BARNSTABLE SHOOTING RANGE
INITIAL ASSESSMENT

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1.0 INTRODUCTION

The Town of Barnstable is developing information to aid in determining the future of Barnstable Shooting Range. This range is located in the Town's West Barnstable Conservation Area and is a short distance south of Route 6 (Mid-Cape Highway), west of a dirt trail known as Crocker Road, and north of a power line right-of-way (Figure 1).

The Shooting Range consists of three individual ranges oriented for shooting in a south and south-west direction: a) 100-yard rifle range, b) 25-yard handgun/pistol range, and c) shotgun range. The rifle and pistol ranges have been cleared to beyond the backstops, while the shotgun range has been cleared to approximately 75 yards where a small berm has been built. The total area of the clearings is less than 2 acres with the ranges being separated by side berms and/or wooded areas, and surrounded by undisturbed wooded conservation property. The area to the south of the ranges is heavily wooded and used by hunters, hikers and other recreational users. The nearest residence is approximately 0.1 mile north of the range across Route 6, and based on review of available aerial photos, the closest residence downrange appears to be about 1.5 miles to the southwest.

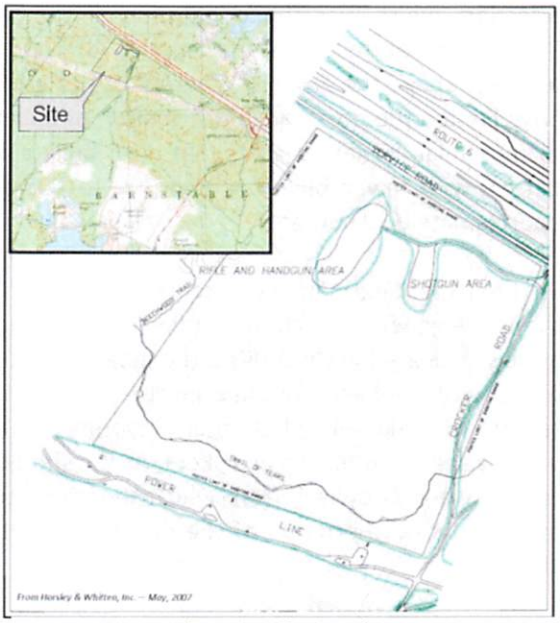

Figure 1 - Site Location

According to a history of shooting at the site (Houle, 2014), informal shooting began at the site in a sand and gravel pit in the 1960s or earlier. Since then, the Town acquired the property and shooting ranges were constructed. As use increased, so did sound, safety, and other issues. The Town hired a consultant to complete an Environmental Stewardship Plan (Horsley Witten, 2003) and a Master Plan for the Barnstable Shooting Range (Horsley Witten, 2007). The latter report proposed a 4-phase upgrade and expansion of the ranges. Recently, the Town suspended shooting to address issues relating to insurance and concerns raised by the Division of Conservation Services, part of the Massachusetts Executive Office of Energy and Environmental Affairs.

This report constitutes an initial step toward developing information to support planning for the future of the Barnstable Shooting Range site. This effort, intended as a scoping exercise, provides planning-level approximations of the present distribution of lead in surface soils from past shooting at the site, and outlines the activities and provides an estimate of the potential costs to(a) remediate the range site, or (b) develop modern shooting ranges at the site. This information will assist the Town in moving toward selecting one of these options or some combination of them for implementation at the site.

2.0 DISTRIBUTION OF LEAD

2.1 Overview

The site history (Houle, 2014) indicates that during the years of informal shooting in the sand and gravel pit at the site, rifles, pistols, and shotguns may have been fired in "any direction". Even so, it is reasonable that shooting toward Route 6 was probably not extensive. It is also likely that most shooting was to the south in an arc from generally northwest to southeast. As the ranges became better established, the orientation of rifle and pistol shooting became more fixed in a south-southwesterly direction, which was the orientation of the sand and gravel pit (see "Circa 1968 Overlay" in Site Photographs at the end of the report). Rifle and pistol shooting is generally at stationary targets on or a few feet above the ground. Whether or not a backstop existed in the early years, the thick woods may have limited the downrange distribution of bullets fired at targets on or near the ground. Experience at many similar ranges suggests that most bullets would be found on the backstops, range floors and side berms, with fewer bullets within 300 to 600 feet of the shooting positions in a downrange arc of approximately 30 degrees.

Shotgun shooting may have occurred on the rifle range, and while it may have been predominantly in the same general direction as rifle shooting, that is not necessarily the case. After the shotgun range area was cleared in the 1980's, the majority of shooting was probably in a southerly direction, but there may well have been shooting in other directions. While some shooting may have been at stationary targets, the majority of shotgun shooting was probably done at clay targets thrown into the air at various angles, as in trap and skeet. At the shotgun range there has not been a fixed location from which targets were thrown or from which shooting occurred. This suggests that shooting was likely from the area at the northern end of the range at targets thrown by hand or portable trap machines near the shooters.

Most shotgun shooting at clay targets is with ammunition that has a maximum range of 700 to 800 feet (230 to 270 yards) (EPA, 2001; NSSF, 1997). Thus, most shot would be expected within these distances from the northern end of the range. However, shotgun shooting may have occurred at the rifle and pistol ranges, at least in earlier years, as well as on the present shotgun range. Thus, shot may be distributed in an approximately 180-degree arc south of Route 6 (e.g., generally from northwest to southeast of the shooting positions). At trap and skeet fields, relatively little shot accumulates close to the shooters and the shot accumulation is usually greatest between about 125 to 200 yards from the shooting positions (EPA, 2001; NSSF, 1997), and drops off rather quickly beyond about 250 yards. Experience suggests that is reasonable to expect a similar pattern at the Barnstable Shooting Range. While the berm may have stopped some shot, it is expected that the majority of shot is behind the berm because of the elevated angle of shooting at airborne targets.

2.2 Sampling and Laboratory Analyses

At an outdoor shooting range the cumulative distribution of lead from all shooting *de facto* determines the actual size and shape of the range, unrelated to any administrative or other property designation based on other considerations. Based on Section 2.1, sampling of surficial soils was conducted to identify the approximate distribution of lead associated with past shooting at the site. The information obtained was used to:

(1) estimate the perimeter of lead distribution and thus the limits of a 'lead management area',
(2) approximate lead concentrations within that perimeter, and
(3) support the development of cost estimates for either remediating the site or developing modern shooting ranges.

Because this was a scoping exercise intended to provide only planning-level approximations of the present distribution of lead for these three purposes, detailed sampling and analysis were neither necessary nor appropriate. Whichever management option the Town selects, additional sampling will be required before implementation to more precisely define the distribution of lead in relation to applicable thresholds.

2.2.1 Sampling Locations

Surficial soil samples were collected on November 9, 10, and 11, 2014 from an area approximated by a 180-degree arc of 300-yard radius in a general pattern of 4 transects radiating from the shooting positions on the shotgun range and 3 transects radiating from the rifle range shooting positions, modified and augmented in response to observations during sampling. In addition, samples were collected on the backstops and floors of the three ranges. The locations of the 87 samples are shown on Figures 2, 3 and 4.

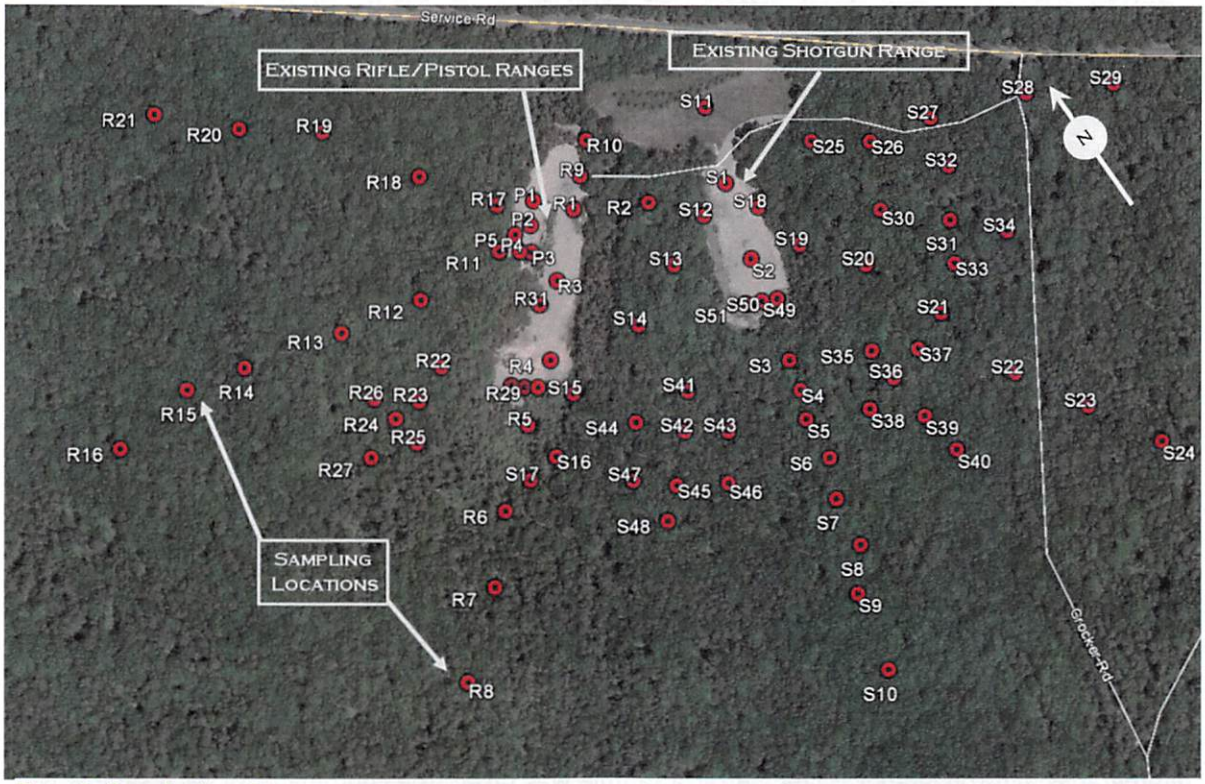

Figure 2 - Sampling Locations

At each location, surficial samples were collected by raking away any leaf litter, then sampling several square inches of the duff[1] and about an inch of the underlying mineral soil with a hand trowel. Samples from the backstops and shotgun berm consisted of the top 6 inches of material collected with a small spade. Samples were placed in zip-closure bags, and labeled with indelible marker with the date and

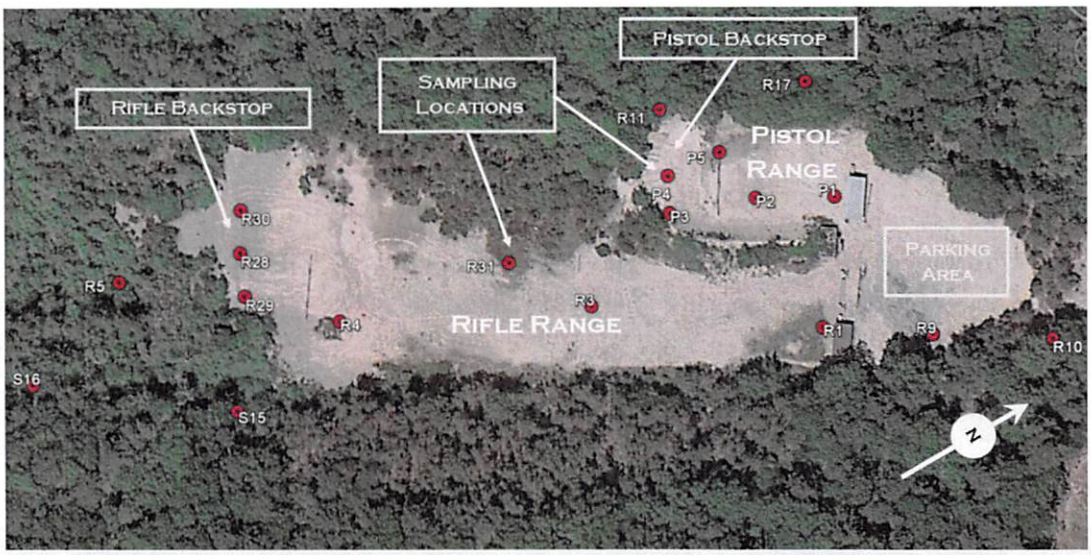

Figure 3 - Sampling Locations near Rifle-Pistol Ranges

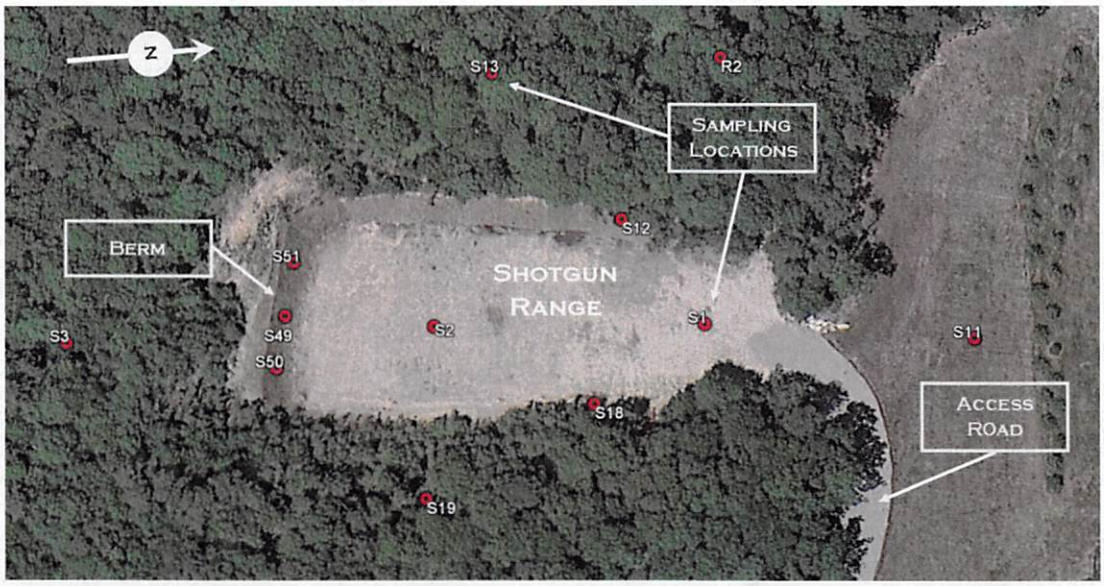

Figure 4 - Sampling Locations near Shotgun Range

location of the sample. Initial locations were determined by use of a compass, range finder, pin flags, air photographs and topographic maps. After a sample was taken, the coordinates of each sample were

[1] Duff is the layer of moderately to highly decomposed leaves, needles, fine twigs, and other organic material found between the litter layer and the mineral layer of the forest floor.

recorded in a field notebook to 0.001 degree as indicated by a hand-held global positioning system (GPS) unit, along with field observations and notes. Photographs were taken to document conditions, some of which are presented at the back of this report (see Site Photographs). Upon completion of sampling, samples were verified, cataloged, and shipped to the MT2 laboratory in Arvada, Colorado.

2.2.2 Laboratory Analyses

Each sample was logged in, oven dried, and weighed when it arrived in the laboratory. Lead concentrations were determined by X-ray fluorescence (XRF) using standard laboratory procedures. XRF has proven to be a reliable, quick, and inexpensive screening tool for metal concentrations in shooting range soils. XRF measurements of lead were recorded from a minimum of three points in the sample. The sample was then screened through a series of sieves sized to separate bullets, shot, and other material of similar size, followed by a second set of XRF measurements.

For each sample, steel shot and other ferrous material were removed magnetically from the material retained on the sieves, and bullet jackets that had separated from bullets were removed by hand. These materials were combined and weighed. Non-metal material retained on the sieves was discarded. The remaining material on the sieves (i.e., bullets, bullet fragments, and lead shot) was then weighed and recorded. This weight, less the weight of steel and non-magnetic bullet jackets, was recorded as the percent lead in the original sample. A visual estimate of percentage of steel shot was made using a magnet to separate the steel from remaining lead shot.

A pH reading was obtained for 15 representative samples using EPA method 9045D for Soil and Waste pH. Using this procedure, the sample was mixed with reagent water for a period of time using a magnetic stir plate, and the pH of the resulting aqueous solution measured and recorded.

2.3 ANALYTICAL RESULTS

The analytical results for the 87 samples are presented in Tables 1A, 1B and 1C, found in the back of this report. For the 87 samples, the lead concentrations ranged from 35 parts per million (ppm) to 28,811 ppm. The maximum and minimum values generally associated with the three ranges follow:

Range	Pistol Range	Rifle Range	Shotgun Range	Entire Range
Minimum Value (ppm)	154	35	50	35
Maximum Value (ppm)	4,880	28,811	27,453	28,811
Number of Samples	5	31	51	87

It should be noted that sampling for the Pistol Range was limited to the current floor and backstop, thus only 5 samples were taken. The samples allocated to the Rifle Range include locations adjacent to and west of the Pistol Range. This is because the primary objective of the field work was to determine distribution of total lead in the surficial soils, followed by a qualitative assessment of shot vs. bullets distribution. The following summarizes the number of samples containing shot and/or bullets:

Type of Ammunition	Number of Samples	% of Samples
Shot	37	43
Shot and Bullets	10	11
Bullets	9	10
Neither Shot nor Bullets	31	36
TOTAL	87	100

Among the 47 samples that contained shot, steel shot was only found in samples associated with the Shotgun Range; comprising 0% to 8% of the total amount of shot, and averaging about 3%. For the 15 samples tested for pH, the values ranged from 4.2 to 6.95. Those samples taken from distances greater than 150 yards downrange had pH values below 5. Those samples with pH values at or above 6, were located on range floors or backstops.

2.4 TYPES OF AMMUNITION FOUND IN SURFICIAL SOILS

As discussed above and presented in Tables 1A, 1B, and 1C, 56 soil samples contained shot, bullets or both. The distribution of these forms of ammunition, as depicted in Figure 5, supports the idea that some historic shooting did occur in a wider pattern than would typically be expected.

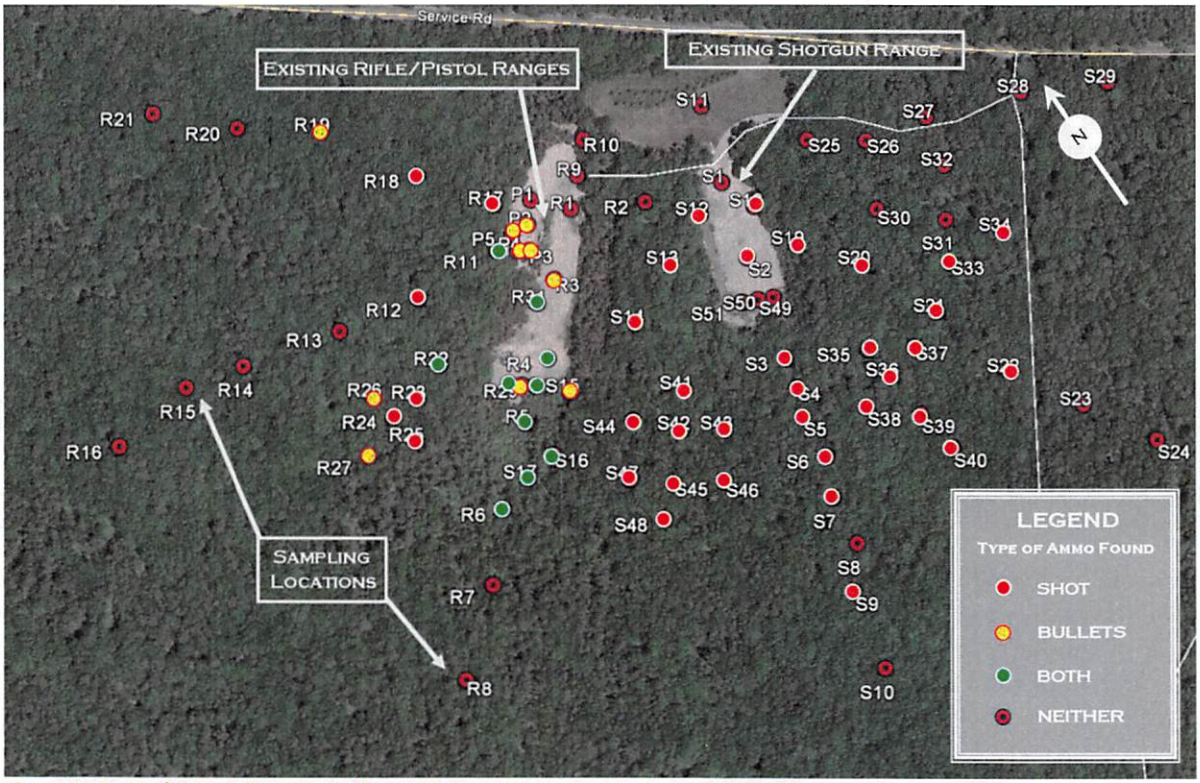

Figure 5 - Type of Ammo found in Surface Soils

2.5 LEAD DISTRIBUTION IN SURFICIAL SOILS

To illustrate lead distribution across the site, the lead values plotted on Figure 2 were contoured to show the outer perimeter of samples exceeding each of two lead concentrations. One of the contoured concentrations is based on State Standards for Lead in Soil published at 310 CMR 40.0975. These state standards are established for 3 categories of soil use defined by criteria found at 310 CMR 40.0933. The 3 categories of soil use are summarized as follows:

- Category S-1 applies to soil associated with unrestricted use. Activities commonly associated with the S-1 soil category include residences, playgrounds, and schoolyards. Based on sensitive uses of the property and accessible soil, either currently or in the foreseeable future, lead concentrations up to 200 ppm are acceptable for Category S-1 soils.
- Category S-2 applies to soil associated with moderate exposure, including infrequent (or light) use by children. Activities commonly associated with the S-2 soil category include non-residential uses such as retail and landscaped areas. Based on property uses associated with moderate exposure and accessible soil, either currently or in the foreseeable future, lead concentrations up to 600 ppm are acceptable for Category S-2 soils.
- Category S-3 applies to soil associated with potential incidental ingestion and/or dermal contact with the soil. Activities commonly associated with the S-3 soil category include commercial and industrial uses. Based on restricted access and property with limited potential for exposure, either currently or in the foreseeable future, lead concentrations up to 600 ppm are acceptable for Category S-3 soils.

If appropriate on a case-by-case basis, other site-specific numerical standards for soil in any category may be negotiated with State agencies based on risk assessment methodologies.

The criteria found at 310 CMR 40.0933 for category S-2 appear to describe most closely the soil use of West Barnstable Conservation Area around the range. Therefore, 600 ppm lead was used as the basis for defining the area for addressing lead under the two site management options discussed in Section 3.0. The area within the 600 ppm lead contour in Figure 6 is approximately 20 acres.

The other contoured concentration is based on the use of soil in construction of modern ranges (Section 3.3), if that option is implemented. Soil with greater than 5,000 ppm lead would be excavated, treated, and used in construction of modern ranges. The area within the 5,000 ppm lead contour in Figure 6 is just over 7 acres.

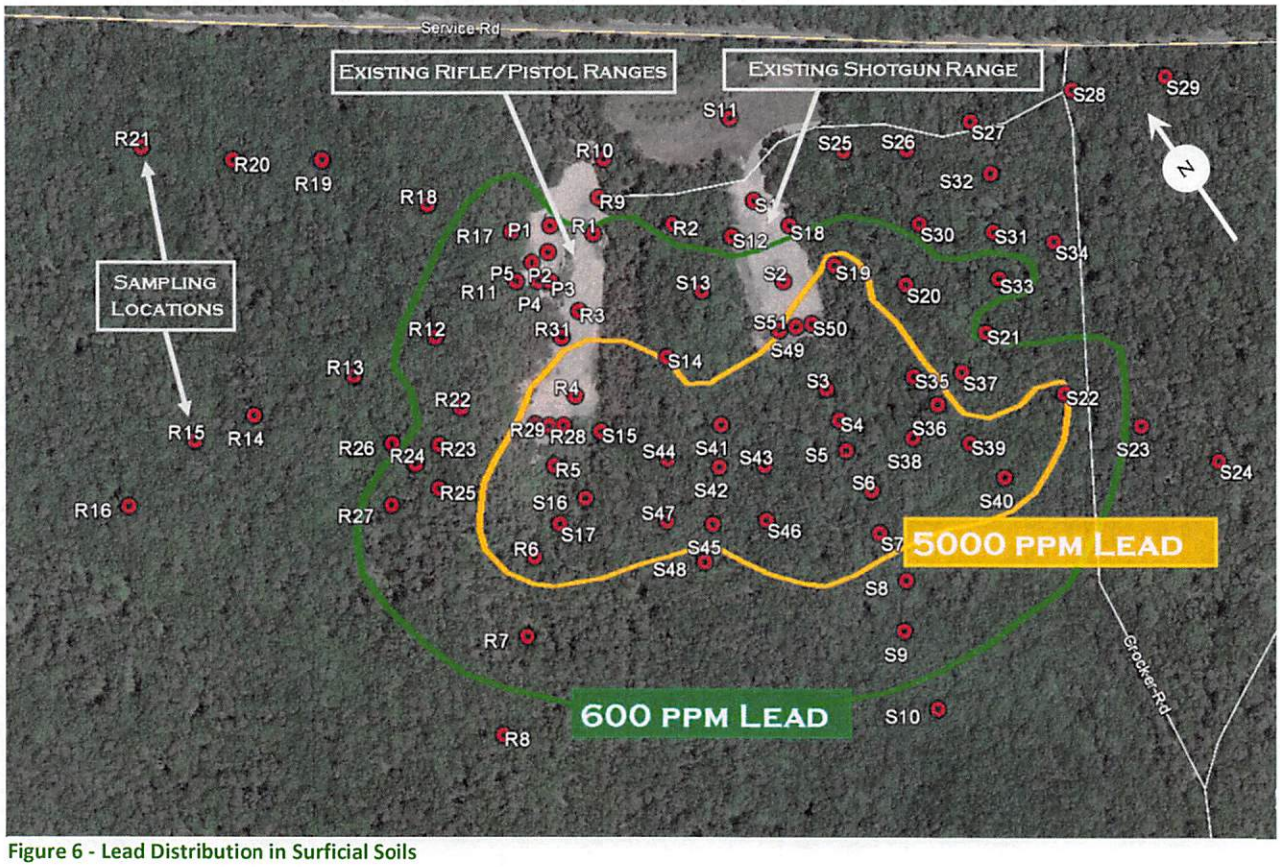

Figure 6 - Lead Distribution in Surficial Soils

3.0 MANAGEMENT OPTIONS AND COST ESTIMATIONS

3.1 OVERVIEW OF SITE MANAGEMENT OPTIONS

There are two fundamental options for management of the present Barnstable Shooting Range, although there is the possibility of multiple variations under each option. The two options for the site considered here are:

(a) Remediation
(b) Development of modern ranges

The basic option of site remediation is summarized in Section 3.2, and the basic option of developing modern ranges is summarized in Section 3.3. The summary of each option includes scoping-level cost estimates intended to be useful for planning purposes, but *not* intended for budgeting purposes. Unit costs for the various work elements are based on experience at similar ranges and/or discussions with vendors. The costs that are presented below are estimated capital costs; operation and maintenance costs are *not* included.

3.2 SITE REMEDIATION

The area considered for site remediation is shown in Figure 6. The remediation perimeter includes all locations where the pre-sieved samples exceeded the Massachusetts lead criterion of 600 ppm for soil (see Section 2.4). While this perimeter, which encompasses approximately 20 acres, might be more precisely defined by additional sampling and analyses, it is sufficiently well defined to support the scoping-level cost approximations of this project.

The major components of site remediation include the following:

- Work Plans/Design
- Sampling to provide a more precise definition of areas for clearing and excavation
- Permitting
- Silt fencing and other erosion control structures
- Tree clearing; approximately 18 acres
- Stump grinding on site and use of chipped materials for erosion control and mulch for revegetation
- Demolition and disposal of structures at the firing lines at the Pistol and Rifle ranges
- Excavation of soils containing greater than 600 ppm lead; approximately 40,000 cubic yards
- Screening of the existing Rifle and Pistol backstops and immediately adjacent areas with high lead content; approximately 2,000 cubic yards; reclaimed lead to be recycled
- Treatment/Stabilization of all excavated soils to below TCLP levels of 5 ppm lead, so they can be managed as a solid waste
- Transport of treated soils between 600-2,000 ppm and disposal within MA; approximately 8,500 tons
- Transport of treated soils greater than 2,000 ppm and disposal outside MA; approximately 50,000 tons
- Revegetation via Hydroseeding of disturbed areas, allowing natural encroachment of the surrounding forest.

THE ESTIMATED COSTS FOR REMEDIATION ARE BETWEEN $7.5 and $9.5 million.

The majority of the costs for this option are associated with the treatment, transportation and off-site disposal of the excavated soils. It is important to note that to develop these cost estimates, it was necessary to assume certain depths of excavation since all sampling was done at the surface. Based on experience at similar ranges, it was assumed that the depth of excavation varied with concentration, ranging from 0.5 feet near the 600-ppm perimeter to 1.5 feet within the 5,000-ppm contour. Additionally, it was assumed that each backstop and the shotgun berm would be entirely excavated.

Other factors included:

- Incorporation of proven and approved techniques widely used to stabilize lead so that the soils meet the regulatory standards for classification and management as solid waste.
- The State only allows soils with lead concentrations less than 2,000 ppm to be disposed in-state. Soils with lead concentrations greater than 2,000 ppm have to be transported and disposed of out-of-state.

A relevant consideration is that "remediation" means permanent cessation of shooting at this site. That in turn implies either permanent loss of recreational and law enforcement shooting capacity previously provided by the site, or developing equal or greater shooting capacity at some other site. If this shooting capacity is to exist in the future, doing so will require a decision about whether it is better to provide this capacity at this site, which has been historically used for that purpose, or to relocate everything associated with a range to another site that may or may not involve undeveloped land and other issues.

3.3 DEVELOPMENT OF MODERN RANGES

Any discussion of range development requires identification of the type and size of ranges to be developed consistent with anticipated needs. The range development considered herein approximates the type and size of the present ranges. If the Town should decide to develop smaller or larger rifle, pistol, or shotgun ranges, eliminate one or more of these types of ranges, or develop other range configurations, the cost estimates would have to be adjusted accordingly.

If this option is implemented, lead at the site should be managed consistent with the U.S. Environmental Protection Agency guidance "Best Management Practices for Lead at Outdoor Shooting Ranges" (EPA 2005). This U.S. EPA guidance is a major component of the Massachusetts Department of Environmental Protection (DEP) "Lead Shot Initiative" under which the agency manages lead at shooting ranges in the State. It has been the position of DEP that both historical and future depositions of lead at a shooting range site can be managed under a site-specific Environmental Stewardship Plan (ESP) consistent with the Lead Shot Initiative (Pinaud, 2014).

Under this option, soil that presently has lead above 5,000 ppm would be excavated, stabilized, and used in the construction of modern ranges, while areas with soil between 600 and 5,000 ppm would be managed according to the existing Environmental Stewardship Plan (ESP) developed for this site (Horsley Witten 2003).

In the context of developing modern ranges in this Initial Assessment, the "Lead Management Area" is defined by the 600 ppm lead contour except that the Area is expanded slightly to the north to include shooting positions of the new Shotgun, Rifle and Pistol ranges (Figure 7). In addition, a few acres would be required to support the ranges (i.e., access road, parking, support structures and a portion of the

Safety Zone (NRA, 2012)). While the perimeter of the Lead Management Area might be more precisely defined by additional sampling and analyses, this perimeter is sufficiently well defined to support the scoping-level cost estimations presented below.

3.3.1 Rifle and Pistol Ranges

Developing modern rifle and pistol ranges includes design consistent with the NRA Range Source Book (NRA, 2012). For the purposes of this report, it is assumed that each range would consist of earthen backstops and side berms, target stanchions, pavilions and bench rests at the firing lines, overhead baffles to intercept errant bullets that otherwise would overshoot the backstop. Some grading would be required to provide proper drainage. Similar to the existing ranges, the Pistol Range would be about 25 yards long and 40 feet wide, and the Rifle Range would be 100 yards long and about 40 feet wide.

The area of the existing Rifle and Pistol Ranges within the 5,000-ppm lead contour would be cleared, and the soil excavated, treated, and used as appropriate for the construction of new backstops, side berms, and perhaps range floors. In the area outside the 5,000-ppm contour, the terrain would be cleared only as necessary for construction of the new ranges and managing the existing lead. Within the Lead Management Area, lead from both historical and future shooting will be managed consistent with the site-specific ESP (Horsley Witten, 2003). This approach is consistent with U.S. EPA (EPA, 2005) guidance and the Massachusetts DEP Lead Shot Initiative (Pinaud, 2014).

3.3.2 Shotgun Range

The size and shape of the area described by the National Shooting Sports Foundation (NSSF, 1997) to accommodate a skeet field is not available at this site within the scope of this project. However, if there is flexibility to modify the range perimeter slightly, a trap field can be constructed, as described in this section. A trap field would result in deposition of shot over a defined area that is smaller and shaped differently than the shotfall area that has resulted from the informal shooting in the past. The modern Shotgun Range would consist of one complete trap field consistent with National Rifle Association (NRA, 2012) design, including an appropriate Safety Zone, where personnel would be precluded from entering during trap shooting. To optimize the location, the new trap field would be reoriented more to the southwest, and the shooting position moved to the east approximately 100 feet (Figure 7). This reorientation would provide the following benefits:

- The NSSF (1997) shotfall limits would be within the Lead Management Area (600 ppm contour)
- The Safety Zone would not impinge on Crocker Road
- The targets on the Rifle Range would lie outside the Safety Zone

Figure 7 and 8 depict the NSSF shotfall limits, and Safety Zone, respectively. The shaded area in the middle of the NSSF shotfall limits is from approximately 125 yards to 200 yards from the nearest shooters and will receive the majority of shotfall. This area would be graded to facilitate lead reclamation and, consistent with the ESP (Horsley Witten, 2003), maintained in grasses to minimize erosion. The area closest to the shooters would receive limited shotfall, but should be free of tall vegetation because the majority of used clay targets and wads would be deposited here. The outermost area would receive some shot and therefore is included in the Lead Management Area. The Safety Zone extends out to 300 yards and personnel should be excluded from this area during shooting activities.

For the new Shotgun Range, the area within the Safety Zone and the area within the 5,000 ppm lead contour (Figure 8) would be cleared and graded for safety considerations and to facilitate the necessary implementation of the site-specific ESP (Horsley Witten, 2007), particularly the lead shot reclaiming and recycling component. In addition, small areas may be cleared near the fringes of the Rifle and Pistol Range as necessary for the lead management and range construction components of developing those ranges. Lead from both historical and future shooting would have to be managed consistent with the full provisions of the ESP throughout both cleared and uncleared portions of the entire Lead Management Area (Figure 8).

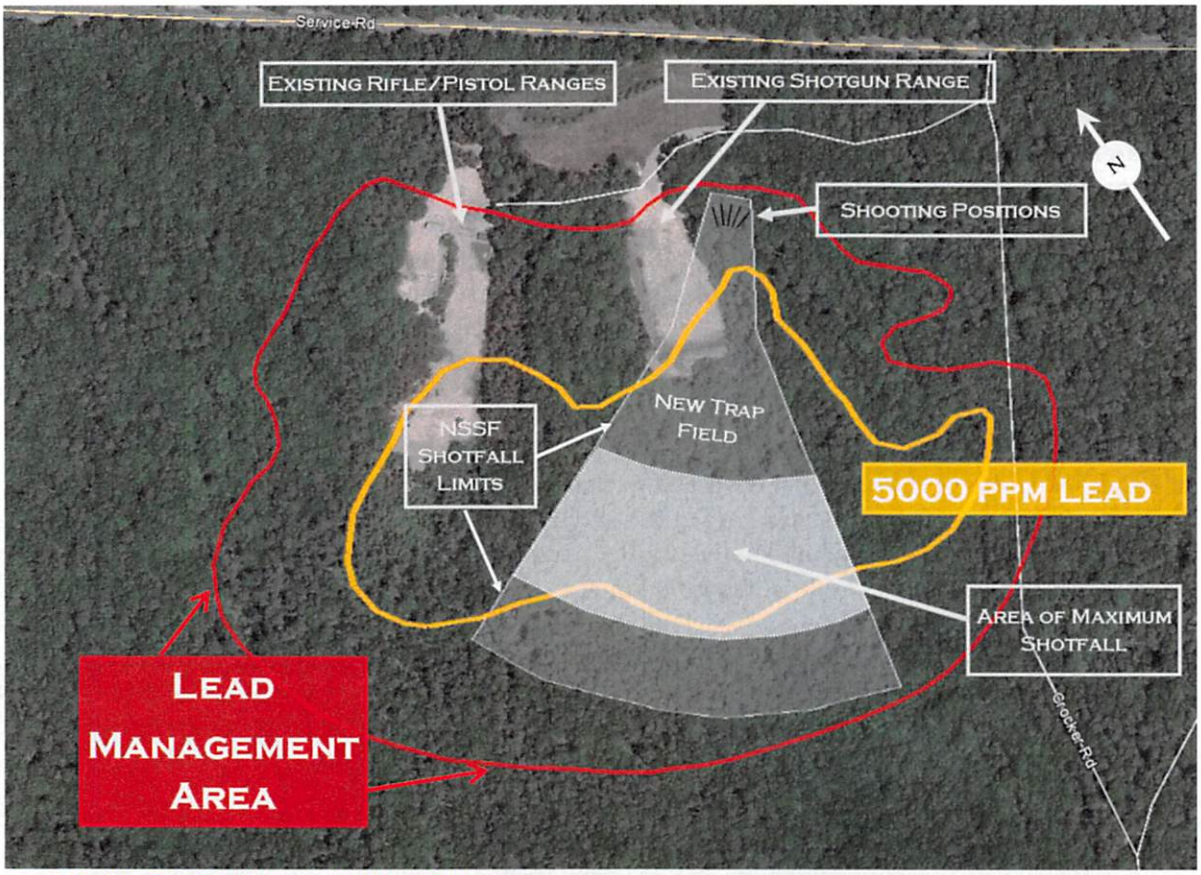

Figure 7 - New Trap Field showing NSSF Shotfall Limits

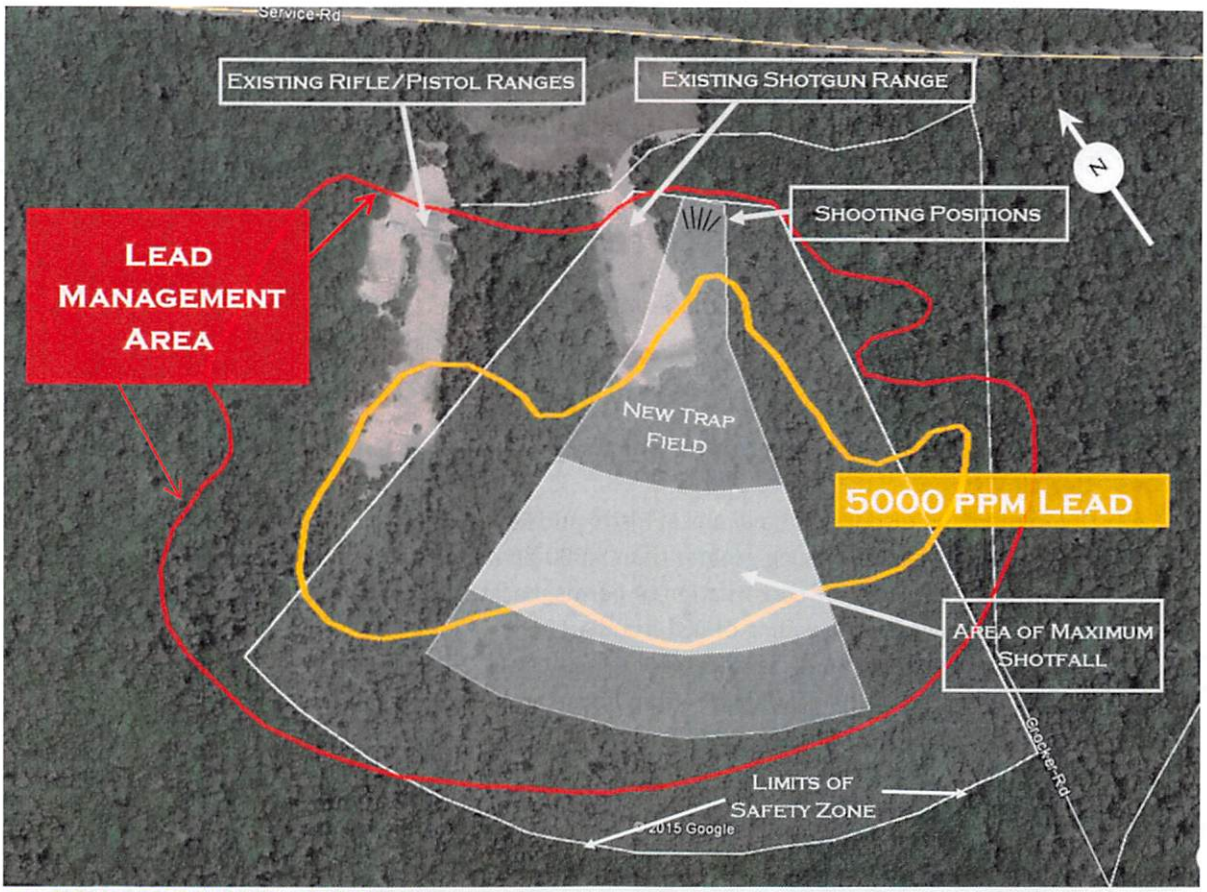

Figure 8 - New Trap Field showing Safety Zone

As described above for the Rifle/Pistol Ranges, the area within the 5,000-ppm contour would be cleared and the soil excavated, treated and used on-site for the construction of backstops, side berms, and range floors. The terrain outside of 5,000-ppm contour, but within the Safety Zone and Lead Management Area, will be cleared only as necessary for construction of the new range and to facilitate lead management according to the site-specific ESP, and federal and State guidance.

3.3.3 Development of Rifle, Pistol and Shotgun Ranges

The two major components associated with building modern ranges at the site are:

1. Lead management actions associated with the existing lead
2. Construction of modern ranges

Activities associated with the lead management actions include:

- Work Plans
- Soil Sampling
- Permitting
- Silt fencing and other erosion control structures
- Tree clearing

- Demolition and disposal of pavilions at Pistol and Rifle Ranges
- Excavation of soils containing greater than 5,000 ppm of lead; approximately 25,000 cubic yards
- Screening of the existing Rifle and Pistol backstops and immediately adjacent areas with high lead content; approximately 2000 cubic yards; recycle reclaimed lead
- Treatment/stabilization of excavated soils so they may be managed as solid waste; approximately 25,000 cubic yards
- Revegetation via Hydroseeding of disturbed areas

Activities associated with construction of modern ranges include:

- Work Plans/Design
- Soil Sampling
- Permitting
- Silt fencing and other erosion control structures
- Tree clearing
- Demolition and disposal of pavilions at Pistol and Rifle Ranges
- Excavation of soils containing greater than 5,000 ppm of lead; approximately 25,000 cubic yards
- Use of on-site soils in the construction of berms, backstops, range floors, etc.
- Revegetation via Hydroseeding of disturbed areas
- Grading of the Safety Zone, as necessary
- Building the Trap Field, including the trap house and shooting pads
- Building the Rifle/Pistol Pavilions
- Construction of overhead baffles on the Pistol and Rifle ranges
- Bringing electricity from service road to power the trap machine

THE ESTIMATED COSTS FOR DEVELOPMENT OF MODERN RANGES ARE BETWEEN $2 and $2.5 million.

The estimated range of costs associated with the two components is:

1. Lead management activities: $1.2 – 1.5 million, the majority of the cost being associated with treatment/stabilization of excavated soils. (While it may not be necessary to employ treatment technology at the site, doing so will stabilize the historic lead in the soils and reduce its environmental mobility. The assumption of excavation depth for soils greater than 5,000 ppm lead used in estimating costs for developing new ranges is the same as that used in estimating costs for the remediation option.)
2. Construction of modern ranges: $0.8 – 1.0 million, the majority of the cost being associated with the overhead baffles

4.0 SUMMARY

The purpose of this report is to assist the Town of Barnstable in developing information to support planning for the future of the Barnstable Shooting Range site. This effort, intended as a scoping exercise, provides planning-level approximations of the present distribution of lead in surface soils from past shooting at the site, and provides an estimate of the potential costs to (a) clean up the range site, or (b) develop modern shooting ranges at the site. While these are the two fundamental options for the Shooting Range, there is the possibility of multiple variations under each option.

87 samples were taken from locations across the site. These samples were sent to MT2's laboratory and analyzed for lead concentrations using XRF instrumentation. Additionally, pH and percent steel shot were determined on selected samples. Once the lead concentrations were determined, they were plotted on a site plan and contoured. The areas defined by these contours were used to develop estimated costs for the two options based on either experience at similar ranges and/or discussions with vendors.

Based on the analysis of the data gathered and the unit costs, it is estimated that the capital costs for the two management options are:

- REMEDIATION $7.5 – 9.5 million
- DEVELOPMENT OF MODERN RANGES $ 2 – 2.5 million

The major cost items for the remediation option include the treatment/stabilization, transport, and off-site disposal of soils containing lead. The State requires soils with concentrations over 2000 ppm lead to be disposed of out-of-state.

The major cost items for the modern ranges options include the construction of overhead baffles and the treatment/stabilization of excavated soils. While it may not be necessary to employ treatment technology at the site, doing so will stabilize the historic lead and minimize its environmental mobility.

5.0 REFERENCES

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TABLES
Laboratory Analytical Results

TABLE 1 – ANALYTICAL DATA

TABLE 1A PISTOL RANGE			
Sample Number	pH	Average Lead Concentration (ppm)	Total % Pb by wt. (g)
P1		154	0.0%
P2		2319	0.2%
P3	6.45	553	25.7%
P4		1642	30.9%
P5	6.71	4880	0.0%

LEGEND

- Bullets only
- Shot only
- Bullets and Shot
- Neither Bullets nor Shot

TABLE 1B RIFLE RANGE			
Sample Number	pH	Average Lead Concentration (ppm)	Total % Pb by wt. (g)
R1		670	0.0%
R2		249	0.0%
R3	6.16	2803	1.5%
R4		11915	2.1%
R5		12858	4.0%
R6	5.30	8129	5.0%
R7		1238	0.0%
R8	4.84	124	0.0%
R9		55	0.0%
R10		460	0.0%
R11		2296	1.5%
R12		1907	0.9%
R13	4.65	436	0.0%
R14		325	0.0%
R15		35	0.0%
R16		48	0.0%
R17		1628	2.5%
R18		235	0.4%
R19		356	0.6%
R20		88	0.0%
R21		59	0.0%
R22		1792	4.0%
R23		2510	1.8%
R24		2185	2.9%
R25		4195	2.1%
R26		495	1.9%
R27		1063	0.4%
R28	6.95	19661	17.1%
R29		28811	7.2%
R30		11163	15.7%
R31		4613	3.3%

LEGEND

- Bullets only
- Shot only
- Bullets and Shot
- Neither Bullets or Shot

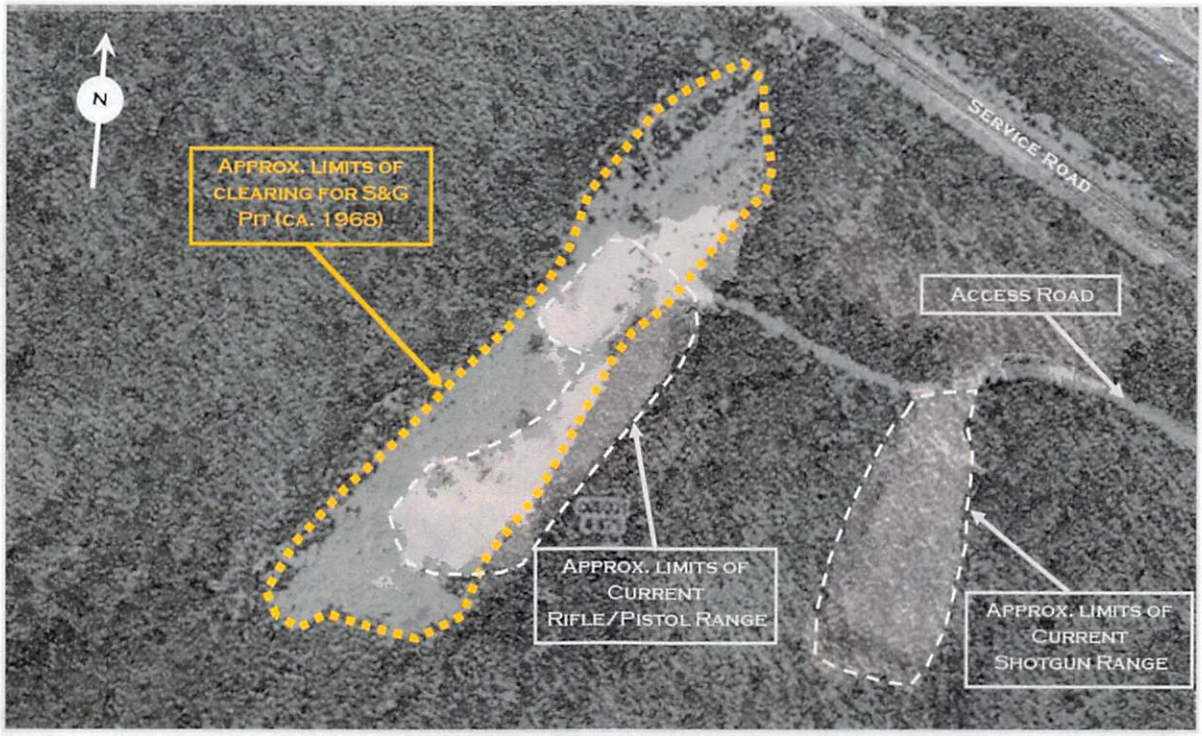
TABLE 1C SHOTGUN RANGE			
Sample Number	pH	Average Lead Concentration (ppm)	Total % Pb by wt. (g)
S1		59	0.0%
S2	6.40	50	0.3%
S3	5.31	16512	4.1%
S4		11941	6.6%
S5		27453	10.2%
S6		26460	16.4%
S7	5.63	9291	6.5%
S8		749	0.0%
S9		1360	1.8%
S10		214	0.0%
S11	5.69	57	0.0%
S12		295	0.2%
S13		1016	2.5%
S14		3183	2.3%
S15		20058	9.4%
S16	4.65	7401	14.0%
S17		12383	21.4%
S18		261	0.7%
S19		6001	3.1%
S20		929	1.4%
S21		318	0.1%
S22		5286	3.5%
S23		151	0.0%
S24		75	0.0%
S25		133	0.0%
S26		65	0.0%
S27		51	0.0%
S28		194	0.0%
S29		166	0.0%
S30		102	0.0%
S31	4.97	177	0.0%
S32		226	0.0%
S33		868	3.8%
S34		277	1.6%
S35		6442	3.5%
S36		6066	9.9%

TABLE 1C SHOTGUN RANGE (cont.)			
Sample Number	pH	Average Lead Concentration (ppm)	Total % Pb by wt. (g)
S37		1373	4.0%
S38		2486	3.3%
S39		5057	6.7%
S40		8319	2.7%
S41		8887	3.3%
S42		15907	8.1%
S43		23621	8.0%
S44		5452	3.0%
S45		14946	5.5%
S46		13008	6.3%
S47		4644	5.2%
S48	4.19	3933	1.8%
S49	6.50	81	0.0%
S50		195	0.0%
S51		103	0.0%

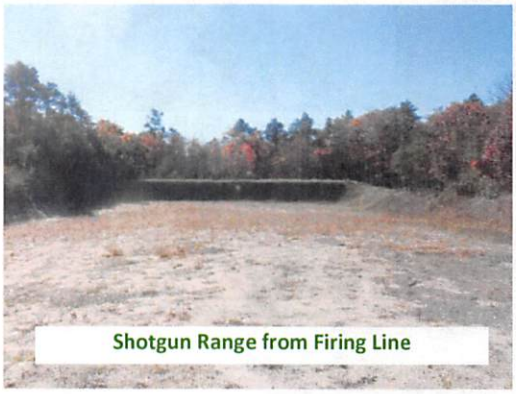
LEGEND

- Bullets only
- Shot only
- Bullets and Shot
- Neither Bullets or Shot

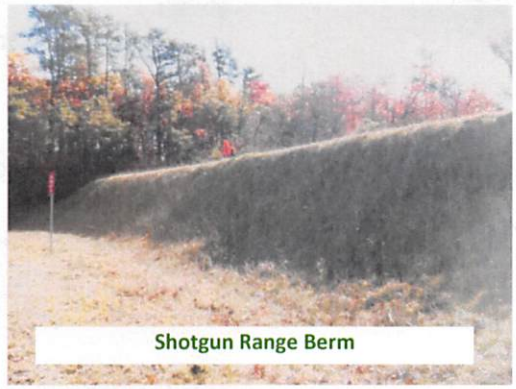
SITE PHOTOGRAPHS



Circa 1968 Overlay on Current Conditions

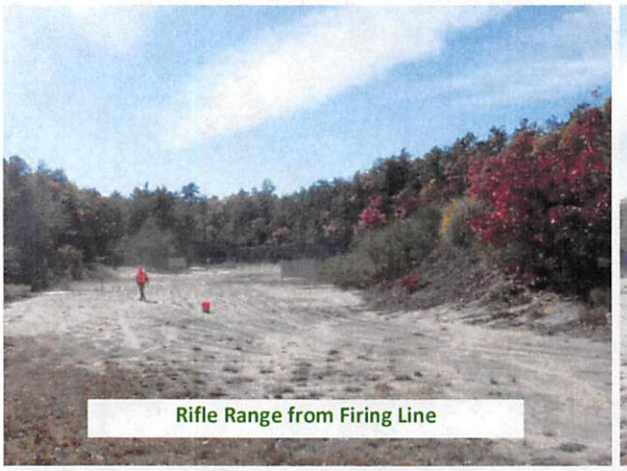


Shotgun Range from Firing Line

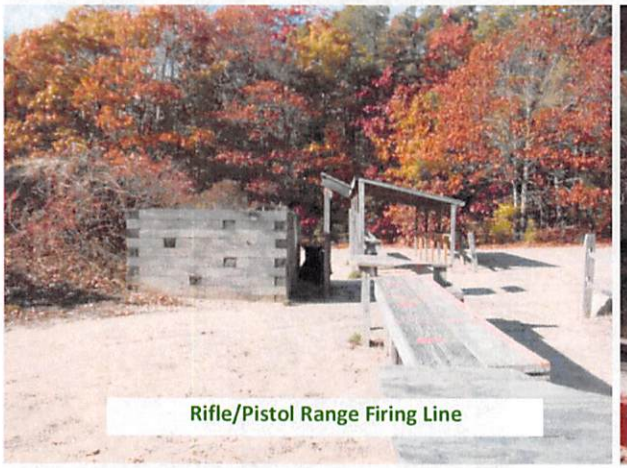


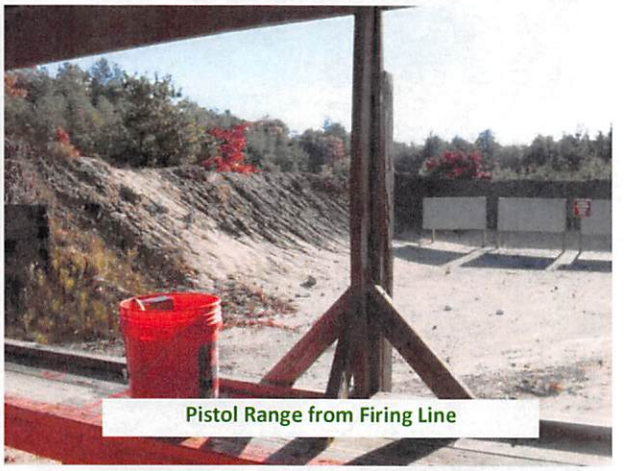
Shotgun Range Berm

Shotgun Range Side Berm


Rifle Range from Firing Line


Side Berm between Rifle and Pistol Ranges


Rifle/Pistol Range Firing Line

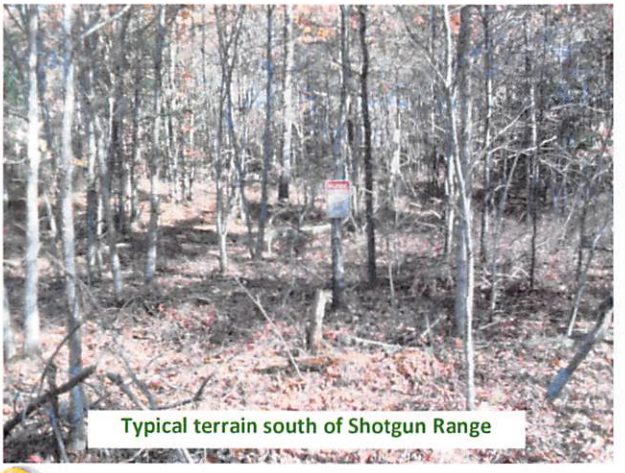

Pistol Range from Firing Line


Pistol Range Backstop


Shot scarring south of Shotgun Range


Elevated bullet scarring south of Rifle Range


Lodged bullets south of Rifle Range


Typical terrain south of Shotgun Range


Typical terrain south of Rifle Range