to avoid cumulative impacts.

Forested buffers, serving as natural windbreaks and noise abatement, will be maintained around Juliet Range. Each year in March, before the peak training period begins, Camp Edwards will trim tree limbs on the range boundary. Any diseased or dead trees may be removed, as advised by E&RC or MAARNG Environmental Office. Camp Edwards will clear this range maintenance with Range Control to minimize interference with any scheduled training on the range.

4.3.5 Soil pH

When soil pH levels are neutral, lead remains relatively unavailable for migration in soils. Camp Edwards will amend soils with material to increase alkalinity, typically lime, with a goal of maintaining neutral soil pH. When lime is added to the soil, maximum contact with the soil is essential therefore it is most appropriate to use pulverized limestone.

Ground calcitic limestone (calcium carbonate) is faster acting than ground dolomitic limestone (calcium-magnesium carbonate) and is recommended for addition to the sandy soils on site. For example, to raise the soil pH from 5.9 to 7.0, 5 to 8 pounds of ground calcitic limestone will be added per 100 square feet of soil. Soil amendments should be spread evenly over the soil using a spreader and will affect the top 2.5 to 5 cm of soil. It may take one to two years for the soil to fully reflect the pH change (University of Minnesota 2007; Clemson 2007a).

4.4 Inspection Summary

A variety of inspections and maintenance activities are discussed in Section 4. In an effort to summarize all of these activities and the frequency in which they occur, the following table was complied.

Table 4-4. Summary of Inspections

Cycle	Type of Inspection	Responsible office	Activity / Repair
Bi-weekly or major storm event (more then 5 cm within a 24 hrs period	Visual inspection - Range Floor - STAPP - Berm	MAARNG - Range Control - Environmental Section - Senior Staff	- Exposed granules – repair within 72 hours - Tear in upper membrane / exposed seam – schedule repair 72 hours
Day of training	Visual inspection - Range Floor - STAPP - Berm	Military Personnel - Range Control - Using unit	
3x a year (trial period)	Lysimeter sampling	MAARNG – Environmental Section	See Table 4-2
Quarterly / 3x during peak training period	- Range condition report - Detailed inspection	MAARNG – Range Control	- Scheduled within 72 hours
Annual	- Soil sampling - Groundwater sampling - Range Maintenance Rpt - Periodic Review Rpt - State of the Reservation Rpt	MAARNG - Range Control - Environmental Section	See Table 4-1, Table 4-3

Cycle	Type of Inspection	Responsible office	Activity / Repair
As needed	- STAPP water access port - STAPP maintenance repair - Photo log - Revise the OMMP - Public updates	MAARNG - Range Control - Environmental Section - Senior Staff	- After 15 cm - Within 72 hrs - Within 72 hours
Unannounced	- Visual Inspections - Unit training - Inspection records	- MAARNG - Environmental Agencies (EPA, MassDEP, EMC)	
500,000 rounds or every 3-years whichever comes first	- internal inspection of STAPP - lead removal from STAPP	MAARNG	

5.0 CONCLUSIONS AND CONTINUAL IMPROVEMENT

5.1 Conclusions

MANG will conduct marksmanship training on Juliet Range, using standard lead-bullet ammunition, including use of tracer ammunition. This training will include:

- Familiarization, zeroing, marksmanship practice, and alternate qualification using the 5.56mm rifle (M16 and M4) and machine gun (M249) and the 7.62mm machine guns (M240 and M60); and
- Familiarization, zeroing, marksmanship practice, and alternate qualification using all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols.

Based on the CSM for Tango Range, evaluations of SAR P2 BMPs conducted in the SAR P2 Overview, and the current assessment of training and management of Tango range, the STAPP™ system provides positive BMPs for small arms training. As such, the MANG will continue to satisfy the requirement of AO2 to employ "maximum feasible use" of P2 technologies by:

- Implementing a system of range upgrades and BMPs that will either sever potential migration and exposure pathways or monitor environmental conditions to confirm that pathways remain incomplete.
- Implementing a "contain, maintain, and monitor" approach to SAR BMPs that will include redundant methods to prevent pollution (e.g., bullet containment, pH management, erosion control) and methods to assess the effectiveness (e.g., inspections, sampling) of each system in each environmental media (e.g., soil, groundwater). This approach will include:
  - Managing metals on Juliet Range at their source, through containment in the STAPP™ system and periodic removal and recycling.
  - Monitoring potential migration pathways, such as surface soil, soil-pore water, and groundwater, to evaluate whether contaminants are being transported in environmental media.
  - Implementing a number of other monitoring and maintenance BMPs to sustain the conditions on Juliet Range that limit metals mobility (e.g., monitoring the condition of the bullet containment system, stormwater management, maintaining healthy vegetation on range areas to prevent soil erosion, maintaining windbreaks to limit windborne metals transport, and maintaining soil pH to minimize corrosion/dissolution of metals into groundwater.

The BMPs selected and described in this BMP OMM Plan will support the employment of small arms on Juliet Range in a manner that meets training requirements while protecting human health and the environment. As training requirements change, MANG may seek to conduct additional training activities on Juliet Range. As environmental conditions or the understanding of conditions change, it may become necessary to add or modify management actions to protect human health and the environment. All such modifications to training activities or management action will be fully coordinated with the EMC, EPA, and MassDEP.

5.2 Record keeping

To facilitate the periodic review and continual improvement of this plan and, in turn, the management of Juliet Range MANG will document operations, monitoring, and maintenance. Table 5-1 identifies the records that MANG will maintain for Juliet Range. These records will be maintained indefinitely and will become part of the permanent real property records of the site.

Table 5-1. Recordkeeping Procedures

Record	Contents	Frequency	Responsible Office
Range Utilization Report	• Use days • Munitions expenditures by type, quantity, and using unit	Annually	Range Control
Range Condition Inspection Report	• General conditions • Erosion • Vegetation • Bullet containment system	Quarterly	Range Control
Environmental Sampling and Analysis Report	• Water from bullet containment systems • Groundwater • Lysimeter • Soil • pH	Annually	E&RC
Range Maintenance Report	• Bullet containment system • Periodic metals removal (mass, locations, and methods) • Vegetation • Soil pH	Annually	Range Control
Periodic Review Report	see Section 5.3	Annually	E&RC
Photo logs	see Section 4.2.1	As Needed	Range Control

5.3 Reviewing and updating this plan/Periodic Review

MANG will conduct periodic reviews of this plan to evaluate whether training activities, environmental conditions, and BMPs on Juliet Range remain protective of human health and the environment. The first review will take place 6 months after the range returns to live-fire. Subsequent reviews will occur when MANG desires to significantly modify the training activities at Juliet Range, when MANG, EMC, and or EPA becomes aware of information that indicates environmental conditions are not protective of human health or the environment, or at an interval not to exceed three years. The E&RC will provide an update on the operation of Juliet Range in the annual State of the Reservation Report as required by Chapter 47 the acts of 2002, Environmental Performance Standards.

The purpose of periodic reviews is to answer three general questions:

- Are the BMPs on Juliet Range functioning as intended?
- Are the assumptions used at the time of BMP selection still valid?
- Does new information indicate that the previously selected BMPs are no longer protective of human health and the environment?

Stakeholders and regulators will be involved in the periodic review process through coordination with EMC. MANG will notify EMC and the SAR Working Group at the time the periodic review is initiated to seek their involvement. Other notifications, including notification of the availability of results, will be made when a review is completed.

The periodic review will consist of an evaluation of the records described in Section 4.2, as well as the identification and review of new information, a site visit, and preparation of a short Periodic Review Report. MANG will identify readily available information regarding Juliet Range that has become available since implementation of this plan or the last periodic review. New information may also be gathered through interviews with persons knowledgeable about the site, including stakeholders such as adjacent property owners, local agencies, and regulators. MANG will gather information pertaining to the following areas:

- New training missions or training activities supported on Juliet Range;
- Modifications to the layout of Juliet Range;
- New development or changes in land use in the vicinity of Juliet Range (on and off installation);
- Recreational or other new activities at Juliet Range or in the vicinity of Juliet Range;
- Changes in accessibility to Juliet Range;
- Changes to statutes, regulations, or policies effecting the use and management of Juliet Range; and,
- New technologies or techniques that can cost-effectively improve training or environmental conditions at Juliet Range.

MANG will prepare a short Periodic Review Report to document the information collected and evaluated, and present the findings of the evaluation to EMC and EPA in coordination with MassDEP and other stakeholders. The report will document whether training activities and BMPs continue to be protective of human health and the environment. The report will also recommend follow-up actions, as warranted. Based on the conclusions drawn in the report, MANG will update the Juliet Range BMP OMM Plan to reflect recommended actions. A draft of the modified Juliet Range BMP OMM Plan will be coordinated with EMC, EPA, MassDEP, and other stakeholders for review and comment. Final copies of the plan will be made available to these stakeholders.

MANG believes that implementing the SAR BMPs will support the adjustment of the environmental performance standards established in Chapter 47 of the Acts of 2002, Section 10(d). Through these BMPs, MANG will demonstrate that the resumption of small arms marksmanship training on Juliet Range is protective of the drinking water supply and wildlife habitat on Camp Edwards.

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Appendix A
Training Facility Utilization Report

Appendix A: Training Facility Utilization Report

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CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT

This form will be completed by all units/ organizations conducting training at Camp Edwards IAW CE Reg 385-63, AUG 2006. Return form to Range Control upon completion of training.

UNIT:	**UIC**:	**COMPONENT**:
ADDRESS:		**DATE OF TRAINING**:
POC CONTACT NUMBERS	**DSN**:	**CELL**:
NAME/ RANK / LAST 4 RANGE OIC:	**NAME/ RANK / LAST 4 RANGE RSO**:	
NUMBER OF PERSONNEL TRAINED:	**RANGE HOT TIME**:	**RANGE COLD TIME**:

FIRING LANES USED DURING TRAINING
(circle the lanes used): **1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29**

WEAPONS SYSTEMS:	**TYPE OF AMMUNITION**:	**NUMBER EXPENDED**:

VEHICLES BY TYPE PRESENT ON RANGE:	**QTY**:

BIVOUAC AREA USED:	**NUMBER of PERSONNEL**:	**NUMBER of NIGHTS**:

TYPES OF EXERCISES CONDUCTED:

AAR COMMENTS:

SIGNATURE OF RANGE OIC/ RSO:
DATE:

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CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT			
GRID COORDINATES FOR THE FOLLOWING TRAINING MUST BE PROVIDED			
Activity	**TYPE**	**Location 6 digit**	**Other**
Small Arms Simulated	Blank / Simunition / Paint Ball		
RSOP (FA Dry Fire)			
Convoy Overlay	DAY / NIGHT		Number of Vehicles
Dismounted Training			
ISBC Scenario & Overlay			
Command Post Ex			
Heavy Equip Operations:			
Land Nav Course	I / II / III / Mounted		
Excavations:	STANDARD / NON-STANDARD*		
	*If NON-STANDARD has request been approved? YES / NO		ATTACH APROVAL
Describe Excavation training:			
OTHER :			

TRAINING AREA / ROAD CONDITION ASSESSMENT						
	RANGE(S) / TRAINING AREA(S) OCCUPIED					
OBSERVATION						
Minor erosion or obstruction(s)						
Movement difficulty, erosion or obstruction(s)						
Movement severely impeded, erosion or obstruction(s)						
Vegetation damaged, soil disturbed						
Bare ground and soil disturbed						
Denuded of vegetation and / or soil disturbed						
Other Training Land damage or improvement						

E = Excellent; G = Good; F= Fair; P=Poor; N=Needs improvement

Appendix B
J Range Inspection Form

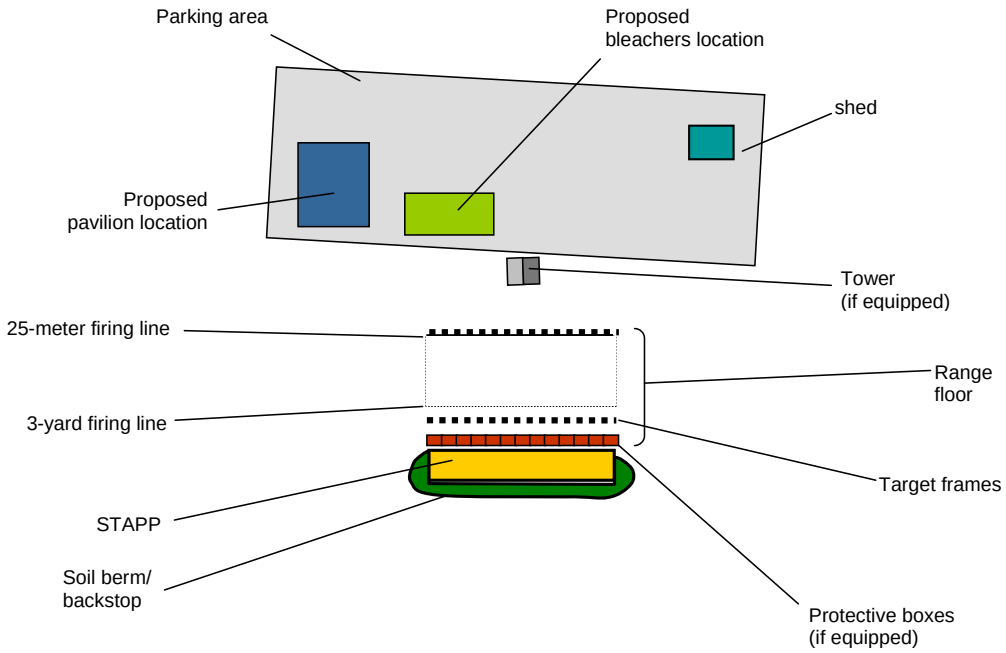
Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

A.	**Administrative Data**		
Range:	Date:	Range Control Observer:	
Unit:		Unit OIC:	Comp:

B.	**STAPP System Inspection**		
	Pre-Fire Inspection	Post Fire Inspection	Remarks
1. Check site for POL / CLP stains, leaks, spills	GO / NOGO	GO / NOGO	
2. Did sand boxes protect base of STAPP?	GO / NOGO	GO / NOGO	
3. Holes, tears, damage to sand box tarps?	GO / NOGO	GO / NOGO	
4. Is the STAPP cover in need of repair?	GO / NOGO	GO / NOGO	
5. Are there separations on cover seams?	GO / NOGO	GO / NOGO	> 1" / > 6"
6. Any bulging or irregular settling of rubber granular material?	GO / NOGO	GO / NOGO	
7. Is synthetic lumber framing in good condition?	GO / NOGO	GO / NOGO	
8. Any fresh signs of over / undershot?	NA	GO / NOGO	
9. Ponding of water on cover/ water leaking from STAPP?	GO / NOGO	GO / NOGO	
10. Does water inspection port have water visible, 15 cm?	GO / NOGO	GO / NOGO	
11. Was any soot / smoke released from STAPP?	Yes / No	Yes / No	
12. Use diagrams to indicate locations of items 1-9 and other impact effects / damage. Use reverse to describe any special situations.			

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	23	24	24	26	27	28	29

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C



Generic STAPP Site Plan Not to Scale – Oct 08

C.	Remarks

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

E. STAPP™ detailed inspection

This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel 3 times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October once peak training period is completed.

1. What is the depth of water in the reservoir? Less than 2 inches / Greater than 2 inches

   If more than 2 inches deep, how deep is it?: _____

2. Any significant irregular settling or bulging of granular rubber material? NO YES

   This may be indicative of a problem with the liner. The material must be at an even level across the STAPP to stop bullets effectively. The minimum depth of material at any one point should be 15 inches deep. If yes, please describe: _____

3. Complete the photo log at the end of this form, documenting site features listed in log. Photos should be taken of the firing line, the soil berm, bullet containment system, and range floor. Note any field observations on the log.

4. Notes regarding need for repair and maintenance: _____

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

F. STAPP™ internal inspection
This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel when the bullet sifting of the STAPP system is conducted after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first. At that time, all of the granular rubber material is removed.

1. Is the water collection unit and surrounding support structure in good condition? NO YES
   Look for any conditions which would allow water to be released to ground surface. If no, please describe: _____

2. Any perforations of the impermeable liner? NO YES
   Inspect the liner for any holes, rips, punctures, or seam failures. If yes, please describe: _____

4. Notes regarding need for repair and maintenance: _____

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

Photo Log:

Photo No.	Date	
Location: Firing Line from firing position No 4 Range: J Range		Place photo here
Description		

Photo No.	Date	
Location: Soil Berm from firing position No 4 Range: J Range		Place photo here
Description		

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

Photo No.	Date	
Location: Bullet Containment System from firing position No 4 Range: J Range		
Description		Place photo here

Photo No.	Date	
Location: Range Floor from firing position No 4 Range: J Range		
Description		Place photo here

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

Photo No.	Date	
Location: Firing Line from firing position No 13 Range: J Range		Place photo here
Description		

Photo No.	Date	
Location: Soil Berm from firing position No 13 Range: J Range		Place photo here
Description		

Camp Edwards Range Control
STAPP System Unit Utilization Inspection Form – Appendix C

Photo No.	Date	
Location: Bullet Containment System from firing position No 13 Range: J Range		Place photo here
Description		

Photo No.	Date	
Location: Range Floor from firing position No 13 Range: J Range		Place photo here
Description		

Revised Draft

KILO RANGE
BEST MANAGEMENT PRACTICES:
OPERATIONS, MAINTENANCE, AND MONITORING PLAN

CAMP EDWARDS, MASSACHUSETTS

prepared for:

Massachusetts National Guard
Environmental & Readiness Center
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(Rev 3: 3 June 2011)

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ACRONYMS & ABBREVIATIONS

AO	Administrative Order
ASP	Ammunition Supply Point
BMP	Best Management Practice
CM	Centimeter
CSM	Conceptual Site Model
DoD	Department of Defense
DODIC	Department of Defense Identification Code
DPT	Director of Plans and Training
EMC	Environmental Management Commission
EPA	US Environmental Protection Agency
E&RC	Environmental and Readiness Center
FCC	Facility Category Code
FE	Facilities Engineering
HEPA	High-Efficiency Particulate Air
HMWMP	Hazardous Material and Waste Management Plan
IAGWSP	Impact Area Groundwater Study Program
Kg	Kilogram
L	Liter
m	Meter
MANG	Massachusetts National Guard
MassDEP	Massachusetts Department of Environmental Protection
Mg	Milligram
MIS	multi-increment sample
MMR	Massachusetts Military Reservation
NGB	National Guard Bureau
OMM	Operations, Maintenance and Monitoring
P2	Pollution Prevention
RFMSS	Range Facility Management Support System
RSO	Range Safety Officer
SACON	Shock Absorbing Concrete
SAR	Small Arms Range
SDWA	Safe Drinking Water Act of 1974
TCLP	Toxicity Characteristic Leaching Procedure
ug	Microgram
USAEC	US Army Environmental Command
XRF	X-ray Fluorescent (Sampling Device)

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1.0 INTRODUCTION

Camp Edwards is an important training center for National Guard, Reserve Components, US Coast Guard, and law enforcement agencies throughout the northeastern United States. Located on Cape Cod, an environmentally sensitive region, Camp Edwards contains threatened and endangered wildlife species, prime wildlife habitat, archeological sites, and culturally sensitive areas (Massachusetts National Guard [MANG] 1997). Moreover, the Camp sits on top of the Sagamore lens, a sole source drinking water aquifer for Cape Cod. The northern 15,000 acres of Camp Edwards, the Reserve/Training Area, are located within the recharge area of the aquifer. Camp Edwards is committed to excellence in environmental protection, training, readiness and management of training sites. Training facilities available at Camp Edwards include small arms ranges (SARs), training areas, battle positions, observation posts, and maneuver roads and trails. These facilities 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. MANG will seek to constantly improve upon training practices that protect the future of the surrounding eco-system and the aquifer, and maintain a viable, ready force.

1.1 Purpose

The purpose of this range Best Management Practice (BMP): Operations, Maintenance, and Monitoring (OMM) Plan is to identify the operations and management practices that MANG will implement to return "K" ("Kilo") Range to service in support of small arms weapons marksmanship training. This plan identifies BMPs that allow the employment of small arms at Kilo Range in a manner that:

- Meets current and future training requirements and
- Employs maximum feasible use of pollution prevention (P2) to protect the Upper Cape Water Supply Reserve, managed as a Massachusetts Department of Environmental Protection (MassDEP) Zone II for public water supplies.

This plan, along with other range-specific plans, is in support of the Camp Edwards *Pollution Prevention Overview (Small Arms Range Supplement)* (SAR P2 Overview) (MANG 2007). Per the phased approach outlined in the SAR P2 Overview, MANG is developing BMP OMM plans for each SAR that will support marksmanship training (see Figure 1-1). The phases in Figure 1-1 indicate the initial priorities of the MANG to support mission requirements; however, the ranges listed in these phases do not imply they will remain in that order. Based on mission requirements, the MANG will request approval of additional ranges during the T (Tango) Range trial period. Due to revised mission requirements to support a greater number of soldiers, Juliet and K (Kilo) ranges are first priority for approval to fire after Tango Range. However, efforts for the E (Echo) Range, Sierra East Range, and Sierra West Range will continue with the intent to bring these ranges on-line as quickly as is practical to sustain current and future military training while protecting the environment.

The Kilo small arms range is a 25-meter (m) bermed range that is very similar to Tango Range, in that Tango is also a 25-meter SAR. Based on their similarities, the SAR P2 Overview document, and the success of STAPP™ system as an effective containment system for managing small arms training as demonstrated on Tango Range, the MANG, in discussion with the environmental agencies, selected the STAPP™ system as the major management system for Kilo Range.

Prior to the employment of lead-bullet ammunition on any SAR, Camp Edwards will present the corresponding range-specific BMP OMM plan to the environmental agencies, the Environmental Management Commission (EMC) and US Environmental Protection Agency (EPA) for review and approval. The range-specific BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR Working Group; however, state approval would be through the EMC. MANG will program for funding requirements to implement the BMPs on an annual basis. Lead-bullet ammunition will only be fired at Camp Edwards on ranges with approved BMP OMM plans and as BMPs are funded and implemented.

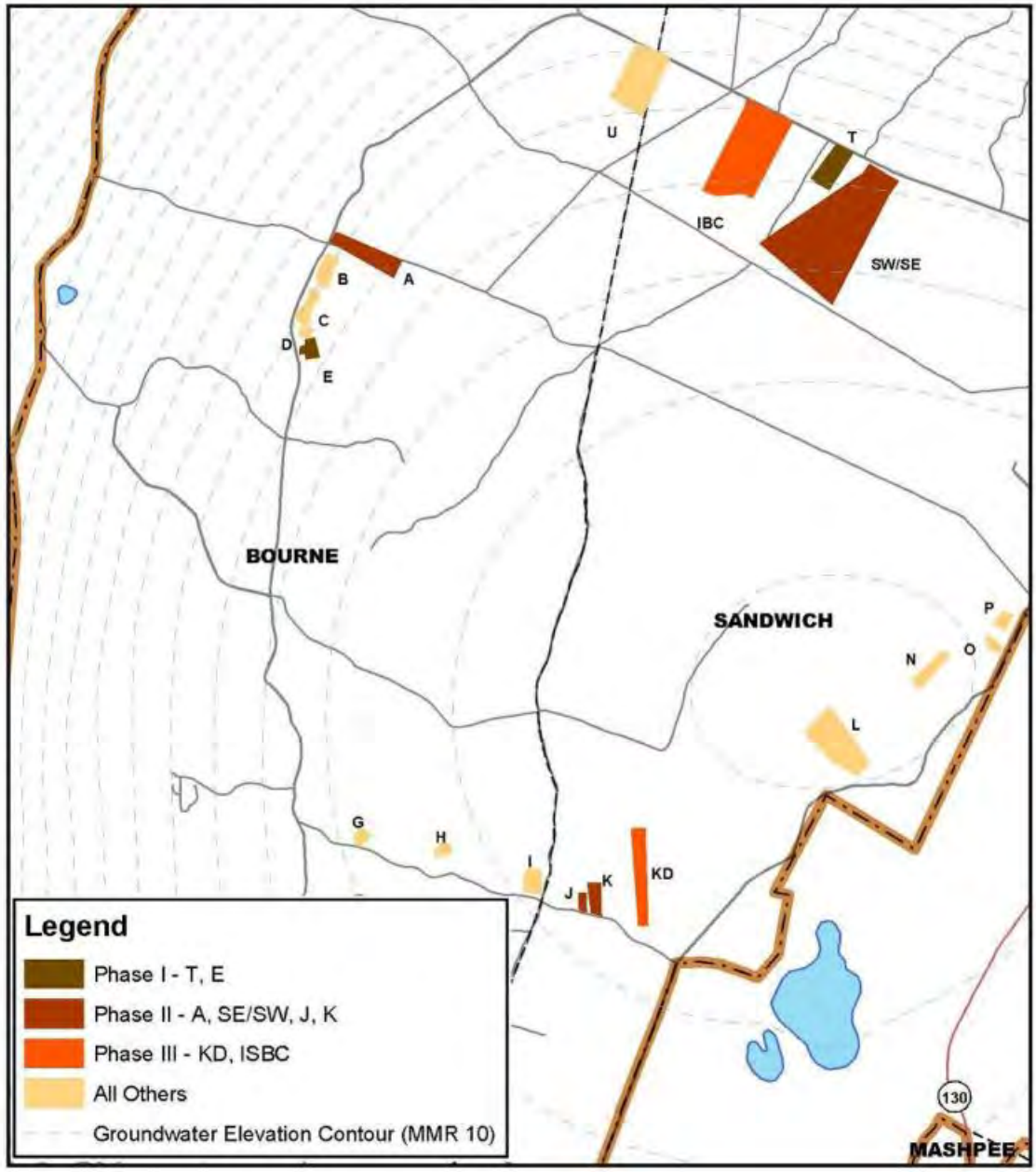

Figure 1-1. Small Arms Ranges and Initial Phases (June 2007) for Return to Live Fire

1.2 Scope

This BMP OMM plan is limited to the operation and use of Kilo Range. It supports the use of Kilo Range as a fully operational 25-m Rifle/Machine Gun Zero Range (Category Code [FCC] 17801) to meet current and anticipated requirements for small arms training exercises at Camp Edwards. Although this plan identifies specific BMPs for the management of metals to sustain operations at Kilo Range, the scope of the BMPs addressed is not limited to typical environmental management options. It also includes BMPs for safe and efficient administration, use, management, and maintenance. The analysis of alternative approaches for sustainable operation of Kilo Range and the BMPs recommended in this plan are based on range-specific conditions and are not intended to apply to other SARs at Camp Edwards or on other Army or Department of Defense (DoD) installations or ranges.

1.3 Background

Kilo Range represents a high-priority range in the sequence of SARs that Camp Edwards seeks to bring on-line to support small arms marksmanship training. Although it has historically supported many training requirements, in the future it will be used as a standard 25-m Rifle/Machine Gun Zero Range primarily in support of training with M16 and M4 rifles, M249 and M240 pistols, and M60 machine guns.[1]

1.3.1 Historical Use

Kilo Range is located directly north of Pocasset-Forestdale Road, next to and east of Juliet Range, and historically was used as a pistol range to train soldiers in pistol marksmanship. It was established at the same time as Juliet Range in the late 1980s at the site of the former Air Force B pistol range, which was used as a small bore range where 5.56mm and .38 caliber rounds were fired. “The remnants of the former Air Force B pistol range firing line (with approximately 30 firing points) were observed at the edge of the parking area on the extreme southern end of the open area. The current Kilo Range firing line is located over 230 feet north of the parking area. Twenty six firing points exist along the east-west trending, 191-foot long firing line. Target frames are 80 feet (approximately 25 meters) north of the firing line and an earthen backstop berm is positioned 142 feet beyond that.” (IAGWSP 2003)

Paper silhouette targets on wooden frames are currently located 25 m from the firing line and a soil berm backstop is located approximately 18 m behind the targets. Lead-bullet ammunition for 5.56mm, .38 caliber, 9mm, .40 caliber, .45 caliber, and 12 gauge was fired on Kilo Range through 1997. The backstop berm was treated for lead during the 1998 Berm Maintenance Program (IAGWSP 2007). The program involved removing spent munitions from the soil, then treating soil with Maectite™ to immobilize any remaining lead. None of the post-processed soils exceeded the 5.0 mg/L performance value when tested for TCLP lead; the maximum total lead concentration was 4,450 mg/kg before treatment (Clausen, et al 2007). After 1997, military and civilian law enforcement personnel fired tungsten-nylon and plastic 5.56mm ammunition and frangible (copper and/or tungsten powder composite) 9mm and .40 caliber ammunition on

[1] FCC 17801, 25-m Rifle/Machine Gun Zero Range, can also be used to support pistol marksmanship and as an alternate qualification course for M16.

Kilo Range. MANG suspended the use of tungsten ammunition in 2006. Tungsten-impacted soils were excavated from the berm at Kilo Range. After the soil excavation, 37 samples were collected and no sample exceeded 150 ppm for tungsten (URS 2006).

1.3.2 Environmental Drivers

For MANG to resume effective small arms training, two significant legal drivers define the path forward: the EPA Region 1 Administrative Order 2 (AO2), issued to MANG in 1997; and the revised Massachusetts Environmental Performance Standards for Camp Edwards, Massachusetts, dated 11 July 2007.[2]

Appendix A, Section II.E of AO2 states the following conditions and requirements for the resumption of prohibited training activities. "If…EPA approves resumption of Respondents' activities at the Training Range and Impact Area, Respondents shall ensure maximum feasible use at such time of pollution prevention technologies in any training activities. Specific measures to be evaluated by Respondents include the following:

- Use of non-toxic lead-free combat ammunition;
- Use of bullet traps at all small arms ranges;
- Use of munitions-capturing material, such as 'SACON';
- Use of non-exploding artillery and mortar rounds; and
- Development of guidance for the operation and maintenance of the ranges consistent with the pollution prevention strategies."

With regard to the resumption of small arms marksmanship training, the Environmental Performance Standards require the MANG to develop small arms range specific operations, maintenance and monitoring plans and have those plans approved through the Environmental Management Commission (EMC). Once the plans are approved, the small arms ranges will be operated in compliance with EPS 19.0 Range Performance Standard and other applicable EPSs.

In its endeavor to meet the requirements of these two legal drivers, MANG is following the tenants of the Army's Strategy for the Environment—Mission, Environment, and Community. Development of a SAR P2 Overview provided the management strategy and prioritization of Camp Edwards SARs. The development of range-specific BMP OMM plans to prevent the migration of pollution to the water supply and sensitive natural resources fulfills the requirements of both of the drivers.

As such, this range-specific BMP OMM plan identifies potential pathways for migration of, and potential exposure to, contaminants from Kilo Range. Environmental management and P2 BMPs are analyzed and selected based on their ability to disrupt the pathways to potential receptors. The selected BMPs for Kilo Range are described in this plan. Prior to beginning marksmanship training on Kilo Range, Camp Edwards will present this BMP OMM plan to EMC and EPA for review and approval. The Kilo Range OMM plan is a document that the MANG will use to

[2] AO2 was issued in April 1997 following AO1, issued in February of that year. AO1 required the National Guard Bureau (NGB) to investigate sources of contamination potentially from the training ranges and Central Impact Area.

comply with applicable federal, state and local regulations on operational small arms ranges. The BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR Working Group; however, state approval would be through the EMC.

1.4 Roles and Responsibilities

To implement this BMP OMM plan, Camp Edwards will involve a team of experts to manage training operations, facility maintenance, and environmental protection functions.

1.4.1 Training Site Commander

The Training Site Commander is responsible for the overall operation of Camp Edwards to include the immediate supervision, control, coordination, and safety of all Camp Edwards facilities and promotion of mission compatible and environmentally sustainable uses of Camp Edwards resources.

1.4.2 Director of Plans and Training

The Director of Plans and Training (DPT) is the primary advisor to the Training Site Commander on all matters concerning the safe, efficient utilization of Camp Edwards training facilities. Within the overall responsibility for Range Control operations, the DPT will:

- Provide review, comments, and approval of the SAR P2 Overview and individual range BMP OMM plans;
- Identify and program for range modernization, operations, and maintenance requirements based on training load and doctrine; and
- Include requirements within the SAR P2 Overview and individual range BMP OMM plans for planning and budgeting actions as appropriate for sustainable OMM of ranges.

1.4.3 Range Control Officer

The Range Control Officer is the primary representative of the Training Site Commander at Range Control and, as such, will:

- Coordinate the generation of range modernization requirements and oversee range modernization projects;
- Control access to ranges;
- Schedule and issue ranges to using units and clear/close out units upon completion of range use;
- Coordinate operation of ranges and oversee using units while training on Camp Edwards ranges;
- Enforce applicable guidance and regulations, range standard operating procedures, and safety requirements;
- Conduct periodic inspections of range conditions and identify requirements for repair and maintenance;
- Coordinate the repair of damage to range facilities (e.g., bullet containment systems);

- Collect Training Facility Utilization Reports from using units; and,
- Maintain range utilization, inspection, repair, and maintenance records.

1.4.4 Director of Facilities Engineering

The Director of Facilities Engineering (FE) is the primary representative of the Training Site Command for accomplishment of facility sustainment, restoration, and modernization and, as such, will:

- Coordinate necessary maintenance on SARs to include:
  - Periodic lead removal from SAR berm and other bullet containment systems that are integral to the range facility;
  - Repair damaged range facilities (e.g., bullet containment systems); and,
  - Repair erosion damage to firing points, target areas, berm, and other range areas;
- Coordinate necessary maintenance on all training support facilities on ranges (e.g., bleachers, parking areas, buildings).

1.4.5 Environmental and Readiness Center

The Environmental and Readiness Center (E&RC) is the primary representative for the Training Site Commander for accomplishment of sustainable environmental management requirements. To support the return and sustainment of small arms training at Camp Edwards in accordance with environmental agreements, orders, and regulatory and legal requirements, the E&RC will:

- Make adequate professional personnel resources available to the DPT and Range Control Officer to oversee or review implementation of P2 or pollution control BMPs;
- Coordinate with the Range Control Officer and FE to support the recovery, management, recycling, or disposal of metals from ranges in accordance with DoD guidance and federal and state solid waste regulations, as applicable;
- Conduct periodic reviews of range BMP OMM plans;
- Coordinate with MANG Environmental personnel, both full-time and part-time, to conduct periodic inspections of Kilo Range to ensure compliance with the BMPs;
- Coordinate required environmental sampling and monitoring on ranges; and
- Ensure coordination with the EMC, EPA, MassDEP, and other appropriate federal, state, and local environmental resource protection agencies to monitor concerns with SAR operations.

2.0 TRAINING DESCRIPTION

Small arms training conducted at Camp Edwards may vary per using unit depending on the unit's mission and the types and amounts of training required to maintain proficiency in mission essential tasks. This section describes training types and amounts anticipated on Kilo Range. It also describes range use procedures and restrictions that support safety and protection of human health and the environment.

2.1 Training Capabilities

Camp Edwards' current training requirements include the need for small arms familiarization, zeroing sights, marksmanship practice, weapons qualification, and small unit tactics. Table 2-1 provides basic descriptions of various types of small arms weapons training. The Army specifies certain range types to conduct these tasks for different weapons systems. The Army also specifies the number of repetitions needed to become proficient in each task. Camp Edwards must have a sufficient number of ranges to accommodate the throughput requirements for all soldiers, weapons systems, and training types.

Table 2-1. Small Arms Weapons Training Terms

Term	Description
Weapons 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 for a given ammunition load.
Practice/Marksmanship	Marksmanship training by which soldiers learn to accurately fire a given weapons 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 short range firing at fixed targets to field firing at various target types and longer ranges. Transition firing can include moving down the range floor towards the target and engaging the target at different firing lines/points along the range floor. It can also include transitioning from firing a rifle to a pistol during the same training event. 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 requires a gunner to complete several phases of firing tasks to qualify to operate a particular weapon. Record fire is scored to provide the gunner with feedback and to record the gunner's qualification.

As a 25-m Rifle/Machine Gun Zero Range with 29 firing lanes, Kilo Range is designed for training shot-grouping and zeroing exercises with pistols, rifles, and machine guns. Training tasks will include weapons familiarization, zeroing, practice marksmanship, and alternate qualification (see Section 2.1.1). In some scenarios, in order to train to standard, personnel will need to move down the firing lane towards the target and engage the target at different distances from the target. Soldiers will develop the skills necessary to align the sights and practice basic marksmanship techniques against stationary targets (Headquarters Department of the Army 2006).

As shown in Figure 2-1, Kilo Range is a south to north oriented firing range. The line of fire is south to north, the firers are at the southern end of the range, and the target line and berm backstop are at the northern end. The firing line at Kilo Range is currently 52 m long with 29 firing positions spaced along the range floor width of 61 m. The first firing line from the vehicle parking area, the southernmost firing line, is also the 25-m line and is at the maximum distance from the target line. The northernmost firing line, which is 3 yards from the target line, is the minimum distance from which weapons will be fired to safely engage targets. While STAPP™ can handle point blank firing, it is not intended at this time to be used for training in this manner. The distance between the 25-m firing line and the 3-yard firing line is part of the range floor; in some scenarios for personnel to train to standard, the firers will move within their designated firing lane between the 25-m and the 3-yard line to engage targets on the target line. There are 29 wooden frame target holders placed 25 m downrange from the southernmost (maximum distance) firing line also known as the 25-m firing line. Soldiers will expend all ammunition from the designated firing positions (prone, kneeling, standing) along the firing lines and/or lanes downrange to the targets. No weapons will be discharged forward of the northernmost (minimum distance) 3 yard firing line, across firing lanes, or at an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems (MANG 2006). In addition to the requirements of this plan, all firing on Kilo Range will be managed in accordance with Camp Edwards Regulation 385-63, which is summarized below in Section 2.1.3. Figure 2-1 depicts the bullet path from the maximum firing line on Kilo Range.

The multiple firing lines on the range floor between the maximum distance of 25 m and the minimum distance of 3 yards from the target line allows personnel to zero and conduct marksmanship training with rifles, pistols and machine guns authorized for use on Kilo Range.

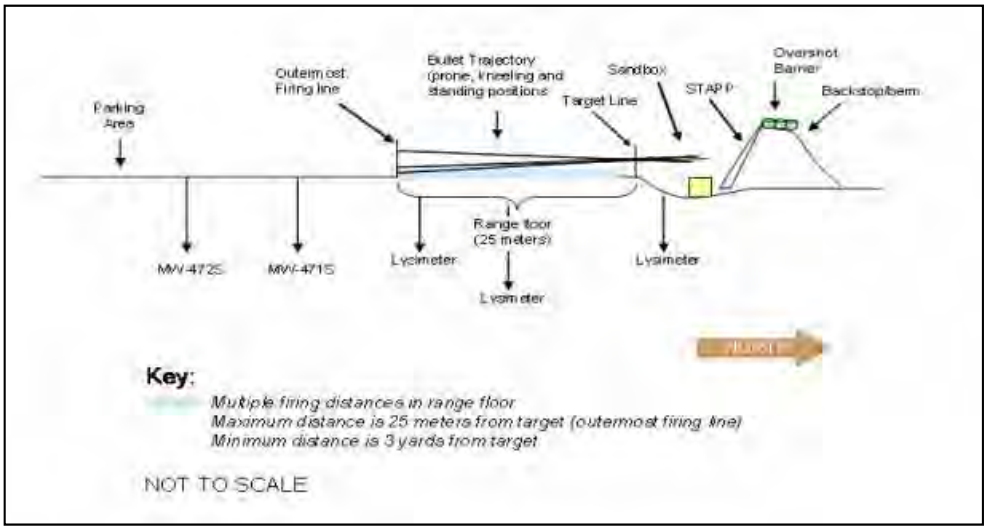

Figure 2-1. Basic Lateral View of Kilo Range

Range personnel can zero rifles and machine guns and conduct marksmanship training with these weapons systems in three different positions: prone, kneeling, and standing. Users may also zero and practice pistol marksmanship at the firing line.

Kilo Range can also be used as an alternate range for M16 and M4 qualification using scaled targets although the use of this range for qualification is suboptimal. Scaled targets simulate firing at longer ranges by using reduced image size and perspective (see Figure 2-2).

Figure 2-2. Scaled Target

2.1.1 Training Types/Exercises

During a training exercise, a unit occupies the range for one to five days. The length of the unit's occupation depends on the training goals for that exercise. After checking out the range from Range Control, the designated Range Safety Officer (RSO) delivers any requisite safety and/or environmental announcements (see Section 4.1.2). The unit erects a small covered space with a folding table that acts as a desk for the records (e.g., ammunition log). The safety officer distributes ammunition to each soldier, notating rations in the records log.[3] No training is permitted forward of the firing line.

Familiarization exercises include a review of the weapon's basic components, applicable ammunition, and any firing attachments. Soldiers learn safe operating procedures for clearing ammunition from the chambers, function check, and inspection. Maintenance lessons include cleaning, lubrication, and preventive procedures to keep the weapon in combat-ready operation. Soldiers learn how to load and unload ammunition, adhering to safety procedures. Familiarization can be conducted at the firing line or in the assembly area.

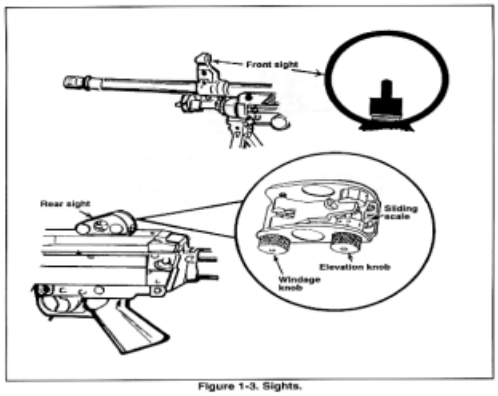

Figure 2-3. Front and Rear Sights

Zeroing is one of the most basic and universal training tasks for small arms marksmanship. During zeroing, one soldier occupies each of the 29 positions along the 10-m or 25-m firing line, depending on the weapon system. To set the sights, soldiers learn the turns required of the windage knob or peep sight for accuracy. Having mastered those basics, soldiers move onto the adjustments required to engage targets at various ranges (elevation) (i.e., 25 m, 100 m, etc.). Rotation of the elevation knob toward the muzzle (front of the weapon) increases the range, whereas rotation toward the butt stock (back of the weapon) decreases

[3] At the end of the exercise, soldiers return unused ammunition. The safety officer subtracts the number of rounds returned from the amount distributed to record the munitions expenditure. The unit turns in this record to Range Control upon check out proceedings.

the range (see Figure 2-3). Fine adjustments for zeroing are made by adjusting the peep sight. Kilo Range is a 25-m range, so units use scaled targets to depict targets beyond 25 m (see Figure 2-2). These scaled targets have smaller silhouettes to represent targets that are farther away.

Marksmanship training is divided into three phases: preliminary, basic, and advanced. Skills trained in the preliminary phase include the practice of steady position, aim, breath control, and trigger control. For example, breath control is practiced when the user inhales, places his/her finger on the trigger while holding the breath, and then releases that breath when shooting. This basic skill controls the shooter's firing rate and promotes accuracy. The basic phase applies these fundamentals in day and night cover conditions. The advanced phase trains the soldier in combat techniques of fire and techniques of employment.

The objectives of marksmanship training are:

- Accurate initial burst. Obtaining initial burst of fire on the target is essential to good marksmanship. This requires the rifleman to estimate range to the target, set the sights, and apply the fundamentals of marksmanship while engaging targets.
- Adjustment of fire. The rifleman must observe the strike of the rounds when the initial burst is fired. If not on target, the soldier must manipulate the weapon for accuracy.
- Speed. Speed is essential and is an acquired skill gained through extensive training. Speed should not be stressed to the detriment of accuracy (Headquarters Department of the Army 1985).

2.1.2 Weapons Systems and Ammunition Types

Kilo Range will be used primarily for zeroing the 5.56mm rifle (M16 and M4) and machine gun (M249) and 7.62mm machine gun (M240 and M60). Kilo Range may also serve as an alternate range for training on all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols. The most frequently fired pistol caliber on Kilo Range, by both law enforcement and military, is the 9mm (M9).

2.1.3 Use Procedures and Restrictions

Camp Edwards Regulation 385-63 outlines extensive rules and procedures for the ranges and training lands on Camp Edwards (MANG 2006). It notes that, "Users are to minimize environmental disturbance to protect the ecosystem as well as preserve the long-term value of our training site." Applicable subsections of this manual that apply to Kilo Range are:

- Section 2-3, Safety and Environmental Briefing
- Section 2-5, Ammunition, Demolition, and Pyrotechnics Restrictions
- Chapter 3, Environmental Considerations
- General Training and Environmental Protection Approvals and Conditions

Range Control personnel are well-versed with this regulation and educate RSOs during the scheduling and issuance of ranges to using units. Camp Edwards personnel oversee and assist the training conducted on Kilo Range and evaluate whether training is conducted in accordance with

operational, safety and environmental requirements. Camp Edwards will update Regulation 385-63 to resolve any inconsistencies with the requirements of this BMP OMM plan. All such inconsistencies will be identified prior to range use.

Before occupying Kilo Range, the unit must designate an RSO who will receive a safety briefing. The briefing informs units of the installation's restricted areas (impact area, forward of the firing line at any range), prohibitions of mortar and artillery munitions and pyrotechnics, misfire and malfunction procedures, communication procedures, and environmental considerations. Procedures directly related to environmental protection include:

- Weapons maintenance, cleaning, and lubrication will be conducted in a manner that minimizes the potential for release of solvents or lubricants to the environment.
- Cleaning/lubricating/preservative compound (CLP) and other weapons maintenance, cleaning, and lubricants will be conducted in a manner that minimizes the potential for release to the environment. Personnel will sparingly use these products when maintaining their weapons. When CLP containers are not in use, dependent upon their size, they will be kept on the soldier's person; or, when not in use and where practical, these containers will have their lids on and will be placed in a box, plastic bag or container, such as 5-gallon bucket. If cleaning materials are used on the range - rags, patches, and other materials - they will be disposed of in a separate plastic trash bag; this bag will then be disposed of in an enclosed container at the designated Range Control collection point. It will be inspected weekly by MANG staff; and when appropriate, by the MANG environmental staff.to determine the disposition of the waste and then dispose of it in accordance with applicable federal, state, and local regulations.
- Units will use portable latrines.
- Units will avoid wildlife and damage to wildlife habitat.
- Units should take precautions for ticks.
- Soldiers will expend all ammunition from the designated firing positions along the firing line (between the maximum distance of 25 m and minimum distance 3 yards) to within the firing lanes downrange of the targets. No weapons will be discharged:
  - Without permission from the RSO; or,
  - Forward of the firing line or across firing lanes; or,
  - At an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems.
- Units must get approval from Range Control prior to employment of tracer and hollow point ammunition on Kilo Range (see 4.2.1.5 **Holes in the cover**).
  - The delinking of tracer rounds is not authorized (MANG 2006).
  - All fire (particularly tracer and hollow point fire) will be observed by the Range Control Officer (or authorized designee) to evaluate that bullet flight through target holders proceeds into the bullet containment system
  - Inspect the top cover immediately following training events where hollow points are employed and initiate repairs in accordance with section 4.2.1.5.
  - Ensure that training is conducted in accordance with applicable procedures.
- After training with Automatic Weapons (e.g. 7.62mm, M4) the Range Control Officer (or authorized designee) will inspect the surface of STAPP to assess whether irregularities have formed at the surface due too rearrangement of rubber filler material from automatic firing.

If it is determined that there has been a seam failure or significant reduction in rubber filler (15 inches or less) the appropriate repairs will be initiated in accordance with section 4.2.1.5.

2.2 Training Capacity

For planning purposes, MANG has estimated the throughput capacity of Kilo Range. The throughput capacity of a range is the maximum number of soldiers or units that it can accommodate in a given period of time. The calculations provided below represent the maximum number of soldiers that could be trained on Kilo Range given the stated assumptions and default values. Calculation of throughput capacity is based on the type of training, the time required for a single individual or unit to complete a training event or series of events, and the period of time (day, week, month, year) that applies. Throughput calculations for some types of ranges may also include the number of soldiers or units that can train simultaneously.

The daily throughput capacity of Kilo Range (25-m Rifle/Machine Gun Zero Range) with 29 lanes is estimated as follows[4]:

Number of lanes: 29

Time required for one soldier to complete firing: 30 minutes or 2 soldiers/hour

Time available for training: 8 hours/day

Number of soldiers per hour: 29 lanes x 2 soldiers/lane/hour: 58 soldiers/hour

Maximum throughput capacity: 58 soldiers/hour x 8 hours/day: 464 soldiers/day

To obtain the annual capacity, multiply the daily capacity by the number of days available for training:

Maximum daily throughput capacity: 464 soldiers/day

Days available for training: 280 (estimated)

Maximum annual throughput capacity: 464 soldiers/day x 280 days/year: 129,920 soldiers/year

The calculation above represents a theoretical maximum of 129,920 soldiers per year using Kilo Range. MANG does not foresee this level of training usage on Kilo Range because MANG has approximately 6,000 soldiers, of which some are deployed or training elsewhere. The following sections provide a conservative estimate of the number of soldiers trained and related munitions expenditures for a year on Kilo Range.

Assuming each of MANG's 6,000 soldiers would train and qualify with the standard issue M16 or M4 rifle, each soldier would require 98 rounds of 5.56mm ammunition per year. If all of these

[4] The calculation of throughput capacity is an estimate for planning purposes only. It is not intended to establish a limit on the utilization of T Range. Adjusting any assumed value (e.g., hours of training/day, number of training days/year), will increase the throughput on T Range.

soldiers were to train and qualify at Camp Edwards, the training load could be estimated as follows:

Estimated number of soldiers: 6,000 soldiers/year

Ammunition issued: 98 rounds of 5.56mm ammunition per soldier allocation per year

Estimated ammunition load at Camp Edwards: 6,000 soldiers/year x 98 rounds of 5.56mm ammunition: 588,000 5.56mm rounds/year

Estimated ammunition load at Kilo Range: Estimated ammunition load at Camp Edwards / 3 ranges available to support training (Tango Range, Juliet Range and Kilo Range): 196,000 5.56mm rounds/year

This is a conservatively high estimate of munitions firing level because MANG estimates that at any given time 1,500 soldiers are deployed and not training and 1,000 soldiers are qualifying at other installations. Although this calculation does not account for variations in the types and calibers of weapons systems and ammunitions that could be fired on Kilo Range, it does provide insight into the total firing load that Kilo Range could experience.

Table 2-2 contains ammunition expenditures from 1994 to 2007 on all Camp Edwards SARs where 5.56mm (M16 and M4) rifle and (M249) machine gun, 7.62mm (M60 and M240) machine gun, and pistols were fired. The table includes expenditures (for relevant calibers) from B, C, D, E, G, H, I, J, K, N, O, P, and T Ranges.

Table 2-2. Historical Ammunition Usage on All Relevant Ranges at Camp Edwards

Training Year[5]	Training Days	5.56mm Tung	5.56mm Plastic	5.5mm6 Lead	7.62mm Lead	.45 Lead/ Frang[6]	.40 Lead/ Frang	.38 Lead/ Frang	9mm Lead/ Frang
2007	20	0	0	8,547	0	0	0	0	100
2006	97	77,703	0	0	0	0	0	0	1,989
2005	52	124,331	0	0	0	0	0	0	5,552
2004	98	204,293	11,242	0	0	2,700	6,900	2,150	22,320
2003	93	286,920	100	0	0	3,900	2,900	0	10,750
2002	80	223,241	30,662	0	0	3,880	3,000	0	6,000
2001	49	75,217	26,210	0	0	6,651	38,747	0	16,233
2000	42	69,473	46,250	0	0	6,630	8,650	0	5,550
1998	36	0	131,056	0	0	0	0	0	0
1997		0	44,757	215,461	34,894	0	24,172	21,031	202,660
1996		0	0	365,836	64,207	11,165	79,557	62,279	388,956
1995		0	0	531,665	64,541	7,860	66,850	85,003	488,920
1994		0	0	532,900	99,118	68,224	5,915	65,983	454,220
TOTAL	**567**	**1,061,178**	**290,277**	**1,654,409**	**262,760**	**111,010**	**236,691**	**236,446**	**1,603,250**

Note: 1997 was the last training year that training with lead-bullet ammunition was permitted on Camp Edwards

MANG will track and report the actual amount of ammunition fired on Kilo Range annually. The following information will be collected each time Kilo Range is in use: total number of personnel trained, the weapon systems used, the type of ammunition, and the number of rounds expended will be collected each time (See Appendix A, Training Facility Utilization Report).

[5] Training year is a fiscal year, October to September.
[6] Pistol fire prior to 1998 used lead-core ammunition. After 1998 pistol fire was conducted primarily using frangible bullets.

3.0 RANGE LAYOUT

The purpose of this section is to provide visual/pictorial representations of the physical design modifications to Kilo Range to support the P2 BMPs described in Section 4. The primary P2 design feature of Kilo Range is the STAPP™ bullet containment system, on the existing soil berm (Figure 3-1).

3.1 Range Plan

Kilo Range is located north of Pocasset-Forestdale Road, east of and directly adjacent to Juliet Range. The two ranges are separated by a soil berm covered with trees. Kilo Range has generally flat topography, with the exception of a soil berm/backstop. Paper silhouette targets on wooden frames are located 25 m from the firing line. Two other smaller, soil berms covered with trees are located on either side of the range floor to the west and east, bordering the 61 m wide range floor. The berm on the western side of range floor separates Juliet and Kilo Ranges. Distinct features of Kilo Range include a parking area, a storage shed for target frames shared with Juliet Range, a firing line, the range floor, a soil berm/backstop with STAPP™ bullet containment system, and 29 target frames. Kilo Range is surrounded by trees, which buffer noise and act as a windbreak. The parking area is open to and accessed from Pocasset-Forestdale Road. MANG proposes to install a range tower and support facilities. A few modifications made to the range layout of Kilo Range are discussed below.

Number and Locations of Firing Positions. The firing line at Kilo Range was 52 m long with 26 firing positions. After range modifications, Kilo Range has 29 firing lanes with a firing line 52 m in length. The STAPP™ system is installed in such a way as to allow proper trajectory of fired rounds through targets and into the STAPP™ system from standing, kneeling, and prone positions.

In their previous configurations, MANG could not operate Juliet and Kilo Ranges simultaneously due to range safety requirements. Because the firing positions on Juliet Range were located further south than those of Kilo Range, it created an unsafe condition for users of Kilo Range to move forward from the firing line towards the current target line on Kilo Range. In order to maximize training requirements, the firing lines and target lines of both ranges were aligned with one another.

Berm Relocation. To improve concentration and capture of bullets fired from the relocated firing positions through the target frames, a new soil berm/backstop with a STAPP™ system was constructed on Kilo Range. The new soil berm on Kilo Range is aligned with the Juliet Range soil berm approximately 12 feet behind the target frames (see Figure 3-1). The old soil berm/backstop on Kilo Range was removed.

Figure 3-1. Berm Relocation on Kilo Range

MANG will install 29 wooden framed target holders 25 m downrange from the outermost firing line. The range floor between the firing positions and target frames is relatively flat and will be covered with grass. Protective timber "sand boxes" will be placed end-to-end behind the target frames at the base of the STAPP™ system to protect it from undershot. Figure 2-1, shown again in this section for convenience, shows a number of these features. The STAPP™ bullet containment system is located on the new soil berm/backstop. Kilo Range will be surveyed and the target frames will be relocated 12 feet south of the toe of the berm, and the firing line will be placed 25 m south of the range targets. The new soil berm on Kilo Range is directly aligned with the existing berm on Juliet Range; this will allow the ranges to operate simultaneously.

The STAPP™ system is described in detail below in Section 3.2. Other proposed Kilo Range construction includes a range tower, bleachers, and a pavilion. These support facilities will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located near the proposed parking area of Kilo Range. The bleachers will provide seating for training announcements and will be situated behind the outermost firing line in order to safely observe firing.

The Kilo Range plan incorporates several elements selected to disrupt migration pathways identified in the SAR P2 Overview and currently in use on Tango Range as shown in Figure 3-1. The STAPP™ system limits the interaction of precipitation with bullets and retards the vertical movement of metals into soil and the transport of dissolved and particulate metals toward the toe of the berm. Vegetation on the sides and back slope of the berm will prevent erosion of berm soil caused by surface water flow. The entire range floor is buffered by trees to prevent wind erosion

and the migration of small arms firing residue off-range through wind entrainment. One pan lysimeter is located at the toe of the berm; a second pan lysimeter is located two yards in front of the maximum firing line. A third pan lysimeter is located on the range floor midway between the toe of the berm and the maximum firing line. A fourth lysimeter will be paced under the infiltration area of the stormwater drainage system. The three lysimeters on the range floor of Kilo Range are located in the center firing lane 2 feet below ground surface. These lysimeters are used to monitor soil-pore water for dissolved metals as an early indication of contaminant migration from the ground surface towards the water table. Because groundwater flows from northeast to southwest across the range, one of the existing groundwater monitoring wells (MW-474S) is located appropriately to monitor for the presence of munitions constituents in groundwater.

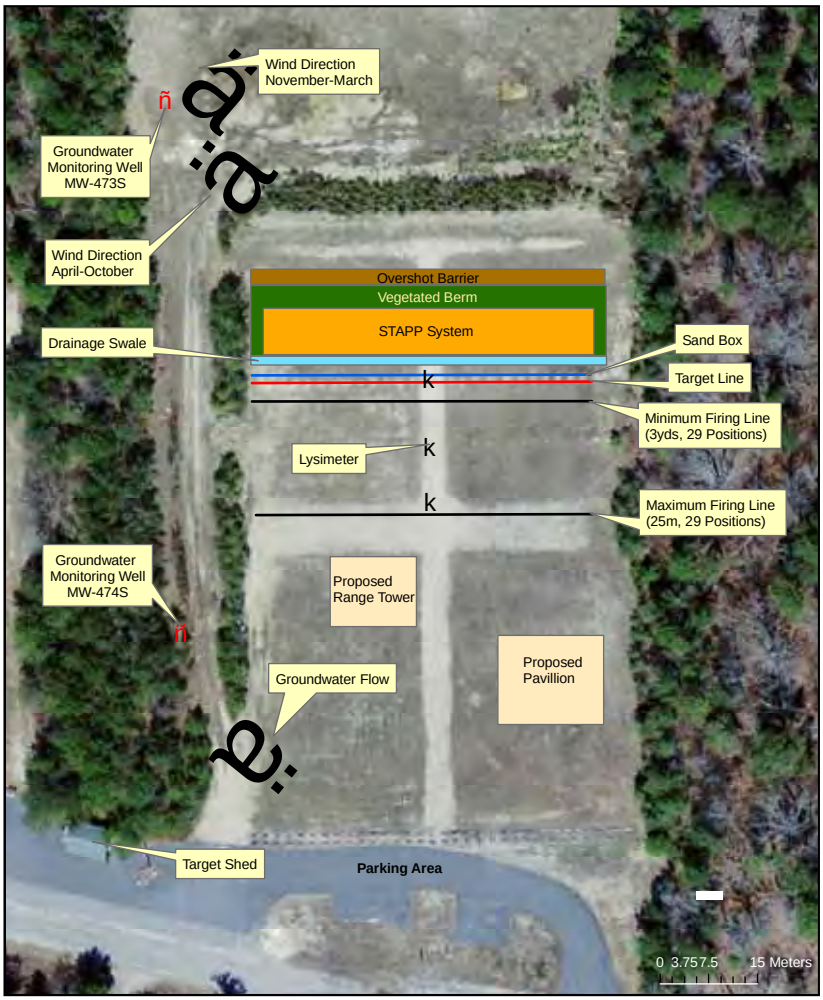

Figure 3-2. Aerial View of Kilo Range Pla

3.2 Details and Specifications of Bullet Containment System

Kilo Range employs several features that collectively sever pathways of metals migration; they include the STAPP™ system, an overshot barrier, the vegetated back slope, the vegetated range floor, and the two vegetated earthen berms on the east and west side of the range floor. The most significant feature is the STAPP™ system itself, which will contain the majority of the fired bullets. The STAPP™ system is a rubber sandwich framed by synthetic lumber; the system consists of a bottom rubber membrane, a matrix of rubber granules, and a cover that is a self-closing membrane that permits bullets to pass through but prevents precipitation from getting inside the system. Figure 3-3 shows the STAPP™ system on Kilo Range installed on an earthen berm.

Figure 3-3 Kilo Range Installed with STAPP™

The impermeable liner (see Figure 3-4a and 3-4b) prevents bullets in the granular rubber from interacting with berm soil. Additionally, the liner will collect condensation or water that has passed through perforations in the self-closing cover and will direct it toward the water collection piping for removal and disposal in accordance with local, state, and federal law.

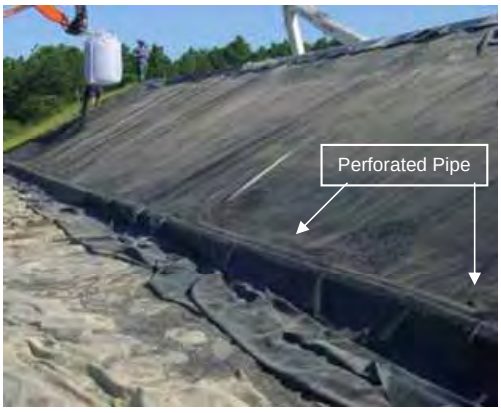

Figure 3-4a Liner with Perforated Pipe

Figure 3-4b Perforated Pipe & Rubber Granules

On the top of the berm at Kilo Range an overshot barrier will be installed to capture potential overshot (Figure 3-6). The barrier will be constructed to an appropriate height to contain most overshot.

To protect the base of the STAPP™ system from being undershot a series of sand-filled timber framed Boxes will be placed behind the target frames. The 8' long sand boxes are constructed with 6" x 6" pressure treated timbers, 2" x 4"s and plywood. The boxes are fastened using nails, spikes, and wood dowels; the use of spikes was minimized to help prevent ricochet hazards with wood dowels providing most of the fastening strength. The boxes are filled with clean/washed sand, then a plywood top is secured with nails. A heavy duty vinyl geotextile fabric (Thoroshield 4050) is secured to the box to allow it to shed rain water. The sand box placement is illustrated in Figures 3-6 and 3-7.

In addition to the sand boxes placed to protect the base of the STAPP™ system, the ground surface between the target line and the berm with STAPP™ will be graded in such a fashion that the base of STAPP™ is below the target line. This grade/elevation difference will provide additional protection to the base of STAPP™. Figure 3-6 provides an exaggerated view of the grade difference between the target line and STAPP™. This area will be appropriately graded to reduce erosion and manage surface water runoff. On Kilo Range, the elevation between the target line and STAPP™ will be maintained at the current gradual slope to the west. The site will be graded and maintained to minimize the potential of any long-term standing water, see Section 4.2.1.4 for further discussion on storm water management.

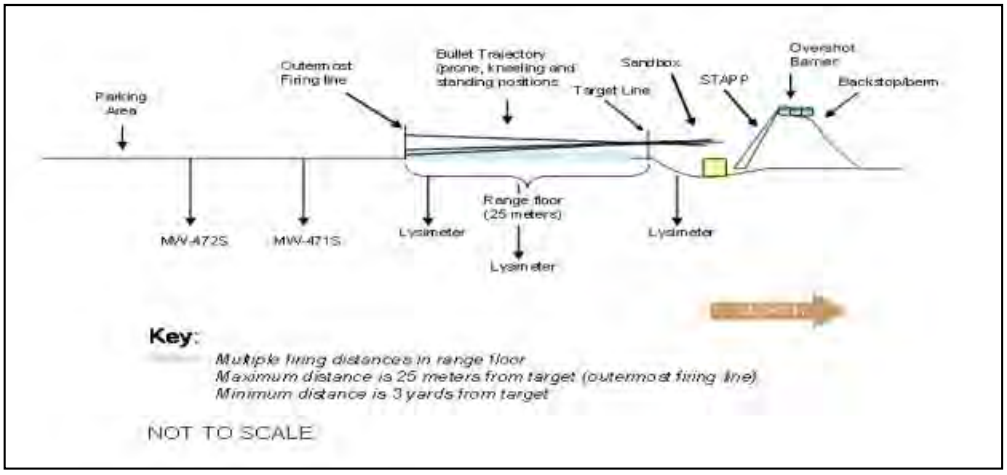

Figure 3-6. STAPP System and Grade Change between Target Line and Berm, Kilo Range

Figure 3-7 on the following page depicts the features associated with the target line and the STAPP™ system. The lysimeter shown in the figure represent the approximate location of the lysimeters to be installed. The 10º ground surface slope shown in the "Detail A" box is an approximate slope and is used to demonstrate the elevation difference between the target line and the base of the STAPP™ system.

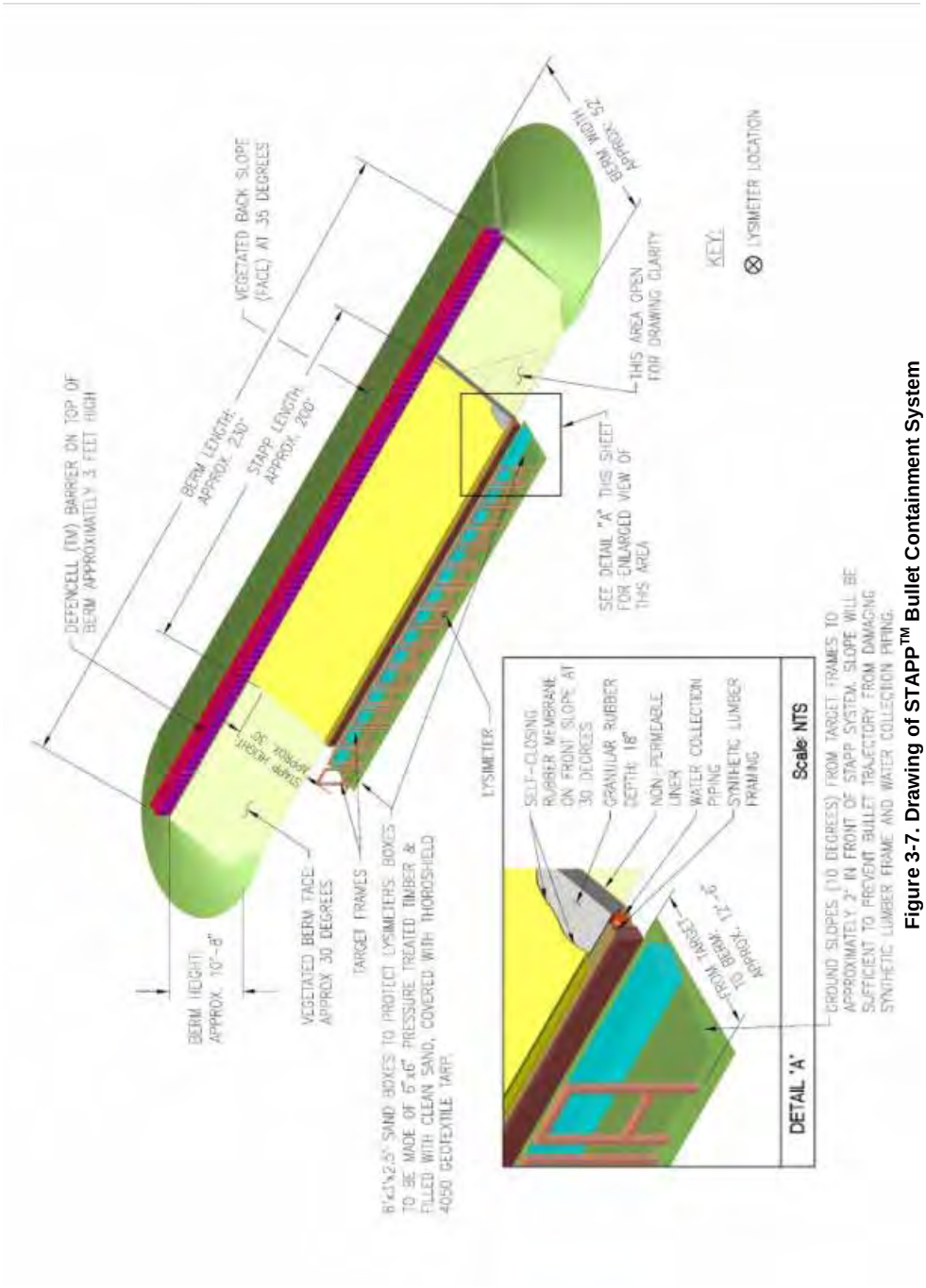

Figure 3-7. Drawing of STAPP™ Bullet Containment System

3.3 Details of Monitoring Features

Two groundwater monitoring wells are located on the west side of Kilo Range (MW-473S and MW-474S). After the relocation of the soil berm/backstop, one of the monitoring wells (MW-474S) is appropriately located to monitor impacts from firing on Kilo Range. The second well (MW-473S) will be hydraulically up gradient from the new soil berm/backstop location. Depth to groundwater at Kilo Range is approximately 27 m, and the installed wells will sample groundwater to a depth of 30 m. Specifications of the groundwater monitoring wells installed on Kilo Range are shown below on Figure 3-8.

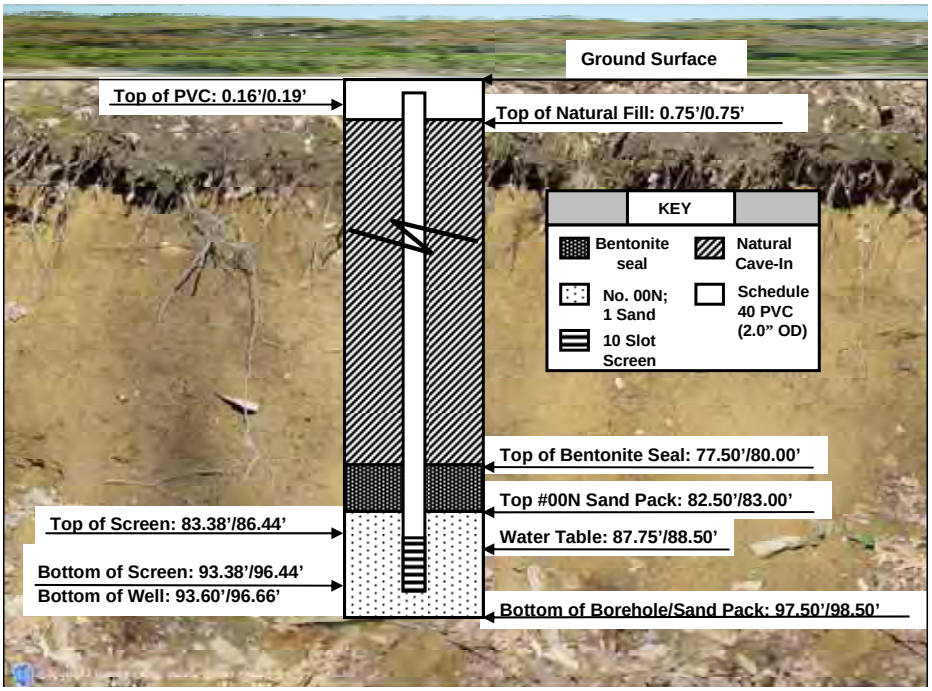

Figure 3-8. Groundwater Monitoring Well Construction Details for MW-473S and MW-474S, respectively

Lysimeters will also allow MANG to monitor for dissolved munitions constituents in soil-pore water on Kilo Range. The lysimeters will function as an early warning sign of lead migration within the first 2 feet of surface soil at the toe of the berm, at the firing line, and on the range floor. The lysimeter at the toe of the berm will detect whether metals from fired ammunition are contained by the STAPP^{TM} system. The lysimeters at the maximum firing line and on the range floor between the toe of the berm and the maximum firing line will detect the migration of any metals or propellants from the muzzle blast of fired weapons. Lysimeter sampling will characterize contaminant migration through the soil-pore water toward the aquifer.

Pan lysimeters (Figure 3-9) will be use and are constructed with an open-faced container filled with washed quartz sand or other inert material. The container, or pan, is placed horizontally in the soil and is equipped with a drain port connected to a collection bottle by tubing. Water percolating through the soil above the pan is collected via gravity, and then pumped to the surface for sampling.

Figure 3-9. Example of a Pan Lysimeter

MANG installed pan lysimeters on Juliet and Kilo Ranges. The benefits of pan lysimeters include: the ability to collect larger volumes of water, a more reliable method to collect soil-pore water, fewer steps in sample collection, and an easier installation process.

The pan lysimeters are made of HDPE and 10" x 13" in size. Teflon-lined poly tubing (3/8" O.D.) is connected to the pan lysimeter and run to a 2 L HDPE container placed below the lysimeter. A fine screen mesh is placed at the inlet port to keep soil from entering the influent tubing. Washed sand is placed over the mesh and fills the lysimeter pan. Poly tubing (¼" O.D.) will run from the bottom of the 2 L container through a protective sleeve to the ground surface; soil-pore water is extracted through this tubing with a peristaltic pump. A protective cap placed at the end of the sleeve allows the tubing to be kept slightly below ground surface, but still accessible for sampling.

By monitoring weather conditions, attempts to sample soil-pore water will occur after rain events. 100mL of water is required for collection of a sample. The water will be analyzed for the required analytes listed in Section 4.2.2.3. Actual precipitation amounts will be recorded using a weather website with ties to meteorological equipment on base and precipitation data will presented in a log sheet.

4.0 RANGE OPERATIONS AND MAINTENANCE

This section provides guidance for the OMM of Kilo Range that is consistent with, and complimentary to, the P2 strategies evaluated and selected in the SAR P2 Overview and duplicates the strategies adopted for Tango Range. The following guidance satisfies the criteria identified by MANG for the "maximum feasible use of P2." As such, guidance was developed to be implementable, protective of human health and the environment, and to be cost effective.

If the MANG determines or anticipates that it may not be able to comply with any requirement of the OMMP, it will notify EPA and EMC within 24 hours of this determination in writing. Within an additional 48 hours, the MANG will provide a plan for EPA and EMC approval for addressing the potential deviation.

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By the tenth day of each month, the MANG will prepare and submit to EPA and EMC a monthly report that includes: 1) the actions that have been taken toward maintaining compliance with the Administrative Order and the OMMP during the previous month, 2) a summary of all sampling results and tests and all other data during the previous month, 3) all work plans, reports, and other deliverables required by the Order, and 4) all actions scheduled for the next 6 weeks including percentages of work completed to date on ongoing tasks, delays encountered, and a description of efforts made to mitigate any delays.

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By December 15, MANG will submit an annual report containing all data collected during the year. Any issues that were encountered should also be described.

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4.1 General Range Operations

4.1.1 Range Access

"During legally established hunting seasons in Massachusetts, licensed hunters with legally registered firearms may be permitted in select portions of Camp Edwards. Use of any portion of Camp Edwards for hunting is at the sole discretion of the Massachusetts National Guard. (MANG 2003)" Both Juliet and Kilo Ranges will be secure sites; trespassers are prohibited and hunting activities are not authorized on either of these ranges.

4.1.2 Range Scheduling

Kilo Range may be used for weekend training, inactive duty training, or during the two week-long annual training periods of MANG units. Deploying and Annual Training units have the first priority for scheduling training areas and ranges over Individual Duty Training and civilian requests. Per Camp Edwards Regulation 385-63, Range Control schedules Kilo Range usage based upon written input received from using units. Units forward a written request to "Commander Camp Edwards, ATTN: Range Control" or use the Range Facility Management Support System (RFMSS) Program stating the dates and facility desired. The written request must include the anticipated number of soldiers or other users occupying and using the range, the types of weapons to be used, the types of ammunition to be used (by DoD Identification Code [DODIC]), and estimated amounts of ammunition to be expended. A master schedule is available

for viewing electronically via the RFMSS Program. To avoid conflicts, co-use of a previously scheduled area will be confirmed only after Camp Edwards Operations and Range Control receive a written consent from the originally scheduled unit.

4.1.3 Issuing and Clearing the Range

A unit representative will sign out Kilo Range from Range Control prior to occupation or use. Units must confirm the information provided at the time the range was scheduled (e.g., numbers of users, weapons, and ammunition). Each unit will receive a Kilo Range usage packet, which will include a Weekly Range Bulletin. This bulletin indicates training facilities scheduled, airspace requirements, local restrictions, and other information pertinent to units training at Camp Edwards. Commanders are responsible for distribution to subordinate units and appropriate personnel. Prior to occupation, or immediately thereafter, unit personnel will inspect the range and report any deficiencies immediately to Range Control. Camp Edwards personnel will conduct safety and environmental awareness briefings to designated Officers in Charge and RSOs prior to issuing the range. The briefing will cover the requirements of this document as well as requirements of Camp Edwards Regulation 385-63, *Range Safety and Trainers Guide*, and safety requirements from applicable weapons manuals, Field Manuals, and Technical Manuals.

Upon completion of training, units shall police their brass and ammunition containers and packaging. Using units remove expended cartridge casings from the range, visually inspect them to remove any live rounds, and turn over the expended casings to the temporary Ammunition Supply Point (ASP)[7]. Other range residue such as weapons cleaning materials and trash generated on the range will be collected on-site in a waste receptacle issued by Range Control upon check-in. The waste receptacle will be returned to Range Control upon check out. Range control will establish a satellite accumulation point for wastes generated from weapons cleaning. Upon accumulation of 55-gallons of such waste, it will be disposed of per the Camp Edwards HMWMP and in compliance with state and federal solid and hazardous waste management regulations.

All units/organizations using Kilo Range will complete a Training Facility Utilization Report (see Appendix A[8]). This report summarizes the training activities conducted on the range and includes: the weapons systems used, the type and amount of ammunition used, the firing lanes that were used, and the types of vehicles present on the range. After policing their brass and related range residue, the unit/organization will inspect the range using the Kilo Range Inspection Form (see Appendix C). This form includes a review of the general order and condition of the facility, a visual check of erosion and vegetation on the range, and a visual inspection of the STAPP™ system. Blank copies of both of these reports will be included in the check-in packet distributed at Range Control. Upon clearing Kilo Range, each unit/organization will submit the completed reports to Range Control. The Range Control Officer or authorized designee will be available to answer any questions that arise during the visual inspection, but it is

[7] A temporary ASP is typically established by each using unit for the duration of each training event on the range. The location may be a tent or the back of a vehicle and provides a single location for ammunition drawn from the installation ASP to be issued to and turned-in by the using soldiers.
[8] The range inspection report in the Appendix is being continually improved for use on K Range.

the unit/organization's responsibility to complete the range inspection. Once Kilo Range is inspected and cleared by Range Control personnel, via signature on the inspection forms, the unit or organization representative will report to Range Control returning any Kilo Range packets or equipment issued and to close out the hand receipt prior to clearing the range.

4.1.4 Oversight of Training Operations

Per Section 1.4, the Range Control Officer is responsible for oversight of Kilo Range operations. The Range Control Officer issues and clears Kilo Range; he/she is the main point of contact for using units for range communications, usage requirements, and conflict resolution. The Range Control Officer will monitor units on Kilo Range to support compliance with this plan and Camp Edwards Regulation 385-63. The Range Control Officer will schedule all required monitoring described in Section 4.2 and all maintenance described in Section 4.3 with the appropriate Camp Edwards staff.

In coordination with Range Control, E&RC will have the MANG Environmental personnel conduct site inspections of the range. Inspections can be conducted in conjunction with Range Control personnel or separately. Also, the various environmental agencies will also inspect the range and/or units for compliance with the established Kilo Range OMM plans. If the range is operational, the environmental agency representatives will identify themselves to the Officer or Non-Commissioned Officer In Charge, who is responsible for the overall conduct of the range that day.

4.2 Range Monitoring

In addition to routine compliance monitoring, Range Control coordinates the general and environmental inspections and requisite rehabilitation on Kilo Range. Small arms training with lead-bullet ammunition will leave metals within the bullet containment system and possibly munitions constituents elsewhere on Kilo Range. In order to monitor the nature and extent of munitions constituents on Kilo Range, Camp Edwards instituted a monitoring program for soil, soil-pore water, and groundwater. MANG will also implement a number of other inspection and monitoring BMPs to ensure the conditions on Kilo Range that limit metals mobility are maintained. These BMPs include monitoring the condition of the bullet containment system, vegetation cover, and soil pH to minimize corrosion/dissolution of metals into subsurface soil or groundwater.

4.2.1 Range Inspections

Each time the range is used range inspections will be conducted by Range Control and accompanied by units or other users NCOIC or person in charge. This will provide with time a functional familiarity in how the range is cared for and its proper use. Range Control will inspect the range on a regularly scheduled bi-weekly (every two weeks) basis, as the weather permits. Furthermore, Range Control will conduct detailed inspections three times during the peak training period and internal inspections of the STAPP™ system during periodic lead removal. There are three levels of inspections at Kilo Range: visual inspections, detailed inspections, and internal inspections. The requirements of each type of inspection are presented

on the Kilo Range Inspection Form (see Appendix C). Each type of inspection is described in detail below and summarized in Table 4-4 at the end of Section 4.

As the MANG is currently regulated by the EMC under Chapter 47 and EPA Administrative Order II, in regards to small arms ranges and other aspects of live fire training on Camp Edwards, the EMC and EPA will conduct inspections of Kilo range.

Metric: When *the EPA or EMC provides an inspection report to the MANG the MANG will reply within 5 business days in writing, email, or other documentable form of communication.*

Most MANG training occurs between April and October. During this peak training period, the Range Control Officer will conduct a bi-weekly visual inspection of Kilo Range using the Kilo Range Inspection Form in Appendix C and compare his/her observations with the recently completed inspection forms of using units. The Range Control Officer will also conduct a visual inspection within 72 hours after major storm events[9].

Range Control will also conduct a detailed inspection of Kilo Range at the start, midpoint, and the completion of the peak training period. The detailed inspections will be conducted 3 times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October at the end of the peak training period. This detailed inspection will include features described in the Kilo Range Inspection Form Sections A-E (see Appendix C) as well as photo documentation of range conditions.

During the initial detailed inspection of Kilo Range conducted each year in March, Range Control will take baseline condition photos of the firing line, range floor, soil berm, and bullet containment system while standing at firing positions 4 and 13. These baseline photos will help field crews evaluate future observed conditions against the baseline and help document the rehabilitation of any reported range deterioration. Range Control 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. The following sections contain guidance for conducting range inspections.

MANG will also conduct an internal inspection of the components of the STAPP™ system each time MANG removes the cover and sifts the granular rubber material to remove and recover captured projectiles. Regularly scheduled internal inspections will occur after 500,000 rounds have been fired on Kilo Range or every 3 years, whichever occurs first. The internal inspection will include features described in the Kilo Range Inspection Form Section F (see Appendix C).

Range Control collects the Kilo Range Inspection Forms and schedules any required maintenance with either Facilities Engineering (FE) or the Environmental Office accordingly. Range Control files the inspection forms for administrative record keeping.

4.2.1.1 General Conditions and Order of Facility

[9] A major storm event is defined as an accumulation of more than 5 cm in a 24-hour period.

Distinct features of Kilo Range include a parking lot, a target shed shared with Juliet Range, a firing line, the range floor, STAPP™ bullet containment system on a new soil berm, and 29 target frames. Proposed Kilo Range future construction includes troop support facilities and a range tower. The support facilities will include bleachers and a pavilion that will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located adjacent to the current parking area of Kilo Range. The bleachers will provide seating for training announcements and will be situated behind the maximum firing line in order to safely observe firing. The parking area will be inspected for general condition and any POL stains from vehicles. The target frames/holders, firing positions, shed, and proposed range tower must be in adequate condition to support unit training use. The protective timber "sand boxes" behind the target frames will be evaluated to identify deterioration, damage or excessive amounts of undershot. Units will note the condition of each of these features and any specific deficiencies in need of repair.

4.2.1.2 Erosion

Erosion is the displacement of soil by wind or water or by downward or downslope movement in response to gravity or human activity. Kilo Range is generally flat, with the exception of three sloped areas: the berm/backstop with the STAPP™ system, and the two soil berms covered with trees on the east and west side of the range floor. The potential causes of erosion on Kilo Range are lack of vegetation or human activity/disturbance, such as staff climbing the vegetated berm to inspect the top of the berm and the STAPP™ system.

4.2.1.3 Vegetation

Camp Edwards will plant and maintain Massachusetts Highway (MassHighway) seed mix to provide a vegetative cover on the berm areas around the bullet containment system and the range floor to reduce erosion (Ciaranca 2006).

4.2.1.4 Stormwater Management

On Kilo Range (Figure 4-1), there is a gently sloping drainage swale at the toe of the berm, which slopes both east and west. Surface water flows from east and west from the center of the drainage swale at the base of the STAPP system. Water flows into two drainage swales one to the north west and one to the southeast. The drainage swales are lined with limestone riprap and graded slightly to conduct overland surface water flow away from Kilo Range. This system will need periodic maintenance to keep it in working condition. The drainage swale lined with riprap will be kept free of vegetation and the proper grade will be maintained to conduct surface water flow away from the range.

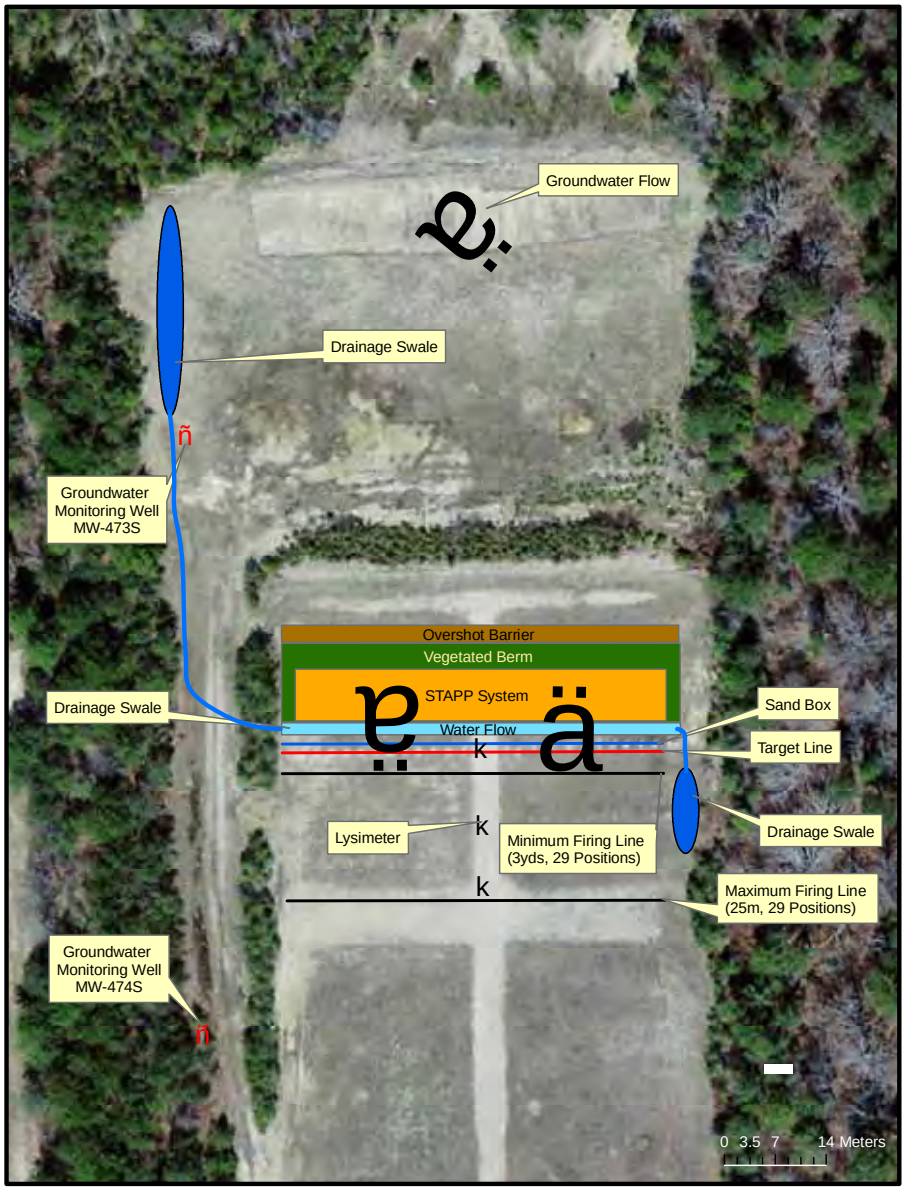

Figure 4-1. Stormwater Flow on Kilo Range

4.2.1.5 Bullet Containment System

The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs will be conducted in accordance with the metrics outlined below. A number of features of the STAPP™ bullet containment system will be monitored to contain metals and sever potential migration pathways. These features include:

- the self-closing rubber membrane cover (faces and seams),
- the rubber filler material,
- the impermeable liner,
- the internal water reservoir, and,
- the synthetic lumber support structure.

General Metric: *If repairs cannot be scheduled or initiated within 72hours then all appropriate MANG leadership and appropriate federal and state environmental agencies will be notified in writing (email, letter or other documentable form of communication) within 72 hours of this detremination.*

General Metric: *If it is determined that repairs needed preclude the use of any lane or the range in total Range Control will shut down part or all of the range, providing for safety and environmental protection.*

Self-closing rubber membrane (faces and seams)

The self-closing cover is the top layer of the STAPP™ system. Although the rubber membrane that covers the granular rubber is "self-closing" it can become worn and perforated to the point where significant amounts of precipitation can accumulate within the system. The wear and perforation of the rubber membrane is heavily dependent upon range use. Both the frequency of operations at the range and the caliber of projectiles used in training will affect the useful life of the rubber membrane. Figure 4-2 depicts the progression of wear and perforation on a heavily used STAPP™ system over a number of years.

Figure 4-2. Examples of Wear and Deterioration of the Self-Closing Rubber Membrane on the STAPP™ System (photos not taken at Camp Edwards)

Holes in the cover. MANG will inspect the rubber membrane in accordance with the range inspections outlined in Section 4.2.1. If granular rubber media is exposed the cover is not preventing exposure of bullets to air and water. As such, repairs should be scheduled to occur within 72 hours. This applies to all holes created by firing as well other occurrence that may cause holes, tears, seam failures or the like. No tracer fire will be conducted when such holes are present.

METRIC: *When underlying rubber media is visible, repairs will be scheduled to occur within 72 hours.*

Failed seams. Seam failure is most problematic in the bottom one foot of the STAPP™ system, near the base. In this area, the cover gradient is less steep than throughout the rest of the system and at times water may pond on the top of the self-closing cover. If the self-closing cover has a seam failure in the lower portion of the STAPP™, ponding water could penetrate the cover and accumulate in the water collection system. Larger seam failures can also be problematic in the upper portions of the STAPP™ system as they will also allow precipitation to leak into the system and will allow air-flow, thus supporting continued combustion of tracer rounds.

METRIC: *Failed seams occurring above the bottom one foot of self-closing cover (where water is not likely to pond on the membrane) require repair if the seam failure exceeds 6 inches. Failed seams occurring at/near the toe (within the bottom one foot) require repair if greater than one inch in size. Repairs will be initiated within 72 hours inspection, weather permitting.*

Ponding on the surface of the cover. A slight leveling of the self-closing cover may occur. If this leveling becomes a depression, water ponds on the top of the self-closing cover in this area. Ponding water may seep into the STAPP™ system through failed seems or holes in the cover.

METRIC: *Each time the top membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media appropriately to prevent any ponding of water on top of the self-closing cover.*

Rubber filler material

The rubber filler material is approximately 18 inches of loose, granular rubber fill situated below the self-closing cover. Irregularities in the surface of the STAPP™ system may be indicative of two different problems: (1) irregular distribution or settling of the granular rubber media, causing "thin-spots" and poor bullet stopping capacity; or (2) erosion or irregular settling of soil beneath the STAPP™ system causing stretching or other stresses that may damage the impermeable liner.

METRIC: *A bulge or depression that exceeds 4 inches in height/depth over a length of 4 feet will be considered "significant" and will be repaired. Irregular settling will be measured using a 4 foot long straight edge placed on the surface of the self-closing cover. Separation of 4 inches between the straight edge and the cover of the STAPP™ will indicate a need to "re-grade" or "rake" the rubber filler material to an even level distribution across the STAPP™. Repairs will be initiated within 72 hours of inspection, weather permitting. Furthermore, each time the top*

membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media to a minimum depth of 15 inches.

Impermeable liner

The impermeable liner is situated below the rubber filler material in the STAPP™ system and lies directly on the surface of the earthen berm. Figure 4-3 shows punctures in the impermeable liner beneath a STAPP™ system caused by.50 caliber projectiles that were not intended for this STAPP system. MANG will inspect the impermeable liner for punctures and tears each time the granular material is sifted to remove and recover captured projectiles (i.e., after 500,000 rounds have been fired on Kilo Range or every three years, whichever occurs first).

METRIC: *Any perforations, holes, rips, or seam failures in the impermeable liner will be repaired. Repairs will be initiated within five working days of inspection, weather permitting.*

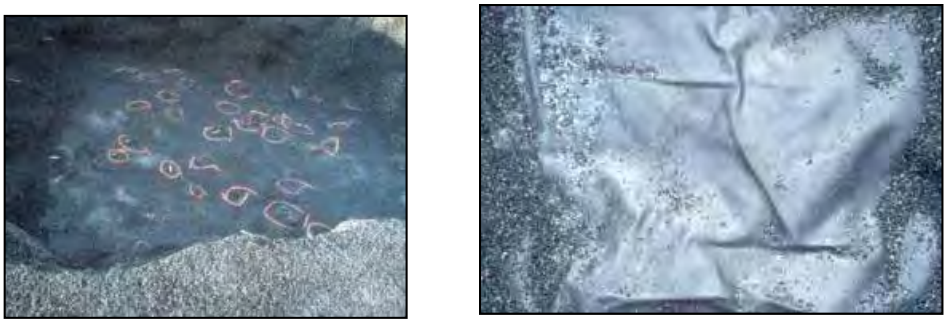

Figure 4-3. Examples of Perforated (left) and Intact (right) Liners (photos not taken at Camp Edwards)

Internal water reservoir system

External Visual Inspection. Units and Range Control will conduct a visual inspection of the ground surrounding the STAPP™ water reservoir at the bottom of the berm to check for any leaking.

METRIC: Any leaking will be immediately contained. Repairs will be initiated 72 hours of inspection, weather permitting.

Internal Visual Inspection. The internal water reservoir system is situated at the base of the STAPP™ system. It allows water to accumulate and be removed (Figure 4-4). The water reservoir system will be checked for excess water, punctures or cracks. Proper inspection of the impermeable liner and the internal water reservoir requires removal of the self-closing cover and displacement of

Figure 4-4. Internal Water Reservoir System

some of the granular rubber material. This process will also require redistribution of the granular rubber across the system and resealing the self-closing cover around the edges of the STAPP™ system. MANG will inspect the internal reservoir system for punctures and cracks each time the granular material is sifted to remove and recover captured projectiles (i.e., after 500,000 rounds have been fired on Kilo Range or every three years, whichever occurs first).

METRIC: *All cracks or punctures in the reservoir will be repaired. Repairs will be initiated within five 72 hours inspection, weather permitting. Camp Edwards will sample, collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm of water accumulates in the reservoir. Water removal from the internal reservoir will be scheduled to occur within 72 hours, weather permitting.*

Synthetic lumber support structure

The synthetic lumber support structure makes up the frame surrounding the rubber granular material and holds the impermeable liner and self-closing cover in place. Figure 4-5 illustrates damage to the support frame for the installed bullet containment system.

(photo not taken at Camp Edwards)

METRIC: *Conditions that affect the distribution of granular material or integrity of the cover or liner will be noted on the Range Inspection Form. Units and Range Control will also note the firing lanes in which they occur. Range Control will capture the initial damage with a photo and Camp Edwards will make repairs in accordance with the process and schedule outlined in Section 4.3.1. Repairs will be initiated within 72 hours of inspection, weather permitting.*

4.2.2 Environmental Sampling and Analysis

As part of the Monitoring/Sampling BMP, Camp Edwards will sample a number of environmental media on Kilo Range, including the water collected in the reservoir of the bullet containment system, groundwater, soil-pore water, and surface soils. Camp Edwards will sample the existing groundwater monitoring well (Figure 3-2). Also, Camp Edwards will install lysimeters (Figure 3-2) in soil at the toe of the bullet containment system, in the range floor between the toe of the berm and maximum firing line, and at the maximum firing line. If chemical constituents from the ammunition are not contained by the system and begin to percolate through the soil-pore water toward the aquifer, the lysimeters will provide an early warning. Sampling and analysis will be coordinated with EMC, EPA, and MassDEP. All monitoring and field work conducted at the range will be conducted in accordance with a health and safety plan that specifically addresses the potential risks associated with lead exposure at the range. The goal of the monitoring is to initiate routine range maintenance activities as needed to promote range sustainability. The following sections provide guidance for sampling and analysis of environmental media on Kilo Range.

4.2.2.1 Water from Bullet Containment System

4.2.2.2 Water from Bullet Containment System

Comment [p4]: Changes in this section made in response to EPA item a)

Experience has shown that the STAPP bullet collection systems accumulate water over time. It seems that precipitation makes its way through or under the upper membrane and collects at the bottom of the STAPP systems between the rubber membranes. Condensation within the system may also be a factor. Water has been emptied from all of the STAPP systems multiple times. The STAPP system on T Range collects the most water and has been emptied most often. Samples of the accumulated water have been collected several times to characterize the water in the STAPP system. Several metals have been consistently detected with antimony and zinc commonly detected at concentrations above drinking water standards. Therefore the water is pumped from the STAPP systems and disposed of off-site and not simply dumped out onto the range floor. The receiving facility specified a suite of analyses needed to characterize the water for disposal. Samples have also been collected from water that accumulated in the J and K Range STAPP systems in 2009 and 2011 to determine if the water in those systems shares the same characteristics. Metals concentrations have been similar in all three systems. The most recent samples were collected in from T Range in March 2011 and from J and K Range STAPP systems in April 2011. Results show similar concentrations to previous sampling events. Hence, process knowledge has been obtained and further sampling is not routinely needed. The disposal facility has agreed that the water is adequately characterized for disposal. Camp Edwards will continue to sample the water as needed to maintain compliance with the disposal facility's requirements.

Figure 4-6. Port Access for Water Inspection and Removal

To access the water, MANG personnel will access the STAPP™ system through the drain port as shown in Figure 4-6. The STAPP system will be inspected for the accumulation of water after significant precipitation events and in the spring after the water that accumulates over the winter thaws. The MANG will collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm or more of water accumulates in the reservoir. Camp Edwards will dispose of the water in accordance with all applicable state and federal laws and regulations. In no cases will water from the STAPP™ system reservoir be discharged onto the ground at the range.

4.2.2.3 Groundwater

Figure 3-2 indicates the location of the two down gradient groundwater monitoring wells (MW-473S and MW-474S). MANG will sample these wells annually in October for propellants and metals. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples. The groundwater samples will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007).

As per the request of EPA, all analyses will be conducted using unfiltered samples. This will provide a total concentration of both solid and dissolved metals. The MANG may, at its option, also collect and analyze a filtered sample to determine dissolved metals concentrations.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-3. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt.

4.2.2.4 Lysimeters

Camp Edwards installed three lysimeters at a depth of 2 feet at the maximum firing line, between the toe of the berm and maximum firing line, and along the toe of the STAPP™ system (see Figure 3-2 for lysimeter locations). Soil between the minimum and maximum firing lines is a potential hotspot for metals accumulation. Muzzle blast from small arms may deposit metals and energetic materials onto surface soils. Lysimeters will provide an early indication if dissolved metals are migrating through soil-pore water toward groundwater. Camp Edwards will sample the lysimeters twice annually, once before and once after the peak training season. Lysimeter sampling is inherently dependent on recent precipitation so some flexibility in sampling schedules should be anticipated. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples. The soil-pore water samples will be analyzed for lead,

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Deleted: <sp><*sp*>The E&RC will sample, collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 5 or more cm of water accumulates in the reservoir, or at least once every 6 months. The water level will be inspected after all significant precipitation events. Camp Edwards will identify and coordinate with the receiving treatment and disposal facility to determine the appropriate analytical methods for testing the water. Based on the results of this sampling, Camp Edwards will dispose of the water in accordance with all applicable state and federal laws and regulations. In no cases will water from the STAPP™ system reservoir be discharged onto the ground on Kilo Range.¶
¶
After a series of consistent sampling results, Camp Edwards may employ "process knowledge" rather than sampling and analysis as a means of characterizing the water. To collect the water, Camp Edwards personnel will access the STAPP™ system through the drain port that has been installed through the upper membrane, as shown in Figure 4-6.

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copper, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerin (using method 8330) (US EPA 2007). As per the request of EPA, all analyses will be conducted using unfiltered samples. This will provide a total concentration of both solid and dissolved metals. The MANG may, at its option, also collect and analyze a filtered sample to determine dissolved metals concentrations.

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Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-2. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt.

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Deleted: the first year and annually thereafter in September / October, depending on rainfall. The soil-pore water samples will be analyzed for lead, copper, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007).

4.2.2.5 Surface Soil

Camp Edwards will sample surface soil on Kilo Range between the maximum firing line and the toe of the berm. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples. The range floor will be divided up into six sample areas that are each 5 meters wide and the full length of the range. The first sample area (Area 1) will begin at the firing line and subsequent 5 meter wide areas will progress downrange to the berm (Area 6). Figure 4-7 shows the locations of the proposed sampling areas on Kilo Range.

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Comment [p11]: Text added as per EPA h)

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-1. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt. Resampling may not be needed to confirm exceedences of soil interim action levels where previous sampling events have also detected the same analyte. In this case, the accuracy of the result would not be in question so there would be no value in resampling. MANG will provide a comparison of the data over time to determine if there are any apparent trends but resampling would be optional.

Comment [p12]: Text added as per EPA item f) and g)

Deleted: ARNG

Deleted: ARNG

In addition, where multiple replicate samples are collected from a single area, the relative percent differences (RPD) of lead and nitroglycerine concentrations between the replicate samples will be calculated to determine the repeatability of the sampling procedure. RPD is defined as the standard deviation of the data set divided by the average value of the data set expressed as a percentage. For example the RPD of the values 15, 20, and 25 is 16 %.

Comment [p13]: In response to EPA item d)

The average of the RPDs for lead and the average of the RPDs for nitroglycerine will be calculated. If the average of the RPDs for either analyte is greater than 25%, and if this variation affects the usability of the data set for making range maintenance decisions, the sampling plan will be modified in an attempt to obtain better quality (i.e. more repeatable) data. The sample areas might be sub-divided into smaller areas or a greater number of incremental sub-samples might be collected within a given sample area. A plan for improving the data quality, if it is decided that the available data is not adequate for decision making, will be provided within 14 days of deciding that improvement is needed. The plan will include a schedule for re-sampling. Note that in case where the detected concentrations in a sample area are all either well below the interim action levels or well above them, the data can be compared to the interim action levels and sample repeatability is not a significant issue. In those cases, re-sampling would not be beneficial.

Where multiple replicate samples are collected from a sample area, all replicates will be compared to the interim action levels.

Comment [p14]: In response to EPA item d)

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¶

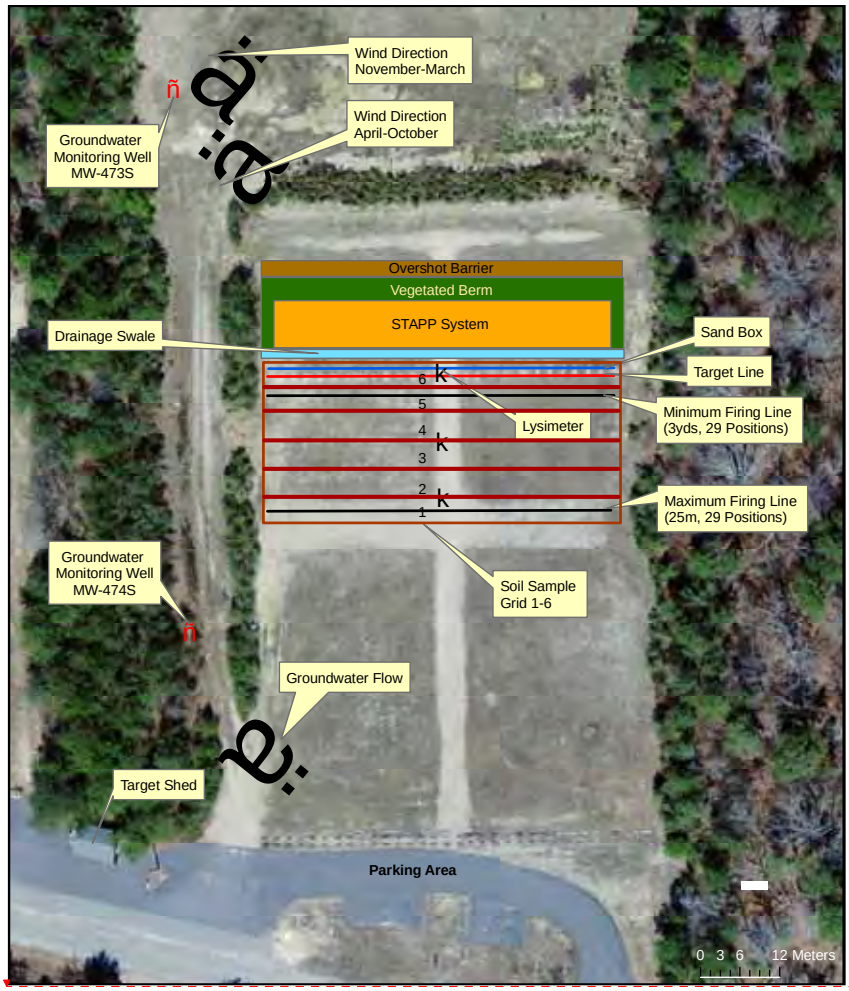

Figure 4-7. Surface Soil Sampling Areas, Kilo Range

Once a year, in October, MANG will sample the surface soil in the sampling areas as outlined below:

Areas 1, 3 & 5 – Each area gets a 100-point multi-increment samples (MIS) sample collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the sample will be ground to a fine powder following Cold Regions Research & Engineering Laboratory (CRREL) recommendations for firing-point samples. The ground sample will be used for analyses of nitroglycerin using method

8330b, and additional tests for lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). Each of these areas will also get two replicate samples. These will be 100-point MIS samples, ground according to CRREL and analyzed for nitroglycerin, lead, copper, zinc, antimony, and tungsten, in similar fashion to the primary ground samples listed above.

Areas 2 & 4 – Each area gets a 100-point MIS sample collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the composite sample will be ground to a fine powder following CRREL recommendations for firing-point samples. The ground sample will be used for analyses of nitroglycerin (using method 8330b), and additional tests for lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). No replicates for these areas.

Area 6 – One 100-point MIS sample will be collected from a depth of 0-3 inches. From this sample, close to 2 grams of homogenized soil will be removed and digested according to method 3050B Nitric Acid Digestion for Soils. This sample will be analyzed for lead, copper, zinc and antimony (using method SW6010B), and tungsten (using method SW6020). The soil remaining from the composite sample will be ground to a fine powder following CRREL recommendations for firing-point samples. The ground sample will be used for analyses of lead, copper, zinc, antimony (using method SW6010B), and tungsten (using method SW6020). No replicates for this area.

All samples are to be collected by a systematic random sampling method. As per CRREL recommendations, this requires dividing the sample area into exactly as many sub-areas as the number of increments required for the sample. One increment is collected from each sub-area. The location within the sub-area is irrelevant, but the same relative location should be used for each sub area. For example, if the center of the first sub-area is used to collect the first soil increment, the center of each following sub-area should also be used until the sample is complete. Replicate samples should be collected in the same way, but from a different location within the sub-areas. Replicates can be collected at the same time if practical. Decontamination between replicates or between sub-areas is not necessary since all three samples are characterizing the same sample area. Decontamination is required before beginning to sample a different sample area.

In addition to the laboratory analysis, on-site soil sampling may occur using the X-ray fluorescent (XRF) device. The XRF is design to detect metals and can be used to sample soil as well as the STAPP™ membrane. This sampling can occur randomly through time.

These sampling, processing and analytical methods will be re-evaluated after the first year of monitoring and thereafter for validation and refinement. Camp Edwards staff will use a plug extractor to systematically collect representative samples from each grid and will not concentrate samples in one portion of the sampling grid.

4.2.2.6 pH

A neutral pH in soil will help reduce metals migration on the range. Lead is least mobile between a pH of 6.5 and 8.5. Within this range, lead binds more easily to clay and organic matter in the soil. Therefore, it is important to keep the pH of the soil as close to neutral (pH of 7) as possible to stabilize the lead in the soil. A neutral pH will inhibit corrosion and allow the lead in the soil to bind to clay and organic particles (ATSC 1998). Camp Edwards will manage the soil pH through soil amendment with lime with the goal of maintaining neutral soil pH (see Section 4.3.5).

Camp Edwards will test soil pH twice annually – once before and once after peak training season. To determine the average soil pH of each area, 6–12 soil samples will be collected at a depth of 6 inches along the firing line and along the toe of the berm. The soil samples will be mixed thoroughly to accurately represent soil from the sampling locations (Clemson 2007b). The soil samples will then be tested for pH.

Comment [p15]: Text added to address EPA item e)

Deleted: Camp Edwards will test soil pH on a annual basis, in March or April, at the firing line and the toe of the berm in the first year of fire operations.

Limestone (lime) addition to surface soils is standard practice for increasing pH and neutralizing soils. A pulverized variety of lime will be applied before peak training season to increase its effectiveness. When the optimum pH is reached, pH should be checked once a year and lime applied as needed to promote vegetative growth and prevent vertical migration of lead (ATSC 1998).

4.3 Range Maintenance

Camp Edwards will conduct periodic maintenance on Kilo Range to ensure it remains in adequate condition to support training requirements and design features and BMPs function as intended. To the maximum extent possible, maintenance will be conducted during off-peak training periods (between October and April). This preventative maintenance will be conducted as needed, regardless of other maintenance schedules. Maintenance and repairs at Kilo Range will be documented in a maintenance log and summarized in an Annual Range Maintenance Report. All maintenance and field work conducted at the range will be conducted in accordance with a health and safety plan that specifically addresses the potential risks associated with lead exposure at the range.

4.3.1 Bullet Containment System

The bullet containment system on Kilo Range consists of a soil berm and the STAPP™ system. Repairs will be initiated within five working days of inspects, weather permitting.

Based on the unit observations reported on Kilo Range Inspection Forms and Range Control's visual inspections, the following steps will be taken to repair holes or tears to the self-closing rubber membrane cover of the STAPP™ when granular rubber filler material is clearly visible through external inspection.

1. Sand the perimeter of the damaged area.
2. Wipe area clean using rubbing alcohol.

3. Cut a repair patch of the self-closing rubber membrane that is slightly larger than the damaged area to allow a 2.5–5 cm overlap. (The overlap provides a sound surface to which the repair patch adheres.)
4. Sand and wipe clean the underside of the repair patch.
5. Place a bead of the STAPP™-supplied glue on both the perimeter of the damaged area as well as the coordinating under side of the patch.
6. Lay the patch on top of the damaged area and apply hand-pressure.

The glue provided is made of cyanogeneacrylate; therefore, the manufacturer recommends breathing protection for large repairs (STAPP 2006). The same procedures will be conducted to repair any perforations in the impermeable liner material using appropriately matched materials and adhesives. Damage to the STAPP™ support frame will be repaired on an as needed basis. The time required to complete minor repairs is generally less than 10 minutes. Larger repairs may require up to 30 minutes. During use the glue container will be handle such that there is no release of material to the environment. The container will be put in secondary containment whne not in use during seam repair.

After 15 cm of liquid in the reservoir, Camp Edwards personnel will sample, remove, and dispose of the water in the internal reservoir system per the guidelines outlined in Section 4.2.2.1.

4.3.2 Periodic Metals Removal

MANG will periodically remove bullets from the STAPP™ system, bullets will be removed after 500,000 rounds have been fired on Kilo Range or every three years, whichever occurs first. MANG will use either the specially designed STAPP™ sifter, or a compatible system, for removing metals from the STAPP™ system (see Figure 4-8). This unit has a very simple design consisting of a table positioned at a defined slope with a small vibrator positioned on the underside of the table. The granular rubber and bullet mixture is placed onto the table, and due to the vibration slowly moves down the slope of the table. A piece of piping at the end of the table is connected to a cyclone vacuum with a high-efficiency particulate air (HEPA) filter. The vacuum has enough suction to remove the granular rubber but not the bullets. The granular rubber is sucked up via the cyclone and the air is filtered with a HEPA filter. Total mass of metals removed from the bullet containment system will be compared with the total computed mass loading of bullets fired on Kilo Range from the Training Facility Utilization Reports (see Appendix A). This comparison is indicative of the efficiency with which the STAPP™ system eliminates the source of metals on Kilo Range. This process must be conducted with appropriate environmental protections as required. At a minimum secondary containment must be placed in all active work areas where metal removal will occur. Prior to work beginning, contractors or in house personnel conducting this work will coordinate with Range Control and MAARNG Environmental Office to ensure that the proper environmental protections are in place. Also, this process must not be conducted during precipitation events or high winds.

Figure 4-8. STAPP™ Sifter

4.3.3 Interim Triggers for Focused Assessments and Maintenance Actions for the Initial Year of Fire Operations on Kilo Range

Based on the results of soil, lysimeter and groundwater sampling described in Section 4.2.2, Camp Edwards will initiate range characterization and maintenance actions to prevent pollution, in coordination with the EMC, EPA, and MassDEP. The need for maintenance actions will be indicated by comparing monitoring results to a series of action levels. The type of action necessary will be dependent on the media being sampled / analyzed and the action level triggered (see action levels presented in Tables 4-1, 4-2, and 4-3). The action levels in the tables below are the same interim numbers currently in use for the time period of July 2007 to December 2008 for operations on Tango Range. They are subject to change as more information is developed on the leaching potential of these compounds and the effectiveness of the P2 Plan as a whole. These action levels will be periodically reviewed (per Section 5.3) in coordination with the EMC, EPA, and MassDEP.

The surface soil action Level 2 numbers are based on modeled potential for leaching to groundwater calculated using proposed sampling areas and a sample depth of 3 inches. Level 1 numbers are derived by taking 50% of the Level 2 numbers and are established to ensure close monitoring of elevated analyte concentrations in surface soils. The action levels for surface soil are provided in Table 4-1.

Table 4-1. Interim Surface Soil Action Levels for the Initial Year of Fire Operations on Kilo Range

Analyte	Level 1 Resampling and Validation[1]	Level 2 Focused Reassessment[2]
Lead	4,535 mg/Kg	9,070 mg/Kg
Antimony	1,750 mg/Kg	3,500 mg/Kg
Nitroglycerine	5 mg/Kg	10 mg/Kg

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. The purpose of the Focused Reassessment will be to evaluate the cause, and assess the hazards. Results will be reviewed with stakeholders and may result in modification of the Conceptual Site Model. If reassessment verifies sampling results, MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., soil removal). Actions may include temporary suspension of the use of the range.

Soil-pore water action level numbers are based on a relevant drinking water standard (or similar risk-based concentration) for the respective compound. Level 1 numbers are based on one-third the drinking water standard and require resampling and validation of results. Level 2 numbers are based on one-half the drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the drinking water standard for the respective compound and will require some form of range maintenance activity to address the risks to human health and the environment. Action levels for soil-pore water are provided in Table 4-2.

Table 4-2. Interim Soil-Pore Water Action Levels for the Initial Year of Fire Operations on Kilo Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Range Maintenance[3]
Lead	10 ug/L	15 ug/L	30 ug/L
Copper	867 ug/L	1,300 ug/L	2,600 ug/L
Antimony	4.0 ug/L	6.0 ug/L	12 ug/L
Nitroglycerine	3.2 ug/L	4.8 ug/L	9.6 ug/L

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause or need for action and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow on action could result. MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., dust control, pH control, soil removal).
3. Range Maintenance may include soil removal, resampling, or temporary suspension of firing on the range. The range will be reconstructed once favorable results from the post excavation sampling are received. Soil removal may not be required if a removal action has already been conducted based on soil monitoring results.

With proper BMP implementation, surface soil and soil-pore water monitoring, and appropriate maintenance actions, MANG does not anticipate significant detections of target analytes in groundwater samples. Therefore, detection at Level 3 concentrations provided in Table 4-3 reflects a potentially serious condition that could require significant actions, such as a cease fire at the Kilo Range. Level 1 numbers are based on one-third of the relevant drinking water standard (or equivalent risk number) and require resampling and validation of results. Level 2 numbers are based on one-half the relevant drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the relevant drinking water standard and require significant corrective actions such as cease fire and reassessment of the P2 program.

Table 4-3. Interim Groundwater Action Levels for the Initial Year of Fire Operations on Kilo Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Cease Fire and Maintenance Action[3]
Lead	5.0 ug/L	7.5 ug/L	15 ug/L
Copper	434 ug/L	650 ug/L	1,300 ug/L
Antimony	2.0 ug/L	3.0 ug/L	6.0 ug/L
Nitroglycerine	1.6 ug/L	2.4 ug/L	4.8 ug/L

Notes:

1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow on action could result.
3. Groundwater concentrations at or above Level 2 concentrations require significant actions including cease fire at the range, a complete reassessment of the pollution prevention program and follow on assessment and possible remediation.

Nitroglycerin has been detected in soil samples taken on the range floor of Kilo Range in concentrations up to 47 mg/kg. MANG may need to conduct periodic soil removal maintenance every three to five years, depending on the volume of training and the results of surface soil sampling outlined in Section 4.2.2.4. If periodic soil removal is necessary at Kilo Range, Camp Edwards anticipates removing 3 inches of surface soil from the firing line (the depth of past nitroglycerin detections at other ranges). The removed soil will be characterized through a complete toxicity characteristic leaching procedure (TCLP) metals series, loaded into dump trucks, and disposed of at an approved and permitted facility, in accordance with state and federal solid and hazardous waste regulations. MANG will replace the removed soil with clean fill and revegetate the area.

4.3.4 Vegetative Cover and Wind Breaks

At the beginning (March) and conclusion (October) of the training year, the Camp Edwards Range Control will coordinate the spread of MassHighway Seed mix, as required, on areas of the Kilo Range floor, and areas of the existing berm/backstop supporting the STAPP™ that have less that 50% vegetative cover. If during the course of the training year, the Kilo Range Inspection Forms identify areas of low vegetative cover, Range Control shall coordinate and schedule range maintenance as soon as growing conditions allow. Maintenance activities will be timed and conducted as to not interfere with scheduled training and to avoid cumulative impacts.

Forested buffers, serving as natural windbreaks and noise abatement, will be maintained around Kilo Range. Each year in March, before the peak training period begins, Camp Edwards will trim tree limbs on the range boundary. Any diseased or dead trees may be removed, as advised by E&RC or the MAARNG Environmental Office. Camp Edwards will clear this range maintenance with Range Control to minimize interference with any scheduled training on the range.

4.3.5 Soil pH

When soil pH levels are neutral, lead remains relatively unavailable for migration in soils. Camp Edwards will amend soils with material to increase alkalinity, typically lime, with a goal of maintaining neutral soil pH.. When lime is added to the soil, maximum contact with the soil is essential therefore it is most appropriate to use pulverized limestone.

Ground calcitic limestone (calcium carbonate) is faster acting than ground dolomitic limestone (calcium-magnesium carbonate) and is recommended for addition to the sandy soils on site. For example, to raise the soil pH from 5.9 (the lowest measured pH on T Range) to 7.0, 5 to 8 pounds of ground calcitic limestone will be added per 100 square feet of soil. Soil amendments should be spread evenly over the soil using a spreader and will affect the top 2.5 to 5 cm of soil. It may take approximately one to two years for the soil to fully reflect the pH change (University of Minnesota 2007; Clemson 2007a).

4.4 Inspection Summary

A variety of inspections and maintenance activities are discussed in Section 4. In an effort to summarize all of these activities and the frequency in which they occur, the following table was complied.

Table 4-4. Summary of Inspections

Cycle	Type of Inspection	Responsible office	Activity / Repair
Bi-weekly or major storm event (more then 5 cm within a 24 hrs period	Visual inspection - Range Floor - STAPP - Berm	MAARNG - Range Control - Environmental Section - Senior Staff	- Exposed granules – repair within 72 hours - Tear in upper membrane / exposed seam – schedule repair within 72 hours
Day of training	Visual inspection - Range Floor - STAPP - Berm	Military Personnel - Range Control - Using unit	
3x a year (trial period)	Lysimeter sampling	MAARNG – Environmental Section	See Table 4-2
Quarterly / 3x during peak training period	- Range condition report - Detailed inspection	MAARNG – Range Control	- Scheduled within 72 hours

Cycle	Type of Inspection	Responsible office	Activity / Repair
Annual	- Soil sampling - Groundwater sampling - Range Maintenance Rpt - Periodic Review Rpt - State of the Reservation Rpt	MAARNG - Range Control - Environmental Section	See Table 4-1, Table 4-3
As needed	- STAPP water access port - STAPP maintenance repair - Photo log - Revise the OMMP - Public updates	MAARNG - Range Control - Environmental Section - Senior Staff	- After 15 cm - Within 72 hrs - Within 72 hours
Unannounced	- Visual Inspections - Unit training - Inspection records	- MAARNG - Environmental Agencies (EPA, MassDEP, EMC)	
500,000 rounds or every 3-years whichever comes first	- internal inspection of STAPP - lead removal from STAPP	MAARNG	

5.0 CONCLUSIONS AND CONTINUAL IMPROVEMENT

5.1 Conclusions

MANG will conduct marksmanship training on Kilo Range, using standard lead-bullet ammunition, including use of tracer ammunition. This training will include:

- Familiarization, zeroing, marksmanship practice and alternate qualification using the 5.56mm rifle (M16 and M4) and machine gun (M249) and the 7.62mm machine guns (M240 and M60); and
- Familiarization, zeroing, marksmanship practice and alternate qualification using all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols.

Based on the CSM for Tango Range, evaluations of SAR P2 BMPs conducted in the SAR P2 Overview, and the current assessment of training and management of Tango range, the STAPP™ system provides positive BMPs for small arms training. As such, the MANG will satisfy the requirement of AO2 to employ "maximum feasible use" of P2 technologies by:

- Implementing a system of range upgrades and BMPs that will either sever potential migration and exposure pathways or monitor environmental conditions to confirm that pathways remain incomplete.
- Implementing a "contain, maintain, and monitor" approach to SAR BMPs that will include redundant methods to prevent pollution (e.g., bullet containment, pH management, erosion control) and methods to assess the effectiveness (e.g., inspections, sampling) of each system in each environmental media (e.g., soil, groundwater). This approach will include:
  - Managing metals on Kilo Range at their source, through containment in the STAPP™ system and periodic removal and recycling.
  - Monitoring potential migration pathways, such as surface soil, soil-pore water, and groundwater, to evaluate whether contaminants are being transported in environmental media.
  - Implementing a number of other monitoring and maintenance BMPs to sustain the conditions on Kilo Range that limit metals mobility (e.g., monitoring the condition of the bullet containment system, stormwater management, maintaining healthy vegetation on range areas to prevent soil erosion, maintaining wind breaks to limit windborne metals transport, and maintaining soil pH to minimize corrosion/dissolution of metals into groundwater.

The BMPs selected and described in this BMP OMM Plan will support the employment of small arms on Kilo Range in a manner that meets training requirements while protecting human health and the environment. As training requirements change, MANG may seek to conduct additional training activities on Kilo Range. As environmental conditions or the understanding of conditions change, it may become necessary to add or modify management actions to protect human health and the environment. All such modifications to training activities or management action will be fully coordinated with the EMC, EPA, and MassDEP.

5.2 Record keeping

To facilitate the periodic review and continual improvement of this plan and, in turn, the management of Kilo Range; MANG will document operations, monitoring, and maintenance. Table 5-1 identifies the records that MANG will maintain for Kilo Range. These records will be maintained indefinitely and will become part of the permanent real property records of the site.

Table 5-1. Recordkeeping Procedures

Record	Contents	Frequency	Responsible Office
Range Utilization Report	• Use days • Munitions expenditures by type, quantity, and using unit	Annually	Range Control
Range Condition Inspection Report	• General conditions • Erosion • Vegetation • Bullet containment system	Quarterly	Range Control
Environmental Sampling and Analysis Report	• Water from bullet containment systems • Groundwater • Lysimeter • Soil • pH	Annually	E&RC
Range Maintenance Report	• Bullet containment system • Periodic metals removal (mass, locations, and methods) • Vegetation • Soil pH	Annually	Range Control
Periodic Review Report	see Section 5.3	Annually	E&RC
Photologs	see Section 4.2.1	As Needed	Range Control

5.3 Reviewing and updating this plan/Periodic Review

MANG will conduct periodic reviews of this plan to evaluate whether training activities, environmental conditions, and BMPs on Kilo Range remain protective of human health and the environment. The first review will take place 6 months after the range returns to live-fire. Subsequent reviews will occur when MANG desires to significantly modify the training activities at Kilo Range, when MANG, EMC, and or EPA becomes aware of information that indicates environmental conditions are not protective of human health or the environment, or at an interval not to exceed three years. The E&RC will provide an update on the operation of Kilo Range in the annual State of the Reservation Report as required by Chapter 47 the acts of 2002, Environmental Performance Standards.

The purpose of periodic reviews is to answer three general questions:

- Are the BMPs on Kilo Range functioning as intended?
- Are the assumptions used at the time of BMP selection still valid?
- Does new information indicate that the previously selected BMPs are no longer protective of human health and the environment?

Stakeholders and regulators will be involved in the periodic review process through coordination with EMC. MANG will notify EMC and the Small Arms Range Working Group at the time the periodic review is initiated to seek their involvement. Another notification, including notification of the availability of results, will be made when a review is completed.

The periodic review will consist of an evaluation of the records described in Section 4.2, as well as the identification and review of new information, a site visit, and preparation of a short Periodic Review Report. MANG will identify readily available information regarding Kilo Range that has become available since implementation of this plan or the last periodic review. New information may also be gathered through interviews with persons knowledgeable about the site, including stakeholders such as adjacent property owners, local agencies, and regulators. MANG will gather information pertaining to the following areas:

- New training missions or training activities supported on Kilo Range;
- Modifications to the layout of Kilo Range;
- New development or changes in land use in the vicinity of Kilo Range (on and off installation);
- Recreational or other new activities at Kilo Range or in the vicinity of Kilo Range;
- Changes in accessibility to Kilo Range;
- Changes to statutes, regulations, or policies effecting the use and management of Kilo Range; and,
- New technologies or techniques that can cost effectively improve training or environmental conditions at Kilo Range.

MANG will prepare a short Periodic Review Report to document the information collected and evaluated, and present the findings of the evaluation to EMC and EPA in coordination with MassDEP and other stakeholders. The report will document whether training activities and BMPs continue to be protective of human health and the environment. The report will also recommend follow-up actions, as warranted. Based on the conclusions drawn in the report, MANG will update the Kilo Range BMP OMM Plan to reflect recommended actions. A draft of the modified Kilo Range BMP OMM Plan will be coordinated with EMC, EPA, MassDEP, and other stakeholders for review and comment. Final copies of the plan will be made available to these stakeholders.

MANG believes that implementing the SAR BMPs will support the adjustment of the environmental performance standards established in Chapter 47 of the Acts of 2002, Section 10(d). Through these BMPs, MANG will demonstrate that the resumption of small arms marksmanship training on Kilo Range is protective of the drinking water supply and wildlife habitat on Camp Edwards

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Appendix A
Training Facility Utilization Report

Appendix A: Training Facility Utilization Report

CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT

This form will be completed by all units/ organizations conducting training at Camp Edwards IAW CE Reg 385-63, AUG 2006. Return form to Range Control upon completion of training.

UNIT:	**UIC**:	**COMPONENT**:
ADDRESS:		**DATE OF TRAINING**:
POC CONTACT NUMBERS	**DSN**:	**CELL**:
NAME/ RANK / LAST 4 RANGE OIC:	**NAME/ RANK / LAST 4 RANGE RSO**:	
NUMBER OF PERSONNEL TRAINED:	**RANGE HOT TIME**:	**RANGE COLD TIME**:

FIRING LANES USED DURING TRAINING
(circle the lanes used): **1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29**

WEAPONS SYSTEMS:	**TYPE OF AMMUNITION**:	**NUMBER EXPENDED**:

VEHICLES BY TYPE PRESENT ON RANGE:	**QTY**:

BIVOUAC AREA USED:	**NUMBER of PERSONNEL**:	**NUMBER of NIGHTS**:

TYPES OF EXERCISES CONDUCTED:

AAR COMMENTS:

SIGNATURE OF RANGE OIC/ RSO:
DATE:

CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT			
GRID COORDINATES FOR THE FOLLOWING TRAINING MUST BE PROVIDED			
Activity	**TYPE**	**Location 6 digit**	**Other**
Small Arms Simulated	Blank / Simunition / Paint Ball		
RSOP (FA Dry Fire)			
Convoy Overlay	DAY / NIGHT		Number of Vehicles
Dismounted Training			
ISBC Scenario & Overlay			
Command Post Ex			
Heavy Equip Operations:			
Land Nav Course	I / II / III / Mounted		
Excavations:	STANDARD / NON-STANDARD*		
	*If NON-STANDARD has request been approved? YES / NO		ATTACH APROVAL
Describe Excavation training:			
OTHER :			

TRAINING AREA / ROAD CONDITION ASSESSMENT						
	RANGE(S) / TRAINING AREA(S) OCCUPIED					
OBSERVATION						
Minor erosion or obstruction(s)						
Movement difficulty, erosion or obstruction(s)						
Movement severely impeded, erosion or obstruction(s)						
Vegetation damaged, soil disturbed						
Bare ground and soil disturbed						
Denuded of vegetation and / or soil disturbed						
Other Training Land damage or improvement						

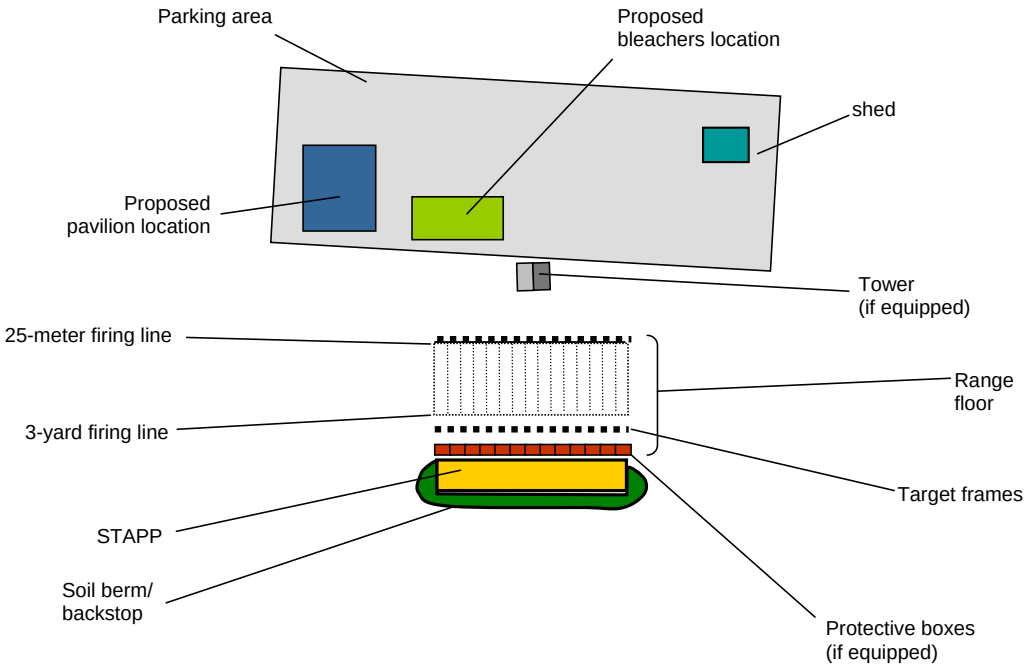
E = Excellent; G = Good; F= Fair; P=Poor; N=Needs improvement

Appendix B
K Range Inspection Form

A.	**Administrative Data**		
Range:	Date:	Range Control Observer:	
Unit:		Unit OIC:	Comp:

B.	**STAPP System Inspection**		
	Pre-Fire Inspection	Post Fire Inspection	Remarks
1. Check site for POL / CLP stains, leaks, spills	GO / NOGO	GO / NOGO	
2. Did sand boxes protect base of STAPP?	GO / NOGO	GO / NOGO	
3. Holes, tears, damage to sand box tarps?	GO / NOGO	GO / NOGO	
4. Is the STAPP cover in need of repair?	GO / NOGO	GO / NOGO	
5. Are there separations on cover seams?	GO / NOGO	GO / NOGO	> 1" / > 6"
6. Any bulging or irregular settling of rubber granular material?	GO / NOGO	GO / NOGO	
7. Is synthetic lumber framing in good condition?	GO / NOGO	GO / NOGO	
8. Any fresh signs of over / undershot?	NA	GO / NOGO	
9. Ponding of water on cover/ water leaking from STAPP?	GO / NOGO	GO / NOGO	
10. Does water inspection port have water visible, 15cm?	GO / NOGO	GO / NOGO	
11. Was any soot / smoke released from STAPP?	Yes / No	Yes / No	
12. Use diagrams to indicate locations of items 1-9 and other impact effects / damage. Use reverse to describe any special situations.			

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	23	24	24	26	27	28	29



Generic STAPP Site Plan Not to Scale – Oct 08

C.	Remarks

E. STAPP™ detailed inspection

This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel 3 times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October once peak training period is completed.

1. What is the depth of water in the reservoir? Less than 2 inches / Greater than 2 inches

   If more than 2 inches deep, how deep is it?: _____

2. Any significant irregular settling or bulging of granular rubber material? NO YES

   This may be indicative of a problem with the liner. The material must be at an even level across the STAPP to stop bullets effectively. The minimum depth of material at any one point should be 15 inches deep. If yes, please describe: _____

3. Complete the photo log at the end of this form, documenting site features listed in log. Photos should be taken of the firing line, the soil berm, bullet containment system, and range floor. Note any field observations on the log.

4. Notes regarding need for repair and maintenance: _____

F. STAPP™ internal inspection

This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel when the bullet sifting of the STAPP system is conducted after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first. At that time, all of the granular rubber material is removed.

1. Is the water collection unit and surrounding support structure in good condition? NO YES
   Look for any conditions which would allow water to be released to ground surface. If no, please describe: _____

2. Any perforations of the impermeable liner? NO YES
   Inspect the liner for any holes, rips, punctures, or seam failures. If yes, please describe: _____

4. Notes regarding need for repair and maintenance: _____

Photo Log:

Photo No.	Date	
Location: Firing Line from firing position No 4 Range: K Range		
Description		Place photo here

Photo No.	Date	
Location: Soil Berm from firing position No 4 Range: K Range		Place photo here

Description		
Photo No.	Date	Place photo here
Location: Bullet Containment System from firing position No 4 Range: K Range		
Description		

Photo No.	Date	
Location: Range Floor from firing position No 4 Range: K Range		Place photo here
Description		

Photo No.	Date	
Location: Firing Line from firing position No 13 Range: K Range		Place photo here
Description		

Photo No.	Date	
Location: Soil Berm from firing position No 13 Range: K Range		Place photo here
Description		

Photo No.	Date	
Location: Bullet Containment System from firing position No 13 Range: K Range		Place photo here
Description		

Photo No.	Date	
Location: Range Floor from firing position No 13 Range: K Range		Place photo here
Description		

Revised Draft

T RANGE
BEST MANAGEMENT PRACTICES:
OPERATIONS, MAINTENANCE, AND MONITORING PLAN

CAMP EDWARDS, MASSACHUSETTS

prepared for:

Massachusetts National Guard
Environment & Readiness Center
Bldg. 1204 West Inner Road
Camp Edwards, MA 02542

prepared by:

URS Corporation
2450 Crystal Drive, Suite 500
Arlington, VA 22202
Doc. 0702091

8 June 2007
(Revision 2: 23 January 2009)
Revision 3: 29 March, 2011)
(Rev 4: 3 June 2011 by MANG)

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ACRONYMS

AO	Administrative Order
ASP	Ammunition Supply Point
BMP	Best Management Practice
CSM	Conceptual Site Model
DoD	Department of Defense
DODIC	Department of Defense Identification Code
DPT	Director of Plans and Training
EMC	Environmental Management Commission
EPA	US Environmental Protection Agency
E&RC	Environmental and Readiness Center
FCC	Facility Category Code
FE	Facilities Engineering
HEPA	High-Efficiency Particulate Air
HMWMP	Hazardous Material and Waste Management Plan
IAGWSP	Impact Area Groundwater Study Program
MA DOT	Massachusetts Department of Transportation
MANG	Massachusetts National Guard
MassDEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MMR	Massachusetts Military Reservation
NATO	North Atlantic Treaty Organisation
OMM	Operations, Maintenance and Monitoring
P2	Pollution Prevention
PVC	Polyvinyl chloride
RFMSS	Range Facility Management Support System
RSO	Range Safety Officer
SACON	Shock Absorbing Concrete
SAR	Small Arms Range
SDWA	Safe Drinking Water Act of 1974
USAEC	US Army Environmental Command

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1.0 INTRODUCTION

Camp Edwards is an important training center for National Guard, Reserve Components, US Coast Guard, and law enforcement agencies throughout the northeastern United States. Located on Cape Cod, an environmentally sensitive region, Camp Edwards contains threatened and endangered wildlife species, prime wildlife habitat, archeological sites, and culturally sensitive areas (Massachusetts National Guard [MANG] 1997). Moreover, the Camp sits on top of the Sagamore lens, a sole source drinking water aquifer for Cape Cod. The northern 15,000 acres of Camp Edwards, the Reserve/Training Area, are located within the recharge area of the aquifer. Camp Edwards is committed to excellence in environmental protection, training, readiness and management of training sites. Training facilities available at Camp Edwards include small arms ranges (SARs), training areas, battle positions, observation posts, and maneuver roads and trails. These facilities 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. MANG will seek to constantly improve upon training practices that protect the future of the surrounding eco-system and the aquifer, and maintain a viable ready force.

1.1 Purpose

The purpose of this Range Best Management Practice (BMP): Operations, Maintenance, and Monitoring (OMM) Plan is to identify the operations and management practices that MANG will implement to return "Tango" ("T") Range to service in support of small arms weapons marksmanship training. This plan identifies BMPs that allow the employment of small arms at T Range in a manner that:

- Meets current and future training requirements and
- Employs maximum feasible use of pollution prevention (P2) to protect the Upper Cape Water Supply Reserve, managed as a Massachusetts Department of Environmental Protection (MassDEP) Zone II for public water supplies.

This plan, along with other range-specific plans, is in support of the Camp Edwards *Pollution Prevention Overview (Small Arms Range Supplement)* (SAR P2 Overview) (MANG 2007). Per the phased approach outlined in the SAR P2 Overview, MANG is developing BMP OMM plans for each SAR that will support marksmanship training (see Figure 1-1). Prior to the employment of lead-bullet ammunition on any SAR, Camp Edwards will present the corresponding range-specific BMP OMM plan to the Environmental Management Commission (EMC) and US Environmental Protection Agency (EPA) for review and approval. The range-specific BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR working group; however, state approval would be through the EMC. MANG will program for funding requirements to implement the BMPs on an annual basis. Lead-bullet ammunition will only be fired at Camp Edwards on ranges with approved BMP OMM plans and as BMPs are funded and implemented.

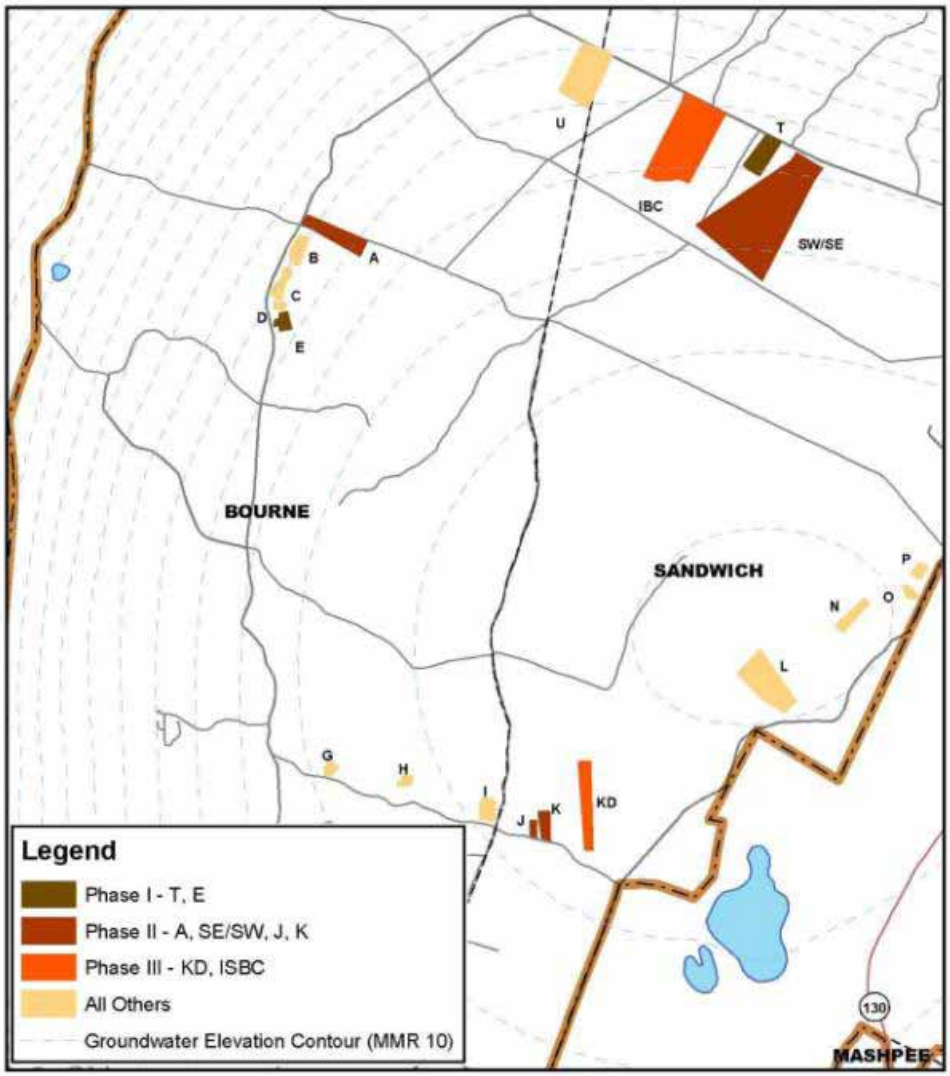

Figure 1-1. Small Arms Ranges and Phases for Return to Live Fire

1.2 Scope

This BMP OMM plan is limited to the operation and use of T Range. It supports the use of T Range as a fully operational 25-m Rifle/Machine Gun Zero Range [Facility Category Code (FCC) 17801] to meet current and anticipated requirements for small arms training exercises at Camp Edwards. Although this plan identifies specific BMPs for the management of metals to

sustain operations at T Range, the scope of the BMPs addressed is not limited to typical environmental management options. It also includes BMPs for safe and efficient administration, use, management, and maintenance. The analysis of alternative approaches for sustainable operation of T Range and the BMPs recommended in this plan are based on range-specific conditions and are not intended to apply to other SARs at Camp Edwards or on other Army or Department of Defense (DoD) installations or ranges.

1.3 Background

T Range represents the highest priority and is first in the sequence of SARs that Camp Edwards seeks to bring on-line to support small arms marksmanship training. Although it has historically supported many training requirements, in the future it will be used as a standard 25-m Rifle/Machine Gun Zero Range primarily in support of training with M16 and M4 rifle and M249, M240, and M60 machine guns.[1]

1.3.1 Historical Use

T Range has historically supported multiple training requirements. In the late 1980s, T Range was an assault course where primarily blank ammunition was used. In 1990 or 1991, MANG began using T Range to familiarize soldiers with firing the .50 caliber M2 machine gun using plastic bullets. In the early 1990s MANG also began using T Range to support pistol marksmanship training. 9mm lead-bullet ammunition was fired until banned in 1997. Subsequently, military and civilian law enforcement personnel fired frangible (copper and/or tungsten powder composite) bullets in .38 caliber, 9mm, and .40 caliber on T Range. A small amount of 12 gauge shotgun ammunition was also fired on T Range.

T Range has two distinct firing lines. The first firing line is 76.2 meters (m) long and consists of 6 large (approximately 6.7 × 12.2 × 2.4 m) 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, is a hardened maintenance trail that allows for mounted machine gun firing from a parked tactical vehicle. This machine gun firing line will be knocked down and re-graded; this soil will be used to raise the 25 meter firing about 18 inches. The second firing line is 43.9 m long with 15 firing positions and sits 15.2 m in front of the machine gun firing positions; this firing line is 25 meters from the target line.

[1] FCC 17801, 25-m Rifle/Machine Gun Zero Range, can also be used to support pistol marksmanship and as an alternate qualification course for M16.

1.3.2 Environmental Drivers

For MANG to resume effective small arms training, two significant legal drivers define the path forward; they are EPA Region 1 Administrative Order 2 (AO2) issued to MANG in 1997 and Massachusetts Chapter 47 of the Acts of 2002.[2]

Appendix A, Section II.E of AO2 states the following conditions and requirements for the resumption of prohibited training activities. "If…EPA approves resumption of Respondents' activities at the Training Range and Impact Area, Respondents shall ensure maximum feasible use at such time of pollution prevention technologies in any training activities. Specific measures to be evaluated by Respondents include the following:

- Use of non-toxic lead-free combat ammunition;
- Use of bullet traps at all small arms ranges;
- Use of munitions-capturing material, such as 'SACON';
- Use of non-exploding artillery and mortar rounds; and
- Development of guidances for the operation and maintenance of the ranges consistent with the pollution prevention strategies."

With regard to the resumption of small arms marksmanship training, Chapter 47 of the Acts of 2002, Section 10(d), states the following: "After consultation with the science advisory council and the community advisory council, the commission may adjust environmental performance standards based upon sound and accepted scientific analysis, monitoring data and other relevant information. The proponent of any adjustment shall bear the burden of justifying the proposed adjustment and demonstrating that the proposed adjustment is protective of the drinking water supply and wildlife habitat."

MANG, in its endeavor to meet the requirements of these two legal drivers, is following the tenants of the Army's Strategy for the Environment—Mission, Environment, and Community. MANG development of a SAR P2 Overview to provide the management strategy for Camp Edwards SARs and identify range-specific BMPs to prevent the migration of pollution to the water supply and sensitive natural resources fulfills the requirements of both of the drivers.

As such, this plan identifies potential pathways for migration of, and potential exposure to, contaminants from T Range. Environmental management and P2 BMPs are analyzed and selected based on their ability to disrupt the pathways to potential receptors. The selected BMPs for T Range are described in this plan. Prior to beginning marksmanship training on T Range,

[2] AO2 was issued in April 1997 following AO1, issued in February of that year. AO1 required the NGB to investigate sources of contamination potentially from the training ranges and Central Impact Area. AO2 required that Camp Edwards cease certain training activities (e.g., firing lead small arms ammunition, artillery fire, and mortar fire) pending environmental investigations. These activities are still prohibited.
Chapter 47 of the Acts of 2002 codified a Memorandum of Agreement, ensuring permanent protection of the drinking water supply and wildlife habitats in the Reserve/Training Area, while allowing compatible military training. It created the EMC, to oversee compliance with and enforcement of Environmental Performance Standards and environmental laws and regulations within the Reserve/Training Area.

Camp Edwards will present this BMP OMM plan to EMC and EPA for review and approval. The BMP OMM plan will also be sent to MassDEP for review and coordination as part of the SAR working group; however, state approval would be through the EMC.

1.4 Roles and Responsibilities

To implement this BMP OMM plan, Camp Edwards will involve a team of experts to manage training operations, facility maintenance, and environmental protection functions.

1.4.1 Training Site Commander

The Training Site Commander is responsible for the overall operation of Camp Edwards to include the immediate supervision, control, coordination, and safety of all Camp Edwards' facilities and promotion of mission compatible and environmentally sustainable uses of Camp Edwards resources.

1.4.2 Director of Plans and Training

The Director of Plans and Training (DPT) is the primary advisor to the Training Site Commander on all matters concerning the safe, efficient utilization of Camp Edwards' training facilities. Within the overall responsibility for Range Control operations, the DPT will:

- Provide review, comments, and approval of the SAR P2 Overview and individual range BMP OMM plans;
- Identify and program for range modernization, operations, and maintenance requirements based on training load and doctrine; and
- Include requirements within the SAR P2 Overview and individual range BMP OMM plans for planning and budgeting actions as appropriate for sustainable OMM of ranges.

1.4.3 Range Control Officer

The Range Control Officer is the primary representative of the Training Site Commander at Range Control and, as such, will:

- Coordinate the generation of range modernization requirements and oversee range modernization projects;
- Control access to ranges;
- Schedule and issue ranges to using units and clear/close out units upon completion of range use;
- Coordinate operation of ranges and oversees using units while training on Camp Edwards ranges;
- Enforce applicable guidance and regulations, range standard operating procedures, and safety requirements;
- Conduct periodic inspections of range conditions and identify requirements for repair and maintenance;
- Coordinate the repair of damage to range facilities (e.g., bullet containment systems);

- Collect Range utilization reports from using units; and,
- Maintain range utilization, inspection, repair, and maintenance records.

1.4.4 Director of Facilities Engineering

The Director of Facilities Engineering (FE) is the primary representative of the Training Site Command for accomplishment of facility sustainment, restoration, and modernization and, as such, will:

- Coordinate necessary maintenance on SARs to include:
  - Periodic lead removal from SAR berms and other bullet containment systems that are integral to the range facility;
  - Repairing damaged range facilities (e.g., bullet containment systems); and,
  - Repairing erosion damage to firing points, target areas, berms, and other range areas;
- Coordinate necessary maintenance on all training support facilities on ranges (e.g., bleachers, parking areas, buildings).

1.4.5 Environmental and Readiness Center

The Environmental and Readiness Center (E&RC) is the primary representative for the Training Site Commander for accomplishment of sustainable environmental management requirements. To support the return and sustainment of small arms training at Camp Edwards in accordance with environmental agreements, orders, and regulatory and legal requirements, the E&RC will:

- Make adequate professional personnel resources available to the DPT and Range Control Officer to oversee or review implementation of P2 or pollution control BMPs;
- Coordinate with the Range Control Officer and FE to support the recovery, management, recycling, or disposal of metals from ranges in accordance with DoD guidance and federal and state solid waste regulations, as applicable;
- Conduct periodic reviews of range BMP OMM plans;
- Coordinate with MANG Environmental personnel, both full-time and part-time, to conduct periodic inspections of T Range to ensure compliance with the BMPs;
- Coordinate required environmental sampling and monitoring on ranges; and
- Responsible for day-to-day coordination with the EMC, EPA, MassDEP, and other appropriate federal, state, and local environmental resource protection agencies to monitor concerns with SAR operations.

2.0 TRAINING DESCRIPTION

Small arms training conducted at Camp Edwards may vary per using unit depending on the unit's mission and the types and amounts of training required to maintain proficiency in mission essential tasks. This section describes training types and amounts anticipated on T Range. It also describes range use procedures and restrictions that support safety and protection of human health and the environment.

2.1 Training Capabilities

Camp Edwards' current training requirements include the need for small arms familiarization, zeroing sights, marksmanship practice, weapons qualification, and small unit tactics. Table 2-1 provides basic descriptions of various types of small arms weapons training. The Army specifies certain range types to conduct these tasks for different weapons systems. The Army also specifies the number of repetitions needed to become proficient in each task. Camp Edwards must have a sufficient number of ranges to accommodate the throughput requirements for all soldiers, weapons systems, and training types.

Table 2-1. Small Arms Weapons Training Terms

Term	Description
Weapons 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 for a given ammunition load.
Practice/Marksmanship	Marksmanship training by which soldiers learn to accurately fire a given weapons 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 short range firing at fixed targets to field firing at various target types and longer ranges. Transition firing can include moving down the range floor towards the target and engage the target at different firing lines/points along the range floor. It can also include transitioning from firing a rifle and transitioning to a pistol during the same training event. 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 requires a gunner to complete several phases of firing tasks to qualify to operate a particular weapon. Record fire is scored to provide the gunner with feedback and to record the gunner's qualification.

As a 25-m Rifle/Machine Gun Zero Range with 15 firing lanes, T Range is designed for training shot-grouping and zeroing exercises with pistols, rifles, and machine guns. Training tasks will include weapons familiarization, zeroing, practice marksmanship, and alternate qualification (see Section 2.1.1). In some scenarios, in order to train to standard, personnel will need move down the firing lane towards the target and engage the target at different distances from the target. Soldiers will develop the skills necessary to align the sights and practice basic marksmanship techniques against stationary targets (Headquarters Department of the Army 2006).

Adjacent to the parking area, there was a row of elevated former firing positions approximately 76 m long. There were 6 large mounds, approximately 7 × 12 × 3 m in size, with 2 foxholes on the top of each mound. This firing line will no longer be used. These mounds will be knocked down and re-graded to raise the area around the 25 meter firing to an approximate height of 18 inches. The purpose of removing them is to remove the potential for unauthorized firing from the mounds and to provide material to raise the height of the 25 meter firing line to improve the line of firing, more horizontal, between the 25 meter firing line and the target line. This improves the majority of the rounds fired from this position to hit at or below the horizontal center line of the STAPP system.

The firing lines at T Range are 44 m long with 15 firing lanes. The Northern most firing line begins at 15 m in front of the existing elevated mounds. This Northern most firing line, the 25 meter line, is at the maximum distance from the target line. The Southern most firing line, the minimum distance from the target line that weapons can be fired to ensure maximum safety is 3 yards. While STAPP can handle point blank firing it is not intend at this time to be used for training in this manner. The distance between the 25 meter firing line and the 3 yard firing line is part of the range floor; in some scenarios for personnel to train to standard, the firers will move within their designated firing lane between the 25 m and the 3 yd line to engage targets on the target line. There are 15 wooden framed target holders placed 25 m downrange from the Northern most (maximum distance) firing line also known as the 25 m firing line. Soldiers will expend all ammunition from the designated firing positions (prone, kneeling, standing) along the firing lines and or lanes downrange to the targets. No weapons will be discharged forward of the Southern most (minimum distance) 3 yd firing line, across firing lanes, or at an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems (MANG 2006). In addition to the requirements of this plan, all firing on T Range will be managed in accordance with Camp Edwards Regulation 385-63, which is summarized below in Section 2.1.3. Figure 2-1 depicts the bullet path from the firing line on T Range.

The multiple firing lines within the range floor between the maximum distance of 25 m and the minimum distance of 3 yds from the target line allows personnel to zero and conduct marksmanship training with rifles, pistols and machine guns authorized for use on Tango range.

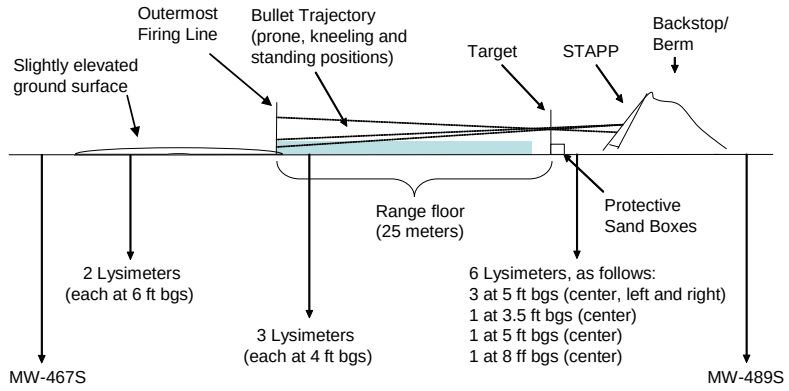

Figure 2-1. Lateral View of T Range

The ground level firing line allows users to zero rifles and machine guns and conduct marksmanship training with these weapons systems. Users may also zero and practice pistol marksmanship at the firing line.

T Range can also be used as an alternate range for M16 and M4 qualification using scaled targets; although, the use of this range for qualification is suboptimal. Scaled targets simulate firing at longer ranges by using reduced image size and perspective (see Figure 2-2).

Figure 2-2. Scaled Target

2.1.1 Training Types/Exercises

The primary use for T Range, as a 25-m Rifle/Machine Gun Zero Range is training shot-grouping and zeroing exercises with 5.56mm and 7.62mm rifles and machine guns. 25-m Rifle/Machine Gun Zero Ranges are used to train soldiers on the skills necessary to align the sights and practice basic marksmanship techniques against stationary targets (Headquarters Department of the Army 2006). This type of range can also be used as an "alternate course" to qualify on the M16 and M4 with scaled targetry. Finally, it can also support basic pistol familiarization, zeroing, and marksmanship training.

During a training exercise, a unit occupies the range for 1–5 days. The length of the unit's occupation depends on the training goals for that exercise. After checking out the range from Range Control, the designated Range Safety Officer (RSO) delivers any requisite safety and/or environmental announcements (see Section 6.1.2). The unit erects a small covered space with a folding table that acts as a desk for the records (e.g., ammunition log). The safety officer distributes ammunition to each soldier, notating rations in the records log.[3] No training is permitted forward of the firing line.

Familiarization exercises include a review of the weapon's basic components, applicable ammunition, and any firing attachments. Soldiers learn safe operating procedures for clearing ammunition from the chambers, function check, and inspection. Maintenance lessons include cleaning, lubrication, and preventive procedures to keep the weapon in combat-ready operation. Soldiers learn how to load and unload ammunition, adhering to safety procedures. Familiarization can be conducted at the firing line or in the assembly area.

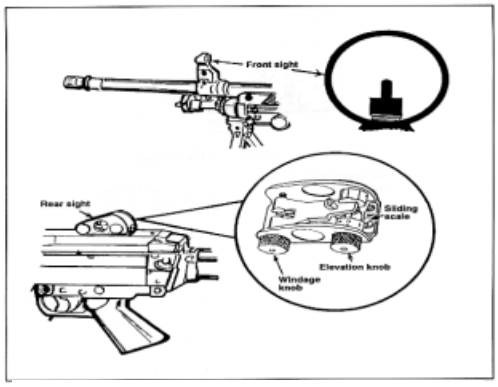

Figure 2-3. Front and Rear Sights

Zeroing is one of the most basic and universal training tasks for small arms marksmanship. During zeroing, one soldier occupies each of the 15 positions along the second firing line. To set the sights, soldiers learn the turns required of the windage knob or peep sight for accuracy. Having mastered those basics, soldiers move onto the adjustments required to engage targets at various ranges (elevation) (i.e., 25 m, 100 m, etc.). Rotation of the elevation knob toward the muzzle (front of the weapon) increases the range, whereas rotation toward the buttstock (back of the weapon) decreases the range (see Figure 2-3). Fine adjustments for zeroing are made by adjusting the peep sight. T Range is a 25-m range, so units utilize scaled targets to depict targets beyond 25 m (see Figure 2-2). These scaled targets have smaller silhouettes to represent targets that are farther away.

[3] At the end of the exercise, soldiers return unused ammunition. The safety officer subtracts the number of rounds returned from the amount distributed to record the munitions expenditure. The unit turns in this record to range control upon check out proceedings.

Marksmanship training is divided into three phases: preliminary, basic, and advanced. Skills trained in the preliminary phase include the practice of steady position, aim, breath control, and trigger control. For example, breath control is practiced when the user inhales, places his/her finger on the trigger while holding the breath, and then releases that breath when shooting. This basic skill controls the shooter's firing rate and promotes accuracy. The basic phase applies these fundamentals in day and night cover conditions. The advanced phase trains the soldier in combat techniques of fire and techniques of employment.

The objectives of marksmanship training are:

- Accurate initial burst. Obtaining initial burst of fire on the target is essential to good marksmanship. This requires the rifleman to estimate range to the target, set the sights, and apply the fundamentals of marksmanship while engaging targets.
- Adjustment of fire. The rifleman must observe the strike of the rounds when the initial burst is fired. If not on target, the soldier must manipulate the weapon for accuracy.
- Speed. Speed is essential and is an acquired skill gained through extensive training. Speed should not be stressed to the detriment of accuracy (Headquarters Department of the Army 1985).

2.1.2 Weapons Systems and Ammunition Types

T Range will be used primarily for zeroing the 5.56mm rifle (M16 and M4) and machine gun (M249) and 7.62mm machine gun (M240 and M60). T Range may also serve as an alternate range for training on all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols. The most frequently fired pistol caliber on T Range, by both law enforcement and military, is the 9mm (M9). A more detailed discussion of ammunition types potentially used on T Range and an evaluation of potential usage of "non-toxic lead-free combat ammunition" is included in Section 4.1

2.1.3 Use Procedures and Restrictions

Camp Edwards Regulation 385-63 outlines extensive rules and procedures for the ranges and training lands on Camp Edwards (MANG 1997). It notes that, "Users are to minimize environmental disturbance to protect the ecosystem as well as preserve the long-term value of our training site." Applicable subsections of this manual that apply to T Range are:

- Section 2-3, Safety and Environmental Briefing
- Section 2-5, Ammunition, Demolition, and Pyrotechnics Restrictions
- Chapter 3, Environmental Considerations
- General Training and Environmental Protection Approvals and Conditions

Range Control personnel are well-versed with this regulation and educate RSOs during the scheduling and issuance of ranges to using units. Camp Edwards' personnel oversee and assist the training conducted on T Range and evaluate whether training is conducted in accordance with operational, safety and environmental requirements, see Section 6 for additional OMM procedures relevant to environmental BMPs. Camp Edwards will update Regulation 385-63 to

resolve any inconsistencies with the requirements of this BMP OMM plan. All such inconsistencies will be identified prior to range use.

Before occupying T Range, the unit must designate an RSO who will receive a safety briefing. The briefing informs units of the installation's restricted areas (impact area, forward of the firing line at any range), prohibitions of mortar and artillery munitions and pyrotechnics, misfire and malfunction procedures, communication procedures, and environmental considerations. Procedures directly related to environmental protection include:

- Units must conduct any vehicle maintenance on paved or concrete parking areas. No vehicle maintenance will be conducted on T Range.
- Weapons maintenance, cleaning, and lubrication will be conducted in a manner that minimizes the potential for release of solvents or lubricants to the environment.
- Units will dispose of empty containers or waste rags, patches, and cleaning materials per the Camp Edwards Hazardous Material and Waste Management Plan (HMWMP). Specifically, units will be issued a waste receptacle when checking into a range. All cleaning supplies and oily rags generated on the range will be collected in the receptacle, which will be returned to Range Control upon check out. Range control will establish a satellite accumulation point for these wastes. Upon accumulation of 55-gallons of such waste, it will be disposed of per the Camp Edwards HMWMP and in compliance with all State and Federal Solid and Hazardous waste requirements.
- Units will use portable latrines.
- Units will avoid wildlife and damage to wildlife habitat.
- Units should take precautions for ticks.
- Soldiers will expend all ammunition from the designated firing positions along the firing line (between the maximum distance of 25 m and minimum distance 3 yds) within the firing lanes downrange to the targets. No weapons will be discharged:
  - Without permission from the range safety officer; or,
  - Forward of the firing line or across firing lanes; or, at an angle of fire inconsistent with bullet trajectory through the target holder and into bullet containment systems.
- Units must get approval from Range Control prior to employment of tracer and hollow point ammunition on T Range (see 6.2.1.4 **Holes in the cover**).
  - The delinking of tracer rounds is not authorized (MANG 1997). For details regarding the use of tracer rounds on T Range, see Section 4.1.1 under Standard Combat Lead-ball Bullet Ammunition.
  - All fire (particularly tracer and hollow point fire) will be observed by the Range Control Officer (or authorized designee) to evaluate that bullet flight through target holders proceeds into the bullet containment system
  - Inspect the top cover immediately following training events where hollow points are employed and initiate repairs in accordance with section 4.2.1.5.
  - Ensure that training is conducted in accordance with these applicable procedures.
- After training with Automatic Weapons (e.g. 7.62mm, M4) the Range Control Officer (or authorized designee) will inspect the surface of STAPP to assess whether irregularities have formed at the surface due too rearrangement of rubber filler material from automatic firing. If it is determined that there has been a seam failure or significant reduction in rubber filler (15 inches or less) the appropriate repairs will be initiated in accordance with section 4.2.1.5.

2.2 Training Capacity

For planning purposes, MANG has estimated the throughput capacity of T Range. The throughput capacity of a range is the maximum number of soldiers or units that it can accommodate in a given period of time. The calculations provided below represents the maximum number of soldiers that could be trained on T Range given the stated assumptions and default values. Calculation of throughput capacity is based on the type of training, the time required for a single individual or unit to complete a training event or series of events, and the period of time (day, week, month, year) that applies. Throughput calculations for some types of ranges may also include the number of soldiers or units that can train simultaneously.

The daily throughput capacity of T Range (25-m Rifle/Machine Gun Zero Range) with 15 lanes is estimated as follows[4]:

Number of lanes: 15

Time required for one soldier to complete firing: 30 minutes or 2 soldiers/hour

Time available for training: 8 hours/day

Number of soldiers per hour: 15 lanes x 2 soldiers/lane/hour = 30 soldiers/hour

Maximum throughput capacity = 30 soldiers/hour x 8 hours/day = 240 soldiers/day

To obtain the annual capacity, multiply the daily capacity by the number of days available for training:

Maximum daily throughput capacity = 240 soldiers/day

Days available for training: 280 (estimated)

Maximum annual throughput capacity = 240 soldiers/day x 280 days/year
= 67,200 soldiers/year

The calculation above represents a theoretical maximum of 67,200 soldiers per year using T Range. MANG does not foresee this level of training usage on T Range because MANG has approximately 6,000 soldiers, of which some are deployed or training elsewhere. The following sections examine a conservative number of soldiers and related munitions expenditures.

[4] The calculation of throughput capacity is an estimate for planning purposes only. It is not intended to establish a limit on the utilization of T Range. Adjusting any assumed value (e.g., hours of training/day, number of training days/year), will increase the throughput on T Range.

Assuming each of MANG's 6,000 soldiers would train and qualify with the standard issue M16 or M4 rifle, each soldier would require 98 rounds of 5.56mm ammunition per year. If all of these soldiers were to train and qualify on T Range, the training load could be estimated as follows:

Estimated number of soldiers = 6,000 soldiers/year

Ammunition issued = 98 rounds of 5.56mm ammunition per soldier allocation per year

Estimated ammunition load on T Range = 6,000 soldiers/year x 98 rounds of 5.56mm ammunition = 588,000 5.56mm rounds/year

This is a conservatively high estimate of munitions firing level because MANG estimates that at any given time 1,500 soldiers are deployed and not training and 1,000 soldiers are qualifying at other installations. Although this calculation does not account for variations in the types and calibers of weapons systems and ammunitions that could be fired on T Range, it does provide insight into the total firing load that T Range could experience.

Table 2-2 contains ammunition expenditures from 1994 to 2004 on all Camp Edwards SARs where 5.56mm (M16 and M4) rifle and (M249) machine gun, 7.62mm (M60 and M240) machine gun, and pistols were fired. The table includes expenditures (for relevant calibers) from B, C, D, E, G, H, I, J, K, N, O, P, and T Ranges.

Table 2-2. Historical Ammunition Usage

Training Year[5]	Training Days	5.56mm Tung	5.56mm Plastic	5.5mm6 Lead	7.62mm Lead	.45 Lead/ Frang[6]	.40 Lead/ Frang	.38 Lead/ Frang	9mm Lead/ Frang
2005	43	106,771	0	0	0	0	0	0	5,552
2004	58	125,990	11,242	0	0	2,700	4,750	2,150	22,320
2003	66	235,580	0	0	0	3,900	2,900	0	10,750
2002	49	147,053	20,752	0	0	3,880	3,000	0	6,000
2001	49	75,217	26,210	0	0	6,651	38,747	0	16,233
2000	42	69,473	46,250	0	0	6,630	8,650	0	5,550
1998	36	0	131,056	0	0	0	0	0	0
1997		0	44,757	215,461	34,894	0	24,172	21,031	202,660
1996		0	0	365,836	64,207	11,165	79,557	62,279	388,956
1995		0	0	531,665	64,541	7,860	66,850	85,003	488,920
1994		0	0	532,900	99,118	68,224	5,915	65,983	454,220
TOTAL	**347**	**760,084**	**280,267**	**1,645,862**	**262,760**	**111,010**	**234,541**	**236,446**	**1,601,161**

Note: 1997 was the last training year that training with lead-bullet ammunition was permitted on Camp Edwards

MANG will track and report the actual amount of ammunition fired on T Range annually. The following information will be collected each time T Range is in use: total number of personnel trained, the weapon systems used, the type of ammunition, and the number of rounds expended will be collected each time (See Appendix A, Training Facility Utilization Report).

[5] Training year is a fiscal year, October to September.
[6] Pistol fire prior to 1998 used lead-core ammunition. After 1998 pistol fire was conducted primarily using frangible bullets.

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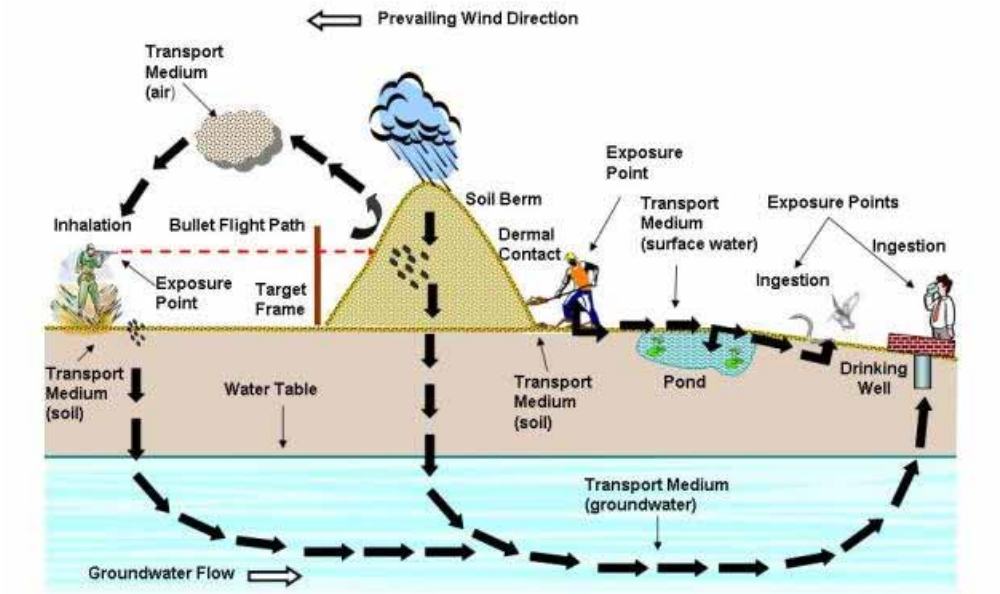
3.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) is a description of a site and its environment based on existing knowledge. It is used to develop site-specific hypotheses regarding the location and movement of environmental pollutants and any potential interaction (exposures) with humans and other environmental resources. The basic components of a CSM are the source, pathway, and receptor.

This CSM evaluates exposure pathways for which BMPs must be selected and implemented to protect human health and the environment. The CSM supports the feasibility evaluation of BMPs (i.e., alternative ammunition and bullet containment systems) in Section 4.2 and the development of OMM procedures in Section 6. Although a STAPP™ bullet containment system is currently installed on T Range, this CSM evaluates theoretical sources, pathways, and receptors of contaminants assuming no such BMPs are in place.

Figure 3-1 provides a pictorial representation of the general CSM for theoretical metals migration from T Range with no BMPs in place. The pictorial CSM also depicts theoretical exposure via multiple media and mechanisms. It is used to identify the potential migration and exposure pathways for which BMPs must be developed and implemented. Descriptions of potential sources, pathways, and receptors are provided in the following sections.



3.1 Sources

On T Range, metals (typically lead) originate from small arms weapons fire. Metals are deposited into the environment through muzzle blast or bullet deposition on the range floor or into the berm on T Range. Bullets fired into the range berm or deposited on the range floor 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. Small particles are more susceptible to transport mechanisms than intact bullets because of their lower mass and higher relative surface area exposed to weathering. Metals released from the muzzle blast may be entrained in the air and trace amounts may fall out to surface soils, becoming available to transport mechanisms other than air. While observing weapons firing, particularly night fire with tracer ammunition, range control personnel can see trajectories, points of impact, and ricochets[7]. The amount of rounds impacting in front of the bullet containment system or ricocheting away from the bullet containment system is indicative of the system's effectiveness at containing rounds fired.

The muzzle blast associated with small arms fire may also release residual energetic materials, primarily nitroglycerin, from propellants. Trace amounts of unconsumed propellant can be entrained in the air and fall out to surface soils. Deposition of propellants occurs primarily at the firing line. See Appendix B for a detailed listing of compounds within each type of ammunition.

Table 3-1 summarizes the total metals loading rates assuming the training load described in Section 2.2 (i.e., 588,000 rounds of 5.56mm ammunition) and the standard issue military service ammunition. If alternative training ammunition is employed by military units or civil law enforcement, these amounts may vary.

Table 3-1. Annual Metals Loading (Source Term) for CSM on T Range[8]

Munitions Constituent (kg)	Mass (lbs)
Lead	1,452.58
Copper	600.10
Antimony	14.67

[7] Tracers use special bullets that are modified to accept a small pyrotechnic charge in their base. When they are ignited upon firing, the composition in the tracer burns brightly to make the projectile visible to the naked eye. This allows the shooter to follow the bullet trajectory relative to the target in order to make corrections to their aim. See Section 4.1.1 for more information regarding use of tracer ammunition on T Range.

[8] Assumes specifications for 5.56mm (M193), 7.62mm (M80), .45 cal (M1911), .38 cal (M41), and .40 cal and 9mm (M882) (MIDAS 2002).

3.2 Potential Pathways

3.2.1 Surface and Subsurface Soil

Bullets deposited into the range berm may become fragmented when striking rocks upon impact or from impacts of other subsequent bullets. Trace amounts of metals and propellants from muzzle blasts may be deposited on the range floor. These particles may adsorb to surface soil. "Once introduced into the environment, metallic lead oxidizes (rusts) resulting in the formation of lead salts on the metallic lead surface (Scheetz 2004). Rainfall encountering the lead salts dissolves a small portion, which can travel with the infiltrating water into the soil. The solubility of the salts is low, which limits mobility. Any remaining dissolved lead reacts with the soil matrix resulting in the precipitation of various less-soluble lead species and sorption of lead onto soil particle surfaces. The capacity of soil for lead sorption is not infinite, but in some cases, the mass of lead introduced into the environment and subsequently dissolved is negligible compared to the sorptive capacity of the soil" (Clausen, et al 2007).

"Camp Edwards surface soils are coarse-grained and typically classified as sandy loams and loamy sands. These soils permit rapid recharge of percolating water and facilitate air exchange with the atmosphere" (Clausen, et al 2007). The permeability of the sandy soil on-site seems to indicate that dissolved metals may move vertically (downward) from surface to subsurface soils rapidly, as surface water would. However, soil conditions on Camp Edwards are not sufficiently acidic to readily dissolve metallic lead. The soils have very little organic matter and pH values ranging from 6.2 to 7.4 with a median pH value of 6.5. The soil and groundwater conditions are aerobic at Camp Edwards (Clausen, et al 2007). Actual pH values recently measured on T Range are between 5.9 and 7.4, with a pH median value of 6.4[9] (Impact Area Groundwater Study Program [IAGWSP] 2007). Other geochemical conditions present at Camp Edwards within the surface soils (e.g., chloride, resistivity, permeability, and oxygen) are not conducive for significant corrosion, dissolution, and transport of lead either. "There are two principal reasons corrosion processes are inhibited at Camp Edwards: lack of chloride and coarse soil texture. Chloride is the most important naturally occurring anion with regard to metal-corrosion and its content in Camp Edwards' soils and water is low" (Clausen, et al 2007).

The typical activities of range users, such as soldiers walking on the range and crews conducting maintenance and repairs, may disturb the soil. These users and range workers have the potential to move metals-tainted soil on and off the range. The sandy soil on T Range is highly erodible. Sandy soils on the berm or range floor at T Range, to which metal particles may have adsorbed, are more likely than loamy or clay soils to erode during severe precipitation, which is often experienced at Camp Edwards. However, the low gradient (relatively flat topography) of the area should limit the distance that eroded soil travels. Minor erosion of storm water control swales was noted during operational and environmental assessments of T Range (MANG 2007).

Nitroglycerin and nitrocellulose deposited in surface soils, primarily at the firing line, may be transported through erosion or by soil disturbing activities of range users and range maintenance workers. Nitroglycerin is slightly soluble in water; therefore, it could be transported vertically to subsurface soils.

[9] IAGWSP determined pH at T Range during a recent sampling event in April 2007.

Multiple soil profile samples collected prior to and after remediation from six different SARs on Camp Edwards indicated little vertical migration of lead in soils. The mobility and bioavailability of other metals that do corrode in these conditions will be limited by the adsorptive capacity of the sandy soil. Limited corrosion processes and the soil's ability to adsorb metals will limit the dissolution and migration of metals from surface soils to subsurface soils.

3.2.2 Surface Water

Bullets that have been pulverized into small metal particles theoretically could dissolve when exposed to precipitation and, in this form, would be available for transport via storm water runoff. Trace amounts of metals and propellants from muzzle blast that have fallen onto surface soils would also be available for transport via surface water runoff.

Storm events with intense downpour are common to Camp Edwards and produce significant amounts of rainfall that could potentially transport dissolved metals, metal particles, or trace energetic materials. Swales in the range floor on T Range allow surface water and suspended or dissolved metals to flow from the east side of the firing points downrange toward the west side of the targets. The nearest body of surface water is a pond located near SW Range, located approximately 1,100 m east of the range boundary. Therefore the potential for metals migration from T Range to a surface water body is highly unlikely because the distance between the firing line and the pond is so great. Additionally, the rate of surface water flow is low due to the relatively low gradient (flat topography) on T Range and the high permeability of the sandy soil on the site. The presence of low spots and limited storm water controls gives rain water the opportunity to pool on T Range, but this is largely offset by the highly permeable soils. Once again, "several mitigating factors such as the lack of chloride and coarse soil texture limit corrosion of metallic lead and subsequent dissolution of lead oxides at Camp Edwards" (Clausen, et al 2007). These factors will retard the transport of both dissolved chemicals and metal fragments via surface water.

3.2.3 Groundwater

The high permeability of sandy soil on T Range and the amount of rainfall common to Camp Edwards create the potential for dissolved metals in soil or surface water to percolate to groundwater. However, the highly permeable soils also limit the exposure of metals in surface soils to precipitation and limit corrosion and dissolution. The Camp Edwards Lead Assessment Study states "the principal conclusions are that corrosion and dissolution processes are sufficiently slow and mechanisms for attenuation, such as precipitation and adsorption, sufficiently robust, that lead has not migrated to groundwater" (Clausen, et al 2007). Furthermore, groundwater data collected from across Massachusetts Military Reservation (MMR) demonstrate that lead from firing on SARs has not contaminated groundwater despite significant and continuous releases of lead from weapons training and environmental exposures from one to several decades.

"A qualitative evaluation of lead migration suggests it could take centuries for lead to migrate to groundwater at Camp Edwards. A review of previously-performed modeling suggests the uncertainties in modeling lead migration are very large and the results overpredicted lead

transport in one case. In the other case, modeling results suggested lead would not move appreciably from the SAR. Considering a key uncertainty is the concentration in unsaturated zone moisture, sampling with lysimeters is likely a very useful means of evaluating whether lead migration is occurring or whether the qualitative review indicating significant migration will not occur is sufficient" (Clausen, et al 2007).

Groundwater below T Range flows northwest at a rate of 1–2 ft/day. MANG understands the importance of not only protecting groundwater from lead contamination, but to also protect the vadose zone soils above the water table and the soil-pore water contained in this zone from lead contamination. All feasible pollution prevention measures and BMPs will be implemented to prevent contamination of the vadose zone soils at T Range. MANG will monitor the first 5 feet of soil-pore water for munitions constituents in the range areas most likely to be impacted: at the firing line and at the toe of the berm.

The mobility and bioavailability of metals that do corrode in this environment will be limited by the adsorption capacity of the soil. The factors discussed above indicate a low potential for metal deposited on the range floor to dissolve and percolate the 30 m below ground surface to reach groundwater.

3.2.4 Air

Metal and propellant particles released from muzzle blast and entrained in the air may potentially be transported via the air pathway. Deposition of these particles occurs primarily at the firing line. High wind speeds and gusts are common to T Range with the prevailing wind being westerly. Air transport of lead at firing ranges may account for the movement of more lead quantities than is generally perceived. However, dusts containing metal particles typically do not travel far from the immediate range area before being deposited back on the soil surface (Fabian 2005). Additionally, vegetation on the range and trees surrounding T Range make it less likely for wind to carry metal particles much beyond the range boundary.

3.3 Potential Receptors

3.3.1 Surface and Subsurface Soil

The low mobility of soil combined with relatively controlled range and site access restrict the potential human receptors via the soil pathway to range users, range maintenance workers, and occasional trespassers. Human on-site users, through normal range use, may potentially be exposed to metals in surface soil while conducting range activities. Ecological receptors, such as microscopic organisms, invertebrates, and flora, can potentially absorb metals into their systems through ingestion or absorption of metals from surface soils on T Range.

3.3.2 Surface Water

The high permeability of the sandy soil and limited corrosion processes on T Range make off-sight movement of metals via surface water very unlikely. Site access is relatively well controlled, and the potential for human exposure to on-range surface water, in the form of run-off or short lived pooling of precipitation, is restricted to range users and range maintenance

workers. Human on-site users, through normal range use, may potentially be exposed to metals in surface water pooled on the range while conducting range activities. Potential ecological receptors may include soil microorganisms, invertebrates, or flora consuming or absorbing metal contaminated surface water that exists on or off range. The possibility exists for bioaccumulation as a result of these smaller organisms being eaten by higher order fauna.

3.3.3 Groundwater

Although it is highly unlikely, metals that potentially dissolve and leach to groundwater on T Range could move to the sole source aquifer beneath the site through advection and dispersion processes. The nearest drinking water supply wells, WS-2 and WS-3 for the Upper Cape Water Cooperative, are approximately 686 m northeast of the T Range boundary. T Range is hydraulically upgradient of these public water supply wells. Camp Edwards, and T Range specifically, sit above the Sagamore lens of the Upper Cape Water supply, which is 30–76 m thick and supplies water to off-site as well as on-site populations. These potential receptors include the populations of the Upper Cape towns of Bourne, Falmouth, Mashpee, and Sandwich, as well as to the towns of Barnstable and Yarmouth, the Barnstable County Correctional Facility, and the Massachusetts Military Reservation (MMR). The 102nd Fighter Wing water supply system provides water to base residents and to employees working in the general cantonment area of MMR (MMR 2005). Furthermore, MANG understands the importance of not only protecting groundwater from lead contamination, but to also protect the vadose zone soils above the water table and the soil-pore water contained in this zone from lead contamination. All feasible pollution prevention measures and BMPs will be implemented to prevent metals contamination of the vadose zone soils at T Range.

3.3.4 Air

Human and ecological receptors could potentially be exposed to metals in air (e.g., through entrainment of fugitive dust) on T Range. This transport and exposure mechanism is thought to only be viable to on-site receptors, such as range users, range operators, and maintenance personnel. Part of basic small arms training is breath control, whereby the user inhales, places his/her finger on the trigger, and releases that breath when shooting. This basic skill controls the shooter's firing rate and promotes accuracy. Releasing one's breath after firing the weapon may limit the ability for the soldier to inhale fugitive dust, even though the range user is a potential receptor (see Section 2.1.1).

Vegetation on range and trees surrounding T Range make it unlikely for wind to carry metal particles beyond the range boundary, likely preventing human off-site and ecological exposure. In 2006, the US Army Environmental Command (USAEC) evaluated the potential for human health effects to offsite residents breathing air emissions following the functioning (firing of one or more items) of the M855 (5.56mm), M80 (7.62mm), and M882 (9mm) ball cartridges. The risk assessments for each caliber concludes that receptors are safe as close as 300 meters for M855, 200 meters for M80, and 100 meters for M822 (Environmental Health Risk Assessment Program 2006). T Range is over 1,000 m from the installation boundary and the nearest off site receptor, making the potential air pathway to offsite residents highly unlikely.

3.4 Potential Source-Receptor Interaction

Figure 3-2 follows deposited metals through potential transport pathways from T Range. A complete exposure pathway includes all the following elements:

- A source and mechanism of release,
- A transport mechanism and exposure 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).

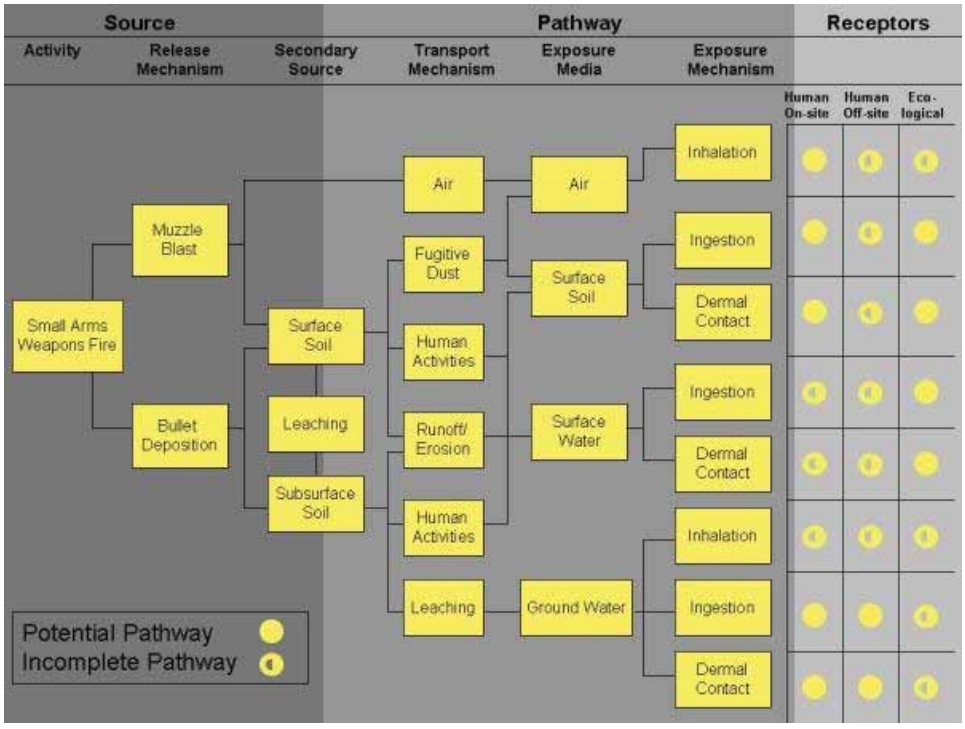


Figure 3-2. Graphic Presentation of T Range CSM

Based on the CSM for T Range, MANG has implemented a system of range upgrades and BMPs that will either sever potential pathways or monitor environmental conditions to confirm that pathways remain incomplete. MANG will manage metals on T Range at their source, through containment and periodic removal and recycling. The feasibility of such containment measures are evaluated in Section 4. MANG will monitor potential migration pathways, such as surface soil and groundwater, to evaluate whether metals are transported to receptors. The monitoring approach is described in Section 6.2.2. MANG will also implement a number of other monitoring and maintenance BMPs to sustain the conditions on T Range that limit metals mobility. These BMPs include maintaining healthy vegetation on range areas to prevent soil erosion, maintaining wind breaks to limit windborne metals transport, and maintaining soil pH to minimize corrosion/dissolution of metals into groundwater. These BMPs are described in Section 6.3.

3.4.1 Surface and Subsurface Soil

Normal activities of both range users and ecological receptors may potentially expose them to metals-contaminated soil through dermal contact and possibly ingestion. Any construction or maintenance work conducted on the range shall be completed in accordance with the site-specific health and safety plan that limits inadvertent exposure to contaminated soil (IAGWSP 2007). Erosion of large amounts of soil from T Range is unlikely because of the low gradient and vegetative cover on the range floor, downgradient area, and swales. Additionally, the nearest installation boundary is 2,225 m, making it highly unlikely for off-site human exposure via erosion of surface or subsurface soil.

Illegal trespassing, sometimes involving all-terrain vehicles with child drivers/passengers, has been observed on MMR. This activity is strictly prohibited, and if caught, violators are prosecuted. In this scenario, exposures of individuals to contaminated soils on T Range are assumed to be brief and acute. Soil contaminant concentrations that are acutely toxic could have a negative effect on the receptor.

3.4.2 Surface Water

The likelihood of metals transport via surface water from T Range is improbable. The nearest body of surface water is approximately 1,100 m from the range boundary, and range floor gradients do not promote high velocity drainage to off-range areas. Standing surface water on the range is also unlikely due to the high permeability of the sandy soil. The majority of storm water and precipitation on the range will percolate through the soil. Storm water that pools on the range or is transported off-range will contain very low quantities of dissolved metals because of the soil properties on site, as discussed in previous sections. These range conditions eliminate the potential for exposure for both human and ecological receptors via surface water.

3.4.3 Groundwater

It is very unlikely that residents of MMR and surrounding towns consuming or using water from the Upper Cape Water Supply Reserve beneath T Range will be exposed to metals. It is unlikely that metals from T Range will dissolve and percolate through soil to the aquifer because of soil

properties previously discussed. The status of the Upper Cape Water Supply Reserve as the sole source of drinking water for a large population demands protection through a very conservative management approach. As such, MANG will manage the groundwater pathway as potentially complete for exposure of on-site and off-site users via ingestion. Potential exposure of ecological receptors to groundwater beneath T Range is limited to groundwater discharge to Shawme Lake, located 1,100 m hydraulically downgradient from T Range (MANG 2007).

3.4.4 Air

Because dusts containing metal particles typically do not travel far before being deposited on the range floor, the only possible air-receptor interaction is the inhalation of dusts by human on-site users conducting training activities or maintenance.

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4.0 RANGE LAYOUT

The purpose of this section is to provide visual/pictorial representations of the physical design modifications to T Range to support the P2 BMPs described in Section 4 and Section 6.

4.1 Range Plan

T Range has generally flat topography, with the exception of two sloped areas: the vegetated backstop/berm supporting the installed STAPP™ system and the elevated mounds behind the firing line. Distinct features of T Range include an access road, a parking lot, a range tower, a target shed, the range floor (that includes multiple firing lines and the target line), protective sand boxes, a bullet containment system, 15 target frames, and future support facilities.

T Range is surrounded by trees, which buffer noise and act as a windbreak. The entrance leads to a gravel parking area approximately 50 m x 250 m in size. Adjacent to the parking area, there is a row of 6 elevated mounds approximately 76 m long. These mounds are covered with grass and are about 7 × 12 × 3 m in size. They were once machine gun firing positions but now serve only to direct access and egress to the firing range and to allow elevated observation of weapons training from several positions. The firing lines at T Range are 44 m long with 15 firing lanes and start about 15 m in front of the elevated mounds. The initial firing line will be slightly elevated (approximately 0.5 m) once the machine gun berms have been knocked and re-graded to improve the trajectory of fired rounds through targets and into the STAPP™ system from standing, kneeling, and prone positions at the 25 m firing line. The maximum distance from the targets where firers can engage targets is 25 m from the target; the minimum distance that firers can engage targets is 3 yards from the target line. There are 15 wooden framed target holders placed 25 m downrange from the initial firing line. The range floor between the 25 m firing line and target frames is relatively flat and covered with grass. Protective timber “sand boxes” are behind the target frames to protect the base of STAPP™ system from undershot. Figure 2-1 shows a number of these features, repeated in this section for convenience. The STAPP™ bullet containment system and the berm are approximately 30 m from the firing line. The STAPP™ system is described in detail below in Section 5.2. Proposed T Range future construction includes re-grading the existing elevated machine guns to improve the 25 m firing line, support facilities, such as bleachers and a pavilion that will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located adjacent to the current parking areas of T Range. The bleachers will provide seating for training announcements and will be situated behind the 25 m firing line in order to safely observe firing.

The T Range plan incorporates several elements selected to disrupt migration pathways identified in the CSM. See Figure 5-1 for the locations of these elements. The primary P2 design feature on T Range is the STAPP™ bullet containment system, which has been installed on the soil berm. The STAPP™ system limits the interaction of precipitation with bullets, retards the vertical movement of metals into soil, and the transport of dissolved and particulate metals toward the toe of the berm. Vegetation on the sides and back slope of the berm will prevent erosion of berm soil caused by surface water flow. The entire range is buffered by trees to prevent wind erosion and the migration of lead particles off-range through wind entrainment. A total of six lysimeters will be installed at a various depths (3.5, 5 and 8 feet) across the toe of the

berm. Three more lysimeters will be installed across the 25 m firing line at the same depth of 5-6 feet below ground surface. Additional lysimeters maybe installed across the range floor to monitor firing lines between the maximum and minimum firing lines. These lysimeters will be used to monitor soil-pore water and vapor for dissolved metals as an early indication of contaminant migration from the ground surface towards the water table. Because groundwater flows from south to north across the range, the existing groundwater monitoring well is located appropriately to monitor for the presence of munitions constituents in groundwater.

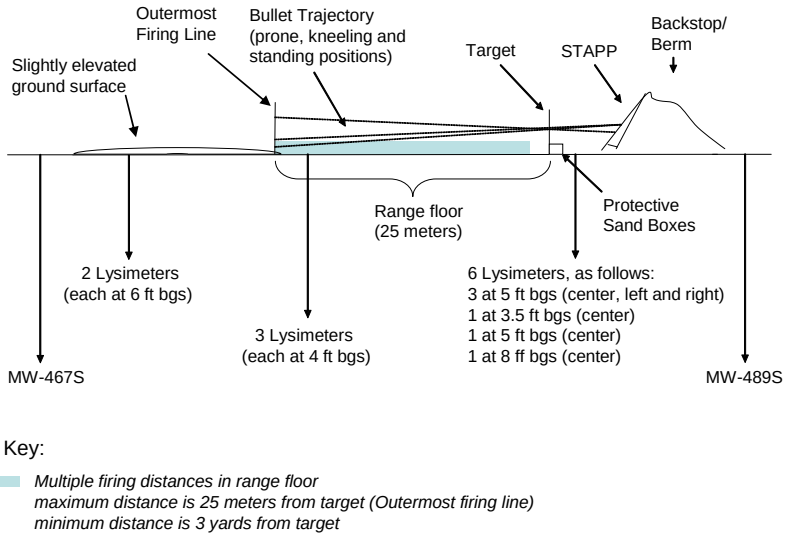

Figure 2-1. Lateral View of T Range

The T Range plan incorporates several elements selected to disrupt migration pathways identified in the CSM. See Figure 5-1 for the locations of these elements. The primary P2 design feature on T Range is the STAPP™ bullet containment system, which has been installed on the soil berm. The STAPP™ system limits the interaction of precipitation with bullets, retards the vertical movement of metals into soil, and the transport of dissolved and particulate metals toward the toe of the berm. Vegetation on the sides and back slope of the berm will prevent erosion of berm soil caused by surface water flow. The entire range is buffered by trees to prevent wind erosion and the migration of lead particles off-range through wind entrainment. Three lysimeters will be installed at a depth of 1.2 m across the toe of the berm. Three more lysimeters will be installed across the firing line at the same depth of 1.2 m below ground surface. These lysimeters will be used to monitor soil-pore water and vapor for dissolved metals as an early indication of contaminant migration from the ground surface towards the water table.

Because groundwater flows from south to north across the range, the existing groundwater monitoring well is located appropriately to monitor for the presence of munitions constituents in groundwater.

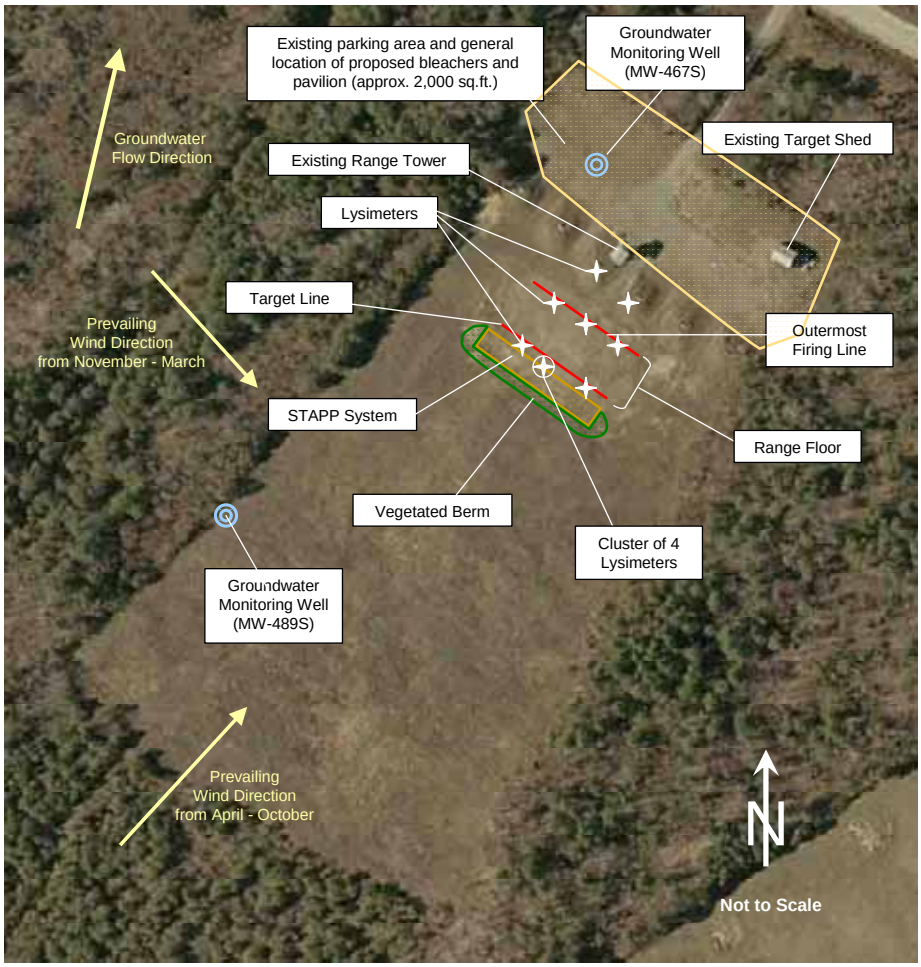

Figure 5-1. Aerial View

4.2 Details and Specifications of Bullet Containment System

The STAPP™ system on T Range employs several features that collectively sever pathways of metals migration noted in the CSM. The vegetated back slope prevents soil erosion, as does the vegetated range floor. The self-closing cover on the front of the berm is waterproof but will allow bullets to pass through its surface and into the granular rubber matrix below. The berm apex was removed in July 2007 to resolve the situation where excess water from precipitation

was entering into the STAPP system. The STAPP system is now the high point of the berm. See figures 5-2a and 5-2b.

Figure 5-2a. STAPP on Tango Range pre-July 2007

Figure 5-2b. STAPP on Tango Range August 2007

The impermeable liner prevents bullets in the granular rubber from interacting with berm soil. Additionally, the liner will collect water that has passed through perforations in the membrane cover and will direct it toward the water collection piping instead of allowing it to percolate through soil and possibly into groundwater.

The base of the STAPP™ system is protected from being damaged by undershot by a series of sand-filled timber frames, see Figure 5-3. The 8' long sand boxes were constructed with 6" x 6" pressure treated timbers, 2" x 4"s and plywood, all pressure treated wood. They are fastened using nails, spikes and wood dowels. The use of nails and spikes were minimized to help prevent bullet ricochet hazards. The wood dowels provide most of the fastening strength. Prior to installation, Camp Edwards leveled the ground surface and placed the 13 sand boxes behind the target line to protect the bottom of the STAPP™ system. The boxes were filled with clean/washed sand from an off-site source. After they are filled with sand, a plywood top was secured with nails. A heavy duty vinyl geotextile fabric (Thoroshield 4050) is then secured to the box to make it shed rain water. Figure 5-4 on the following page depicts these features associated with the target line and the STAPP system.

Figure 5-3. Protective Sand Boxes and Target Frames on Tango Range

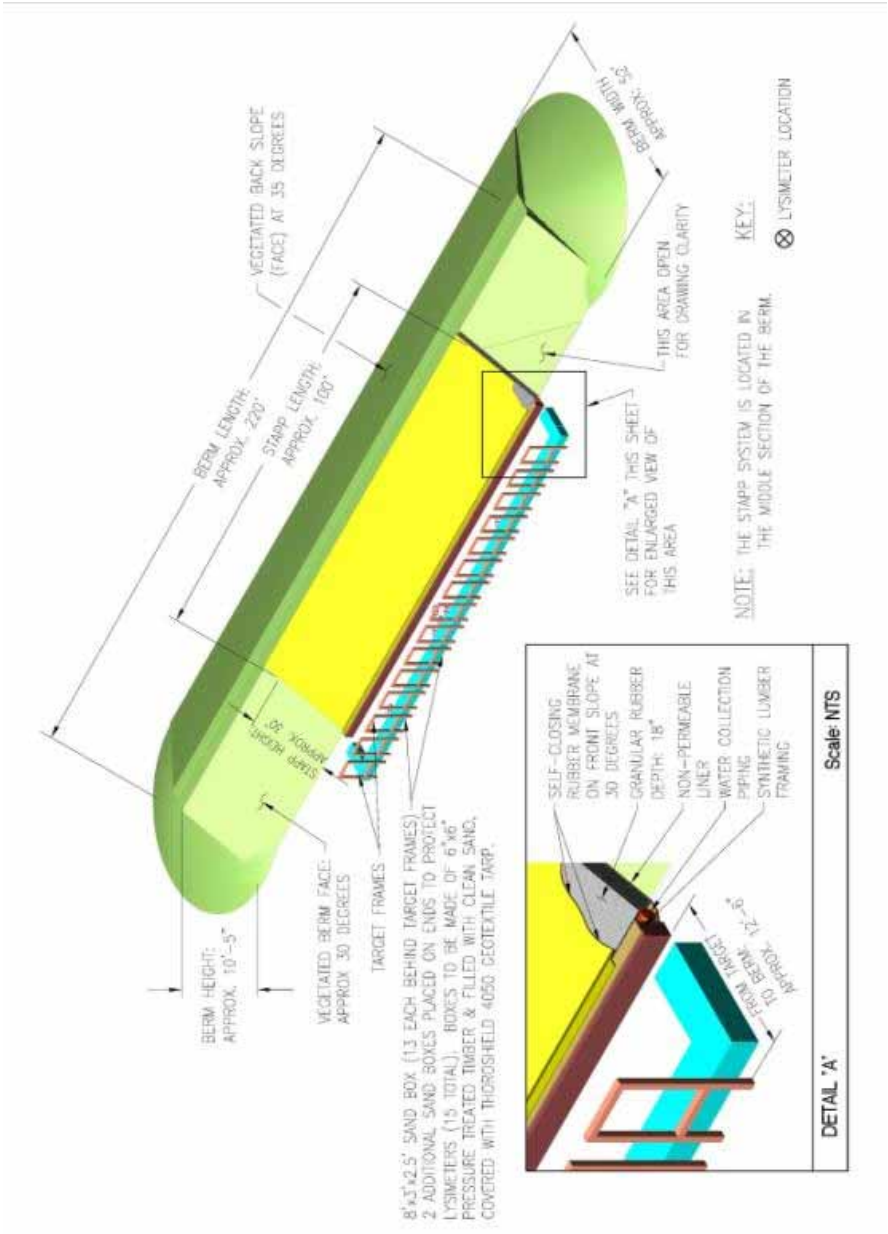

Figure 5-4. Drawing of STAPP™ Bullet Containment System

4.3 Details of Monitoring Features

A groundwater monitoring well is located on the north side of T Range. Its location is appropriate to monitor impacts from firing on T Range because groundwater flows to the north. An upgradient groundwater monitoring well in the northwest corner of the range will allow MANG to monitor for metals in groundwater that may have been contributed from other activities, not related to T Range. Depth to groundwater at T Range is approximately 30.5 m, and the installed wells will sample groundwater to a depth of 42 m below ground surface. Specifications of the groundwater monitoring well installed on T Range are shown below on Figure 5-5.

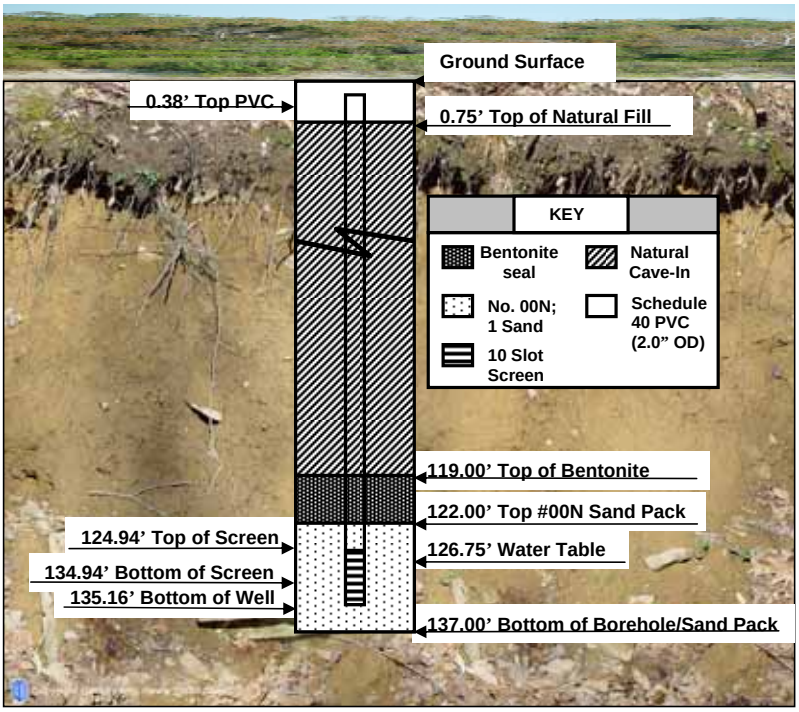

Figure 5-5. SAR Groundwater Monitoring Well Construction Details

Lysimeters will also allow MANG to monitor for dissolved munitions constituents in soil-pore water on T Range. The lysimeters will function as early warning signs of lead migration because of their position within the first 1.5 m of surface soil at the toe of the berm and at the firing line. The lysimeters at the toe of the berm will detect whether metals from fired ammunition are contained by the STAPP™ system. The lysimeters at the firing line will detect the migration of any metals or propellants from the muzzle blast of fired weapons. Lysimeter sampling will characterize contaminate migration through the soil-pore water toward the aquifer. Lysimeter specifications can be seen in Figure 5-6.

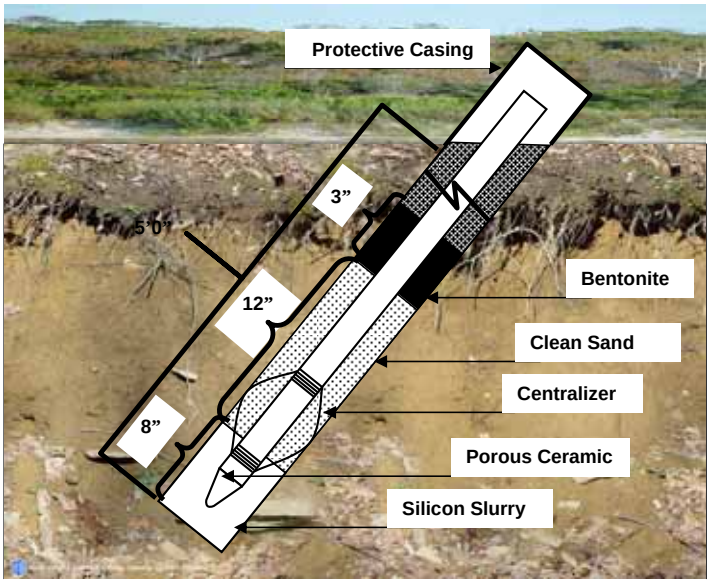

Figure 5-6. SAR Lysimeter Construction Details

5.0 RANGE OPERATIONS AND MAINTENANCE

This section provides guidance for the OMM of T Range that is consistent with the P2 strategies evaluated and selected in Section 4. The following guidance satisfies the criteria identified by MANG to describe the "maximum feasible use of P2." As such, the following guidance was developed to be implementable, protective of human health and the environment, and cost effective.

If the MANG determines or anticipates that it may not be able to comply with any requirement of the OMMP, it will notify EPA and EMC within 24 hours of this determination in writing. Within an additional 48 hours, the MANG will provide a plan for EPA and EMC approval for addressing the potential deviation.

By the tenth day of each month, the MANG will prepare and submit to EPA and EMC a monthly report that includes: 1) the actions that have been taken toward maintaining compliance with the Administrative Order and the OMMP during the previous month, 2) a summary of all sampling results and tests and all other data during the previous month, 3) all work plans, reports, and other deliverables required by the Order, and 4) all actions scheduled for the next 6 weeks including percentages of work completed to date on ongoing tasks, delays encountered, and a description of efforts made to mitigate any delays.

By December 15, MANG will submit an annual report containing all data collected during the year. Any issues that were encountered should also be described.

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5.1 General Range Operations

5.1.1 Range Scheduling and Access Controls

T Range may be used for weekend training, inactive duty training, or during the two week-long annual training periods. Annual training units have the first priority for scheduling training areas and ranges. Per Camp Edwards Regulation 385-63, Range Control schedules T Range usage based upon written input received from using units. Units forward a written request to "Commander Camp Edwards, ATTN: Range Control" or use the Range Facility Management Support System (RFMSS) Program stating the dates and facility desired. The written request must include the anticipated number of soldiers occupying and using the range, the types of weapons to be used, the types of ammunition to be used (by DODIC), and estimated amounts of ammunition to be expended. A master schedule is available for viewing electronically via the RFMSS Program. To avoid conflicts, co-use of a previously scheduled area will be confirmed only after Camp Edwards Operations and Range Control receive a written consent from the originally scheduled unit.

5.1.2 Issuing and Clearing the Range

A unit representative must sign out T Range from Range Control prior to occupation or use. Units must confirm the information provided at the time the range was scheduled (e.g., numbers

of soldiers, weapons, and ammunition). Each unit will receive a T Range usage packet, which will include a Weekly Range Bulletin. This bulletin indicates training facilities scheduled, airspace requirements, local restrictions, and other information pertinent to units training at Camp Edwards. Commanders are responsible for distribution to subordinate units and appropriate personnel. Prior to occupation, or immediately thereafter, unit personnel will inspect the range and report any deficiencies immediately to Range Control (see Section 6.2.1). Camp Edwards' personnel will conduct safety and environmental awareness briefings to designated Officers in Charge and RSOs prior to issuing the range. The briefing will cover the requirements of this document as well as requirements of Camp Edwards Regulation 385-63, *Range Safety and Trainers Guide*, and safety requirements from applicable weapons manuals, Field Manuals, and Technical Manuals.

Upon completion of training, units shall police their brass and ammunition containers and packaging. Using units remove expended cartridge casings from the range, visually inspect them to remove any live rounds, and turn over the expended casings to the temporary Ammunition Supply Point (ASP). Other range residue such as weapons cleaning materials and trash generated on the range will be collected on-site in a waste receptacle issued by Range Control upon check-in. The waste receptacle will be returned to Range Control upon check out. Range control will establish a satellite accumulation point for wastes generated from weapons cleaning. Upon accumulation of 55-gallons of such waste, it will be disposed of per the Camp Edwards HMWMP and in compliance with state and federal solid and hazardous waste management regulations.

All units/organizations using T Range will complete a Training Facility Utilization Report (see Appendix A[10]). This report summarizes the training activities conducted on the range and includes: the weapons systems used, the type and amount of ammunition used, the firing lanes that were used, and the types of vehicles present on the range. After policing their brass and related range residue, the unit/organization will inspect the range using the T Range Inspection Form (see Appendix C). This form includes a review of the general order and condition of the facility, a visual check of erosion and vegetation on the range, and a visual inspection of the STAPP™ system. Blank copies of both of these reports will be included in the check-in packet distributed at Range Control. Upon clearing T Range, each unit/organization will submit the completed reports to Range Control. The Range Control Officer or authorized designee will be available to answer any questions that arise during the visual inspection, but it is the unit/organization's responsibility to complete the range inspection. Once T Range is inspected and cleared by Range Control personnel (via signature on the inspection forms), the unit or organization representative will report to Range Control returning any T Range packets or equipment issued and to close out the hand receipt prior to clearing the installation.

5.1.3 Oversight of Training Operations

Per Section 1.4, the Range Control Officer is responsible for oversight of T Range operations. The Range Control Officer issues and clears T Range. He/She is the main point of contact for using units for range communications, usage requirements, and conflict resolution. Also, the

[10] The range inspection report in the Appendix is being continually improved for use on T Range.

Range Control Officer will monitor units on T Range to support compliance with this plan and Camp Edwards Regulation 385-63. The Range Control Officer will schedule all required monitoring described in Section 6.2 and all maintenance described in Section 6.3 with the appropriate Camp Edwards staff.

E&RC in coordination with Range Control will have the MANG Environmental personnel, both full-time and part-time personnel, conduct site inspections of the range. Inspections can be conducted in conjunction with range control personnel or separately. Also, the various environmental agencies will also inspect the range and/or units for compliance with the established T Range OMM plans. If the range is operational, the environmental agency representative will identify themselves to the Officer or Non-Commissioned Officer In Charge, who is responsible for the overall conduct of the range that day.

5.2 Range Monitoring

In addition to routine compliance monitoring, Range Control coordinates the general and environmental inspections and requisite rehabilitation on T Range. Small arms training with lead-bullet ammunition will leave metals within the bullet containment system and possibly munitions constituents elsewhere on T Range. To understand the nature and extent of munitions constituents on T Range, Camp Edwards will institute a monitoring program for soil, soil-pore water, and groundwater. MANG will also implement a number of other inspection and monitoring BMPs to ensure the conditions on T Range that limit metals mobility are maintained. These BMPs include monitoring the condition of the bullet containment system, vegetation cover, and soil pH to minimize corrosion/dissolution of metals into subsurface soil or groundwater.

5.2.1 Range Inspections

Each time the range is used range inspections will be conducted by Range Control and accompanied by units or other users NCOIC or person in charge. This will provide with time a functional familiarity in how the range is cared for and its proper use. Range Control will inspect the range on a regularly scheduled bi-weekly (every two weeks) basis, as the weather permits. Furthermore, Range Control will conduct detailed inspections 3 times during the peak training period and internal inspections of the STAPP™ system periodically. There are three levels of inspections at T Range: visual inspections, detailed inspections, and internal inspections. The requirements of each type of inspection are presented on the T Range Inspection Form (see Appendix C). Each type of inspection is described in detail below.

As the MANG is currently regulated under Administrative Order II, in regards to small arms ranges and other aspects of live fire training on Camp Edwards, the EPA will conduct inspections of Tango range.

Metric: *The EPA will provide an inspection report to the MANG and the MANG will reply within 5 business days in writing, email, or other documentable form of communication.*

Most MANG training occurs between April and October. During this peak training period, the Range Control Officer will conduct a bi-weekly visual inspection of T Range using the T Range Inspection Form in Appendix C and compare his/her observations with the recently completed inspection forms of using units. The Range Control Officer will also conduct a visual inspection within one week after major storm events[11].

Range Control will also conduct a detailed inspection of T Range at the start, midpoint, and the completion of the peak training period. The detailed inspections will be conducted 3 times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October at the end of the peak training period. This detailed inspection will include features described in the T Range Inspection Form Sections A-E (see Appendix C) as well as photo documentation of range conditions.

[11] A major storm event is defined as an accumulation of more than 5 cm in a 24-hour period.

During the initial detailed inspection of T Range conducted each year in March, Range Control will take baseline condition photos of the firing line, range floor, soil berm, and bullet containment system. These baseline photos will help field crews evaluate future observed conditions against the baseline and help document the rehabilitation of any reported range deterioration. Range Control 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. The following sections contain guidance for conducting range inspections.

MANG will conduct an internal inspection of the components of the STAPP™ system each time MANG removes the cover and sifts the granular rubber material to remove and recover captured projectiles. The internal inspection will be performed once after the first year of training operations. Subsequent to the initial internal inspection, regularly scheduled internal inspections will occur after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first. The internal inspection will include features described in the T Range Inspection Form Section F (see Appendix C).

Range Control collects the Kilo Range Inspection Forms and schedules any required maintenance with either Facilities Engineering (FE) or the Environmental Office accordingly. Range Control files the inspection forms for administrative record keeping.

5.2.1.1 General Conditions and Order of Facility

Distinct features of T Range include an access road, a parking lot, a range tower, a target shed, a firing line, a range floor, protective sand boxes, a bullet containment system, 15 target frames, and future support facilities. Proposed T Range future construction includes support facilities, such as bleachers and a pavilion that will be used for meals, ammunition issue, and weapon breakdown and cleaning. The pavilion will be located adjacent to the current parking areas of T Range. The bleachers will provide seating for training announcements and will be situated behind the firing lanes in order to safely observe firing. The parking areas will be inspected for general condition and any POL stains from vehicles. The range tower, target frames/holders, and firing positions, and shed must be in adequate condition to support unit training use. The protective timber “sand boxes” in front of the target frames will be evaluated to identify deterioration, damage or excessive amounts of undershot. Units will note the condition of each of these features and any specific deficiencies in need of repair.

5.2.1.2 Erosion

Erosion is the displacement of soil by wind or water or by downward or downslope movement in response to gravity or human activity. T Range is generally flat, with the exception of two sloped areas: the vegetated backstop/berm supporting the installed STAPP™ system and the elevated mounds behind the firing line. The potential causes of erosion on T Range are lack of vegetation or human activity/disturbance, such as staff climbing the berm to inspect the top of the berm and the STAPP system. If units did not engage the target accurately, bullets may impact the

vegetated berm surrounding the STAPP™ bullet containment system[12]. Disturbed or deteriorated vegetation on both sloped areas could allow erosion to occur via wind or water.

Four to five months after the STAPP™ was installed, it was observed that rainwater runoff was seeping under the STAPP™ system and causing erosion. The first evidence of the erosion was additional sandy soil observed in a 5 to 6 foot swale beyond the base of the STAPP™ system. Further observation revealed a portion of the berm near the top of the STAPP™ had washed away in a rain event. The surface of the STAPP™ system was no longer a uniform level surface, but had a depression leading from the eroded berm section above the STAPP™ to the swale at the base of the STAPP™. The self-closing cover was opened and the granular rubber was removed to inspect the condition of the impermeable liner. The liner was intact. Soil was added to the berm below the STAPP™ system to fill the depression. To prevent future erosion from the top, a geotextile tarp was installed over the top of the berm and attached to top of the STAPP™ to allow water to runoff the backside of the berm and over the face of the self-closing cover, mitigating the potential for erosion at the top and around the sides of the STAPP™ system.

If the geotextile tarp above the STAPP™ system deteriorates, is severely torn or becomes unsecured, run-off from the soil berm may erode the soil surrounding the frame supporting the STAPP™. After precipitation, erosion is identified by the presence of rills or gullies on the downward slope. Using the T Range Inspection Form (see Appendix C), using units and the Range Control Officer shall identify evidence of erosion on key features of T Range. The inspection form provides a blank comment area to describe conditions and a simple range drawing/map where erosion hotspot locations can be identified.

5.2.1.3 Vegetation

Camp Edwards will plant and maintain Massachusetts Highway (MassHighway) seed mix to provide a vegetative cover on the soil berm areas around the bullet containment system, the range floor, and the elevated mounds behind the firing line to reduce erosion (Ciaranca 2006). Inspectors will visually estimate the percentage of vegetative coverage on these three areas. A space is provided on the inspection form to note the degree of vegetation cover and any need for revegetation.

[12] Although it is highly unlikely that units will fire enough bullets into the berm to create a hotspot (see Section 3.2.2.2), it should be noted that this cumulative impact may further deteriorate the slope, causing erosion.

5.2.1.4 Bullet Containment System

The condition of the bullet containment system will be closely monitored and necessary maintenance and repairs will be conducted in accordance with the metrics outlined below. A number of features of the STAPP™ bullet containment system will be monitored to contain metals and sever potential migration pathways. These features include:

- the self-closing rubber membrane cover (faces and seams),
- the rubber filler material,
- the impermeable liner,
- the internal water reservoir, and,
- the synthetic lumber support structure.

General Metric: *If repairs cannot be scheduled or initiated within 72hours then all appropriate MANG leadership and appropriate federal and state environmental agencies will be notified in writing (email, letter or other documentable form of communication) within 72 hours of this detremination.*

General Metric: *If it is determined that reapairs needed preclude the use of any lane or the range in total Range Control will shut down part or all of the range, providing for safety and environmental protection.*

Self-closing rubber membrane (faces and seams)

The self-closing cover is the top layer of the STAPP™ system. Although the rubber membrane that covers the granular rubber is "self-closing" it can become worn and perforated to the point where significant amounts of precipitation can accumulate within the system. The wear and perforation of the rubber membrane is heavily dependant upon range use. Both the frequency of operations at the range and the caliber of projectiles used in training will affect the useful life of the rubber membrane. STAPP™ has estimated a total replacement of rubber membrane after 10 years of use in its life cycle cost analysis (Ciskowski 2007b). Figure 6-1 depicts the progression of wear and perforation on a heavily used STAPP™ system over a number of years.

Figure 6-1. Examples of Wear and Deterioration of the Self-Closing Rubber Membrane on the STAPP™ System

Holes in the cover. MANG will inspect the rubber membrane in accordance with the range inspections outlined in Section 6.2.1. If granular rubber media is exposed the cover is not preventing exposure of bullets to air and water. As such repairs should be scheduled to occur within 72 hours. This applies to all holes created by firing as well as any other occurrence that may cause holes, tears, seam failures or the like. No tracer fire will be conducted when such holes are present.

METRIC: *When underlying rubber media is visible, repairs will be scheduled to occur within 72 hours, weather permitting, per the instructions outlined in Section 6.3.1.*

Failed seams. Seam failure is most problematic in the bottom one foot of the STAPP™ system, near the base. A slight leveling of the self-closing cover can occur at the "toe" of the system above the internal water collection unit. In this area, the cover gradient is less steep than throughout the rest of the system and at times water may pond on the top of the self-closing cover. If the self-closing cover has a seam failure in the lower portion of the STAPP™, ponding water could penetrate the cover and accumulate in the water collection system. Larger seam failures can also be problematic in the upper portions of the STAPP™ system as they will also allow precipitation to leak into the system and will allow air-flow, thus supporting continued combustion of tracer rounds.

METRIC: *Failed seams occurring above the bottom one foot of self-closing cover (where water is not likely to pond on the membrane) require repair if the seam failure exceeds 6 inches. Failed seams occurring at/near the toe (within the bottom one foot) require repair if greater than one inch in size. Repairs will be initiated within 5 working days of inspection, weather permitting.*

Ponding on the surface of the cover. A slight leveling of the self-closing cover may occur in the bottom one foot of the STAPP™ system, near the base, above the internal water collection unit. If this leveling becomes a depression, water ponds on the top of the self-closing cover in this area. Ponding water may seep into the STAPP™ system through failed seems or holes in the cover.

METRIC: *Each time the top membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media appropriately to prevent any ponding of water in the first foot of the STAPP™ on top of the self-closing cover.*

Rubber filler material

The rubber filler material is approximately 18 inches of loose, granular rubber fill situated below the self-closing cover. Irregularities in the surface of the STAPP™ system may be indicative of two different problems: (1) irregular distribution or settling of the granular rubber media, causing "thin-spots" and poor bullet stopping capacity; or (2) erosion or irregular settling of soil beneath the STAPP™ system causing stretching or other stresses that may damage the impermeable liner.

METRIC: *A bulge or depression that exceeds 4 inches in height/depth over a length of 4 feet will be considered "significant" and will be repaired. Irregular settling will be measured using a 4 foot long straight edge placed on the surface of the self-closing cover. Separation of 4 inches between the straight edge and the cover of the STAPP™ will indicate a need to "re-grade" or "rake" the rubber filler material to an even level distribution across the STAPP™. Repairs will be initiated within 5 working days of inspection, weather permitting. Furthermore, each time the top membrane of STAPP™ is opened to check the water reservoir system (three times annually), the inspector will re-distribute the granular rubber media to a minimum depth of 15 inches.*

Impermeable liner

The impermeable liner is situated below the rubber filler material in the STAPP™ system and lies directly on the surface of the earthen berm. Figure 6-2 on the following page shows punctures in the impermeable liner beneath a STAPP™ system caused by.50 caliber projectiles that were not intended for this STAPP system. MANG will inspect the impermeable liner for punctures and tears each time the granular material is sifted to remove and recover captured projectiles (i.e., after the first year of training operations and subsequently after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first).

METRIC: *Any perforations, holes, rips, or seam failures in the impermeable liner will be repaired. Repairs will be initiated within 5 working days of inspection, weather permitting.*

Figure 6-2. Examples of Perforated (left) and Intact (right) Liners

Internal water reservoir system

External Visual Inspection. Units and range control will conduct a visual inspection of the ground surrounding the STAPP™ water reservoir at the bottom of the berm to check for any leaking.

METRIC: Any leaking will be further investigated and the source of leaking repaired. Repairs will be initiated within 5 working days of inspection, weather permitting

Internal Visual Inspection. The internal water reservoir system is situated at the base of the STAPP™ system. It allows water to accumulate and be removed (Figure 6-3). The water reservoir system will be checked for excess water, punctures or cracks. Proper inspection of the impermeable liner and the internal water reservoir requires removal of the self-closing cover and displacement of some of the granular rubber material. This process will also require redistribution of the granular rubber across the system and resealing the self-closing cover around the edges of the STAPP™ system. MANG will inspect the internal reservoir system for punctures and cracks each time the granular material is sifted to remove and recover captured projectiles.

Figure 6-3. Internal Water Reservoir System

METRIC: *All cracks or punctures in the reservoir will be repaired. Repairs will be initiated within 5 working days of inspection, weather permitting. Camp Edwards will sample, collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm of rain (or 152 cm of snow) or after 15 or more cm of water*

accumulates in the reservoir. Water removal from the internal reservoir will be scheduled to occur within 72 hours, weather permitting.

Synthetic lumber support structure

The synthetic lumber support structure makes up the frame surrounding the rubber granular material and holds the impermeable liner and self-closing cover in place. Figure 6-4 at right illustrates damage to the support frame for the installed bullet containment system.

Figure 6-4. Example of Damage to STAPP™ Support Frame

METRIC: *Conditions that effect the distribution of granular material or integrity of the cover or liner will be noted on the Range Inspection Form. Units and range control will also note the firing lanes in which they occur. Range Control will capture the initial damage with a photo and Camp Edwards will make repairs in accordance with the process and schedule outlined in Section 6.3.1. Repairs will be initiated within 5 working days of inspection, weather permitting.*

5.2.2 Environmental Sampling and Analysis

As part of the Monitoring/Sampling BMP, Camp Edwards will sample a number of environmental media on T Range, including the water collected in the reservoir of the bullet containment system, groundwater, soil-pore water, and surface soils. Camp Edwards will sample the existing groundwater monitoring well and the proposed groundwater monitoring well after it is installed, see Figure 5-1 (repeated in this section for convenience).

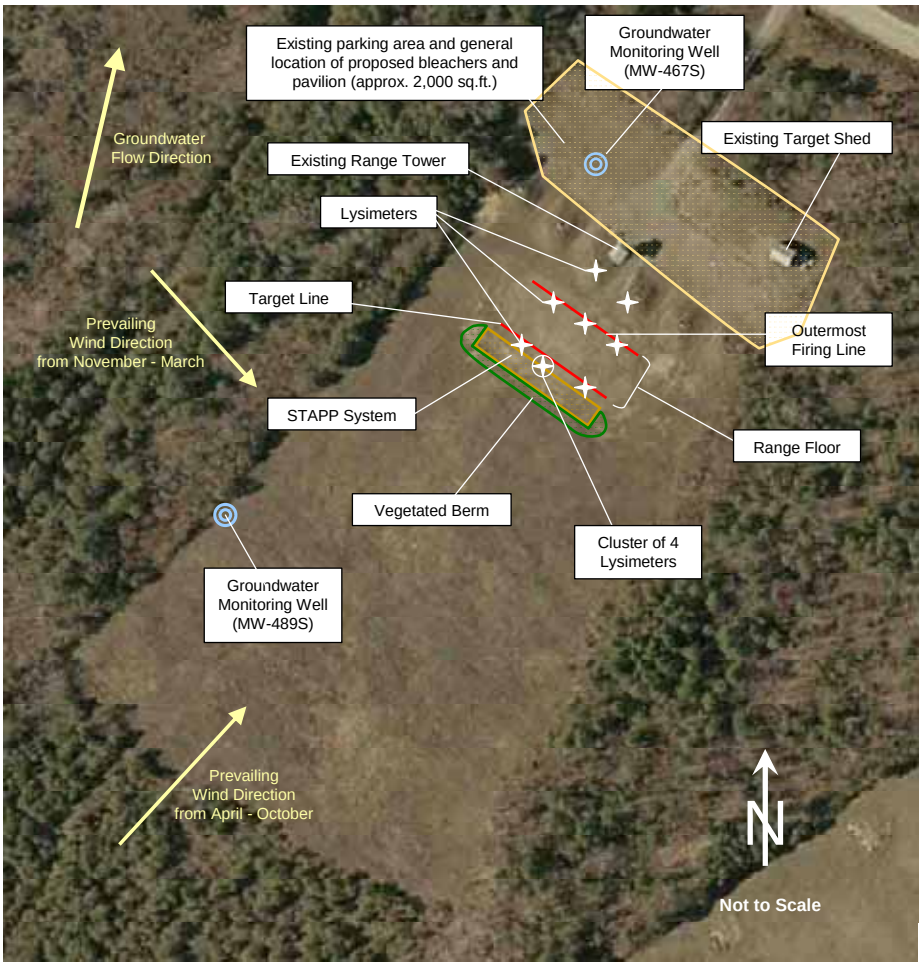

Figure 5-1. Aerial View

Also, Camp Edwards has installed lysimeters in soil under the toe of the bullet containment system and in front of the 25 m firing line. If chemical constituents from the ammunition are not contained by the system and begin to percolate through the soil-pore water toward the aquifer, the lysimeters will provide an early warning. Sampling and analysis will be coordinated with EMC, EPA, and MassDEP. The goal of the monitoring is two-fold: to validate the conceptual site model and to initiate routine range maintenance activities as needed to promote range sustainability. The following sections provide guidance for sampling and analysis of environmental media on T Range.

5.2.2.1 Water from Bullet Containment System

Experience has shown that the STAPP bullet collection systems accumulate water over time. It seems that precipitation makes its way through or under the upper membrane and collects at the bottom of the STAPP systems between the rubber membranes. Condensation within the system may also be a factor. Water has been emptied from all of the STAPP systems multiple times. The STAPP system on T Range collects the most water and has been emptied most often. Samples of the accumulated water have been collected several times to characterize the water in the STAPP system. Several metals have been consistently detected with antimony and zinc commonly detected at concentrations above drinking water standards. Therefore the water is pumped from the STAPP systems and disposed of off-site and not simply dumped out onto the range floor. The receiving facility specified a suite of analyses needed to characterize the water for disposal. Samples have also been collected from water that accumulated in the J and K Range STAPP systems in 2009 and 2011 to determine if the water in those systems shares the same characteristics. Metals concentrations have been similar in all three systems. The most recent samples were collected in from T Range in March 2011 and from J and K Range STAPP systems in April 2011. Results show similar concentrations to previous sampling events. Hence, process knowledge has been obtained and further sampling is not routinely needed. The disposal facility has agreed that the water is adequately characterized for disposal. Camp Edwards will continue to sample the water as needed to maintain compliance with the disposal facility's requirements.

Figure 4-6. Port Access for Water Inspection and Removal

To access the water, MANG personnel will access the STAPP™ system through the drain port as shown in Figure 4-6. The STAPP system will be inspected for the accumulation of water after significant precipitation events and in the spring after the water that accumulates over the winter thaws. The MANG will collect, and properly dispose of the liquid that accumulates in the corrugated plastic reservoir within the STAPP™ system after 15 cm or more of water accumulates in the reservoir. Camp Edwards will dispose of the water in accordance with all applicable state and federal laws and regulations. In no cases will water from the STAPP™ system reservoir be discharged onto the ground at the range.

5.2.2.2 Groundwater

Figure 5-2 indicates the location of the downgradient groundwater monitoring well (MW-467S) and the location of the upgradient groundwater monitoring well (MW-489S). MANG will sample these wells annually in October for propellants and metals. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples.

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¶
After a series of consistent sampling results, Camp Edwards may employ "process knowledge" rather than sampling and analysis as a means of characterizing the water. To collect the water, Camp Edwards personnel will remove the self-closing rubber membrane at the corner of the trap and move enough of the granular rubber material to access the reservoir system cap. The cap is removed and the water in the reservoir will be emptied. ¶

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The groundwater samples will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007).

As per the request of EPA, all analyses will be conducted using unfiltered samples. This will provide a total concentration of both solid and dissolved metals. The MANG may, at its option, also collect and analyze a filtered sample to determine dissolved metals concentrations.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-3. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt.

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5.2.2.3 Lysimeters

Camp Edwards will install three lysimeters at the 25 m firing line at a depth of 5-6 feet and six more at the toe of the STAPP™ system (multiple depths of 3.5, 5 and 8 feet): at firing lane 4, between firing lanes 7 and 8, and at firing lane 10 (see Figure 5-2). Soil on the range floor is a potential hotspot for metals accumulation. Muzzle blast from small arms may deposit metals and energetic materials onto surface soils. Lysimeters will provide an early indication if dissolved metals are migrating through soil-pore water toward groundwater. Camp Edwards will sample the lysimeters three times during the first year of operations on T Range in April, August/September, and November/December based on a significant rain event. Lysimeters will be sampled twice annually, once before and once after the peak training season. Lysimeter sampling is inherently dependent on recent precipitation so some flexibility in sampling schedules should be anticipated. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples.

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The soil-pore water samples will be analyzed for lead, copper, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007).

Results will be compared to the interim action levels presented in Table 6-2. Any exceedence of those interim action levels will be reported to EPA and EMC within 48 hours of receipt (not counting holidays and weekends). Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the original result. The results of any resampling will be provided to EPA and EMC within 7 days of receipt of the results along with a proposed plan of action addressing the exceedence.

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5.2.2.4 Surface Soil

Camp Edwards will sample surface soil from two different areas on T Range: on the range floor to cover the multiple firing lines and along the toe of the berm. The MANG will notify EPA and EMC of upcoming sampling events at least 48 hours before the event commences so that EPA and/or EMC can observe sampling and collect split samples.

Unvalidated data will be forwarded to EPA and EMC within 48 hours of receipt by the MANG (not counting holidays and weekends). Results will be compared to the interim action levels presented in Table 4-1. Any concentrations exceeding the interim action levels will be noted in the results submittal and a proposed plan for resampling will be included pending data validation. Validated data will be forwarded to EPA and EMC within 7 days of receipt. Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the validated result. The results of any resampling will be provided to EPA and EMC within 48 hours of receipt. Resampling may not be needed to confirm exceedences of soil interim action levels where previous sampling events have also detected the same analyte. In this case, the accuracy of the result would not be in question so there would be no value in resampling. MANG will provide a comparison of the data over time to determine if there are any apparent trends but resampling would be optional.

In addition, where multiple replicate samples are collected from a single area, the relative percent differences (RPD) of lead and nitroglycerine concentrations between the replicate samples will be calculated to determine the repeatability of the sampling procedure. RPD is defined as the standard deviation of the data set divided by the average value of the data set expressed as a percentage. For example the RPD of the values 15, 20, and 25 is 16 %.

The average of the RPDs for lead and the average of the RPDs for nitroglycerine will be calculated. If the average of the RPDs for either analyte is greater than 25%, and if this variation affects the usability of the data set for making range maintenance decisions, the sampling plan will be modified in an attempt to obtain better quality (i.e. more repeatable) data. The sample areas might be sub-divided into smaller areas or a greater number of incremental sub-samples might be collected within a given sample area. A plan for improving the data quality, if it is decided that the available data is not adequate for decision making, will be provided within 14 days of deciding that improvement is needed. The plan will include a schedule for re-sampling. Note that in case where the detected concentrations in a sample area are all either well below the interim action levels or well above them, the data can be compared to the interim action levels and sample repeatability is not a significant issue. In those cases, re-sampling would not be beneficial.

Where multiple replicate samples are collected from a sample area, all replicates will be compared to the interim action levels.

Area 1 sampling area will be established on the range floor to characterize the deposition of metals and propellants in surface soils generated from muzzle blast. Area 2 sampling area will be established along the toe of the berm to assess any potential deposition of metals in surface soils from the bullets striking the targets, bullet containment system, and soil berm. Area 1 is

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approximately 44 m by 25 m and Area 2 is approximately 44 m by 5 meters. Since the action level is based on the original size of 35m x 5m, Area 1 will be broken into 5 sampling areas of 44 m x 5 m. Figure 6-5 shows the locations of the proposed sampling areas on T Range.

Once a year, in October, MANG will sample the surface soil in the sampling areas as outlined below:

Figure 6-5. Surface Soil Sampling Areas (Area 1 consists of 5 decision units ~ 44x5 meters each; Area 2 is 1 decision Unit ~ 44x5 meters)

- **Area 1:** A 100-point composite sample will be collected from 0 to 7.6 cm below grade. A second 100-point composite sample will be collected in the same manner, then ground in a puck mill. Grinding of the sample will improve homogeneity for analysis and create finer metals particles. The ground sample will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007). The unprocessed sample will be analyzed for lead, copper, zinc, and antimony (using method SW6010B) and tungsten (using method SW6020). Two 100-point composite replicate samples will also be collected in the same manner as described above, then ground in a puck mill. The replicate samples will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), tungsten (using method SW6020), and nitroglycerine (using method 8330b) (USEPA 2007).

- **Area 2:** A 100-point composite sample will be collected from 0 to 7.6 cm below grade. A second 100-point composite sample will be collected in the same manner, then ground in a

puck mill. Both the ground and the unprocessed sample will be analyzed for lead, copper, zinc, and antimony (using method SW6010B), and tungsten (using method SW6020).

These sampling, processing and analytical methods will be re-evaluated after the first year of monitoring and thereafter for validation and refinement. Camp Edwards' staff will use a plug extractor to systematically collect representative samples from each grid and will not concentrate samples in one portion of the sampling grid.

Results will be compared to the interim action levels presented in Table 6-1. Any exceedence of those interim action levels will be reported to EPA and EMC within 48 hours of receipt (not counting holidays and weekends). Resampling, if required due to an exceedence of an interim action level, will occur within 14 days after receiving the original result. The results of any resampling will be provided to EPA and EMC within 7 days of receipt of the results along with a proposed plan of action addressing the exceedence.

5.2.2.5 pH

A neutral pH in soil will help reduce metals migration on the range. Lead is least mobile between a pH of 6.5 and 8.5. Within this range, lead binds more easily to clay and organic matter in the soil. Therefore, it is important to keep the pH of the soil as close to neutral (pH of 7) as possible to stabilize the lead in the soil. A neutral pH will inhibit corrosion and allow the lead in the soil to bind to clay and organic particles (ATSC 1998).

Limestone (lime) addition to surface soils is standard practice for increasing pH and neutralizing soils. A pulverized variety of lime will be applied before peak training season to increase its effectiveness. If large granules of lime are applied, it may take six months or longer to raise the pH of the soil to the desired level. Once the optimum pH is reached, it should be checked once a year and lime applied as needed to promote vegetative growth and prevent vertical migration of lead (ATSC 1998).

A recent sampling event found pH values on T Range are between 5.9 and 7.4 in the first one foot of soil, with a median of 6.4 (IAGWSP 2007). Camp Edwards will test soil pH twice annually – once before and once after peak training season. To determine the average soil pH of each area, 6–12 soil samples will be collected at a depth of 15 cm along the firing line and along the toe of the berm. The soil samples will be mixed thoroughly to accurately represent soil from the sampling locations (Clemson 2007b). The soil samples will then be tested for pH. Camp Edwards will manage the soil pH through soil amendment with lime with the goal of maintaining neutral soil pH (see Section 6.3.6).

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5.3 Range Maintenance

Camp Edwards will conduct periodic maintenance on T Range to ensure it remains in adequate condition to support training requirements and design features and BMPs function as intended. To the maximum extent possible, maintenance will be conducted during off-peak training periods (between October and April). This preventative maintenance will be conducted as soon as needed, regardless of other maintenance schedules. Maintenance and repairs at T Range will be documented in a maintenance log and summarized in an Annual Range Maintenance Report.

5.3.1 Bullet Containment System

The bullet containment system on T Range consists of a soil berm, the STAPP™ system, and a geotextile tarp covering the top of the berm to prevent erosion along the top and sides of the STAPP™ system. The tarp will be visually inspected for weathering, holes, or tears. Holes in the tarp greater than 10 cm in size will be repaired with like material. Repairs will be initiated within 5 working days of inspection, weather permitting.

Based on the unit observations reported on T Range Inspection Forms and Range Control's visual inspections, the following steps will be taken to repair holes or tears to the self-closing rubber membrane cover of the STAPP™ when granular rubber filler material is clearly visible through external inspection.

1. Sand the perimeter of the damaged area.
2. Wipe area clean using rubbing alcohol.
3. Cut a repair patch of the self-closing rubber membrane that is slightly larger than the damaged area to allow a 2.5–5 cm overlap. (The overlap provides a sound surface to which the repair patch adheres.)
4. Sand and wipe clean the underside of the repair patch.
5. Place a bead of the STAPP™-supplied glue on both the perimeter of the damaged area as well as the coordinating under side of the patch.
6. Lay the patch on top of the damaged area and apply hand-pressure.

The glue provided is made of cyanogeneacrylate; therefore, the manufacturer recommends breathing protection for large repairs (STAPP 2006). The same procedures will be conducted to repair any perforations in the impermeable liner material using appropriately matched materials and adhesives. Damage to the STAPP™ support frame will be repaired on an as needed basis. The time required to complete minor repairs is generally less than 10 minutes. Larger repairs may require up to 30 minutes for a properly equipped worker.

After either 15 cm of precipitation or an observation of 5 cm of liquid in the reservoir, Camp Edwards personnel will sample, remove, and dispose of the water in the internal reservoir system per the guidelines outlined in Section 6.2.2.1.

5.3.2 Periodic Metals Removal

Camp Edwards will remove bullets from the STAPP™ system after completion of the initial year of training. In subsequent years, bullets will be removed after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first. Camp Edwards will use either the specially designed STAPP™ sifter, or a compatible system, for removing metals from the STAPP™ system. This unit has a very simple design consisting of a table positioned at a defined slope with a small vibrator positioned on the underside of the table. The granular rubber and bullet mixture is placed onto the table, and due to the vibration slowly moves down the slope of the table. A piece of piping at the end of the table is connected to a cyclone vacuum with a high-efficiency particulate air (HEPA) filter. The vacuum has enough suction to remove the granular rubber but not the bullets. The granular rubber is sucked up via the cyclone and the air is filtered with a HEPA filter (see Figure 6-6). Total mass of metals removed from the bullet containment system will be compared with the total computed mass loading of bullets fired on T Range from the Training Facility Utilization Reports (see Appendix A). This comparison is indicative of the efficiency with which the STAPP™ system eliminates the source of metals on T Range. This process must be conducted with appropriate environmental protections as required. At a minimum secondary containment must be placed in all active work areas where metal removal will occur. Prior to work beginning, contractors or in house personnel conducting this work will coordinate with Range Control and MANG Environmental to ensure that the proper environmental protections are in place.

Figure 6-6. STAPP™ Sifter

5.3.3 Interim Triggers for Focused Assessments and Maintenance Actions for the Initial Year of Fire Operations on T Range

Based on the results of soil, lysimeter and groundwater sampling described in Section 6.2.2, Camp Edwards will initiate range characterization and maintenance actions to prevent pollution of the environment, in coordination with the EMC, EPA, and MassDEP. The need for maintenance actions will be indicated by comparing monitoring results to a series of action levels. The type of action necessary will be dependent on the media being sampled/analyzed and the action level triggered (see action levels presented in Tables 6-1, 6-2, and 6-3). The action levels in the tables below are interim numbers for the time period of July 2007 to December 2008 of operations on T Range. As such, they are subject to change as more information is developed on the leaching potential of these compounds and the effectiveness of the P2 plan as a whole. These action levels will be periodically reviewed (per Section 7.3) in coordination with the EMC, MassDEP and EPA.

The surface soil action Level 2 numbers are based on modeled potential for leaching to groundwater calculated using proposed sampling areas (of approximately 35 m x 5 m) and a

sample depth of 3 inches. Level 1 numbers are derived by taking 50% of the Level 2 numbers and are established to ensure close monitoring of elevated analyte concentrations in surface soils. The action levels for surface soil are provided in Table 6-1.

Table 6-1. Interim Surface Soil Action Levels for the Initial Year of Fire Operations on T Range

Analyte	Level 1 Resampling and Validation[1]	Level 2 Focused Reassessment[2]
Lead	4,535 mg/Kg	9,070 mg/Kg
Antimony	1,750 mg/Kg	3,500 mg/Kg
Nitroglycerine	5 mg/Kg	10 mg/Kg

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. The purpose of the Focused Reassessment will be to evaluate the cause, and assess the hazards. Results will be reviewed with stakeholders and may result in modification of the Conceptual Site Model. If reassessment verifies sampling results, MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., soil removal). Actions may include temporary suspension of the use of the range.

Soil-pore water action level numbers are based on a relevant drinking water standard (or similar risk-based concentration) for the respective compound. Level 1 numbers are based on one-third the drinking water standard and require resampling and validation of results. Level 2 numbers are based on one-half the drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the drinking water standard for the respective compound and will require some form of range maintenance activity to address the risks to human health and the environment. Action levels for soil-pore water are provided in Table 6-2.

Table 6-2. Interim Soil-Pore Water Action Levels for the Initial Year of Fire Operations on T Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Range Maintenance[3]
Lead	10 ug/L	15 ug/L	30 ug/L
Copper	867 ug/L	1,300 ug/L	2,600 ug/L
Antimony	4.0 ug/L	6.0 ug/L	12 ug/L
Nitroglycerine	3.2 ug/L	4.8 ug/L	9.6 ug/L

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause or need for action and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow on action could result. MANG will coordinate with the EMC, EPA, and MassDEP to identify appropriate maintenance actions (e.g., dust control, pH control, soil removal).
3. Range Maintenance may include soil removal, resampling, or temporary suspension of firing on the range. The range will be reconstructed once favorable results from the post excavation sampling are received. Soil removal may not be required if a removal action has already been conducted based on soil monitoring results.

With proper BMP implementation, surface soil and soil-pore water monitoring, and appropriate maintenance actions, MANG does not anticipate significant detections of target analytes in groundwater samples. Therefore, detection at Level 3 concentrations provided in Table 6-3

reflects a potentially serious condition that could require significant actions, such as a cease fire at the T Range. Level 1 numbers are based on one-third the relevant drinking water standard (or equivalent risk number) and require resampling and validation of results. Level 2 numbers are based on one-half the relevant drinking water standard and will require a reassessment of the Conceptual Site Model and more focused investigation of the mechanism of contamination. Level 3 numbers are based on the relevant drinking water standard and require significant corrective actions such as cease fire and reassessment of the P2 program.

Table 6-3. Interim Groundwater Action Levels for the Initial Year of Fire Operations on T Range

Analyte	Level 1 Sampling and Validation[1]	Level 2 Focused Reassessment[2]	Level 3 Cease Fire and Maintenance Action[3]
Lead	5.0 ug/L	7.5 ug/L	15 ug/L
Copper	434 ug/L	650 ug/L	1,300 ug/L
Antimony	2.0 ug/L	3.0 ug/L	6.0 ug/L
Nitroglycerine	1.6 ug/L	2.4 ug/L	4.8 ug/L

Notes:
1. Results exceeding Level 1 will be validated through resampling and analysis.
2. Focused Reassessment will include resampling and validation of results and an evaluation of the cause and review of the results with stakeholders. Possible modification of the Conceptual Site Model and follow on action could result.
3. Groundwater concentrations at or above Level 2 concentrations require significant actions including cease fire at the range, a complete reassessment of the pollution prevention program and follow on assessment and possible remediation.

Nitroglycerin has been detected in soil samples taken from the center of the firing line at T Range in concentrations up to 47 mg/kg. In response to these findings, Camp Edwards will initiate a range maintenance project at T Range to remove the nitroglycerin contaminated soil as agreed to during coordination with the EMC, EPA, and MassDEP about the results of soil sampling described in Section 6.2.2.4.

MANG anticipates the need to conduct periodic soil removal maintenance every three to five years, depending on the volume of training and the results of surface soil sampling outlined in Section 6.2.2.4. During this periodic soil removal, Camp Edwards anticipates removing 3 inches of surface soil from the firing line (the depth of past nitroglycerin detections) of T Range (approximately 43 m wide and 6 m downrange). MANG will use earthmoving equipment and hand tools to remove approximately 60 tons of soil. The removed soil will be placed in drums, characterized through a complete TCLP metals series, and disposed of at an approved and permitted facility, in accordance with state and federal solid and hazardous waste regulations. MANG will replace the removed soil with clean fill and revegetate the area. The costs associated with the labor, equipment, soil characterization, transportation and disposal, and clean soil is estimated at between $15,000 and $20,000.

5.3.4 Protective Timber "Sand Boxes"

The protective timber "sand boxes" behind the target frames will be evaluated to identify deterioration, damage or excessive amounts of undershot. The top surface of the geotextile tarps covering the boxes will be inspected periodically for signs of wear and tear in order to prevent rain from infiltrating into the sand in the center of the wooden frame. Large holes in the tarps will be patched with like material. The density/amount of bullets lodged in the wooden face of sand boxes will be inspected bi-weekly and by each using unit to check for bullet ricochet hazard. Once the wooden face of a sand box is full of bullets, the box will be rotated 180º to reveal the clean backside towards the firing line. After one rotation, when the wooden face is full of bullets again the sand box will be refurbished or replaced with a new sand box.

5.3.5 Vegetative Cover and Wind Breaks

At the beginning (March) and conclusion (October) of the training year, the Camp Edwards Range Control will coordinate the spread of MassHighway Seed Mix, as required, on areas of the T Range floor, elevated mounds behind firing line, and backstop berm supporting the STAPP™ that have less that 50% vegetative cover. If during the course of the training year, the T Range Inspection Forms identify areas of low vegetative cover, Range Control shall coordinate and schedule range maintenance as soon as growing conditions allow. Maintenance activities will be timed and conducted as to not interfere with scheduled training and to avoid cumulative impacts.

Forested buffers, serving as natural windbreaks and noise abatement, will be maintained around T Range. Each year in March, before the peak training period begins, FE will trim tree limbs on the range boundary. Any diseased or dead trees may be removed, as advised by E&RC. The down-range area of the range fan from the STAPP™ system to the tree-line will be allowed to naturally revegetate. FE will clear this range maintenance with Range Control to minimize interference with any scheduled training on the range.

5.3.6 Soil pH

When soil pH levels are neutral, lead remains relatively unavailable for migration in soils. Camp Edwards will amend soils with material to increase alkalinity, typically lime, with a goal of maintaining neutral soil pH.

Limestone products come in four types: pulverized, granular, pelletized, and hydrated. The finer the particle size of the limestone the faster it will change the soil pH value. When lime is added to the soil, maximum contact with the soil is essential.

Ground calcitic limestone (calcium carbonate) is faster acting than ground dolomitic limestone (calcium-magnesium carbonate) and is recommended for addition to the sandy soils on site. To raise the soil pH from 5.9 (the lowest measured pH on T Range) to 7.0, 5–8 lb of ground calcitic limestone will be added per 100 ft^2 of soil. Soil amendments should be spread evenly over the soil using a spreader and will affect the top 2.5–5 cm of soil. It will take approximately one to two years for the soil to fully reflect the pH change (University of Minnesota 2007; Clemson 2007a).

Figure 6-5. Surface Soil Sampling Areas (Area 1 consists of 5 decision units ~ 44x5 meters each; Area 2 is 1 decision Unit ~ 44x5 meters)

6.0 CONCLUSIONS AND CONTINUAL IMPROVEMENT

6.1 Conclusions

MANG will conduct marksmanship training on T Range, using standard lead-bullet ammunition, including use of tracer ammunition. This training will include:

- Familiarization, zeroing, marksmanship practice and alternate qualification using the 5.56mm rifle (M16 and M4) and machine gun (M249) and the 7.62mm machine guns (M240 and M60); and
- Familiarization, zeroing, marksmanship practice and alternate qualification using all calibers (i.e., .22, .357, .38, .40, 9mm, .45, .44) of pistols.

Based on the CSM for T Range, evaluations of SAR P2 BMPs conducted in the SAR P2 Overview, and the feasibility assessment contained in Section 4.0 of this document, MANG will satisfy the requirement of AO2 to employ "maximum feasible use" of P2 technologies by:

- Implementing a system of range upgrades and BMPs that will either sever potential migration and exposure pathways or monitor environmental conditions to confirm that pathways remain incomplete.
- Implementing a "contain, maintain, and monitor" approach to SAR BMPs that will include redundant methods to prevent pollution (e.g., bullet containment, pH management, erosion control) and methods to assess the effectiveness (e.g., inspections, sampling) of each system in each environmental media (e.g., soil, groundwater). This approach will include:
  - Managing metals on T-Range at their source, through containment in the STAPP™ system and periodic removal and recycling.
  - Monitoring potential migration pathways, such as surface soil, soil-pore water, and groundwater, to evaluate whether contaminants metals are being transported in environmental media.
  - Implementing a number of other monitoring and maintenance BMPs to sustain the conditions on T Range that limit metals mobility (e.g., monitoring the condition of the bullet containment system, maintaining healthy vegetation on range areas to prevent soil erosion, maintaining wind breaks to limit windborne metals transport, and maintaining soil pH to minimize corrosion/dissolution of metals into groundwater.

MANG believes that implementing these SAR BMPs will support the adjustment of the environmental performance standards established in Chapter 47 of the Acts of 2002, Section 10(d). Through these BMPs, MANG will demonstrate that the resumption of small arms marksmanship training on T Range is protective of the drinking water supply and wildlife habitat on Camp Edwards.

The BMPs selected and described in this BMP OMM Plan will support the employment of small arms on T Range in a manner that meets training requirements while protecting human health and the environment. As training requirements change, MANG may seek to conduct additional training activities on T Range. As environmental conditions or the understanding of conditions change, it may become necessary to add or modify management actions to protect human health

and the environment. All such modifications to training activities or management action will be fully coordinated with the EMC, EPA, and MassDEP.

6.2 Record keeping

To facilitate the periodic review and continual improvement of this plan and, in turn, the management of T Range; MANG will document operations, monitoring, and maintenance. Table 7-1 identifies the records that MANG will maintain for T Range. These records will be maintained indefinitely and will become part of the permanent real property records of the site.

Table 7-1. Recordkeeping Procedures

Record	Contents	Frequency	Responsible Office
Range Utilization Report	• Use days • Munitions expenditures by type, quantity, and using unit	Annually	Range Control
Range Condition Inspection Report	• General conditions • Erosion • Vegetation • Bullet containment system	Quarterly	Range Control
Environmental Sampling and Analysis Report	• Water from bullet containment systems • Groundwater • Lysimeter • Soil • pH	Annually	E&RC
Range Maintenance Report	• Bullet containment system • Periodic metals removal (mass, locations, and methods) • Vegetation • Soil pH	Annually	Range Control
Periodic Review Report	see Section 7.3	Annually	E&RC
Photologs	see Section 6.2.1	As Needed	Range Control

6.3 Reviewing and updating this plan/Periodic Review

MANG will conduct periodic reviews of this plan to evaluate whether training activities, environmental conditions, and BMPs on T Range remain protective of human health and the environment. The first review will take place in Fall 2007, assuming the range returns to live-fire in Summer 2007. Subsequent reviews will occur when MANG desires to significantly modify the training activities at T Range, when MANG becomes aware of information that indicates environmental conditions are not protective of human health or the environment, or at an interval not to exceed 3 years. The E&RC will provide a progress report for the operation of T Range in the annual State of the Reservation Report.

The purpose of periodic reviews is to answer three general questions:

- Are the BMPs on T Range functioning as intended?
- Are the assumptions used at the time of BMP selection still valid?
- Does new information indicate that the previously selected BMPs are no longer protective of human health and the environment?

Stakeholders and regulators will be involved in the periodic review process through coordination with EMC. MANG will notify EMC and the Small Arms Range Working Group at the time the periodic review is initiated to seek their involvement. Another notification, including notification of the availability of results, will be made when a review is completed.

The periodic review will consist of an evaluation of the records described in Section 6.2, as well as the identification and review of new information, a site visit, and preparation of a short Periodic Review Report. MANG will identify readily available information regarding T Range that has become available since implementation of this plan or the last periodic review. New information may also be gathered through interviews with persons knowledgeable about the site, including stakeholders such as adjacent property owners, local agencies, and regulators. MANG will gather information pertaining to the following areas:

- New training missions or training activities supported on T Range;
- Modifications to the layout of T Range;
- New development or changes in land use in the vicinity of T Range (on and off installation);
- Recreational or other new activities at T Range or in the vicinity of T Range;
- Changes in accessibility to T Range;
- Changes to statutes, regulations, or policies effecting the use and management of T Range; and,
- New technologies or techniques that can cost effectively improve training or environmental conditions at T Range.

MANG will prepare a short Periodic Review Report to document the information collected and evaluated, and present the findings of the evaluation to EMC and EPA in coordination with MassDEP and other stakeholders. The report will document whether training activities and BMPs continue to be protective of human health and the environment. The report will also recommend follow-up actions, as warranted. Based on the conclusions drawn in the report, MANG will update the T Range BMP OMM Plan to reflect recommended actions. A draft of the modified T Range BMP OMM Plan will be coordinated with EMC, EPA, MassDEP, and other stakeholders for review and comment. Final copies of the plan will be made available to these stakeholders.

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Appendix A
Training Facility Utilization Report

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CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT

This form will be completed by all units/ organizations conducting training at Camp Edwards IAW CE Reg 385-63, AUG 2006. Return form to Range Control upon completion of training.

UNIT:	**UIC**:	**COMPONENT**:
ADDRESS:		**DATE OF TRAINING**:
POC CONTACT NUMBERS	**DSN**:	**CELL**:
NAME/ RANK / LAST 4 RANGE OIC:	**NAME/ RANK / LAST 4 RANGE RSO**:	
NUMBER OF PERSONNEL TRAINED:	**RANGE HOT TIME**:	**RANGE COLD TIME**:

FIRING LANES USED DURING TRAINING
(circle the lanes used): **1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29**

WEAPONS SYSTEMS:	**TYPE OF AMMUNITION**:	**NUMBER EXPENDED**:

VEHICLES BY TYPE PRESENT ON RANGE:	**QTY**:

BIVOUAC AREA USED:	**NUMBER of PERSONNEL**:	**NUMBER of NIGHTS**:

TYPES OF EXERCISES CONDUCTED:

AAR COMMENTS:

SIGNATURE OF RANGE OIC/ RSO:
DATE:

Appendix G Camp Edwards Regulation 385-63 Range Safety, AUG 2006

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CAMP EDWARDS TRAINING FACILITY UTILIZATION REPORT			
GRID COORDINATES FOR THE FOLLOWING TRAINING MUST BE PROVIDED			
Activity	**TYPE**	**Location 6 digit**	**Other**
Small Arms Simulated	Blank / Simunition / Paint Ball		
RSOP (FA Dry Fire)			
Convoy Overlay	DAY / NIGHT		Number of Ve
Dismounted Training			
ISBC Scenario & Overlay			
Command Post Ex			
Heavy Equip Operations:			
Land Nav Course	I / II / III / Mounted		
Excavations:	STANDARD / NON-STANDARD*		
	*If NON-STANDARD has request been approved? YES / NO		ATTACH APROVAL
Describe Excavation training:			
OTHER :			

TRAINING AREA / ROAD CONDITION ASSESSMENT						
	RANGE(S) / TRAINING AREA(S) OCCUPIED					
OBSERVATION						
Minor erosion or obstruction(s)						
Movement difficulty, erosion or obstruction(s)						
Movement severely impeded, erosion or obstruction(s)						
Vegetation damaged, soil disturbed						
Bare ground and soil disturbed						
Denuded of vegetation and / or soil disturbed						
Other Training Land damage or improvement						

E = Excellent; G = Good; F= Fair; P=Poor; N=Needs improvement

Appendix B
T Range Inspection Form

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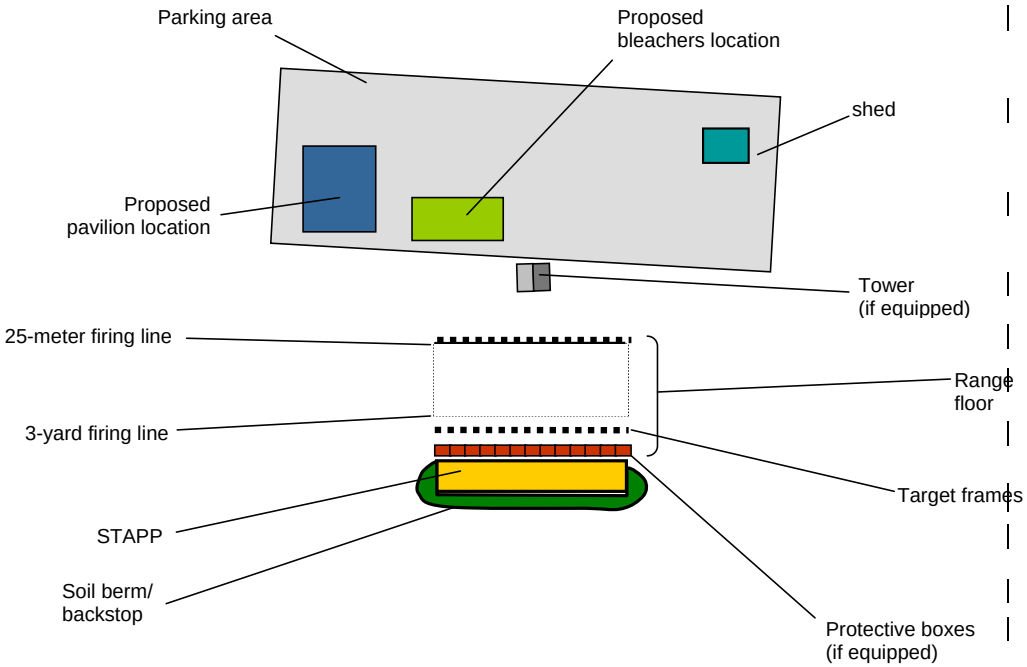
A.	Administrative Data		
Range:	Date:	Range Control Observer:	
Unit:		Unit OIC:	Comp:

B.	STAPP System Inspection		
	Pre-Fire Inspection	Post Fire Inspection	Remarks
1. Check site for POL / CLP stains, leaks, spills	GO / NOGO	GO / NOGO	
2. Did sand boxes protect base of STAPP?	GO / NOGO	GO / NOGO	
3. Holes, tears, damage to sand box tarps?	GO / NOGO	GO / NOGO	
4. Is the STAPP cover in need of repair?	GO / NOGO	GO / NOGO	
5. Are there separations on cover seams?	GO / NOGO	GO / NOGO	> 1" / > 6"
6. Any bulging or irregular settling of rubber granular material?	GO / NOGO	GO / NOGO	
7. Is synthetic lumber framing in good condition?	GO / NOGO	GO / NOGO	
8. Any fresh signs of over / undershot?	NA	GO / NOGO	
9. Ponding of water on cover/ water leaking from STAPP?	GO / NOGO	GO / NOGO	
10. Does water inspection port have water visible, 15cm?	GO / NOGO	GO / NOGO	
11. Was any soot / smoke released from STAPP?	Yes / No	Yes / No	
12. Use diagrams to indicate locations of items 1-9 and other impact effects / damage. Use reverse to describe any special situations.			

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	21	23	24	24	26	27	28	29



Generic STAPP Site Plan Not to Scale – Oct 08

C.	Remarks

E. STAPP™ detailed inspection

This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel 3 times per training year: in the fourth week of March before training begins, in the fourth week of July during training season, and in the fourth week of October once peak training period is completed.

1. What is the depth of water in the reservoir? Less than 2 inches / Greater than 2 inches

   If more than 2 inches deep, how deep is it?: _____

2. Any significant irregular settling or bulging of granular rubber material? NO YES
   This may be indicative of a problem with the liner. The material must be at an even level across the STAPP to stop bullets effectively. The minimum depth of material at any one point should be 15 inches deep. If yes, please describe: _____

3. Complete the photo log at the end of this form, documenting site features listed in log. Photos should be taken of the firing line, the soil berm, bullet containment system, and range floor. Note any field observations on the log.

4. Notes regarding need for repair and maintenance: _____

F. STAPP™ internal inspection

This shaded portion of form to be completed by Range Control.

Units using the range do NOT need to complete this section.
This inspection is to be completed by Camp Edwards personnel when the bullet sifting of the STAPP system is conducted after 500,000 rounds have been fired on T Range or every 3 years, whichever occurs first. At that time, all of the granular rubber material is removed.

1. Is the water collection unit and surrounding support structure in good condition? NO YES
   *Look for any conditions which would allow water to be released to ground surface. If no, please describe:*_____

2. Any perforations of the impermeable liner? NO YES
   *Inspect the liner for any holes, rips, punctures, or seam failures. If yes, please describe:*_____

4. Notes regarding need for repair and maintenance:_____

Photo Log:

Photo No.	Date	
Location: Firing Line from firing position No 4 Range: T Range		
Description		Place photo here

Photo No.	Date	
Location: Soil Berm from firing position No 4 Range: T Range		Place photo here

Description		
Photo No.	Date	Place photo here
Location: Bullet Containment System from firing position No 4 Range: T Range		
Description		

Photo No.	Date	Place photo here
Location: Range Floor from firing position No 4 Range: T Range		
Description		

Photo No.	Date	
Location: Firing Line from firing position No 13 Range: T Range		Place photo here
Description		

Photo No.	Date	
Location: Soil Berm from firing position No 13 Range: T Range		Place photo here
Description		

Photo No.	Date	
Location: Bullet Containment System from firing position No 13 Range: T Range		Place photo here
Description		

Photo No.	Date	
Location: Range Floor from firing position No 13 Range: T Range		Place photo here
Description		