

ER Record I.D.# 0055658

ERID NO: 55658 DATE RECEIVED: 4/23/97 PROCESSOR: YCA PG COUNT: 22

PRIVILEGED (Y/N): N RECORD CATEGORY: P RECORD PACKAGE NO.: N/A

FILE FOLDER: N/A

CORRECTION (Y/N): N CORRECTED NO.: N/A CORRECTED BY: N/A

AR (Y/N): Y AR DESCRIPTION (D/G): N/A

MISCELLANEOUS: N/A

31101



22

55 655

Los Alamos
NATIONAL LABORATORY
memorandum
EXPLOSIVES TECHNOLOGY
M-1

To/MS: Calvin Martell, CLS-1, E525
From/MS: B. W. Harris, M-1, MS C920 *BWH*
Phone/FAX: (505)667-4574/(505)667-0500
Symbol: M-1:93-215
Date: September 1, 1993

SUBJECT: RESULTS FROM FIELD TEST

Attached are the results of our field test for explosives in the soil at Redondo Mesa (L-Site) and TA-14 (Q-Site). If you have any questions, please contact me at the above telephone or FAX number.

BW:l/pdg

Distribution:

J. C. Dullman
J. R. Stine, M-1
T. Rivera, M-1
T. Spontarelli
B. W. Harris *BC*
M-1 File

APR 23 1997
em

REPORT OF FIELD STUDY AT TA-67 (12) L-SITE
AND TA-14 Q-SITE

Wallace Haywood (Group CLS-4), Dexter McRae (Group CLS-4),
Jonathan Powell (Group M-1), and Betty W. Harris (Group M-1)

ABSTRACT

The results of the field investigation to determine the kind and concentration of explosives found in the soil and on articles at sites known to be contaminated with energetic materials are given in this report. We are concerned about safety and health hazards associated with some explosives, nitro-organics and organic nitrates. Results from the use of the old and new field-spot-test kits to detect the presence of energetic materials are given. Also included are data from the High Performance Liquid Chromatography (HPLC) analyses of acetonitrile extracts from Q-Site soil samples, and data from the Energy Dispersive X-Ray Fluorescence (EDXRF) analyses for hazardous metals on the same samples.

INTRODUCTION

On the morning of June 24, 1993, a team of field investigators lead by Calvin Martell, visited TA-67 (12) L-Site located on Redondo Mesa (Map 1). The purpose of the visit was to establish the feasibility of using the field spot-test kits to detect explosives in soil samples where there are known interferences from other media. The field investigation team consisted of Calvin Martell (Group CLS-1), Wallace Haywood (Group CLS-4), Dexter McRae (Group CLS-4), Peter Encinatis (Group MST-3), Steve Watanabe (Group CLS-DO), and Betty Harris (Group M-1). Field tests were run by Dexter McRae, Wallace Haywood, and Betty Harris.

L-Site was constructed in the spring of 1945 and used for approximately one year as an explosives test facility, but was abandoned in mid-1950. Inspection records of that decade indicate that several buildings, subsequently removed, were contaminated with explosives. In 1950 the Laboratory's Health Division used the eastern parameter of L-Site for radiation studies on animals and a section of the parameter became contaminated with radiation. During the Viet Nam War a portion of the site was used by a Laboratory group for "Mortar Locator" experiments in which an acetylene gas gun was part of the apparatus. There is a question about the possible contaminants from this study.

AREAS SAMPLED

The team sampled for unexploded energetic materials in the soil and on metal components around an inactive, closed-firing pit, TA-12-4 (Map 1) and B-19 (Map 2). This pit is steel-lined, partially submerged, hexagonal, and 8-ft per side by 12-ft deep. The pit was built in 1945, after a similar one was abandoned at Far Point, and used for approximately one year as a containment vessel for the detonation of explosives and weapons components. It was decommissioned in 1953. TA-12-4 and the soil that surrounds it is Solid-Waste Management Unit 12-001a (SWMU 12-001a) in Operable Unit 1085.

Also, we sampled for explosives in what is suspected as being the worst-case situation at L-Site, an inactive, open firing pit that lies about 200 yards due east of TA-12-4 on the north side of a utility road (Map 2). This open pit was used extensively in 1945, and on other occasions through 1953 to test weapons components containing uranium, possibly depleted uranium. The site is suspected of being contaminated with lead, uranium, and explosives. Visual evidence of yellow uranium oxide could be seen as far as eight feet from the pit on the east and north sides.

A few yards west of the open pit is an area with small chunks of formulated RDX, identified in the Group M-1 laboratory of Terry Spontarelli. The hard, rock-like pink pieces of explosives are scattered in a graveled semi-circle that has two trees at the outer south edge. Also collected was one piece of yellowish brown material believed to be both HMX, RDX, and possibly some other compound and a binder. This contamination, scattered chunks of explosives, may have resulted from a partial detonation in an attempt to dispose of explosives found in the area during the 1970s.

To ensure that we had test results from an area that is known to be contaminated, we sampled an active open firing Mound at TA-14 (Q-Site) (Map B). Q-Site has been used for development and testing of explosives since 1944. Swipes were taken from the first firing pad near the Control Room, TA-14-23, the back side of the retainer wall associated with this pad, and the surrounding soil about three feet from the firing pad.

In the afternoon of June 25, 1993, Dexter McRae, Wallace Haywood, and Betty Harris also sampled the soil and metal components in and around the gun facility located at the west end of TA-14, Q-Site (Map A).

Dried soil samples and articles from Q-Site, taken on a prior visit, were also tested using the spot-test kits. These samples had

been analyzed by high performance liquid chromatography (HPLC) for explosives and the hazardous metal concentrations were determined by Energy Dispersive X-Ray Fluorescence (EDXRF).

ANALYTES

We were interested in testing for 1,3,5-trinitrotoluene (TNT), 1,3,5-hexahydro-1,3,5-trinitrotriazine (RDX-Royal Demolition Explosive), 1,3,5,7-tetrahydro-cyclo-1,3,5,7-tetranitramine (HMX-High Melting Explosive), pentaerythritol tetranitrate (PETN), 1,3,5-trinitrophenylmethylnitramine (tetryl), (see Figure 1) and Explosive D, ammonium picrate, or ammonium-1,3,5-trinitrophenol.

SPOT TESTS

Old HE Spot-Test Kit - The old spot-test kit consists of three reagents known as:

Reagent A [an 80%/20% mixture of the solvent, N,N-dimethylformamide (DMF) and di-N-butylamine] is used to test for TNT and explosives that are similar in structure (aromatic amines),

Reagent B [tetra-N-butylammonium hydroxide in methanol with a fluorescence dye dissolved in dimethyl sulfoxide (DMSO), 2%/98%, as an indicator] is used to test for RDX, HMX, and PETN. Once applied, the solution is viewed under an ultra-violet to enhance the color of this test.

Reagent C [potassium hydroxide, water, DMSO, 5/5/90 wt%] is used to test for TATB, but gives a distinct color test different from that of TATB for other explosives such as tris-picrylamino-1,3,5-triazine (PYX), hexanitrostilbene (HNS), tetryl, and TNT.

New Spot-Test Kit - The new field spot-test kit consists of

Reagent C from the old kit, more concentrated, now called Solution 1,

Hydrochloric acid and sulfanilide - Solution 2, and

N-naphthalenediamine dihydrochloride - Solution 3.

EXPERIMENTS

While in the field, we swiped soil and metal surfaces of the closed firing pit (TA-12-4), the RDX visibly contaminated soil of a semi-circle, and the soil in an open firing pit. The latter two are located due east and near TA-12-4. We used both old and new field spot-test kits. We also sampled scoops of soil from these areas by putting the soil on the filter paper and adding the test reagent or solution. About ten gram samples from each location were taken back to the laboratory and tested with all of the reagents from both spot-test kits.

Reagent A and Reagent C/Solution 1 were used first. This was followed by all three solutions from the new kit. Note that Reagent B from the old kit, used to test for PETN, RDX, and HMX, was not used in the field, but was used to test all samples in the laboratory.

RESULTS

Hexagonal Closed Firing Pit, TA-12-4 (SWMU-12-001a)

The outer walls of the closed firing pit were swiped and the results were negative. Metal pieces on the ground near the opening of the pit were tested; all were negative. Surface swipes of the soil around the pit were tested; all results were negative.

On June 14, 1993, Ken Uher (Group M-1) was lowered into the pit. He took samples of the white residue on the walls and swipes from the inside walls, and soil from the bottom of the pit. All samples tested negative for explosives.

Open Firing Pit

All swipes of the soil surface and scoops of soil analyzed in the field at TA-12 were negative. The material believed to be Uranium oxide also tested negative for explosives. The very hard, formulated pink pieces of material found scattered in a semi-circle near two trees tested positive for RDX. When grains from these pieces were put into the soil, the soil tested positive. This material had been analyzed previously by Terry Spontarelli (Group M-1) and shown to be RDX and a plastic binder. The results of the laboratory test of soil samples are given in Table I.

Firing Pad 1 Associated with Pull Box (Capacitor Discharge Unit-CDU) TA-14-25

Three swipes were taken from the first firing pad near the control room (Map B); all were negative. A yellow material embedded in the center panel of the retaining wall of the firing pad tested positive for TNT. Swipes of the center wall were negative for TNT. Scoops of soil taken from approximately a three-foot circle around the pad were positive for TNT, although the color was very faint, this indicates a very low quantity of explosive in the sandy soil sample taken. Sand is brought in and placed over the mounds where firing operations are done. Table II shows the results of field spot-test kit for explosives on other samples taken at Q-Site.

The samples in Table IV, Fire Pad 3, were also analyzed for picric acid. The concentration was less than 0.2 mg/kg (<0.2 mg/kg). The area became contaminated with picric acid when a shot designed to dispose of waste explosives failed to detonate.

Q-Site, Gun Facility

We tested the firing pedestal, TA-14-44, for the Gun Facility located at the west end of Q-Site (Map A). This included a large barrel-shaped containment vessel, its metal components, and the soil. We obtained several questionable positive test that were not very intense, which caused us to worry about false positive. Results from these tests are given in Table III.

Q-Site Samples Previously Analyzed

About fifteen samples had been taken previously from Q-Site and analyzed by HPLC for the basic explosives, impurities, and decomposition products. We included these samples in our spot-test analyses and the results are given in Table II. The concentrations of the various explosives, HMX, RDX, tetryl, TNT, and 2,4-DNT, are given in Table IV. HMX was the most concentrated of all of the explosives in the soil (sand) with concentration ranging from a few tenths of a PPM to over three hundred PPMs. Firing mound 1 was the most contaminated.

Also, we analyzed for several samples for metals using EDXRF. The concentrations of metals and the screening-action level (SALs) are given in Table VI. SALs are concentrations of materials, that if exceeded, will require that a hazard assessment to be done. Values for the most concentrated of the toxic metals, chromium, mercury, lead, and uranium, are shown to be less than SALs. Therefore they would not pose a health hazard to workers.

The pH of the soil is also given. This is an important piece of data because it helps determine whether or not the metals are bound or migrating in the soil. Metals are mobile in most acidic soils. The pH values for Q-Site soils are shown in Table V. The pH of the soil is slightly acidic to slightly basic at Firing Mounds 1 and 2 and parts of Firing Mound 3. However, other parts of Firing Mound 3, a sample near an electrical cable at the west end of Q-Site, and a sample near the fire hydrant at the entrance gate were very acidic.

DISCUSSION

The chemistry of the field spot-test kit for explosives has been well established since the 19th century. The application to soils is being explored by several laboratories. Thomas F. Jenkins and Marianne E. Walsh (U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, New Hampshire) have made significant progress in quantifying a kit similar to ours for field studies. Our kit needs to be tested against the by-products and results from explosives in soils quantified.

Test for TNT and Related Compounds

TNT was not found in any of the soil samples tested at TA-12 (67). Yet it was the explosive used the most during World War II. The TNT is believed to rapidly biodegrade in nature after an undetermined length of time and, therefore, is not detected by the spot tests used. However, the brown pieces with bead-like crystals on their surfaces did test positive for TNT (See Table I). This material was not sensitive to a hammer blow.

At Q-Site East, a positive test for TNT was found in the solid taken from the containment wall at Mound 1, in the surrounding soil that was scooped up, but not in the soil that was swiped nor on the metal firing pad. Nearly all of the Q-Site samples shown in Table II gave negative test results for TNT, although the HPLC analyses showed ppm concentration levels of this compound. Soil and metal objects at the Q-Site West gun facility tested negative for TNT.

Test for RDX, HMX, PETN, Tetryl: Tests for the other explosives (RDX, HMX, PETN, TATB, and tetryl) in the soil at L-Site and in the metal part of the hexagonal closed firing pit, TA-12-4, were also negative. The tests were also negative for soils from the open firing pit, except for cases when small pieces of suspected explosives from the ground were placed in the sample to be tested. This suspected explosive was very hard plastic-like material scattered 4 to 8 feet from the open pit. This material was sensitive to a hammer blow.

Positive tests for explosives in the soil and swipes of objects were found for all active areas of TA-14, Q-Site. Reagents 1 and 3 of the old kit and Solution 1 from the new kit all confirmed the presence of TNT. All three solutions from the new kit were used to confirm the presence of RDX/HMX/PETN or compounds that, when hydrolyzed, produce NO_2 ions. At Q-Site West, we questioned the results from all three solutions of the new spot-test kit. This color, though obviously present, was very faint and in some cases was slow to develop. When Reagent B from the old kit was used in the Q-Site West soils, a color different from the deep purple/blue expected was produced. Interference from another contaminant or the pH of the soil could have an effect on this test. All three test solutions from the new spot-test kit seems to be better indicators for HMX. From HPLC analyses, HMX remains in the Q-Site soil and at higher concentrations than the other explosives. HMX may have been used more frequently and/or the half-life of the HMX in the Q-Site soil may be longer than other explosives.

Test for TATB, TNT, RDX, Tetryl:

Reagent 3 and Solution 1 (identical except in concentration) were also used to confirm the presence of TATB (orange color), TNT (purple color), and tetryl (red color). Neither TATB nor tetryl was found in the swipe tests of soils at Q-Site. At L-Site, TATB was not used in explosive tests; therefore, its absence is not surprising. RDX was found in chunks at TA-12 but did not give a positive test with the spot test kit. Solubility was a factor in these results. The presence of RDX was expected from both the cast explosives during the 1940s and the present-day Plastic Bonded Explosives (PBXs) used by M-Division.

Analyses of Samples for Metal

The EDXRF analyses for metals revealed no significant metal contamination, although detectable levels of some hazardous metals were found.

CONCLUSIONS:

The spot-test kits could not be reliably used to swipe soils and could not confirm, with confidence the presence or absence of explosives for some of the sites tested. We obtained negative results, even though we had experimental evidence that the soil in one area was contaminated. This was true of the open firing pit at L-Site

where scattered explosives could be picked up but was not detected with either spot test kit. If the concentration of explosive is above a certain level, then one can test scoops of soil and increase the probability of obtaining positive results, as was done at Q-Site. There is a need to quantify the detection concentration limits on these test.

Both L- and Q-Sites are sandy loam and the firing mound at the latter is sand. Given the very low solubility of explosives in this soil and the nearly fifty years of weathering, especially at L-Site, the probability of swiping the exact location where a grain of explosive is found is very low. Even the soil beneath the chunks of formulated explosives at L-Site did not give positive results. It is a matter both of explosive concentration and locating a contaminated area. The concentration of explosives dissolved in the soil at L-Site is extremely low, whereas parts-per-million level of explosives were found in the Q-Site soil.

From this data, we would not recommend the use of the spot test kits, without other determining methods, to screen for explosive contamination in the soil. This is true where firing operation have been conducted and scattering of explosives is possible.

Of the several metals analyzed, chromium, mercury, lead, and uranium were the most concentrated, but none of these exceed SALs.

TABLE I

The results of field-spot test for explosive on samples taken from surface swipes and scoops of soil taken at L-Site (the closed pit (TA-12-4), the open pit, and a semi-circle area 25-ft west of open pit).

Sample Location	Reagent A	Reagent C	A 1 1 3 Sol'ns
1. Open-pit (center) #1	NR ¹	NR	NR
2. Open-pit (center #2)	NR	NE	NR
3. Open pit (center) #3	NR	NR	NR
4. Open-pit (center) #4	NR	NR	NR
5. Open-pit (center) #5	NR	NR	NR
6. South - tree (edge)	NR	NR	NR
7. 25-ft W of open pit (pieces of pink HE)	NR	?	R ²
8. 25-ft W of open pit (soil composite)	NR	NR	NR
9. 25-ft W of open pit (center of area)	NR	NR	NR
10. 25-ft W of open pit (ridge by trench)	NR	NR	NR
11. 25-ft W of open pit (rim-composite)	NR	NR	NR
12. Open pit HE pieces	NR	NR	R
13. Open pit, 5-ft NW of (small yellowish brown pieces of HE) ³	purple	purple	purple
14. Closed pit soil	NR	NR	NR
15. Open-pit, 8-ft E of tree uranium oxide	NR	NR	NR

¹ NR = No Reaction

² R = Reaction

³ Gave a deep purple color with Reagent B.

TABLE II

Q-Site samples taken previously from firing mounds and surrounding areas for HPLC analyses of eight basic explosives, TNT impurities, and degradation products were also used in this study.

Sample	Reagent A	Reagent B	Reagent C	All 3 Sol'ns
1. Firing Pad 1 Sample #1	R ⁴	NT ⁵	R	R
2. Firing Pad 1 Sample #2	R	NT	R	R
3. Firing Pad 1 Sample #3	NR ⁶	NT	NR	R
4. Firing Pad 1 Sample #4	NR	NT	NR	R
5. Firing Pad 1 Sample #5	NR	NT	NR	R
6. Firing Pad 2 Sample #1	NR	NT	NR	R
7. Firing Pad 2 Sample #2	NR	NT	NR	R
8. Firing Pad 3 Sample #1	NR	NT	NR	NR
9. Firing Pad 3 Sample #2	NR	NT	NR	NR
10. Firing Pad 3 Sample #3	NR	NT	NR	R
11. Q-Site West Under Ground Cable	NR	NT	NR	NR
12. Fire Hydrant Near Entrance W Side	NR	NT	NR	NR

⁴ Reaction

⁵ NT = Not Tested

⁶ NR = Negative Results

TABLE III

Analysis of samples from the Q-Site West, the Firing Pedestal at the Gun Facility. Samples were taken from a metal barrel-shaped containment vessel, soil in this vessel, and sand near target stand.

Sample	Reagent A	Reagent B	Reagent C	All 3 Sol'ns
1. Target Table	NR ⁷	? ⁸	NR	R ⁹
2. Barrel Mat'l (yellow)	NR	?	NR	R
3. Barrel West End	NR	(R) ?	NR	R
4. Metal Plate (in barrel)	NR	NR	NR	NR
5. Barrel Center	NR	NR	NR	R
6. Target Plate	NR	(R) ?	NR	R
7. Black Soil East End	NR	Green	R	R
8. Barrel Oily Black Soil	NR	(R) ?	R	R
9. Barrel Clean Soil	NR	NR	R	R
10. Barrel Right Side	NR	R	R	R

⁷ NR = No Reaction

⁸ ? = Color is different from what is expected.

⁹ R = Reaction

TABLE IV

High Performance Liquid Chromatography (HPLC) analyses of the solution from the extraction of Q-Site soil with acetonitrile. Samples were analyzed using a UV detector at 254 nm.

FIRING PAD	SAMPLE #	COMPOUND	Concentration ug/g
1	1	HMX	82.7
1	1	RDX	4.2
1	1	TETRYL	<0.4
1	1	TNT	15.8
1	1	2,4-DNT	<0.2
1	2	HMX	174.5
1	2	RDX	2.6
1	2	TETRYL	<0.4
1	1	TNT	0.8
1	1	2,4-DNT	<0.2
1	3	HMX	215
1	3	RDX	3.2
1	3	TETRYL	<0.4
1	3	TNT	0.8
1	2	2,4-DNT	<0.2
1	4	HMX	168.6
1	4	RDX	3.4
1	4	TETRYL	<0.4
1	4	TNT	1.0
1	4	2,4 DNT	<0.2
1	5	HMX	315
1	5	RDX	1.8
1	5	TETRYL	<0.4
1	5	TNT	0.6
1	5	2,4-DNT	<0.2

TABLE IV CONTINUED

FIRING PAD	SAMPLE #	COMPOUND	Concentration ug/g
1	6	HMX	72.8
1	6	RDX	6.0
1	6	TETRYL	<0.4
1	6	TNT	0.6
1	6	2,4-DNT	<0.2
1	7	HMX	111.3
1	7	RDX	6.0
1	7	TETRYL	<0.4
1	7	TNT	1.4
1	7	2,4-DNT	<0.2
5'N 2	8	HMX	136
5'N 2	8	RDX	0.4
5'N 2	8	TETRYL	<0.4
5'N 2	8	TNT	0.4
5'N 2	8	2,4-DNT	<0.2
2	9	HMX	39.8
2	9	RDX	1.6
2	9	TETRYL	<0.4
2	9	TNT	0.8
2	9	2,4-DNT	<0.2
3	1	HMX	6.8
3	1	RDX	10.0
3	1	TETRYL	<0.4
3	1	TNT	<0.4
3	1	2,4-DNT	<0.2
3	2	HMX	11.8
3	2	RDX	<0.3
3	2	TETRYL	<0.4
3	2	TNT	<0.4

TABLE IV CONTINUED

FIRING PAD	SAMPLE #	COMPOUND	Concentration ug/g
3	2	2,4-DNT	<0.2
3	3	HMX	9.3
3	3	RDX	1.2
3	3	TETRYL	<0.4
3	3	TNT	<0.4
3	3	2,4-DNT	<0.4
3	4	HMX	11.8
3	4	RDX	<0.3
3	4	TETRYL	<0.4
3	4	TNT	<0.4
3	4	2,4-DNT	<0.2
3	5	HMX	2.4
3	5	RDX	<0.3
3	5	TETRYL	<0.4
3	5	TNT	<0.4
3	5	2,4-DNT	<0.2
SAMPLE	LOCATION	COMPOUND	ug/g
ELECTRIC CABLE	WESTSIDE	HMX	0.6
ELECTRIC CABLE	WESTSIDE	RDX	<0.3
ELECTRIC CABLE	WESTSIDE	TETRYL	<0.4
ELECTRIC CABLE	WESTSIDE	TNT	<0.4
ELECTRIC CABLE	WESTSIDE	2,4-DNT	<0.2
FIRE HYDRANT	EAST GATE	HMX	<0.3
FIRE HYDRANT	EAST GATE	RDX	<0.3
FIRE HYDRANT	EAST GATE	TETRYL	<0.4
FIRE HYDRANT	EAST GATE	TNT	<0.4
FIRE HYDRANT	EAST GATE	2,4-DNT	<0.2

TABLE V

pH of Q-Site Soil Samples

FIRING PAD	SAMPLE	pH
1	1	6.85
1	2	6.80
1	3	7.06
1	4	7.27
1	5	6.86
1	6	7.38
1	7	7.43
2	8	7.34
2	9	6.81
#1 Firing pad #3	10	6.26
#3 Firing pad #3	11	4.27
#4 Firing pad #3	12	5.5
#5 Firing pad #3	13	7.40
LOCATION	SAMPLE	pH
WESTSIDE	ELECTRIC	4.91
EAST GATE	FIRE HYDRANT	4.76

TABLE VI

Metal concentrations in parts-per-million (PPM) for samples taken from firing mounds 1, 2, 3, and the Burn Pit at TA-14 (Q-Site).^a Analyses were performed by Energy Dispersive X-Ray Fluorescence (EDXRF).

ELEMENT (PPM)	CHROMIUM (Cr)	MERCURY (Hg)	LEAD (Pb)	URANIUM
SALS (PPM)	(400)	(24)	(500)	(240)
SAMPLE #				
2	208.2	0.4	27.0	3.7
3	33.8	0.5	32.1	4.1
4	ND	1.2	15.4	21.63
5	ND	ND	67.6	3.1
6	ND	0.7	13.9	19.9
7A	76.2	0.5	24.0	648
8	ND	0.3	78.8	16.2
9	51.9	5.0	44.06	6.7
10	195.2	ND	3.9	3.3
11	58.4	0.1	46.7	32.7
12	ND	ND	ND	16.1
13	79.8	1.3	38.4	24.3
14	97.8	ND	15.3	6.4
15	2.8	0.9	13.8	ND
16	ND	ND	24.5	21.2
17	287.6	2.0	38.7	8.0
18	132.4	0.9	ND	14.8
19	ND	0.8	ND	ND
20	ND	ND	ND	19.2
21	ND	ND	45.1	ND
22	ND	1.4	ND	20.7

^a Although selected samples are reported, a profile was taken and analyzed.

TABLE VII

Analyses of TA-14 (Q-Site) Soil on Firing Mound 3 for Picric Acid after the top soil had been removed.

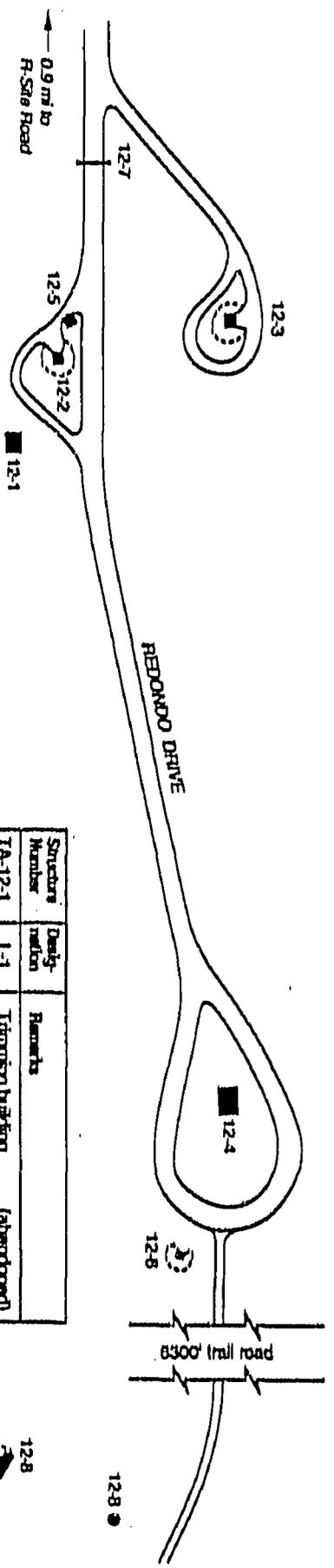
SAMPLE	COMPOUND	ug/g
#3 Firing Pad #1	Picric Acid	<0.2
#1 Firing Mound #3	Picric Acid	<0.2
#3 Firing Pad #3	Picric Acid	<0.2
#4 Firing Pad #3	Picric Acid	<0.2
#5 Firing Pad #3	Picric Acid	<0.2

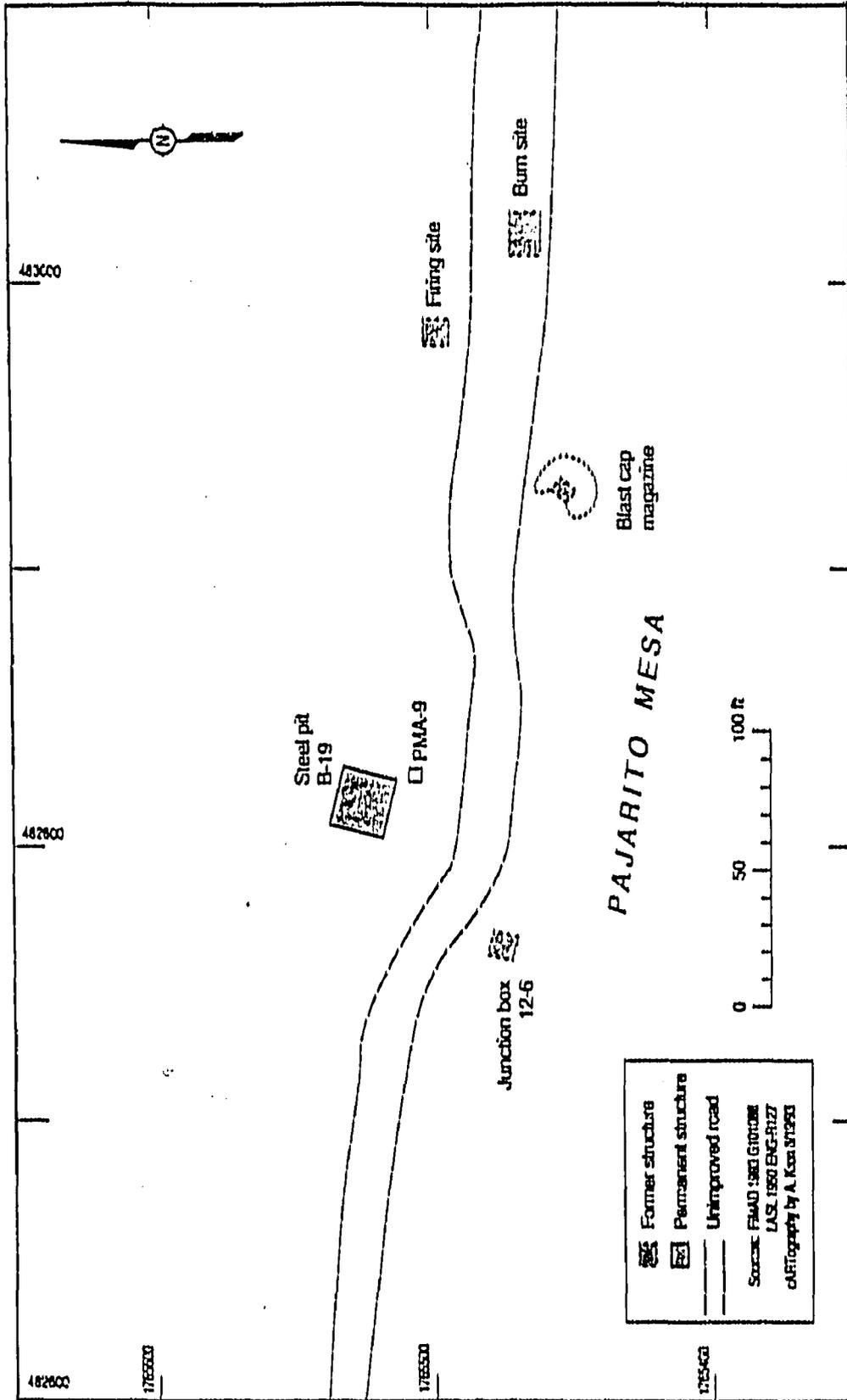
MAP 1 - TA-12 (67) I-Site

0 50 100 150 200 ft
 Source: USA 1950, ENGR 172,
 Structure Location Plan TA-12 I-Site,
 Rev. 5 1953
 Cartography by A. Kern: 87220



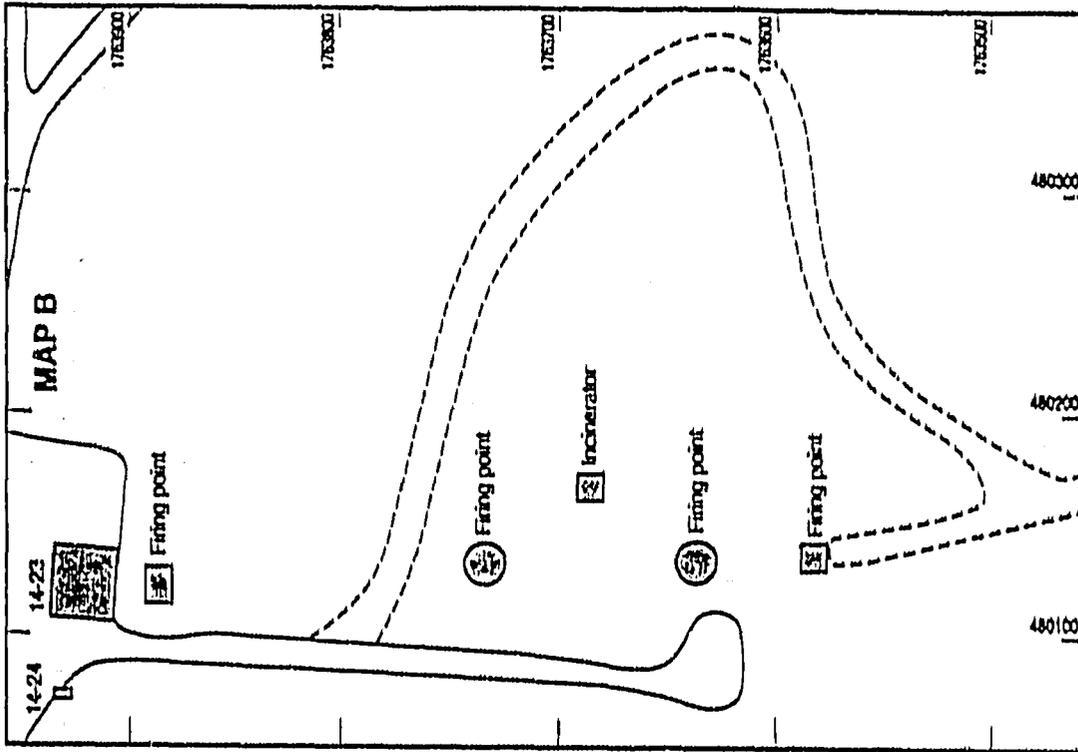
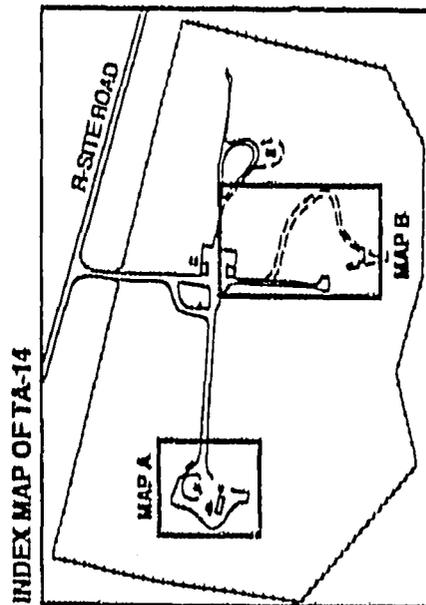
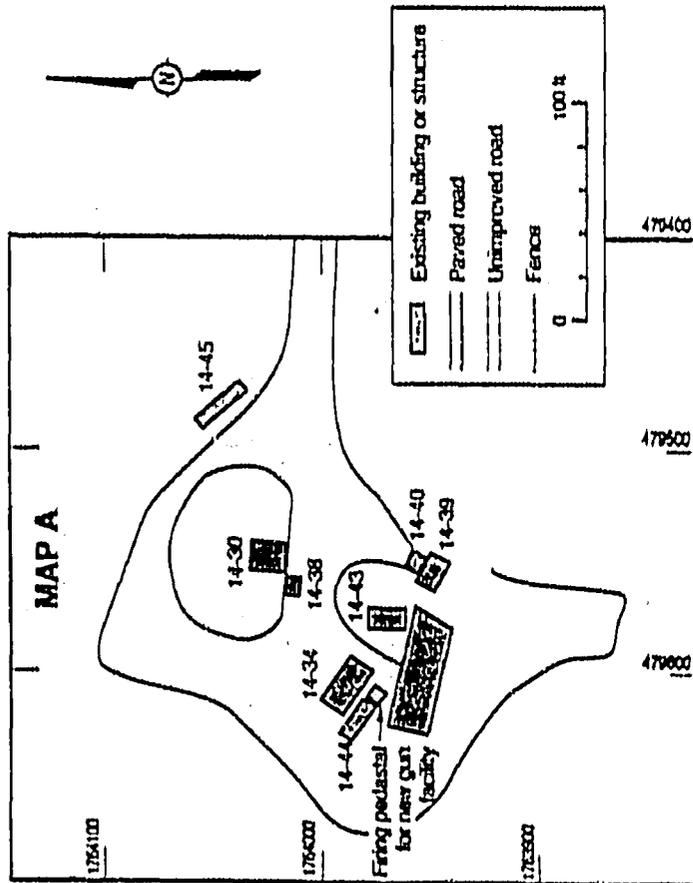
Structure Number	Designation	Remarks
TA-12-1	L-1	Training building (abandoned)
TA-12-2	L-2	Control chamber (abandoned)
TA-12-3	L-3	Storage magazine (abandoned)
TA-12-4	L-4	Firing pit (abandoned)
TA-12-5	L-5	Generator building (abandoned)
TA-12-6	L-6	Junction building (abandoned)
TA-12-7	L-7	Road block (abandoned)
TA-12-8	L-8	Radiation test structure (abandoned)





MAP 2 - TA-12, L-Site with Steel Hexagonal Enclosed Firing Pit, B-19, and Open Firing Pit Firing Site

CONFIDENTIAL



SOURCE: FM440 1981 G10381
 DATE: 1981 ENG-CAS111
 CARTOGRAPHY BY A. KOSKUTSKI

MAP A - TA-14, Q-Site West with New Gun Facility

MAP B - TA-14, Q-Site East with Control Building, T A-14-23 and Firing Points

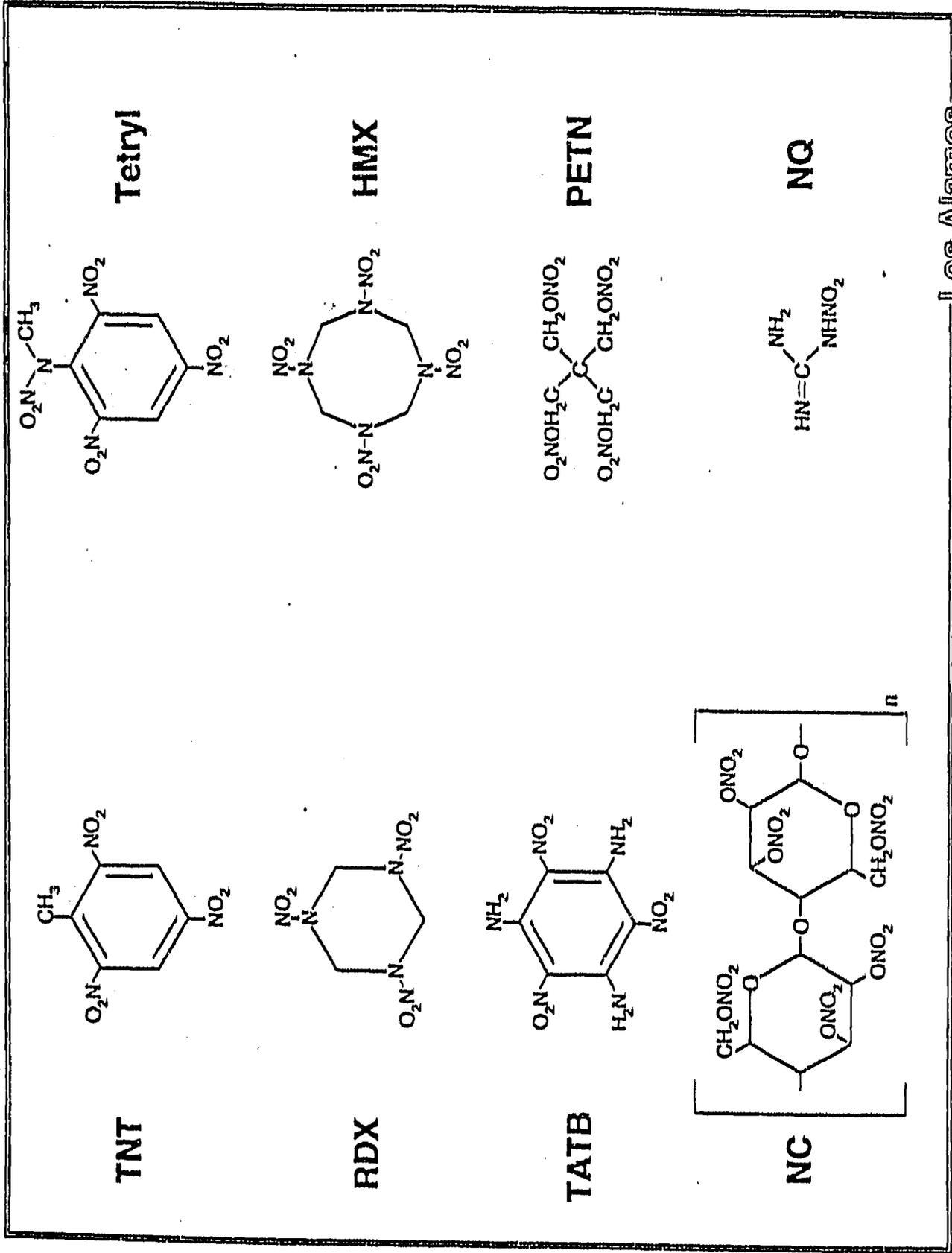


FIGURE I - Commonly Used Basic Explosives