U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE DIVISION

01562

116

RCRA PART B, SUBPART X PERMIT APPLICATION FOR

OPEN BURNING/ OPEN DETONATION

AT
SENECA ARMY DEPOT
ROMULUS, NEW YORK

PREPARED FOR

U.S. ARMY CORPS OF ENGINEERS
HUNTSVILLE, ALABAMA

PREPARED BY

MAIN
1893

RCRA PART B, SUBPART X PERMIT APPLICATION FOR THE OPEN BURN/OPEN DETONATION FACILITY AT SENECA ARMY DEPOT, ROMULUS, NEW YORK

RCRA PART B, SUBPART X PERMIT APPLICATION
OB/OD FACILITY

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ABBREVIATIONS AND DEFINITIONS

AD	Army Depot
ADNL	A-weighted DNL (day-night level)
AEC	Atomic Energy Commission
AED	Ammunition Equipment Directorate
Ag	Silver
AMC	Army Material Command
AMCCOM	U.S. Army Armament, Munitions and Chemical Command
AOC	Area of Concern
APCS	Air Pollution Control System
APE	Ammunition Peculiar Equipment
AR	Army Regulation
ARDC	U.S. Army Armament Research and Development Center
As	Arsenic
ASTM	American Society for Testing and Materials
AWFMS	Automatic Waste Feed Monitor System
Ba	Barium
BACT	Best Available Control Technology
BMDL	Below Method Detection Limit
BTU	British Thermal Unit
CAA	Clean Air Act
Cd	Cadmium
CDNL	C-weighted DNL (day-night level)
CE	Corps of Engineers
CF	Cubic Feet
CFR	Code of Federal Regulations
CO	Carbon Monoxide
Cr	Chromium
D/	Directorate for
DARCOM	Department of the Army Material Development

ABBREVIATIONS AND DEFINITIONS
(Cont.)

dBA	A-weighted decibel
dBC	C-weighted decibel
dBP	Peak decibel
DCP	Disaster Control Plan
DEC	New York State Department of Environmental Conservation
DEH	Directorate for Engineering and Housing
DESCOM	U.S. Army Depot System Command
DLA	Defense Logistics Agency
DNL	Day-night level
DNT	Dinitrotoluem
DOD	U.S. Department of Defense
DOT	Department of Transportation
DPDO	Defense Property Disposal Office
DPDS	Defense Property Disposal Service
DRMO	Defense Reutilization and Marketing Office
DRMO-OSB	DRMO-Off Site Branch
DRMS	Defense Reutilization and Marketing Service
EC	Emergency Coordinator
EEMD	Engineering and Environmental Management Division
EIS	Environmental Impact Statement
ELAP	
EO	Executive Order
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
EWI	Explosive Waste Incinerator
FED	Facility Engineering Division
FEE	Facility Environmental Engineer

ABBREVIATIONS AND DEFINITIONS
(Cont.)

g	Gram
GC\MS	Gas Chromatography/Mass Spectrophotometry
gr	Grain (unit of gun powder measurement; 1 grain = 0.002285 ounces or 0.0648 grams)
HCL	Hydrogen Chloride
HEPA	High Efficiency Particulate
Hg	Mercury
HMX	1,3,5,7-tetranitro - 1,3,5,7-tetraazacyclooctane
HPLC	High Pressure Liquid Chromatography
HQDESCOM	Headquarters Depot Systems Command
HUD	US Department of Housing and Urban Development
HW	Hazardous Waste
HWCP	Hazardous Waste Contingency Plan
IARC	International Agency for Research on Cancer
IAW	In Accordance with
ICUZ	Installation Compatible Use Zone
ID	Identification
IDL	Instrument Detection Limit
Inc	Incorporated
IPE	Industrial Production Equipment
IRI	Ignitable, Reactive, or Incompatible
IS	Insufficient Sample
LAAP	Louisiana Army Ammunition Plant
ug/L	Micrograms per liter; parts per billion
mg/L	Milligrams per liter; parts per million

ABBREVIATIONS AND DEFINITIONS
(Cont.)

mL	Milliliters
mm	Millimeter
MSL	Mean Seal Level
N	Nitrogen
N/A	Non-applicable
NASA	National Aeronautics and Space Administration
NC	Nitrocellulose
ND	Not Detected
NESHAP	National Emissions Standard for Hazardous Air Pollutants
NG	Nitroglycerin
NIPDWR	National Interim Primary Drinking Water Regulation
NOAA	National Oceanic and Atmospheric Administration
NOD	Notice of Deficiency
NO_2	Nitrite
NO_3	Nitrate
NST	No sample taken
NT	Not tested
NYSDEC	New York State Department of Environmental Conservation
OB	Open Burning
OD	Open Detonation
OSHA	Occupational Safety and Health Administration
Pb	Lead
PCB	Polychlorinated Biphenyl
PEP	Pyrotechnics, explosives, and propellants
PETN	Pentaerythritol Tetranitrate
PL	Public Law

ABBREVIATIONS AND DEFINITIONS
(Cont.)

ppm	Parts per million
QA	Quality assurance
QC	Quality control
RCRA	Resource Conservation and Recovery Act of 1976 (as amended)
RDX	Cyclotrimethylenetrinitramine
RPM	Rotations per minute
RTP	Research Triangle Park
SCBA	Self Contained Breathing Apparatus
SCFM	Standard Cubic Feet per Minute
Se	Selenium
SEAD	Seneca Army Depot
SDPDA	Special Defense Property Disposal Account
SOP	Standing Operating Procedure(s)
SPCCP	Spill Prevention Control and Countermeasure Plan
SRV	Spill Response Vehicle
SWMU	Solid Waste Management Unit
TCE	Trichloroethylene
TCLP	Toxicity Characteristic Leaching Procedure
TECOM	US Army Test and Evaluation Command
TEP	Toxic Extraction Procedure; Synonymous with EP Toxicity
Tetryl	2,4,6-trinitrophenyl-methylnitramine
TEP	Toxic Extraction Procedure
TKN	Total Kjeldahl Nitrogen
TLV	Threshold Limit Value
TNT	Trintrotluene

ABBREVIATIONS AND DEFINITIONS
(Cont.)

TOX	Total Organic Halogens
TSD	Treatment/Storage/Disposal
TTCL	Total Threshold Concentration Limit
USAEHA	US Army Environmental Hygiene Agency
USAMBRDL	US Army Medical Bioengineering Research and Development
USATHAMA	US Army Toxic and Hazardous Materials Agency
USC	United Stated Code
USDA	US Department of Agriculture
USGS	US Geological Survey
UXO	Unexploded Ordnance
WAP	Waste Analysis Plan

SECTION A

PART A PERMIT APPLICATION [40 CFR 270.13]

A current Part A for the facility is attached.

Use Only

Date Received
Month Day Year

EPA
United States Environmental Protection Agency
Washington, DC 20460

Hazardous Waste Permit Application
Part A

(Read the Instructions before starting)

For State Use Only

I. ID Number(s)

A. EPA ID Number: NY0213820830

B. Secondary ID Number *(if applicable)*:

II. Name of Facility

SENECA ARMY DEPOT

III. Facility Location *(Physical address not P.O. Box or Route Number)*

A. Street: ROUTE 96

Street *(continued)*:

City or Town: ROMULUS

State: NY

ZIP Code: 14541-5001

County Code *(if known)*:

County Name: SENECA

B. Land Type *(enter code)*: F

C. Geographic Location

LATITUDE (degrees, minutes, & seconds): 42 43 36

LONGITUDE (degrees, minutes, & seconds): 076 51 33

D. Facility Existence Date

Month: 06 Day: 11 Year: 1941

IV. Facility Mailing Address

Street or P.O. Box: ROUTE 96

City or Town: ROMULUS

State: NY

ZIP Code: 14541-5001

V. Facility Contact *(Person to be contacted regarding waste activities at facility)*

Name *(last)*: BATTAGLIA

(first): RANDALL

Job Title: ENVIRON. ENG.

Phone Number *(area code and number)*: 607-869-1450

VI. Facility Contact Address *(See instructions)*

A. Contact Address

Location ☐ Mailing ☒

B. Street or P.O. Box: ROUTE 96 BLDG. 123

or Town: OMULUS

State: NY

ZIP Code: 14541-5001

EPA Form 8700-23 (01-90)

EPA I.D. Number *(enter from page 1)*: N Y 0 2 1 3 8 2 0 8 3 0

Secondary ID Number *(enter from page 1)*:

VII. Operator Information *(see instructions)*

Name of Operator: JAMES CROSS COMMANDING OFFICER

Street or P.O. Box: ROUTE 96

City or Town: ROMULUS

State: NY

ZIP Code: 14541-5001

Phone Number *(area code and number)*: 607-869-1616

B. Operator Type: F

C. Change of Operator Indicator: Yes ☒ No ☐

Date Changed: Month 01 Day 13 Year 92

VIII. Facility Owner *(see instructions)*

A. Name of Facility's Legal Owner: US GOVERNMENT

Street or P.O. Box:

City or Town:

State:

ZIP Code: -

Phone Number *(area code and number)*: - -

B. Owner Type: F

C. Change of Owner Indicator: Yes ☐ No ☒

Date Changed: Month Day Year

IX. SIC Codes *(4-digit, in order of significance)*

Primary	Secondary
(description)	*(description)*

Secondary	Secondary
(description)	*(description)*

X. Other Environmental Permits *(see instructions)*

A. Permit Type *(enter code)*	B. Permit Number	C. Description
N	NY0021296	NPDES-Discharge to Surface Water
F	FW850-80-015	State 404 Wetlands
E	8E453089008	State Restricted Burning

EPA I.D. Number (*enter from page 1*)

N	Y	0	2	1	3	8	2	0	8	3	0

Secondary ID Number (*enter from page 1*)

XI. Nature of Business (*provide a brief description*)

The primary mission of SEAD is the receipt, storage maintenance and supply of ammunition. However, over the years SEAD's mission has broadened to include the receipt, storage, care, and maintenance of general supplies, industrial plant equipment, special weapons, and tank and automotive major items and assemblies. The sole function of the deactivation furnace is the demilitarization of obsolete and unserviceable munitions.

XII. Process - Codes and Design Capacities

A. PROCESS CODE - *Enter the code from the list of process codes below that best describes each process to be used at the facility. Twelve lines are provided for entering codes. If more lines are needed, attach a separate sheet of paper with the additional information. If a process will be used that is not included in the list of codes below, then describe the process (including its design capacity) in the space provided in item XIII.*

B. PROCESS DESIGN CAPACITY - *For each code entered in column A, enter the capacity of the process.*

1. AMOUNT - *Enter the amount. In a case where design capacity is not applicable (such as in a closure/post-closure or enforcement action) enter the total amount of waste for that process unit.*
2. UNIT OF MEASURE - *For each amount entered in column B(1), enter the code from the list of unit measure codes below that describes the unit of measure used. Only the units of measure that are listed below should be used.*

C. PROCESS TOTAL NUMBER OF UNITS - *Enter the total number of units used with the corresponding process code.*

PROCESS CODE	*PROCESS*	*APPROPRIATE UNITS OF MEASURE FOR PROCESS DESIGN CAPACITY*
	DISPOSAL:	
D79	*INJECTION WELL*	*GALLONS; LITERS; GALLONS PER DAY; OR LITERS PER DAY*
D80	*LANDFILL*	*ACRE-FEET OR HECTARE-METER*
D81	*LAND APPLICATION*	*ACRES OR HECTARES*
D82	*OCEAN DISPOSAL*	*GALLONS PER DAY OR LITERS PER DAY*
D83	*SURFACE IMPOUNDMENT*	*GALLONS OR LITERS*
	STORAGE:	
S01	*CONTAINER (barrel, drum, etc.)*	*GALLONS OR LITERS*
S02	*TANK*	*GALLONS OR LITERS*
S03	*WASTE PILE*	*CUBIC YARDS OR CUBIC METERS*
S04	*SURFACE IMPOUNDMENT*	*GALLONS OR LITERS*
	TREATMENT:	
T01	*TANK*	*GALLONS PER DAY OR LITERS PER DAY*
T02	*SURFACE IMPOUNDMENT*	*GALLONS PER DAY OR LITERS PER DAY*
T03	*INCINERATOR*	*SHORT TONS PER HOUR; METRIC TONS PER HOUR; GALLONS PER HOUR; LITERS PER HOUR; OR BTU'S PER HOUR*
T04	*OTHER TREATMENT* *(Use for physical, chemical, thermal or biological treatment processes not occurring in tanks, surface impoundment or incinerators. Describe the processes in the space provided in Item XIII.)*	*GALLONS PER DAY; LITERS PER DAY; POUNDS PER HOUR; SHORT TONS PER HOUR; KILOGRAMS PER HOUR; METRIC TONS PER DAY; METRIC TONS PER HOUR; OR SHORT TONS PER DAY*

UNIT OF MEASURE	*UNIT OF MEASURE CODE*
GALLONS	*G*
GALLONS PER HOUR	*E*
GALLONS PER DAY	*U*
LITERS	*L*
LITERS PER HOUR	*H*
LITERS PER DAY	*V*
SHORT TONS PER HOUR	*D*
METRIC TONS PER HOUR	*W*
SHORT TONS PER DAY	*N*
METRIC TONS PER DAY	*S*
POUNDS PER HOUR	*J*
KILOGRAMS PER HOUR	*R*
CUBIC YARDS	*Y*
CUBIC METERS	*C*
ACRES	*B*
ACRE-FEET	*A*
HECTARES	*Q*
HECTARE-METER	*F*
BTU's PER HOUR	*K*

EPA I.D. Number (*enter from page 1*)

N Y 0 2 1 3 8 2 0 8 3 0

Secondary ID Number (*enter from page 1*)

XII. Process - Codes and Design Capacities (*continued*)

EXAMPLE FOR COMPLETING ITEM XII (shown in line numbers X-1 and X-2 below): A facility has two storage tanks, one tank can hold 200 gallons and the other can hold 400 gallons. The facility also has an incinerator that can burn up to 20 gallons per hour.

Line Number	A. PROCESS CODE (from list above)	B. PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	C. PROCESS TOTAL NUMBER OF UNITS	FOR OFFICIAL USE ONLY
X 1	S 0 2	600	G	0 0 2	
X 2	T 0 3	20	E	0 0 1	
1	S 0 1	24155	G	0 0 3	
2	T 0 3	.154	D	0 0 1	
3	T 0 4	2.3	N	0 0 2	
4					
5					
6					
7					
8					
9					
1 0					
1 1					
1 2					

NOTE: If you need to list more than 12 process codes, attach an additional sheet(s) with the information in the same format as above. Number the lines sequentially, taking into account any lines that will be used for additional treatment processes in Item XIII.

XIII. Additional Treatment Processes (*follow instructions from Item XII*)

Line Number (enter numbers in sequence with item XII)	A. PROCESS CODE	B. TREATMENT PROCESS DESIGN CAPACITY 1. AMOUNT (specify)	B. TREATMENT PROCESS DESIGN CAPACITY 2. UNIT OF MEASURE (enter code)	C. PROCESS TOTAL NUMBER OF UNITS	D. DESCRIPTION OF PROCESS
3	T 0 4	1.5	N	0 0 1	OPEN BURNING Tons per day
3	T 0 4	.8	N	0 0 1	OPEN DETONATION Tons per day
	T 0 4				
	T 0 4				

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GSA No. 0246-EPA-OT

EPA I.D. Number (enter from page 1): N Y 0 2 1 3 8 2 0 8 3 0

Secondary ID Number (enter from page 1):

XIV. Description of Hazardous Wastes

A. EPA HAZARDOUS WASTE NUMBER - *Enter the four-digit number from 40 CFR, Part 261 Subpart D of each listed hazardous waste you will handle. For hazardous wastes which are not listed in 40 CFR, Part 261 Subpart D, enter the four-digit number(s) from 40 CFR, Part 261 Subpart C that describes the characteristics and/or the toxic contaminants of those hazardous wastes.*

B. ESTIMATED ANNUAL QUANTITY - *For each listed waste entered in column A estimate the quantity of that waste that will be handled on an annual basis. For each characteristic or toxic contaminant entered in column A estimate the total annual quantity of all the non-listed waste(s) that will be handled which possess that characteristic or contaminant.*

C. UNIT OF MEASURE - *For each quantity entered in column B enter the unit of measure code. Units of measure which must be used and the appropriate codes are:*

ENGLISH UNIT OF MEASURE	*CODE*	*METRIC UNIT OF MEASURE*	*CODE*
POUNDS	*P*	*KILOGRAMS*	*K*
TONS	*T*	*METRIC TONS*	*M*

If facility records use any other unit of measure for quantity, the units of measure must be converted into one of the required units of measure taking into account the appropriate density or specific gravity of the waste.

D. PROCESSES

1. PROCESS CODES:

For listed hazardous waste: For each listed hazardous waste entered in column A select the code(s) from the list of process codes contained in item XII A. on page 3 to indicate how the waste will be stored, treated, and/or disposed of at the facility.

For non-listed hazardous waste: For each characteristic or toxic contaminant entered in column A, select the code(s) from the list of process codes contained in item XII A. on page 3 to indicate all the processes that will be used to store, treat, and/or dispose of all the non-listed hazardous wastes that processes that characteristic or toxic contaminant.

NOTE: THREE SPACES ARE PROVIDED FOR ENTERING PROCESS CODES. IF MORE ARE NEEDED:

1. *Enter the first two as described above.*
2. *Enter "000" in the extreme right box of item XIV-D(1).*
3. *Enter in the space provided on page 7, item XIV-E, the line number and the additional code(s).*

2. PROCESS DESCRIPTION: *If a code is not listed for a process that will be used, describe the process in the space provided on the form (D.(2)).*

NOTE: HAZARDOUS WASTES DESCRIBED BY MORE THAN ONE EPA HAZARDOUS WASTE NUMBER- Hazardous wastes that can be described by more than one EPA Hazardous Waste Number shall be described on the form as follows:

1. *Select one of the EPA Hazardous Waste Numbers and enter it in column A. On the same line complete columns B, C, and D by estimating the total annual quantity of the waste and describing all the processes to be used to treat, store, and/or dispose of the waste.*
2. *In column A of the next line enter the other EPA Hazardous Waste Number that can be used to describe the waste. In column D(2) on that line enter "Included with above" and make no other entries on that line.*
3. *Repeat step 2 for each EPA Hazardous Waste Number that can be used to describe the hazardous waste.*

EXAMPLE FOR COMPLETING ITEM XIV (shown in line numbers X-1, X-2, X-3, and X-4 below) - A facility will treat and dispose of an estimated 900 pounds per year of chrome shavings from leather tanning and finishing operation. In addition, the facility will treat and dispose of three non-listed wastes. Two wastes are corrosive only and there will be an estimated 200 pounds per year of each waste. The other waste is corrosive and ignitable and there will be an estimated 100 pounds per year of that waste. Treatment will be in an incinerator and disposal will be in a landfill.

Line Number		*A. EPA HAZARD WASTE NO. (enter code)*				*B. ESTIMATED ANNUAL QUANTITY OF WASTE*	*C. UNIT OF MEASURE (enter code)*	*D. PROCESS*			
								(1) PROCESS CODES (enter)			*(2) PROCESS DESCRIPTION (If a code is not entered in D(1))*
	1	K	0	5	4	900	P	T 0 3	D 8 0		
X	2	D	0	0	2	400	P	T 0 3	D 8 0		
X	3	D	0	0	1	100	P	T 0 3	D 8 0		
X	4	D	0	0	2						Included With Above

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EPA I.D. Number *(enter from page 1)*: N Y 0 2 1 3 8 2 0 8 3 0

Secondary ID Number *(enter from page 1)*:

Description of Hazardous Wastes (continued)

Line Number	A. EPA HAZARDOUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES (1) PROCESS CODES (enter)	D. PROCESSES (2) PROCESS DESCRIPTION (If a code is not entered in D(1))
1	D 0 0 3	320	T	T 0 3	
2	D 0 3 0				
3	D 0 0 3	230	T	T 0 4	
4	D 0 3 0				
5	D 0 0 2	3000	P	S 0 1	
6	D 0 0 6				included with above
7	D 0 0 8				included with above
8	D 0 0 5	5000	P	S 0 1	
9	D 0 0 2				included with above
1 0	D 0 0 1	30000	P	S 0 1	
1 1	F 0 0 5	600	P	S 0 1	
1 2	D 0 0 1	200	P	S 0 1	
1 3	F 0 0 4				included with above
[illegible]	F 0 0 5				included with above
1 5	D 0 0 1	1000	P	S 0 1	
1 6	B 0 0 1				included with above
1 7	D 0 0 1	4500	P	S 0 1	
1 8	B 0 0 2				included with above
1 9	D 0 0 1	1500	P	S 0 1	
2 0	B 0 0 3				included with above
2 1	D 0 0 1	5000	P	S 0 1	
2	B 0 0 4				included with above
3	D 0 0 1	3000	P	S 0 1	
4	B 0 0 5				included with above
5	D 0 0 1	1000	P	S 0 1	
6	B 0 0 6				included with above
7	D 0 0 1	3500	P	S 0 1	
8	B 0 0 7				included with above
9					
0					
	D 0 0 2	100	P	S 0 1	
2	F 0 0 2				included with above
3	F 0 0 2	5000	P	S 0 1	

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EPA I.D. Number (enter from page 1): N Y 0 2 1 3 8 2 0 8 3 0 (Continued)Pg.6

Secondary ID Number (enter from page 1):

Description of Hazardous Wastes (continued)

Line Number	A. EPA HAZARDOUS WASTE NO. (enter code)	B. ESTIMATED ANNUAL QUANTITY OF WASTE	C. UNIT OF MEASURE (enter code)	D. PROCESSES (1) PROCESS CODES (enter)	D. PROCESSES (2) PROCESS DESCRIPTION (If a code is not entered in D(1))
1	D040				included with above
2	F003	200	P	S01	
3	R001				included with above
4	F002	200	P	S01	
5	R001				included with above
6	D001	200	P	S01	
7	R001				included with above
8	F002	200	P	S01	
9	D040				included with above
10	R001				included with above
11	F005	200	P	S01	
12	R001				
13	U228	400	P	S01	
[illegible]	U131	3200	P	S01	
[illegible]5	D026	400	P	S01	
16	F027	400	P	S01	
17	F024	400	P	S01	
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
32					
33					

EPA I.D. Number *(enter from page 1)*

N	Y	0	2	1	3	8	2	0	8	3	0

Secondary ID Number *(enter from page 1)*

XIV. Description of Hazardous Waste (continued)

E. USE THIS SPACE TO LIST ADDITIONAL PROCESS CODES FROM ITEM D(1) ON PAGE 6.

Line Number	*Additional Process Codes (enter)*

XV. Map

Attach to this application a topographic map of the area extending to at least one mile beyond property boundaries. The map must show the outline of the facility, the location of each of its existing and proposed intake and discharge structures, each of its hazardous waste treatment, storage, or disposal facilities, and each well where it injects fluids underground. Include all springs, rivers and other surface water bodies in this map area. See instructions for precise requirements.

XVI. Facility Drawing

All existing facilities must include a scale drawing of the facility (see instructions for more detail).

XVII. Photographs

All existing facilities must include photographs (aerial or ground-level) that clearly delineate all existing structures; existing storage, treatment and disposal areas; and sites of future storage, treatment or disposal areas (see instructions for more detail).

XVIII. Certification(s)

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this and all attached documents, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

Owner Signature James B Cross	Date Signed 920113
Name and Official Title *(type or print)* U.S. GOVERNMENT	
Operator Signature James B Cross	Date Signed 920113
Name and Official Title *(type or print)* JAMES B. CROSS - U.S. ARMY, COMMANDING OFFICER	

XIX. Comments

Updated photographs (Section XVII) will be submitted separately at a later date.

Note: Mail completed form to the appropriate EPA Regional or State Office. (refer to instructions for more information)

ATTACHMENT ONE

DEACTIVATION FURNACE (ROTARY KILN INCINERATOR WITH BAGHOUSE)
BUILDING 367

Ammunition from storage and/or disassembly operations is received by the carrier.

Packaged ammunition is placed on the unpacking table and unpacked. Packing material is then placed on pallets for transfer to the demolition grounds for burning or to DRMO for resale if there is no explosive contamination. Unpacked ammunition is placed on an endless conveyor for transfer to the deactivation furnace at prescribed intervals. The ammunition is burned and exploded by the heat in the furnace. The residue from the furnace is transferred by endless conveyor to metal containers and allowed to cool. When cooled, the scrap metal is inspected 100% for any unexploded ordnance. After this inspection, the scrap metal is placed in wooden boxes for the transfer to DRMO.

ATTACHMENT TWO

DEMOLITION GROUNDS
DETONATION OPERATIONS

Ammunition and components to be detonated are transferred to the demolition grounds via carrier.

Demolition holes are prepared by the user of an 18-ton bulldozer.

Ammunition is unpacked at the unpack site at the demolition grounds and transferred to the demolition field by carrier and/or lift truck.

Material to be detonated is placed in a hole dug by the bulldozer. Demolition material used to destroy the ammunition or components is transferred from storage. The material is placed in the hole with the ammunition to be destroyed. A primer cord is attached to the demolition material, and blasting caps are attached to primer cord. The primer cord is attached to the circuit wire. The bulldozer will then fill the hole and place a minimum of eight feet of dirt over the material to be detonated. Operators will retire to the dugout, close the gate, raise the red flag, unlock the control panel, and detonate the desired hole.

ATTACHMENT THREE

DEMOLITION GROUNDS
OPEN BURNING OPERATIONS

Ammunition and components are transferred to the demolition grounds by carrier from disassembly and/or storage locations.

Propellants are burned in a burning pan. The propellants are placed in the burning pan according to Standard Operating Procedures. A primer cord is attached to the circuit wire. Operators retire to the dugout, close the gate, raise the flag, unlock the control panel, and ignite the propellants.

Propellants will be burned on the ground only when an imminent emergency exists.

Explosive contaminated materials such as artillery casings, gloves, boxes, packing materials, etc., are burned or flashed on the ground at pad J.

Combustible beds are prepared at burning pad J utilizing used pallets, wooden boxes, etc. A small amount of fuel oil is used to initiate vigorous combustion. When the combustible beds are prepared, the explosive contaminated material is transferred to the burning pit, and are placed on the combustible bed for burning. A trail of propellant approximately 5 feet long, six inches wide and three inches deep is placed on the ground next to the combustible bed. Electric squib is placed in the propellant trail and connected to the firing wires. Operators close the gates, raise the red flag, and fire the circuits from the panel in the office. After waiting a prescribed time, operators will return to the pits and pick up any metal parts or other metal debris for transfer to DRMO.

ATTACHMENT FOUR

HAZARDOUS WASTE STORAGE FACILITIES

There are three buildings at SEAD in which hazardous waste is stored. Building 307 is a Hazardous Waste Storage Facility, Building 301 is a PCB Storage Facility, and Building 803 is a Mixed Waste Storage Facility.

Hazardous wastes are primarily generated from machine rework operations and are stored in Building 307. These wastes include spent solvents, still bottoms from 1,1,1-trichloroethane vapor degreasers, sludge from oil/grease separators, cleaning compounds, paper filters from paint spray booths, and spent battery acids. Building 301 stores transformers containing oil with PCBs. Building 803 stores paper wipes in drums that have been contaminated with various solvents and low level radioactive components.

SECTION B

FACILITY DESCRIPTION

B-1 FACILITYDESCRIPTION [40 CFR 170.14(B)(1)]

The Seneca Army Depot (SEAD) is located in Seneca County, New York, approximately sixty miles southwest of Syracuse. The SEAD lies immediately west of the village of Romulus, NY. It is bounded by NYS Route 96A on the west and by NYS Route 96 on the east. NYS Route 336 is at the northern boundary and the southern boundary is near West Blaine Road. Seneca Lake, one of the Finger Lakes, is located approximately one mile west of SEAD (refer to **Figure B-1**).

The facilities's mailing address is:

Commander, Seneca Army Depot
Rte. 96
Romulus, New York 14541

The primary mission of the installation is the receipt, storage, maintenance and supply of ammunition. However, over the years SEAD's mission has broadened to include the receipt, storage, care and maintenance of general supplies, industrial plant equipment.

SEAD operates an open burning/open detonation OB/OD facility for the thermal treatment of propellants, explosives, and pyrotechnics, (PEPs). The OB/OD facility is located as shown on **Figure B-2** and on **Figure B-3, Appendix 1.**

B-2 TOPOGRAPHIC MAPS [*40 CFR 270.14(b)(19)*][*6NYCRR Part 373-1.5 (a)(2)(xix)*]

A topography map of the OB/OD area is presented in **Figure B-2**. This figure includes (1) 1-foot surface contours, (2) 1" - 200' scale, (3) an area within a 1,000-foot radius of the OB and OD areas, (4) tree lines, (5) protective dirt mounds, and (6) protective bunkers.

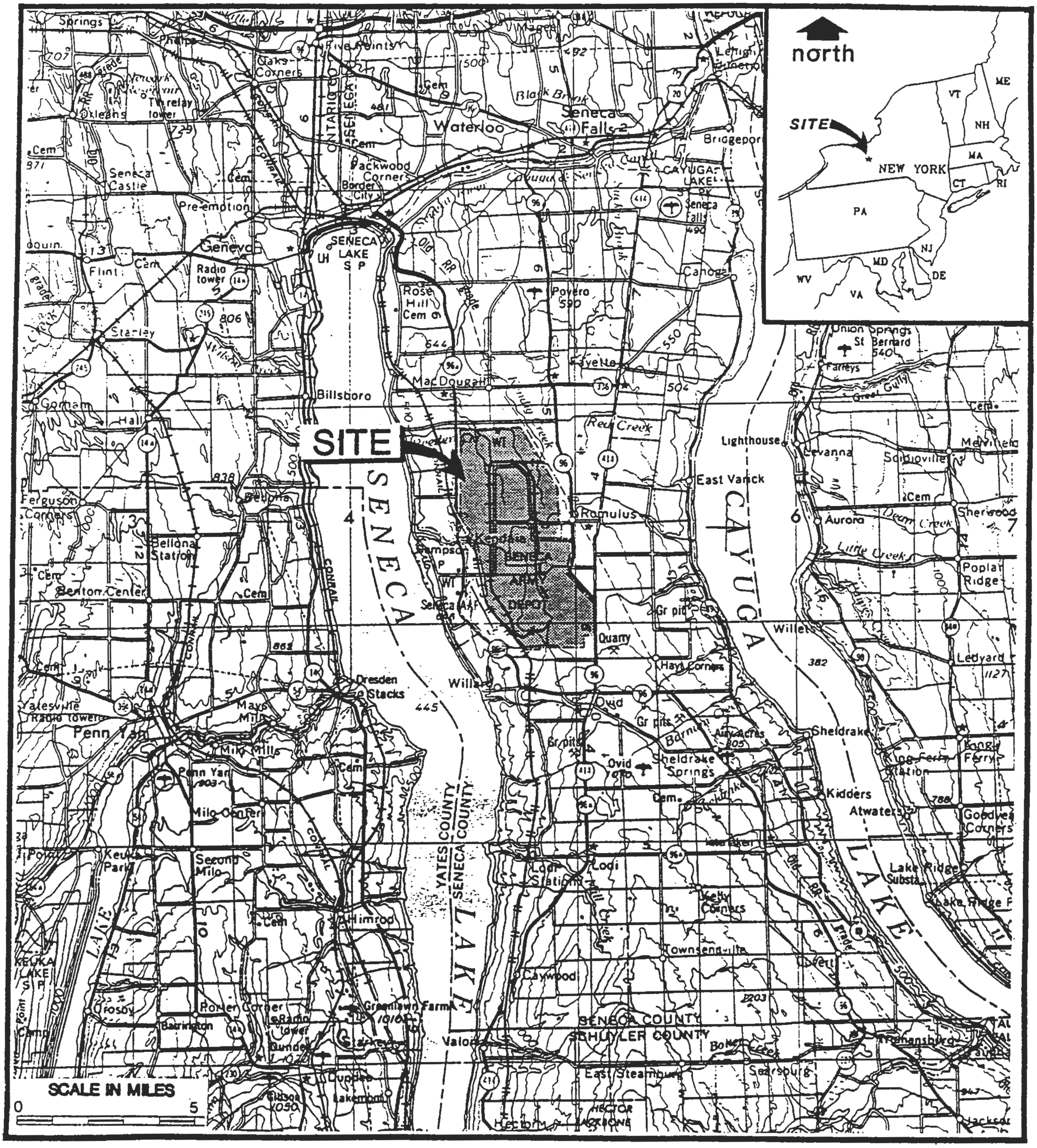
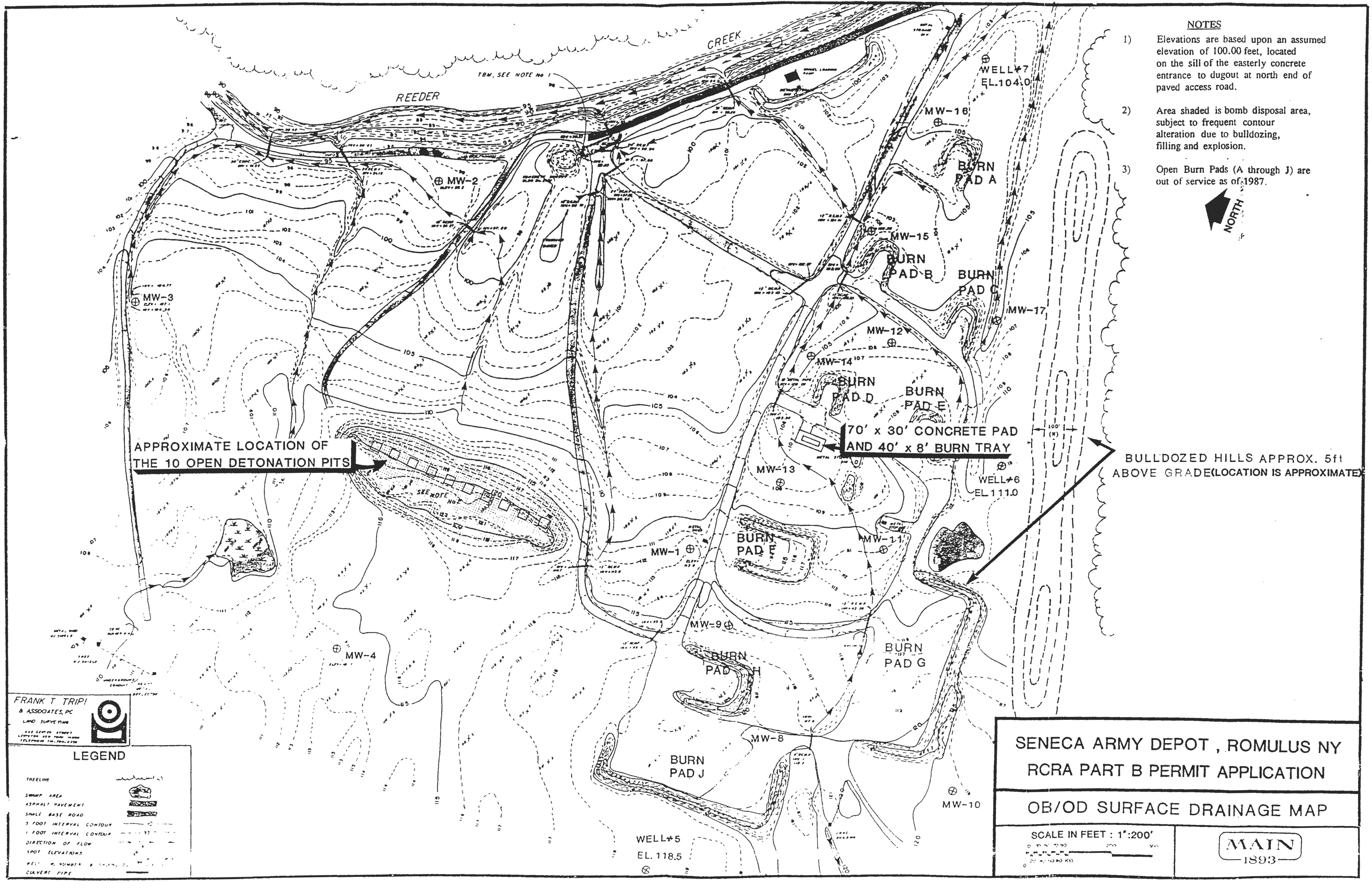


FIGURE B-1 LOCATION MAP

FIGURE B-2



APPROXIMATE LOCATION OF THE 10 OPEN DETONATION PITS

70' x 30' CONCRETE PAD AND 40' x 8' BURN TRAY

BULLDOZED HILLS APPROX. 5ft ABOVE GRADE(LOCATION IS APPROXIMATE)

NOTES

1) Elevations are based upon an assumed elevation of 100.00 feet, located on the sill of the easterly concrete entrance to dugout at north end of paved access road.

2) Area shaded is bomb disposal area, subject to frequent contour alteration due to bulldozing, filling and explosion.

3) Open Burn Pads (A through J) are out of service as of 1987.

SENECA ARMY DEPOT , ROMULUS NY
RCRA PART B PERMIT APPLICATION

OB/OD SURFACE DRAINAGE MAP

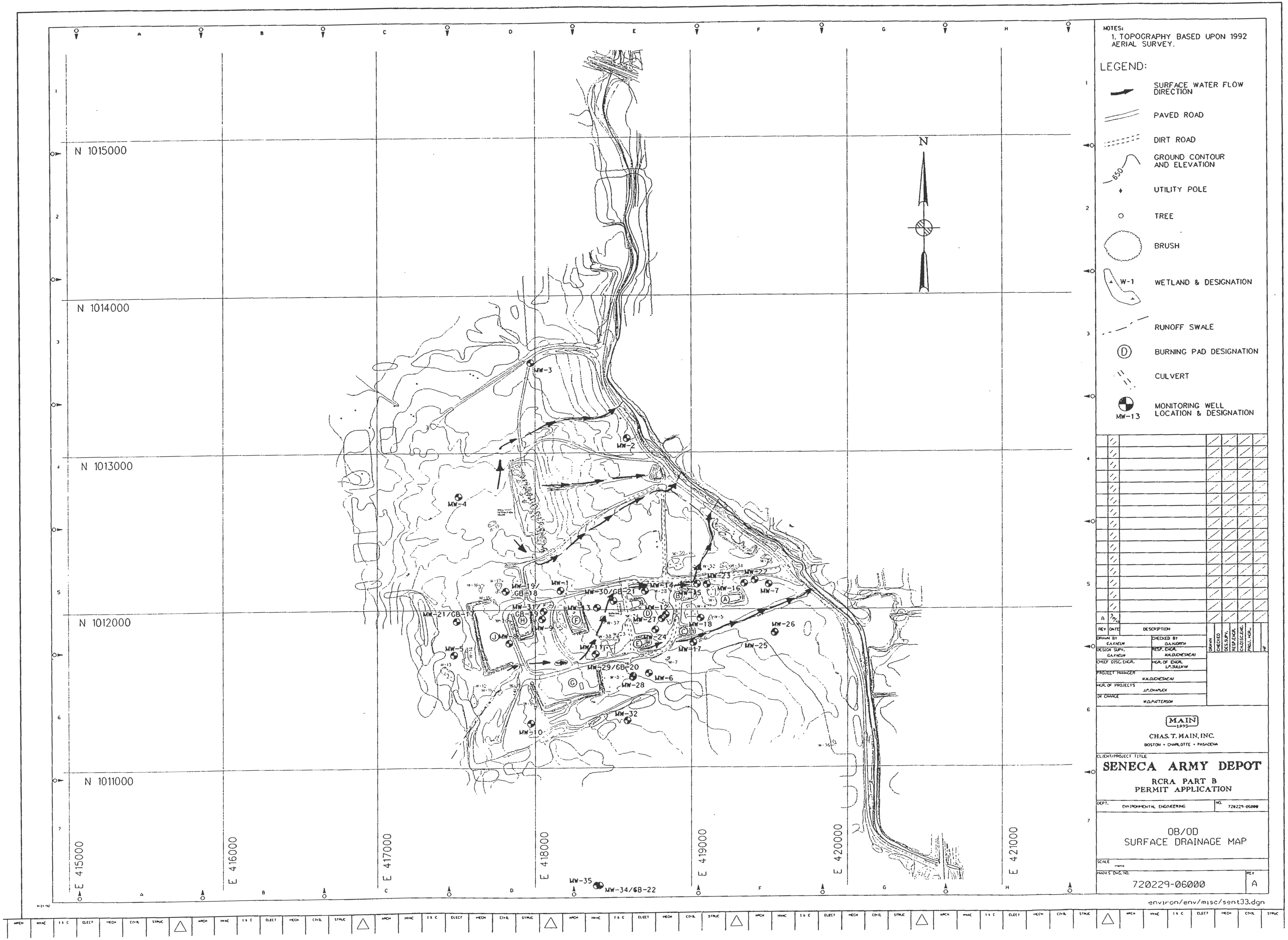

NOTES:
1. TOPOGRAPHY BASED UPON 1992 AERIAL SURVEY.
LEGEND:
SURFACE WATER FLOW DIRECTION
PAVED ROAD
DIRT ROAD
GROUND CONTOUR AND ELEVATION
650
UTILITY POLE
TREE
BRUSH
W-1
WETLAND & DESIGNATION
RUNOFF SWALE
D
BURNING PAD DESIGNATION
CULVERT
MW-13
MONITORING WELL LOCATION & DESIGNATION
N
N 1015000
N 1014000
N 1013000
N 1012000
N 1011000
E 415000
E 416000
E 417000
E 418000
E 419000
E 420000
E 421000
MW-1
MW-2
MW-3
MW-4
MW-5
MW-6
MW-7
MW-9
MW-10
MW-11
MW-12
MW-13
MW-14
MW-15
MW-16
MW-17
MW-18
MW-19/GB-18
MW-21/GB-17
MW-22
MW-23
MW-24
MW-25
MW-26
MW-27
MW-28
MW-29/GB-20
MW-30/GB-21
MW-31/GB-19
MW-32
MW-35
MW-34/GB-22
A
B
C
D
E
F
H
J
REV
DATE
DESCRIPTION
A
DRAWN BY G.A.KAEUN
CHECKED BY D.A.NORTH
DESIGN SUPV. G.A.KAEUN
RESP. ENGR. W.M.DUCHESNEAU
CHIEF DISC. ENGR.
MGR. OF ENGR. L.P.SULLIVAN
PROJECT MANAGER W.M.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON
DRAWN
CHECKED
DES.SUPV.
RESP.ENGR.
CH.DISC.ENG.
PROJ. MGR.
MF
MAIN 1893
CHAS. T. MAIN, INC.
BOSTON • CHARLOTTE • PASADENA
CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
RCRA PART B
PERMIT APPLICATION
DEPT. ENVIRONMENTAL ENGINEERING
NO. 720229-06000
OB/OD
SURFACE DRAINAGE MAP
SCALE none
MAIN'S DWG. NO.
720229-06000
REV A
environ/env/misc/sent33.dgn
ARCH
HVAC
I & C
ELECT
MECH
CIVIL
STRUC

FIGURE B-2

B-2a LAND USE

The SEAD is a government owned installation under the jurisdiction of the U.S. Army Material Command (AMC). The depot lies immediately west of the village of Romulus, NY (refer to **Figure B-3** located in Appendix 1), 12 miles south of the villages of Waterloo and Seneca Falls, and 2.5 miles north of the village of Ovid, NY. The nearest major cities are Rochester, NY and Syracuse, NY located 60 miles northwest and northeast, respectively. The total area of SEAD is 10,587 acres, of which 8,382 are designated storage areas for ammunition, storage and warehouse, and open storage and warehouse. On-post family housing is in two parcels, a 54-acre development adjacent to Route 96 and another 69-acre situated along Seneca Lake. Additionally, troop housing is available for 270 enlisted men (Building 703, 704, and 708). Bachelor officer quarters are located in Building 702, which is designated for 18 men. Other land uses include Administration, Community Services, Airfield.

B-2b HAZARDOUS AND MIXED WASTE MANAGEMENT FACILITIES

The hazardous waste management facilities at SEAD consist of one drum storage area (Building 307), one PCB storage area (Building 301), an incinerator for the demilitarization of small arms and fuses (Building 367), mixed waste storage building (Building 803) and an OB/OD facility used for the thermal treatment of PEPs. The locations of these facilities are shown on the site plan, **Figure B-4, Appendix 1**. It shall be noted that there are no hazardous or mixed waste management facilities located within 1,000 feet of the OB/OD facility.

B-2c WIND ROSE

A wind rose for the area, based upon annual data, is shown in Figure D-19, Section D.

B-2d ACCESS CONTROL

SEAD is a restricted facility with entry and exit monitored 24 hours a day by armed security personnel. The entire depot is enclosed by a 6-foot high chain link fence topped with three strands of barbed wire and security gates at all roads which access SEAD. SEAD access gates are shown on **Figure B-3**. There are perimeter roads inside the SEAD facility fence which are patrolled 24 hours/day by armed DOD personnel. Refer to **subsection F-2** for further details on facility security.

B-2e INJECTION AND WITHDRAWAL WELLS

There are no injection wells at SEAD. On-site water supply wells and off-site water supply wells are shown on **Figure B-5**, located in **Appendix I**.

There are presently two water supply wells on-site. One well is located approximately 3500 feet southeast of the Open Detonation and Open Burning Grounds while the second water supply well is located within the southern portion of the base, in the vicinity of the Seneca Army Airfield, just to the north of building 2301.

B-2f BUILDING, TREATMENT, STORAGE, AND DISPOSAL AREAS, OTHER STRUCTURES

All buildings, structures, and waste storage areas at SEAD are illustrated on the **Figure B-4, Appendix 1**. There are no buildings, treatment, storage, or disposal facilities located within 1,000 feet of the OB/OD facility.

B-2g RECREATIONAL AREAS

SEAD has a swimming pool at the north end of the facility, along with tennis courts, a gymnasium, and a sports field complex. Picnic and playground areas are found on the installation of Hancock Park, the Lake Area and the Family Housing Area. There is also a skeet and trap range at the field. There are no recreational facilities located within 1,000 feet of the OB/OD facility.

B-2h RUNOFF CONTROL SYSTEMS

There are three main watersheds on SEAD. Reeder Creek, draining the north portion of the depot and draining it west to Seneca Lake; Kendaia Creek, receiving runoff from the central portion of the depot and draining west; and Indian and Silver Creeks draining the south portion of the depot and draining it southward. To provide for surface drainage, and

Reeder Creek or the vadose zone by natural infiltration. Surface drainage occurs in the OB/OD area as shown on **Figure B-2**.

B-2i ACCESS AND INTERNAL ROADS

Roads leading to SEAD and those within its borders are illustrated on **Figure B-3, Appendix 1**.

B-2j STORM, SANITARY AND PROCESS SEWERS

There are no storm, sanitary, or process sewers located within 1,000 feet of the OB/OD facility.

B-2k LOADING/UNLOADING AREAS

PEPs that have been designated for disposal either through open burning or open detonation are transported from the storage (in munitions magazine) to the ammunition disassembly plant in Building 2108. They are then loaded into approved vehicles and transported to the OB/OD facility for thermal treatment. The location of the munitions magazines and the ammunition disassembly plant is shown in **Figure B-4, Appendix 1.**

The unloading of waste explosives and pyrotechnics takes place at the OB/OD facility. High explosive waste ordnances are unloaded for thermal treatment at the open detonation area. They are then placed in a hole approximately 8-feet deep and covered with soil. Propellants and pyrotechnics which have been designated for open burning are placed in the burning tray located on the west side of burning pad D. There are no engineered unloading docks, ramps, or other similar structures at the OB/OD facility.

B-2l FIRE CONTROL FACILITIES

Fire protection is provided by a fully equipped on-site fire department staffed by at least eight men 24 hours a day. Building 103 houses the fire department equipped with a team of not less than 6 duty persons on call 24 hours a day, two 500-gallon per minute (gpm) pumper trucks, two 750-gpm pumper trucks, a crash truck, heavy equipment and miscellaneous equipment. Adequate fire protection is provided through appropriate spacing of hydrants and proper sizing of mains.

B-2m SURFACE WATERS

B-2m(1) General

Surface waters within 1,000 feet of the OB/OD facility are indicated on **Figure B-1, B-2** and **B-3 (Appendix 1)**. Specifically, Reeder Creek is the only perennial surface water in the OB/OD area. Surface drainage paths are depicted on **Figure B-2**. There are no intermittent streams in the OB/OD area.

B-2m(2) Flood Control/Drainage Barriers

SEAD is situated on a ridge at the hydrologic divide between Cayuga and Seneca Lakes. The elevation of Cayuga Lake at its nearest point is approximately 390 ft above sea level (asl), while the Seneca Lake level is approximately 450 feet (asl). SEAD is typically in the range of 600 to 700 feet (asl). Based on these elevations, the probability of occurrence of a flood is less than 1 percent. In addition, all thermal treatment operations are conducted only under weather conditions that are conducive to safe operations. Waste explosives are not stored at the OB/OD facility.

Although the SEAD has no major drainage barriers, several controls have been installed on discharge creeks. Reeder Creek has a steel sluice weir at the installation boundary. Kendig Creek has two large ponds controlled by wood board weirs at the installation boundary. Silver Creek has gate valves at its conduit underflow of the West Patrol Road, at the installation boundary. Indian Creek is not controlled. Kendaia Creek has a wood slat weir inside the West Patrol Road, and is not controlled the remaining length through the Lake Housing Area.

Two sewage treatment plants (Building #4 and #715) are capable of retaining flow from the sanitary sewer system, and the outflow of Building #4 into Kendig Creek can be controlled by the downstream weirs discussed above.

B-2m(3) Surface water Description

Reeder Creek is small, second order perennial stream that originates on the Seneca Army Depot. On the Depot, it generally flows in a northwesterly direction but turns sharply to the west after leaving the Deport property and discharges into Seneca Lake. The total drainage basin of Reeder Creek is 3,211 acres (5.02 square miles). Most (71 percent or 2,275 acres) is within the confines of the Depot. The drainage area upgradient of the OB/OD is approximately 1,503 acres. The 29 acre OB grounds comprises 0.9 percent of the total Reeder Creek drainage basin.

Prior to the late fall of 1980, the headwaters of Reeder Creek and Kendig Creek were the same. Flow was split into these two streams downstream of a wetland that serves as part of the treatment system for effluent from a sewage treatment plant. Drainage into Reeder Creek from this wetland was totally blocked during the fall of 1980 (USAEHA 1981).

The normal width of Reeder Creek is from 4 to 10 feet, and typical maximum depths range from 1 to 7 inches. Width and depth of sections of the stream influenced by beaver dams is greater than this-approximately 15 feet wide and 3 feet deep. The potential for seasonal overbank flooding of the creek near the OB/OD facility is minimal. During high flow events width and depth increase, although the steep banks along much of the stream adjacent to the OB/OD grounds limits the width of the flood plain. Normal flow within Reeder Creek near the OB/OD facility is estimated to be 1-2cfs.

The substrate of Reeder Creek is heavily influenced by the occurrence of shale near and at the surface. Most of the stream bottom consists of coarse, angular gravel as well as angular cobbles. There is some deposition of interstitial silt and also a small amount of sand. In some places, the stream bed consists of exposed bedrock. Nearly all components of the substrate are dark grey. The average depth of sediment, include gravel, is approximately 3 inches. In general, the stream bottom which usually comes in contact with the stream water of Reeder Creek is characteristic of mountain streams with loose cobbles. Such streams usually have Manning's N values (a measure of "stream resistance") of 0.040 to 0.050 (Milhouse, Wegner, Waddle 1984).

B-2m(4) Local Flooding History

A history of flooding for Reeder Creek is not available. However, convincing circumstantial evidence of the lack of significant flooding on Reeder Creek is provided by the Flood Insurance Rate Map and associated Flood Insurance Study for the Town of Varick, in which Reeder Creek is located. An early step in a flood insurance study is to meet with appropriate local officials and identify those streams within their town that have historically been associated with damaging overbank flooding. These rivers and streams, along with others that may have hydraulic features that may be conducive to flooding, are included in the "area of detailed study," where detailed cross-sectional data and discharge measurements are used to accurately delineate the floodway and 100-year floodplain. No portion of Reeder Creek is within the "area of detailed study" for the Town of Varick . Hence it is unlikely that there have been significant damaging flood events associated with Reeder Creek.

B-2m(5) Floodplain Boundaries

The FEMA 100-year floodplain boundaries for Reeder and Kendig Creeks are shown on **Figure B-3**. Note that no part of SEAD falls within the 100-year floodplain boundaries of those surface waters.

The Flood Insurance Rate may for the Town of Varick, in which Reeder Creek is located, clearly indicate that the OB/OD facility is well upstream of the 100-year floodplain, which is confined to the lower 1,200 feet of the stream. Since Reeder Creek is not within the limits of detailed study established in the Flood Insurance Study, there are no detailed calculations available in the Flood Insurance Study document. This, along with the steep banks and relatively low volumes of water normally carried by Reeder Creek, provides a basis for concluding that flooding has not been a problem or issue at the OB/OD facility.

B-3 LOCATION INFORMATION [40 CFR 270.14(b)(11), 264.18]

B-3a SEISMIC STANDARD

This regulation is not applicable to existing facilities.

B-4 TRAFFIC PATTERNS [40CFR 270.14(b)(10)]

Primary access to SEAD is through the main gate located on Route 96 (refer to **Figure B-4, Appendix 1**). Vehicles utilized for transportation of hazardous waste are routed to Building 307 along Administration Avenue. After loading, the military police are notified and the road is blocked off to other traffic while the shipment is escorted to the main gate. At the main gate, the truck and its load are weighed prior to exiting the SEAD boundary.

SEAD does not receive explosive hazardous wastes from off-site. All PEPs which have been designated for disposal at the OB/OD facility are routed from the ammunition disassembly plant (refer **Figure B-4**), if they warrant disassembly prior to treatment, or from the appropriate munitions magazine to the OB/OD facility. There have been no studies conducted at this facility to determine the exact number of vehicles which may be expected on these roads during normal operations. However, as an estimate, up to three detonation operations may be performed per day under clear weather conditions. Therefore, the estimated maximum number of vehicles OB/OD facility roads would be 180 per month.

B-4a TRAFFIC CONTROL

Access to the facility is controlled at the entrances by guarded gatehouses, where installation personnel and visitors must report prior to entering or exiting the facility. Two interior guard stations monitor traffic flow into the two higher security areas. Vehicles are stopped, searched and credentials are verified prior to entrance into these areas.

On-base traffic is controlled by military police. They enforce the 45 mile per hour speed limit by the use of radar.

B-4b ACCESS ROAD SURFACING

All roads for the transportation of hazardous waste, including those within the boundary of the OB/OD facility, are paved asphalt roads. The roads were originally constructed of concrete with a crushed limestone bed. The concrete has since been paved over. Roads within the OB/OD are similar in construction.

B-4c LOAD BEARING CAPACITY

The roads upon which hazardous wastes are transported at SEAD, including those within the OB/OD facility boundary, are designed for a load bearing capacity of 18,000 pounds per axle which is the standard design for road construction within built up areas of military installations.

B-4d TRAFFIC CONTROL SIGNALS

There are no traffic control signals at SEAD. However, there are stop signs at all major intersections and caution signs and speed limit signs. Personnel in charge of transporting waste PEP are required to comply with SEAD speed limits and exercise due caution. In addition, DOT warning markers are posted along roads leading to the OB/OD facility when waste PEPs are being transported there for thermal treatment.

SECTION C

WASTE CHARACTERISTICS

The chemical and physical characteristics of PEPs thermally treated at the OB/OD facility are described in this section together with a waste analysis plan for sampling, testing, and evaluating the resulting ash/residue to ensure that sufficient information is available for its safe handling. The information submitted has been developed in accordance with the requirements of 40 CFR 270.14(b)(2) and 264.13(a).

C-1 CHEMICAL AND PHYSICAL ANALYSIS [*40 CFR 270.14(b)(2) and 264.13(a)*]

The wastes resulting from thermal treatment of the PEP's include an ash/residue and scrap metal associated with open burning activities.

The ash/residue from OB operations is assumed to be a hazardous waste since it is derived from a hazardous waste treatment operation. As such, ash/residue is segregated from different PEP materials, burned. Consistent with overall Hazardous Waste Solid, N.O.S.,and indicates the waste PEP which generated it. The Army is claiming a recycling exemption for the scrap metal waste in accordance with 6 NYCR Part 373-1.1(d)(1)(vi):

> (vi) The storage and recycling of the following recyclable materials is exempt:
>
> (c) scrap metals;

This recycling exemption is consistent with SEAD's Part B permit dealing with demilitarization of small arms munitions in the deactivation furnace.

After thermal treatment the ash/residue is transported to Building 307, Seneca's Hazardous Waste Conforming Storage facility. At 307, the OB ash/residue waste is sampled and analyzed in accordance with Seneca's Waste Analysis Plan for this (307) facility. Ultimate off-site disposal is dependent upon this analysis. A given waste ash/residue may test non-hazardous, and be disposed as an industrial waste, based upon results, and under NYSDEC industrial waste stream approval.

The hazard characteristics are based upon knowledge of the waste stream which generated the ash/residue. Residual constituents after burning must be confirmed prior to ultimate disposal. This is a case-by-case basis for OB Wastes; each munition open burned may generate different characteristics in its respective ash/residue. For example, priming compositions, (primes), in general contain heavy metals in their compositions (barium nitrate, lead azide, lead styphanate, etc.) Igniting compositions, and fuzes may contain compounds such as perchlorates. Most bulk propellants contain stabilizing compositions and/or additives which are hazardous waste constituents. Since Seneca's tray was operable, Seneca has generated three different types of ash/residues as follows: grenades (containing acetone and hexachloroethane), and 3.5" rocket motors (M7 propellant contains potassium perchlorate). These wastes may be sampled by October 30, 1992; these wastes have not been analyzed to date.

C-1a <u>CONTAINERIZED WASTE [*40 CFR 270.15(B)(1)*]</u>

Drums containing ash/residue from the open burning of munitions are taken to the hazardous waste container storage building (Building 307) for storage at the end of each operating day. There is no ash/residue remaining from OD operations.

C-1b <u>WASTE IN TANKS [*40 CFR 264.191*]</u>

There are no wastes in tanks associated with the OB/OD facility.

C-1c <u>WASTE IN PILES [*40 CFR 264.314*]</u>

There are no wastes in piles associated with the OB/OD facility.

C-1d <u>LANDFILLED WASTES [*40 CFR 264.314*]</u>

There are no current on-site landfills associated with the OB/OD facility. Any ash/residue generated by OB generations will be analyzed to determine ultimate disposal, i.e., disposing of it in a solid waste landfill if it is non-hazardous or disposing of it in a hazardous waste landfill if it is hazardous.

materials for which little or no historical data exists. It would not be feasible in the aforementioned cases to do a complete chemical analysis of the material in question because of its presumed hazardous nature.

Information to ensure safe handling of materials to be thermally treated is available in historical data and ordnance publications. In the case of materials that have no such information, it will be necessary to perform chemical and physical analysis to determine its reactivity, stability, and ignitability characteristics as applicable. No PEPs are stored at the OB/OD site prior to thermal treatment. They are transported to the site directly from the disassembly plant (Building 2108; refer to **Figure B-4, Appendix 1**) plant or from approved storage locations.

Full hazard characteristic analyses will not be performed prior to OB/OD to avoid dangers associated with excessive handling of such materials and to eliminate costly and potentially dangerous time delays. The waste is visually inspected prior to treatment to ensure that only appropriate wastes are subjected to thermal treatment. SEAD requests that the detailed waste compositions, presented in **Tables 2-1** and **2-2**, located in **Appendix 2**, be substituted for actual waste analyses.

After treatment, the immediate area surrounding the units is inspected and unburned/unexploded PEP materials are collected and held until the next scheduled treatment. This procedure ensures that any waste treatment residues are collected for analysis and disposal will not be of an explosive nature. Scrap metal fragments and containers (canisters, rocket motors, etc.) are collected and disposed of in accordance with applicable environmental regulations.

The primary hazardous characteristic of the waste residue after thermal treatment will originate from heavy metals and possible traces of the PEP material. All of the waste residues from burning and cleaning of the burn pans are containerized and handled as hazardous waste. They are stored on-site, sampled and analyzed in accordance with the hazardous waste analysis plan contained in this document and in accordance with 40 CFR 264. Wastes that are verified as being hazardous are then disposed of in a permitted hazardous waste disposal facility.

All wastes that are thermally treated are assumed to be hazardous prior to treatment. A detailed waste analysis plan is not necessary to ensure successful thermal treatment since the constituents and ballistic properties of the PEP waste are well known prior to treatment.

Detailed chemical and physical data on military PEP waste which are thermally treated at the OB/OD facility are on file at this facility.

C-2 ANALYSIS PLAN FOR THERMAL TREATMENT RESIDUE [*40 CFR 264.13(b)(c)*]

C-2a PARAMETERS AND RATIONALE [*40 CFR 264.13(B)(1)*]

The purpose of the OB/OD ash/residue waste analysis plan is to characterize the ash/residue remaining after OB so that it can be properly handled, stored and disposed.

The waste analysis plan flow scheme is shown in **Figure C-1**. Unreacted PEP and/or ash/residue from thermal treatment of PEPs is tested first for characteristic of reactivity and secondly, for characteristic of toxicity. The rationale behind this analytical sequence is to minimize the potential for laboratory hazards associated with testing an explosive sample. If positive results are obtained from the reactivity tests, the ash/residue will be submitted for additional thermal treatment. After further thermal treatment and after confirming that the ash/residue is not reactive, it shall be tested for the characteristic of toxicity.

If the ash/residue fails the TCLP procedure materials, will be treated in accordance with BDAT as described in the RCRA Land Disposal Restriction prior to land disposal. Metals of concern include Barium (D005), Lead (D008) and Mercury (D009). BDAT for Barium and Lead is stabilization (non wastewaters) for Mercury, BDAT consists of acid leaching followed by chemical oxidation and dewatering (non wastewaters, <260 mg/kg).

Scrap metal fragments and containers (canisters, rocket motors, etc) are inspected and disposed of in accordance with 40 CFR 261 which entitled "Residues of Hazardous Waste in Empty Containers."

C-2b TEST METHODS [*40 CFR 264.13(B)(2)*]

The reactivity tests (Gap Test and Deflagration, Detonation, and Transition Test) presented in **Appendix 3**, is used to determine if the ash/residue meets the criteria of a characteristic reactive waste as specified per 40 CFR 261.23.

The characteristic of toxicity shall be determined from the Toxicity Characteristic Leachate Procedure (TCLP).

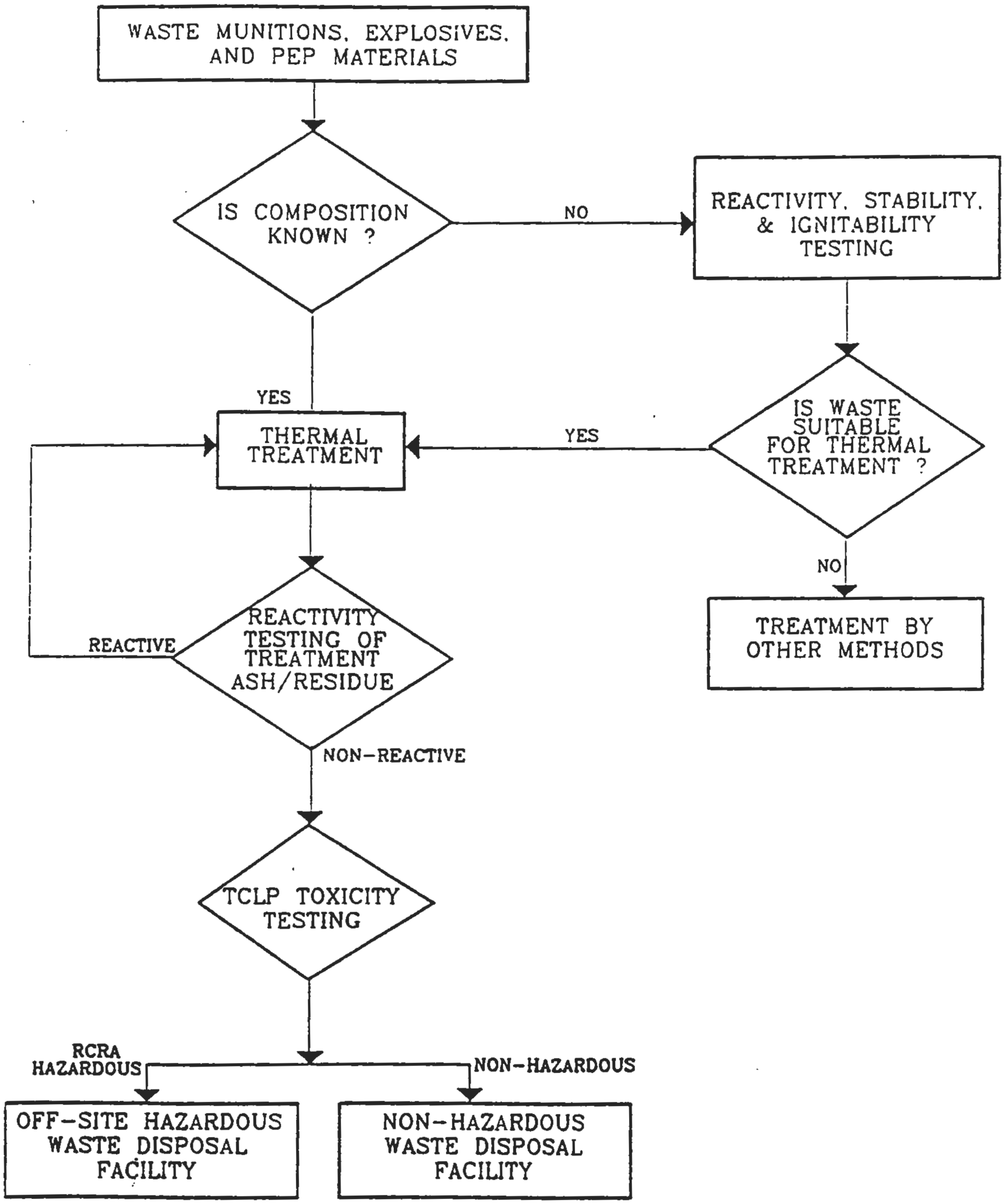


FIGURE C-1 WASTE ANALYSIS PLAN FLOW SCHEME

C-2c SAMPLING METHODS [*40 CFR 264.13(B)(3)*]

Ash/residue will be sampled to ensure that the treatment has been successful in rendering the waste non-hazardous. Any ash/residue generated will be removed from the burning tray after it has cooled sufficiently. The ash/residue will be placed in a labeled, DOT 17H, 55-gallon drum with a bolted, ring-secured lid. When the drum is full it will be sampled and tested for reactivity and hazardous constituents. Sampling will be accomplished through the use of a thief sampler as discussed in **Table C-1**. This sampling device will provide a representative sample of the ash/residue. The drum will be sampled three times and the samples compiled into one composite sample. All appropriate protective clothing will be worn when sampling and appropriate decontamination procedures will be followed for the Thief Sampler. Appropriate chain of custody forms will be used by the person obtaining the sample and the form will be completed before the sample is transported to the laboratory.

C-2d FREQUENCY OF ANALYSIS [*40 CFR 264.13(B)(4)*]

In most cases, OB operations generate relatively little ash/residue. However, any detectable ash will be collected and sampled upon generating a 55-gallon drum or annually at a minimum. In addition, sampling will be performed when the types of munitions normally treated changes significantly from past operations.

C-2e ADDITIONAL REQUIREMENTS FOR WASTE GENERATED OFF-SITE [*40 CFR 264.13*]

This section is not applicable since the facility has no plans to accept wastes generated off-site. In the event that off-site generated PEP waste must be treated at this facility, information necessary to comply with the requirements of this section will be submitted.

C-2f ADDITIONAL REQUIREMENTS FOR IGNITABLE, REACTIVE, OR INCOMPATIBLE WASTES [*40 CFR 264.13(b)(6), 264.17*]

See Section C-2 above.

C-2e RESULTS OF PREVIOUS ANALYSES

No chemical or physical analysis of the waste ash separated from the OB/OD facility is currently available. The quantities of ash generated to date have been very small. The ash

TABLE C-1

PROCEDURES FOR SAMPLING ASH/RESIDUE FROM OPEN BURNING

1. Choose the stainless steel or brass sampling thief for the sampling of residual ash.
2. Make sure that the sampler is clean.
3. Check to make sure that the sampler is functioning properly and that the inner tube can rotate freely to open and close the sampler.
4. Wear appropriate protective clothing and observe required sampling precautions.
5. Ensure that the sampler is in the closed position before any sampling is performed.
6. Slowly lower the sampler into the ash/residue accumulation drum until it reaches the bottom.
7. Slowly rotate the top of the handle clock-wise to open the sampler, allowing the ash residue to enter the sampler.
8. Close the sampler by rotating the top of the handle counter-clockwise to secure the sample.
9. Slowly withdraw the sampler from the drum while wiping the sampler with a disposable cloth or rag as it is withdrawn.
10. Carefully discharge all of the sample into a suitable sample container by slowly opening the sampler. This is done by again rotating the upper handle clockwise.
11. Cap the sample container; attach label and seal; record in field log book; complete chain-of-custody sheet and sample analysis request sheet.
12. Disassemble the sampler, if appropriate, and decontaminate with an appropriate cleaning solution, or store the contaminated parts in a plastic storage tube for subsequent cleaning. Store used rags in a plastic bag for subsequent disposal.

generated has been deemed non-reactive, drummed, stored on-site, and managed in accordance with existing procedures for hazardous waste. Final disposition of the ash will be made when sufficient quantities have been generated to make off-site disposal practical. Wastes that are verified as being hazardous will then be disposed of in a permitted hazardous waste disposal facility.

C-3 WASTE ANALYSIS REQUIREMENTS PERTAINING TO LAND DISPOSAL RESTRICTIONS:

C-3a WASTE CHARACTERIZATION[40 CFR 264.13(A)(1), 268.7]

See **Section C-2** above.

C-3b NOTIFICATION AND CERTIFICATION MEASUREMENTS [40 CFR 268.7]

SEAD Regulation No. 420-2, "Hazardous Waste Management" is included as **Table C-2**. The purpose of this regulation is to set responsibilities, including notification and certification requirements, to assure the systematic management of all hazardous wastes generated at SEAD.

A typical hazardous waste manifest is included as **Figure C-2**.

TABLE C-2

SEAD REGULATION NO. 420-2 - HAZARDOUS WASTE MANAGEMENT

HEADQUARTERS
SENECA ARMY DEPOT
ROMULUS, NY 14541-5001

6 June 1983
(This regulation supersedes SeadR 420-2, 26 June 1981.)

FACILITIES ENGINEERING
HAZARDOUS WASTE MANAGEMENT

1. Purpose. The purpose of this regulation is to set procedures and define responsibilities to assure the systematic management of all hazardous wastes generated at this installation.

2. Scope. This regulation applies to all Directorates and to all personnel whose actions or failure to act may result in noncompliance with federal and state regulations pertaining to hazardous wastes.

3. Definition

   a. Federal Regulations - for the purpose of this regulation,federal regulations mean USEPA Regulations 40 CFR Parts 122, 124, and 260 through 265, and USDOT Regulations 49 CFR Parts 100 through 199.

   b. State Regulations - Regulations yet to be promulgated which must be at least as stringent as federal regulations, and may, in certain areas, be more stringent.

   c. Manage or Management - The systematic control of the accumulation, collection, source separation, storage, transportation, processing, treatment, reclamation, and ultimate disposal of hazardous wastes as mandated by federal and state regulations.

TABLE C-2
(Cont.)

d. Hazardous Waste - Any discarded materials that exhibit any characteristic listed in 40 CFR Part 261.20 or are specifically designated in 40 CFR Part 261.30 that are not reused, recycled, or reclaimed.

e. Generator - Any Directorate, Division, Branch, or Office within a Directorate whose act or process produces a hazardous waste, including those personnel who work at or supervise operations producing a hazardous waste. Directors will be responsible for sub-delegating generator responsibilities to appropriate supervisor.

f. Transporter or Carrier - A commercial firm retained by SEAD which is licensed by the Environmental Protection Agency (EPA) to engage in the transportation of hazardous waste by air, rail, highway, or water.

g. Treatment, Storage, or Disposal Facility (TSDF) - All contiguous land, improvements to the land, structures, and facilities used for treating, storing, or disposing of hazardous wastes licensed by the EPA to conduct such operation. SEAD will have TSDF permit for ammunition wastes. All other wastes will be taken by a carrier to a private, licensed TSDF under contract to provide disposal services.

h. Hazardous Waste Management Committee (Member) - Committee consists of one person from each generator (normally the shop supervisor) who has direct responsibility for the management of the generator's waste. Committee members meet with facilities Engineering Division (FED) collectively and individually to discuss, plan, and implement SEAD's Hazardous Waste Management Program.

i. Manifest - The shipping document that accompanies the waste to an off-site TSDF that contains all information required.

j. EPA Identification Number - The number assigned by the EPA to each generator, transporter, and TSDF authorizing them to conduct hazardous waste activities. SEAD's ID number is NYO21320830.

k. Container - The USDOT specification drum, determined by 49 CFR Parts 100-199, required to offer a hazardous waste for transport. Note that a single trip container (STC) that held the new material may be used to ship the waste material provided the drum is not leaking and/or otherwise defective.

TABLE C-2
(Cont.)

l. Labels, Markings, and Placards - All additional requirements for containers and/or vehicles used to transport hazardous wastes in accordance with 49 CFR Parts 100-199 as well as the EPA hazardous waste label in accordance with 40 CFR Part 262.32.

m. SEAD Waste Certification - Internal document signed by generator and/or responsible supervisor certifying contents of container and that the proper shipping container has been used. DA Form 4508 will be used for this purpose.

4. Responsibilities

   a. The Directorate for Administration and Services will supervise the entire Hazardous Waste Management Program at this installation.

   b. Facilities Engineering Division will:

      (1) Maintain this regulation current in accordance with SEAD Supplement 1 to AR 310-2.

      (2) Determine, through analysis and testing, which wastes are EPA hazardous wastes when requested by generators.

      (3) Prepare, issue, and maintain on file all manifests.

      (4) Supervise the transfer of wastes to Building 307, maintain a log of wastes stored there, and periodically inspect the building and the contents.

      (5) Assure that wastes are shipped to TSDF on time (within 90 days after accumulation begins).

      (6) Insure that licensed TSDFs are retained under contract.

      (7) Prepare and submit the Annual Report to EPA. Work with generators in preparation of applications, reports, plans, or additional information as required by EPA.

TABLE C-2
(Cont.)

   (8) Provide advice and make recommendations to decrease or eliminate the amounts of hazardous wastes generated.

c. Directorate of Quality Assurance will inspect shipping vehicles for conformance with 49 CFR.

d. Directorate for Supply will:

   (1) Maintain stockage levels of DOT containers and labels for all hazardous wastes.

   (2) Comply will all requirements to operate a TSDF (40 CFR Parts 264 and 265) for ammunition wastes.

   (3) Provide all reports, plans and information, etc. required by 50 CFR Parts 264 and 265 to FED for submission to EPA.

   (4) Provide equipment and personnel to transfer wastes from Building 307 to the carrier's vehicles, block, and brace load.

e. Procurement Division, Directorate for Administration & Services will request that all chemicals, solvents, cleaning compounds, etc., purchased are properly identified in accordance with solvent Specification Addendum, Safety Data Sheets, or other informational documents when available from supplier.

f. Generators and/or Responsible Supervisors will:

   (1) Request Hazardous Waste Determination from FED for all new materials purchased after 1 May 1981.

   (2) Make every attempt to decrease or eliminate the hazardous wastes they produce through recycling, reclaiming, reuse, or through alternate processes.

   (3) Draw the proper containers and labels and mark same in accordance with 40 CFR Parts 260 through 263 and 49 CFR Parts 100-199.

   (4) Segregate wastes during accumulation and insure that they remain segregated.

TABLE C-2
(Cont.)

        (5) Certify the contents of the waste container(s) and that the proper container has been used prior to storage in Building 307 by signing the SEAD Waste Certification.

        (6) Be able to prove, beyond reasonable doubt, that all hazardous wastes have been managed and disposed of in accordance with federal and state regulations at the end of February of each year.

        (7) Have on hand at the generation site the appropriate equipment and absorbents necessary to cleanup any hazardous waste spill.

    g. Civilian Personnel Office will insure, the request of the supervisor that personnel who come in contact with hazardous waste, receive required training.

5. Procedures

    a. Generators will draw the proper containers and labels required to properly accumulate their wastes.

    b. Generators will manage their wastes during accumulation in accordance with 40 CFR Parts 260 and 262 and certify the contents and containers by signing the SEAD Waste Certification Statement. Forward statement to his respective Hazardous Waste Committee member.

    c. Generators will contact FED and provide signed Waste Certification Statement prior to transfer to Building 307. DA Form 4508 will be used to transfer wastes to Building 307.

    d. FED will maintain a log of wastes stored in Building 307. The log will contain the proper shipping name, the generic name, the accumulation start date, the date delivered to Building 307, and the date that the waste is shipped.

    e. FED will determine when a shipment is necessary and prepare the manifest. All wastes stored in Building 307 at the time the manifest is prepared will be shipped.

    f. FED will notify D/PA and D/Supply of the date of shipment and the carrier's expected arrival time. FED and D/PA will visit Building 307 and verify that the

TABLE C-2
(Cont.)

shipping names, containers, labels, and manifests are complete and accurate. D/PA representative will sign the manifest on the date of shipment.

g. D/Supply will provide equipment and personnel to transfer the wastes to the carrier's vehicle. FED will offer to the carrier the appropriate placards as required by law.

h. FED will assure that the carrier signs the manifest and will retain one copy for FED records. The wastes will be shipped to an off-post TSD Facility.

6. References

a. AR 200-1
b. 40 CFR Parts 100-199
c. 40 CFR Parts 260-265, 122, 124
d. SEAD Supply 1 to AR 310-2

FIGURE C-2

48-14-1 (3/89)—7f

STATE OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF HAZARDOUS SUBSTANCES REGULATION

HAZARDOUS WASTE MANIFEST

P.O. Box 12820, Albany, New York 12212

Please print or type. Do not Staple.

Form Approved. OMB No. 2050-0039. Expires 9-30-91

In case of emergency or spill immediately call the National Response Center (800) 424-8802 and the N.Y. Dept. of Environmental Conservation (518) 457-7362.

UNIFORM HAZARDOUS WASTE MANIFEST	1. Generator's US EPA No.	Manifest Document No.	2. Page 1 of	Information in the shaded areas is not required by Federal Law.

GENERATOR

3. Generator's Name and Mailing Address

4. Generator's Phone (   )

A. State Manifest Document No. NY B 132934 5

B. Generator's ID

5. Transporter 1 (Company Name)

6. US EPA ID Number

C. State Transporter's ID

D. Transporter's Phone (   )

7. Transporter 2 (Company Name)

8. US EPA ID Number

E. State Transporter's ID

F. Transporter's Phone (   )

9. Designated Facility Name and Site Address

10. US EPA ID Number

G. State Facility's ID

H. Facility's Phone (   )

11. US DOT Description (Including Proper Shipping Name, Hazard Class and ID Number)	12. Containers No.	12. Containers Type	13. Total Quantity	14. Unit Wt/Vol	I. Waste No.
a.					EPA STATE
b.					EPA STATE
c.					EPA STATE
d.					EPA STATE

J. Additional Descriptions for Materials listed Above		K. Handling Codes for Wastes Listed Above	
a	c	a ☐	c ☐
b	d	b ☐	d ☐

15. Special Handling Instructions and Additional Information

16. **GENERATOR'S CERTIFICATION:** I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulations and state laws and regulations.

If I am a large quantity generator, I certify that I have program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and that I have selected the practicable method treatment, storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR if I am a small generator, I have made a good faith effort to minimize my waste and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name	Signature	Mo.	Day	Year

TRANSPORTER

17. Transporter 1 (Acknowledgement of Receipt of Materials)

Printed/Typed Name	Signature	Mo.	Day	Year

18. Transporter 2 (Acknowledgement of Receipt of Materials)

Printed/Typed Name	Signature	Mo.	Day	Year

FACILITY

19. Discrepancy Indication Space

20. Facility Owner or Operator: Certification of receipt of hazardous materials covered by this manifest except as noted in Item 19.

Printed/Typed Name	Signature	Mo.	Day	Year

NY B 132934 5

EPA Form 8700-22 (Rev. 9-88) Previous editions are obsolete.

COPY 1—Disposer State—Mailed by TSD Facility

FIGURE C-2 (Cont'd)

General Information

New York State regulation requires proper completion of all information on a manifest. Omissions, false coding or illegibility is considered a violation. All generators are responsible under New York State and Federal Law for the proper identification, labeling, manifesting and ultimate disposal of all hazardous waste they generate. The manifest system is designed to track hazardous waste from the point of generation until its final disposal (cradle to grave). In order to accomplish this goal, it is essential that all **items on a manifest be properly completed.**

Distribution

Distribution of each copy of the manifest is indicated on the bottom of the form. Copies of the manifest must be mailed promptly. New York State regulations provide five (5) working days for generator and two (2) for a TSDF. The Disposer's state is the state in which the designated TSD facility is located. Generator state is the state in which the installation generating the hazardous waste is located. TSD facility is a treatment, storage or disposal facility.

Generator Section

Item 1-Enter the US EPA ID number (twelve digit number issued by the federal government). The generator must assign a sequential unique, five digit number different for each manifest, as the manifest number.

Item 2-If a continuation sheet is used, please enter the total number of sheets here. Any EPA approved continuation sheet may be used, but distribution and completion must meet New York manifest requirements. The document number in Item A must be placed in Item L of each continuation sheet.

Item 3 and 4-Self Explanatory. These must correspond to the generators US EPA ID number.

Items 5, 6, 7 and 8-These are self explanatory. These numbers must be secured from the transporter. If more than one transporter is used, the generator must supply additional copies of this manifest (copy#5) for each transporter.

Items 9 and 10-The designated TSD facility, name, address and ID number should appear here.

NOTE: All US EPA ID numbers are a twelve digit code starting off with the letters corresponding to the state in which the facility or transporter is located.

NOTE: Only New York State authorized transporters and TSD facilities are allowed to transport or receive hazardous waste in New York State. The generator shall check for authorization.

Item 11-USDOT requires the word "waste" before or in the shipping name for all hazardous waste. See 49 CFR 171 thru 173. Contact USDOT office for description assistance. Any waste in this box is a considered hazardous waste.

Item 12-

Number—indicate number of containers (use whole numbers).

Containers/Type

DM-Metal drums, barrels
DW-Wooden drums, barrels
DF-Fiberboard or plastic drums (glass)
TT-Cargo tank, tank trucks
TP-Tanks, portable
TC-Tank cars
DT-Dump trucks
CY-Cylinders
CM-Metal boxes, cases, roll-offs
CW-Wooden boxes
CF-Fiber or plastic boxes, cartons
BA-Burlap, plastic, paper bags

Public reporting burden for this collection of information is estimated to average: 37 minutes for generators, 15 minutes for transporters, and 10 minutes for treatment, storage, and disposal facilities. This includes time for reviewing instructions, gathering data, and completing and reviewing the form. Send comments regarding the burden estimate, including suggestions for reducing this burden to: Chief, Information Policy Branch, PM-223, U.S. Environmental protection Agency, 401 M Street S.W., Washington, DC 20460; and to the Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

Item 13-Actual number of units indicated in box 14. (Do not use fractions or decimals).

Item 14-Units (wt/vol)

G-Gallons (liquids only)
P-Pounds
T-Tons (2,000 pounds)
Y-Cubic Yards
L-Liters (liquids only)
K-Kilograms
M-Metric Tons (1,000 kilograms)
N-Cubic Meters

Item 15-Use this space to indicate special transportation, treatment, storage or disposal or Bill of Lading information. If an alternate facility is designated, note it here. For international shipments, enter point of departure. Emergency response telephone numbers, or similar information may be included here.

Item 16-The authorized agent of the generator must read and then sign (by hand) and date this certification. The date is the date of receipt by transporter.

NEW YORK STATE REQUIRES THIS ADDITIONAL INFORMATION

Item A-Number preprinted by New York State Department of Environmental Conservation (NYSDEC).

Item B-Generator site address if different from mailing address. If same, write in same.

Item C and E-State of registration and motor vehicle license plate number of waste carrying portion of vehicle used to transport.

Item D and F-Telephone number of authorized agent.

Item G-No entry required by NYSDEC

Item H-Telephone number at site of TSD facility.

Item I-Hazardous waste numbers (letter and three digits) as assigned by Part 371 or 40 CFR 261 must be used to identify hazardous waste. Enter in top box by EPA. If waste is not hazardous in New York but regulated by another state, enter that state's waste code in bottom box.

Item J-If description in item 11 (a,b,c,d) contains NOS or other general term, the hazardous waste constituent must be provided here for each. The specific gravity assumed to be one (1.00) unless indicated in lower right of each box.

Item K-Each material must be assigned an ultimate disposal method code as follows: L = landfill. B = incineration, heat recovery, burning, T = Chemical, physical, or biological treatment. R = Material recovery of more than 75 percent of the total material. Both the generator and the TSDF should agree on codes assigned in this item.

Transporter Section

Items 17 and 18-Print or type the full name of person accepting responsibility and acknowledging receipt of material as listed on manifest for transport. Enter date of receipt and signature.

TSDF Section

Item 19-The authorized representative of the TSDF must note in the space any discrepancy between waste described on manifest and waste actually received. Any rejected materials should be listed and destination of those materials provided.

Item 20-The signature (by hand) of the authorized TSDF agent indicates acceptance (except for Item 19) and agreement with statements on this manifest. The date is the date of signature and receipt of shipment. A TSDF not providing ultimate disposal agrees to transfer waste to a TSDF authorized to provide ultimate disposal as indicated in Item K.

Additional Information

1. If the Disposer State supplies a manifest, that state's form must be used. In any case, New York requires that both the generator and TSDF mail copies to the generator's State and the disposer's State, with the ultimate disposal method indicated in Item K.
2. There may be variations in the requirements between various states regarding items A thru K, therefore, the generator should contact the disposer's State for specific details.
3. If assistance is needed in completion of this manifest, please contact NYSDEC Manifest Section at 518/457-0530 weekdays from 9:00 a.m. to 4:00 p.m.

SECTION D

PROCESS INFORMATION

D-8 OPEN BURNING/OPEN DETONATION FACILITY[40 CFR 270.23]

D-8a DESCRIPTION OF FACILITY[40 CRF 270.231a]

D-8a(1) General

Thermal treatment of propellants, explosives and pyrotechnics (PEPs) is performed within a 90-acre area called the open burning/open detonation (OB/OD) area. Propellants, pyrotechnics and solid wastes containing explosives are open burned on a burn tray located as shown on **Figure B-2**. Explosives are detonated within ten pits located as shown on **Figure B-2**. The OB maximum treatment capacity is limited by Army policy to ~~1~~3,000 lb./day (1,000 lb. per burn, 3 times per day). The OD maximum treatment capacity is limited by Army policy to 2,000 lb./day (10 OD pits, 100 lb. net explosive weight (NEW)/pit, twice per day).

The OB process is contained within a 40-foot by 8-foot by 2-foot deep, welded steel tray with concrete supports and located on a 64-foot by 40-foot by 6-inch-thick reinforced 5000 psi concrete slab. The tray is elevated approximately one foot above the concrete slab for inspection ease. The burn tray is constructed of 2-inch carbon steel with 45° sloping sides. The tray is designed to contain ash/residue that may be generated and any initiating fluids that may be required. The burning tray is equipped with a removable stainless steel cover which is used to keep precipitation out. Burning tray construction details are depicted in **Figure D-1**. The concrete slab will contain any solids (e.g., PEPs and/or ash/residue) that might be spilled during loading of the tray or ash/residue from the tray. Any such spill is swept up thoroughly and HEPA vacuumed up if required. Since the slab is kept free of PEPs to be treated and ash/residue and the tray is covered during inactive periods, there is no need to handle rainwater that falls on the concrete slab. Precipitation runs off the tray cover and off the slab onto adjacent soil without picking up chemical constituents from the treatment unit.

There is no structure associated with OD operations. A 500-foot by 200-foot by 20-foot high earth mound is utilized in this treatment process and is shown on **Figure B-2.**

D-8a(2) Open Burning Area Description

The OB facility is constructed on a weathered shale base, varying between 3 and 5 feet thick. The OB unit is situated on terrain that slopes gently north-northeast, towards Reeder Creek. The terrain is vegetated with grasses and brush. Access roads, ditches and earth berms exist in the OB area, as shown on **Figure B-2.**

The burn pads, designated A through J on **Figure B-2,** are out of service as of 1987 and are currently being investigated under CERCLA.

D-8a(3) Open Detonation Area Description

The OD facility consists of an earth mound (glacial material) approximately 500 feet by 200 feet by 20 feet high. The OD unit is situated on terrain that slopes gently north, towards Reeder Creek. On the east side and within 500 feet of the earth mound, the terrain is unvegetated because it is routinely graded by a bulldozer. The bulldozer resupplies soil to the mound as needed. The remaining terrain surrounding the OD area is vegetated with grasses and brush. The OD facility is currently being investigated under the RCRA Corrective Action process.

D-8a(4) Operating Characteristics [*40 CFR 270.23(a)(2)*]

D-8a(4)(a) Definition of Thermal Treatment

According to 40 CFR 260.10, thermal treatment is defined as:

> " treatment of hazardous waste in a device which uses elevated temperatures as the primary means to change the chemical, physical, or biological character or composition of the hazardous waste. Examples of thermal treatment processes are incineration, molten salt, pyrolysis, calcination, wet air oxidation, and microwave discharge. Also refer to the definitions for 'incinerator' and 'open burning'."

In the same 40 CFR 260.10 section, open burning is defined as:

> "the combustion of any material, without the following characteristics:
> (1) Control of combustion air to maintain adequate temperature for efficient combustion;
> (2) Containment of the combustion reaction in an enclosed device to provide sufficient residence time and mixing for complete combustion; and

(3) Control of emission of the gaseous combustion products."

OB/OD operations fall into these definitions. Open detonation is similar to open burning, except that the detonation combustion reaction occurs relatively faster than the combustion reaction in open burning operations.

D-8a(4)(b) Open Burning

PEPs that have been determined by the Army to be near the end of their shelf life are transported from munitions storage to Building 2108, disassembled and separated from its casing (refer to **Figure B-4, Appendix 1)**. PEP material is put in temperary protective containers and transported to the OB facility where it is placed into the burn tray according to SEAD's standing operating procedures (SOPs, refer to **Appendix 4**). An electric squib is attached to the circuit wire. Operators retire to the protective shelter, close the gate, raise the red signal flag, unlock the control panel, and ignite the propellants. In some instances, casings which contain residual propellants are also placed inside the trays and are flashed.

Following completion of activities, ash/residue and flashed casings are removed from the burn tray, inspected, tested and disposed of in accordance with the **Appendix 4** SOPs.

D-8a(4)(c) Open Detonation

PEPs that have been determined by the Army to be near the end of their shelf life are transported from munitions storage to Building 2108, disassembled as required, then transported to the OD area. Up to ten pits are excavated in the OD earth mound (the location is shown on **Figure B-2**) prior to the arrival of PEP material to be detonated. The pits are approximately 20 feet long by 20 feet wide by 10 feet deep and are excavated by bulldozer such that the pit floor is at or above ground surface of the area surrounding the earth mound.

PEP material to be detonated is carefully placed in the hole according to the **Appendix 4** SOPs. Demolition material, used to destroy the munitions or components, is transferred from storage to the demolition range. A blasting cap is attached to the demolition material and a circuit wire is then attached to the blasting cap. A bulldozer then covers the ammunition or components with a minimum of eight feet of soil. Operators retire to the protective shelter, close gate, raise the red signal flag, unlock control panel, and detonate the ammunition or components.

D-8a(4)(d) Volume of PEP Thermally Treated

The maximum OB thermal treatment capacity is up to 3,000 lbs. of PEP/day, up to 180 days/year, or 270 tons of PEP/year. The maximum OD thermal treatment capacity is up to 2,000 lb. of PEP/day, up to 180 days/year, or 180 tons of PEP/year.

D-8a(5) Additional Information [*40 CFR 270.23(e)*]

This section includes a description of the minimum protective distances and a summary of the SOPs for open burning and open detonation operations. It should be noted, however, that SOPs change on a routine basis as work load changes and as safer procedures are developed. SEAD maintains current SOPs on site, and all personnel involved in the handling and/or treatment of such materials are fully knowledgeable in these operational requirements.

D-8a(5)(a) Minimum Protective Distances

The U.S. Army has established that OB/OD operations must be separated from private property by a minimum protective distance of 3,000 feet. SEAD adheres to this Army requirement. Refer to **Figure B-4.**

D-8a(5)(b) General Safety SOPs for Open Detonation Operations

This section provides a summary of the general safety requirements established in the SOPs for open detonation operations. Copies of the SOPs which specify detailed assignments and operating parameters have been included in **Appendix 4.** The most up-to-date version of SOPs are on file at SEAD for review. General Safety SOPs are:

1. Standing operating procedures (SOPs), the applicable portion, shall be conspicuously posted in rooms, bay, or other areas involving the handling of munitions. Supervisory personnel shall maintain copies of a complete standing operating procedure and be responsible for the enforcement of its provisions. There will be no deviation or changes from the approved SOP without prior approval of the Installation Commander or his designated representative. All persons involved in an OB/OD operation are required to read the SOP. This requirement is ascertained by their signature.

2. Any defect or unusual condition noted that is not covered in SOPs will be reported immediately to supervisory QA personnel.

3. Care will be taken to limit exposure to a minimum number of personnel, for a minimum time, to a minimum amount of hazardous material consistent with safe and efficient operations.

4. Each vehicle operator will have in his possession a valid operator's permit for the particular piece of equipment to be operated.

5. Explosive-loaded ammunition, packaged ammunition or bulk explosives shall not be handled roughly. Large ammunition items, packaged in DOT approved containers designed to permit dragging, rolling, or towing may be so moved when necessary during handling for storage and transportation. Any ammunition determined to be dangerous to handle or store will be reported immediately to supervisory personnel. Operations will be suspended and, if warranted, personnel will be evacuated pending further instructions. Doors of operating buildings should have panic hardware installed and must never be bolted or locked when operations are being conducted. Personnel and explosive limits must not be exceeded.

6. Equipment and grounds shall be tested for electrical resistance and continuity when installed and at intervals determined locally. All exposed explosives or hazardous materials shall be removed prior to making the test.

7. Appropriate fire symbols and/or chemical hazard symbols shall be displayed on vehicles used in transportation ammunition intra-depot. Leather or leather palmed gloves will be worn by all personnel engaged in material handling operations. Steel-toed shoes will be worn by all personnel engaged in material handling operations.

8. No demilitarization/treatment operation will be conducted during an electrical storm or when such a storm is approaching within five kilometers. All personnel will be evacuated to a safe distance.

9. The supervisor is responsible to report to the Safety Officer all injuries and accidents occurring during his/her shift. In the event of a fire or explosion, the person discovering the fire/explosion will notify the Fire Department, Safety Officer, D/QA and D/AO.

10. All material transferred to salvage will be certified free of explosive contamination by the supervisor in charge and verified by the Director of Quality Assurance representative. In addition, all areas that the noise decibel reading is 85 or above, operators will wear ear protection and the area(s) will be properly marked.

11. Components of material being transported from disassembly operation to demolition grounds or deactivation will be properly identified on the exterior pack; any misleading markings will be marked out or obliterated.

12. Servicing of Destruction Site

    a. Trucks transporting explosives material to burning grounds shall meet all applicable safety and inspection requirements. No more than two people shall ride in the cab.

    b. Upon arriving at a burning or demolition ground, trucks may distribute explosive containers or explosive items to be destroyed at sites where destruction (treatment) is to take place. As soon as all items have been removed, trucks shall be withdrawn from the burning or demolition area to a safe location until destruction is complete. Containers of explosives shall not be opened until the truck has been withdrawn.

    c. Containers of explosives or ammunition items to be destroyed at the destruction site shall be spotted and opened at least 10 feet from each other and from explosive material previously laid for destruction to prevent rapid transmission of fire in the event of premature ignition.

    d. Empty containers shall be closed and moved a sufficient distance away to prevent charring or damage during burning of the explosives. Empty containers may be picked up by truck on the return trip after delivery of the next quantity to be destroyed.

13. Materials for Detonating Ammunition

    a. Detonation of explosives or ammunition should, where practicable, be initiated by electric blasting caps using blasting machines or permanently installed electric circuits energized by storage batteries or conventional power lines. Improvised methods for exploding electric blasting caps shall not be used. The initiating explosives should be primed with detonating cord of sufficient length to reach up through the covering to a point where the blasting cap may be connected above the ground level. Ammunition and explosives shall not be burned in containers.

b. Special requirements for using electric blasting caps and electric blasting circuits.

(1) Electric blasting caps, other electric initiators, electric blasting circuits, and the like may be energized to dangerous levels by extraneous electricity of types and sources such as: static electricity, galvanic action, induced electric currents, high tension wires, and radio frequency energy from radio, radar, and television transmitters. Safety precautions shall be taken to reduce the probability of a premature initiation of electric blasting caps and explosive charges of which they form a part.

(2) The shunt shall not be removed from the lead wires of the blasting cap until the moment of connecting them to the blasting circuit, except during electrical continuity testing of the blasting cap and lead wires. The individual who removed the shunt should ground himself by grasping the firing wire prior to performing the operation in order to prevent accumulation of static electricity from firing the blasting cap. NOTE: After electrical continuity testing of the blasting cap lead wires must be short-circuited by twisting the bare ends of the wires together immediately after testing. The wires shall remain short circuited until the time to connect them to the blasting circuit. The Blaster's Galvanometer or DuPont Blaster's Multimeter, Model 101, may be used for continuity testing of blasting caps and lead wires.

(3) When uncoiling the lead wires of blasting caps, the explosives end of the cap should not be held directly in the hand. The lead wires should be straightened out as far as necessary by hand and shall not be thrown, waved through the air, or snapped as a whip to unloosen the wire coils. Avoid loops by running lead wires parallel to each other and close together. If loops are unavoidable, keep them small. Keep wires on the ground in blasting layouts.

(4) Firing wires shall be twisted pairs. Blasting circuit firing wires shall at all times be twisted together and connected to ground at the power source and the ends of the circuit wires where blasting cap wires are connected except when actually firing the charge or testing circuit continuity. The connection between blasting caps and the circuit firing wires must not be made unless the power end of the circuit leads are shorted and grounded.

The following methods should be followed when connecting electric type blasting cap lead wires to the firing circuit wires:

(a) Check wires leading to the blasting machine for continuity and stray currents.

(b) Test electric blasting cap wires for electrical continuity, and after the test, connect to wires leading to the blasting machine.

(c) Evacuate all but two personnel from the area. Place cap into charge to be detonated.

(d) Unshort firing lead wire circuit and check for continuity.

(e) Connect firing lead wire to blasting machine and fire charge(s).

(f) After firing, remove lead wires from blasting machine and twist the end to short them.

(g) Arrange a dummy test circuit, essentially the same as the actual blasting circuit except that a No. 47 radio pilot lamp of known good quality inserted in place of the blasting cap shall be used without applying electric current to the circuit. Any glow is evidence of the presence of a possibly dangerous amount of RF energy, and blasting operations in such areas must be performed with nonelectric blasting caps and safety fuse.

(h) The Dupont Blaster's Multimeter, Model 101 may be substituted for the No. 47 radio pilot lamp when testing for extraneous electricity, but will not detect RF energy.

(5) Blasting or demolition shall not be conducted during an electrical storm or when a storm is approaching. All operations shall be suspended, cap wires shall be short-circuited and all personnel must be removed from the demolition area to a safe location when an electrical storm approaches.

(6) Prior to making connections to the blasting machine, the firing circuit shall be tested. The individual assigned to make the connection shall not complete the circuit at the blasting machine or at the panel, nor shall he give the signal for detonation until he is satisfied that all persons in the vicinity are in a safe place. When used, the blasting machine or its actuating device shall be in the individual's possession at all times. When the individual uses a panel, the switch must be locked in the open position until ready and the single key plug must be in his possession.

(8) Electric blasting caps must be in closed metal boxes when being transported by vehicles equipped with two-way radios and also when in areas where extraneous electricity is known to be present or is suspected of being present.

c. Although electrical blasting caps are the preferred method of initiation, safety fuses may be used in the detonation of explosives and ammunition when enhanced safety and efficiency will result. Safety fuses, when used, must be tested for burning rate at the beginning of each day's operation and whenever a new coil is used. Sufficient length of fuse shall be used to allow personnel to retire to a safe distance, but under no circumstances should a length be less than three feet or have less than a 120 second burning time. Crimping of a fuse which is too large in diameter to enter the blasting cap without forcing shall not be used. Before igniting the safety fuse, all personnel, except the supervisor and not more than one assistant, shall retire to the personnel protective shelter or be evacuated from the demolition area.

d. When using blasting caps involving the electric or non-electric system of destruction, the explosives end of the blasting cap shall always be pointed away from the body.

14. Detonation of Ammunition

a. Ammunition or explosives to be destroyed by detonation should be detonated in a pit not less than four feet deep and covered with not less than two feet of earth. The components should be placed in intimate contact on top of the item to be detonated and held in place by earth packed over the demolition blocks. Where space permits, and the demolition area is remotely located from inhabited buildings, boundaries, work areas, and storage areas, detonation of shells and explosives may be accomplished without the aid of a pit. In either event, however, the total quantity to be destroyed at one time, dependent on local conditions, should be established by trial methods to assure that adjacent and nearby structures and personnel are safe from the blast effect or missiles resulting from the explosion. This procedure should be used for the destruction of fragmentation grenades, HE projectiles, mines, photo flash munitions, mortar shells, bombs, and HE rocket heads which have been separated from motors. Rocket motors containing solid propellants should not be destroyed by detonation.

b. After each detonation, a search shall be made of the surrounding area for unexploded material and items. Items or material such as lumps of explosives or unfused ammunition may be picked up and prepared for the next detonation. Fused ammunition or items which may have internally damaged components should be detonated in place unless the item can be safely handled by using mechanical retrievers providing protection to personnel.

c. In case of misfires, personnel shall not return to the point of detonation for at least 30 minutes after which not more than two qualified personnel shall be permitted to examine the misfire.

15. Operation of Motor Vehicles

a. During loading and unloading of munitions, the brakes must be set. In addition, when on a grade at least one wheel must be chocked.

b. Trucks containing ammunition or explosives should not be refueled within magazines or explosives areas of AMC installations, including refueling from mobile units. A central station located outside the restricted area should be used.

c. No person shall be allowed to ride in or on the truck body or van of a motor vehicle transporting ammunition or explosives except in cases involving limited quantities of small arms, ammunition with non-explosive bullets. In the latter case, the small arms ammunition must be in closed containers which are properly secured in the truck body and sets shall be provided for personnel, restricted in number to the minimum required.

d. No explosives shall be loaded or unloaded from motor vehicles while their motors are running. Motors may be kept running when required to provide power to vehicle accessories such as mechanical handling equipment used in the loading and unloading of the vehicle, provided:

(1) The accessory is an integral part of the vehicle

(2) The exhaust gases from the motor are emitted at least six feet from the point at which the loading operations are conducted and are directed away from this point

(3) The exhaust pipe is equipped with a spark arrestor

16. Inspection of Vehicles

a. All vehicles used to transport ammunition and/or explosives will be inspected monthly by D/QA using DD Form 626.

b. Government owned motor vehicles used for transportation of hazardous materials shall be inspected at frequent intervals by a competent person to see that mechanical conditions and safety devices are in good working order and that oil and motor pans under engines ar clean. Daily inspection shall be made by operators to determine that:

(1) Fire extinguishers are serviceable

(2) Electric wiring is in good condition and properly attached

(3) Fuel tank and piping are secure and not leaning

(4) Brakes; steering, and other equipment are in good condition

(5) The exhaust system is not exposed to accumulation of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials

17. Government motor vehicles involved only in on-post shipments shall be equipped, as a minimum, with one Class 10-BC rated portable fire extinguisher mounted outside the cab on the driver's side of the vehicle.

D-8a(5)(c) General Safety SOPs For Open Burning Operations

This section provides only a summary of the general burning requirements, and the open safety of out-loaded HE projectiles. Other general safety precautions for the handling of pyrotechnics and propellants are the same as those for handling explosives described in the previous section, **D-6.2.**

1. Servicing of Destruction Site

   a. Trucks transporting explosive material to burning grounds shall meet all safety requirements. No more than two people shall ride in the cab.

   b. Upon arriving at a burning or demolition ground, trucks may distribute explosives containers or explosive items to be destroyed (treated) at sites where destruction is to take place. As soon as all items have been removed, trucks shall be withdrawn from the burning or demolition area to a safe location until destruction is completed. Containers of explosives shall not be opened until the truck has been withdrawn.

   c. Containers of explosives or ammunition items to be destroyed at the destruction site shall be spotted and opened at least 10 feet from each other and from explosives material previously laid for destruction to prevent rapid transmission of fire in event of premature ignition.

   d. Empty containers shall be closed and moved a sufficient distance away to prevent charring or damage during burning of the explosives. Empty containers may be picked up by truck on the return trip after delivery of the next quantity to be destroyed.

e. When materials being processed at destruction sites are to be handled by gasoline or diesel powered forklift truck, all safety and operational requirements will be observed. All such material handled will be properly packaged and must not be contaminated with explosives.

2. General Burning Requirements

a. Except in specific cases, such as Explosive D loaded projectiles, ammunition and explosives shall not be burned in containers.

b. Bulk initiating explosives and others used predominantly in detonator and photoflash compositions shall be destroyed by detonation except that small quantities (not exceeding 28 grams) may be decomposed chemically.

c. Loose explosives, other than initiating explosives, may be burned in beds not more than three inches deep. Wet explosives may require a thick bed of readily combustible material such as excelsior underneath and beyond to assure that the explosives will be consumed once the materials are ignited. From the end of the layer of explosives the combustible material should be extended in a train to serve as the ignition point. If an ignition train of combustible material leading to the explosives is used, it must be arranged so that both it and the explosives burn into the wind. The combustible train of explosive, if ignited directly, must be ignited by a safety fuze of a length which will permit personnel to withdraw safely to the protective shelter. In some cases, it may be necessary to tie two or more squibs together to assure ignition of the combustible train. When a misfire occurs, personnel shall not return to the point of initiation for at least 30 minutes. Not more than two qualified persons shall be permitted to examine the misfire.

(1) Loose, dry explosive may be burned without being placed on combustible material if burning will be complete and the burning does not become unduly contaminated. The ground must be decontaminated as frequently as is necessary for the safety of personnel and operations.

(2) Wet explosives shall not be burned without first preparing a bed of nonexplosive combustible material upon which the explosives are placed to assure complete burning. It is necessary to burn RDX wet to prevent detonation.

(3) Dry grass, leaves, and other extraneous combustible material in amounts sufficient to spread fire shall be removed within a radius of 200 feet from the point of destruction.

3. Burning Out-Loaded HE Projectiles

a. TNT, Explosive D, Composition B, pentolite, and other explosives filler in open projectiles may be burned out when destruction by detonation or washing out and burning the explosive filler separately is impracticable. Projectiles that are burned out are done in burning trays.

b. Projectiles to be burned out should be placed on their sides and arranged in groups of not more than six projectiles, with all open ends facing in one direction. Open ends of projectiles should not be pointed into the wind.

c. Combustible material such as excelsior or scrap lumber should be used to ignite the explosive filler. Oil-soaked waste may also be used; however, it shall not be placed in the interior of the fuze activities. use of oil or wood treated pentachlorophenol (PCP is prohibited, unless specifically authorized by Commander, AMC, ATTN: AMCSF.

D-8b WASTE CHARACTERISTICS [*40 CFR 264.601(a)(1), 264.601(b)(1), 264.601(c)(1)*]

A description of the waste residue from OB/OD operations is presented in Section C-1. Any generated ash shall be removed from the burning trays and/or from the detonation pits and placed in DOT 17H drums. Upon placing the ash in such drums, the drums shall be labeled as containing hazardous waste and the date which the ash was placed in the container will be clearly marked. The drums will be kept closed at all times except for when waste is being added to or removed from the drums. After burning/detonation operations are completed, the drums will be transported to the container storage building (Building 307). The drums shall be handled in accordance with 40 CFR 264 Subpart I for management of containers.

D-8c DEMONSTRATION OF EFFECTIVENESS OF TREATMENT [40 *CFR 270.23(d)*]

Hazardous materials are being treated at SEAD to remove the hazardous characteristics of reactivity. After open burning or open detonation ash/residue is collected, as discussed in Section C, and a determination is made if the materials are still reactive. If the materials are not reactive a further determination is made in regards to its toxicity (TCLP testing).

The U.S. Army considers OD and OB treatment of reactive materials as the safest and most expeditious method of treatment for ordinance. However, due to the inherent and obvious safety issues regarding sampling such an event little information is currently available to evaluate treatment effectiveness.

Nonetheless, the Army has initiated a program which is attempting to develop testing procedure that could be used in the future to determine treatment effectiveness. This report entitled "Consolidated Report on the Test Program for the Identification and Characterization of Products and Residues from the Open Burning/Open Detonation of Munitions," U.S. Army Armament Munitions Chemical Command, Rock Island, IL (1987) is currently unavailable but has been requested. This report will described the results of a program intended to determine the best technique to measure treatment effectiveness, it will not describe the actual treatment effectiveness of OB/OD operations. This will apparently be a follow-up program.

The results from this program will be given to the EPA when thley become available. See Section D-8c.

D-8d ENVIRONMENTALPERFORMANCESTANDARDS [40 CFR 264.601 and 602]

At a minimum §270.23(b) requires the facility owner to demonstrate that the performance standard, described in §264.601, is not violated by facility operations. This may be demonstrated by conducting an environmental assessment of hydrology, geology and meteorology. The results of this environmental assessment are presented in Sections D-8d(1) through (4). Based on the assessment performed, SEAD must develop and maintain performance standards for the OB/OD facility.

The environmental performance standard requires the facility owner to prevent the release and migration of waste constituents to environmental media (groundwater, subsurface, surface water, wetland, soil and air) to the extent necessary to ensure protection of human health and the environment. This section includes the performance standard elements, listed in §264.601, that must be considered to determine if the facility is in compliance.

D-8d(1) Protection of Groundwater and Subsurface Environment [40 CFR 264.601(a)]

D-8d(1)(a) Waste Quantity and Characteristics

Because of the nature of OB/OD processes, there is relatively little waste remaining in the unit after the thermal treatment processes are completed. Any ash/residue remaining in the burn tray of the OB operation is removed from the unit after the burn is completed. The extent of residual constituents in environmental media is the subject of ongoing investigations at the OB/OD facility (CERCLA Remedial Investigation (RI/FS) and RCRA Facility Investigation (RFI), respectively).

The waste residues associated with OB/OD thermal treatment operations are ash/residue from the OB treatment process (there is no residual from the OD operation). PEPs to be treated are characterized as described in Section C. SEAD is in the process of characterizing ash/residue from the OB operation (refer to Section C).

D-8d(1)(b) Geology and Hydrogeolgoy

The Finger Lakes uplands area is underlain by a broad north-to-south trending series of rock terraces mantled by glacial till. As part of the Appalachian Plateau, the region is underlain by a tectonically undisturbed sequence of Paleozoic rocks consisting of shales, sandstones, conglomerates, limestones and dolostones. **Figure D-2** shows the regional geology of Seneca County. In the vicinity of SEAD, monoclinal black shale of the Devonian age (385 million years bp), Hamilton group, dip shallowly to the south, 35 feet per mile, and show little evidence of tectonic disturbance, by folding or faulting.

Locally, the shale is a soft, grey, fissile, highly jointed upper member of the Hamilton Group. **Figure D-3**, Bedrock Stratigraphy, is a stratigraphic section of Paleozoic rocks of Central New York. The shale contains interbeds of calcareous shale and limestone. The shale is extensively jointed or fractured at the contact with overlying tills. Joint spacings are 1 inch to 4 feet in surface exposures. Prominent joint directions are N 60° E, N 30° W, and N 20° E, with the joints being primarily vertical. Corings performed on the upper 5 to 8 feet of the bedrock revealed low Rock Quality Designations (RQDs), i.e., <5% with almost 100% recovery. This information indicates that at the glacial till/shale interface, the rock is highly fractured but has not weathered to the point of being unrecoverable. Much of the fracturing in the underlying bedrock may be attributed to the glacial event, coupled with regional stresses. The shale has been relatively unaffected by tectonic events to the south and east. Bedding dips to the south at approximately 35 feet per mile. The upper 3 feet to more than 5 feet of shale is highly fractured, probably as a result of glaciation and normal erosion. RQDs for core samples from the upper 5-8 feet of shale were generally less than 5%, the highest being 37%. The tectonically undisturbed nature of the shales in this area reduces the potential of vertical migration of shallow groundwater into deeper (>100 feet) aquifers, as there is no evidence of major structures.

Pleistocene age (Wisconsinan event, 20,000 bp) glacial till deposits overlie bedrock shales. **Figure D-4**, Physiographic Map of Seneca County, presents an overview of the subsurface soils in the area. The site is shown on **Figure D-4** as lying on the western edge of a large glacial till plain between Seneca Lake and Cayuga Lake. The till matrix, the result of glaciation, varies locally but generally consists of horizons of unsorted silt, clay, sand, and gravel. The till would be expected to have a high percentage of clay, as they were derived from the underlying shales. Thicknesses of the glacial till deposits on SEAD ranges from 1 to 15 feet.

Darien silt-loam soils, 0 to 18 inches thick, have developed over Wisconsinan age glacial tills. These soils are developed on glacial till where they overlie the shale. In general, the topographic relief associated with these soils is 3-8%. **Figure D-5** presents the U.S. Department of Agriculture General Soil map for Seneca County. **Figure D-6** presents the soil map for the area surrounding the OB/OD grounds.

The soil is silty clay loam developed over glacial tills. This soil has such poor percolation characteristics that the original burn pads had to be built up because it was difficult to maintain the burn due to the wet soils. As a result, the burn pads were constructed of crushed shale, from SEAD quarries, and form the topographic highs on the site (refer to **Figure B-2**). Berms around the pads are composed of soil and till pushed up around the pads. The glacial till has a variable composition ranging from clay to sandy gravel.

Table D-1 presents average background concentrations for arsenic, barium, cadmium, chromium, mercury, lead and selenium in shale, sandstone, limestone, soil and sediment of the Great Lakes. The table shows shales to contain from 2 to more than 10 times the heavy metals concentration of other sedimentary rocks. This is due to the cation complexing capacity of the clays that make up the shales.

Regionally, four distinct hydrologic units have been identified within Seneca County. These include two distinct shale formations, a series of limestone units and unconsolidated Pleistocene glacial sediments. Overall, the groundwater in the county is very hard, and therefore, the quality is minimally acceptable for use as potable water.

A substantial amount of information concerning the hydrogeology in the area has been compiled by the state of New York (Mozola, A.J., 1951). This report has been reviewed to better understand the hydrogeology of the area surrounding SEAD. Geologic cross-sections from Seneca Lake and Cayuga Lake have been constructed by the state of New York (Mozola, A.J., 1951) and are presented in **Figure D-7.** This information suggests that a groundwater divide exists approximately half way between the two finger lakes. SEAD is located on the western slope of this divide and therefore the regional surficial groundwater would be expected to flow westward toward Seneca Lake. Southerly flow would likely be blocked by the Valley Heads Moraine. The data from the report indicate that within a 4-mile radius of the site, a total of 32 wells exist for which information has been obtained. This information includes (1) the depth and the diameter of wells; (2) the individual well's yield; and (3) the geological strata the well was drilled through. Although this information is not up to date, these data are useful in providing an understanding and characterization of the aquifer(s) present. A review of this information indicates that 3 geologic strata have been used to provide water for both domestic and agricultural purposes. These include: 1) a bedrock aquifer, which in this area is predominantly shale; 2) an overburden aquifer, which includes Pleistocene sediments (glacial till); and 3) deep beds of limestone. The occurrence of limestone is considered to be unusual for this area and is more commonplace to the north. As of 1957, 25 wells obtained water from the shale aquifer, 6 wells tapped the overburden aquifer, and 1 used the deep limestone as a source of water.

For the 6 wells which utilized groundwater extracted from the overburden, the average yield is approximately 7.5 gpm. The average depth of these wells iss 36 feet. The geologic material which comprised the aquifer is generally Pleistocene till, with the exception of one well located to the northeast of the site. This well had penetrated an outwash sand and gravel deposit. The yields from these overburden wells range from 4 to 15 gpm. The well located in the outwash sand and gravel deposit, drilled to 60 feet, yielded only 5 gpm. A 20-foot hand dug well, located southeasterly from the outwash well, yielded 10 gpm.

The information reviewed indicates that the upper portions of the shale formation would be expected to yield small supplies of water, adequate for domestic use. For mid-Devonian shales such as those of Hamilton group, the obtained yields, (i.e., less than 15 gpm), are consistent with what would be expected for shales (LaSala, 1968). The deeper portions of the shale formation, (at depths greater than 235 feet) have provided yields up to 150 gpm. These high yields may be due to the presence of limestone cavities at depth. The solutioning of limestone joints can cause the formation of elongated cavities. In general, as the depth of penetration into the shale is increased, beyond >100 feet, the yields become less, unless a limestone cavity is intercepted. A limestone cavity was noted in one well log at approximately 610 feet. This well, drilled to a final depth of 787 feet, yielded approximately 150 gpm. It appears that the yields in the upper 100 feet almost doubled those measured at depths below 100 feet. This is consistent with what would be expected, i.e.,as the depth of penetration is increased, the fracturing in the shale is decreased, making less water available.

As mentioned previously, in the deep portions of the shale, limestone cavities are encountered which provide substantial quantities of water. This source of water is considered to comprise a separate source of groundwater for the area. Very few wells in the region adjacent to SEAD utilize the limestone as a source of water, which may be due to the drilling depths required to intercept this water.

Approximately 95 percent of the wells are used for domestic or farm supply and the average water withdrawal rate from the wells is around 500 gallons/day (0.35 gpm) (Mozola, A.J., 1951). About five percent of the wells in the county are used for commercial, industrial, or municipal purposes. Seneca Falls and Waterloo, the two largest communities in the county, are in the hydrogeologic region which is most favorable for the development of a groundwater supply. However, because the hardness of the groundwater is objectionable to the industrial and commercial establishments operating within the villages, both villages utilize surface water as their municipal supplies. The villages of Ovid and Interlaken, both of which are without substantial industrial establishments, utilize ground water as their public water supplies. Ovid obtains its supply from two shallow gravel-packed wells, and Interlaken is served by a developed seepage-spring area. Regionally, the phreatic aquifer of the unconsolidated surficial glacial deposits of the region would be expected to flow in a direction consistent with the ground surface elevations.

As many as three aquifers exist in the OB/OD area, a shallow unconfined aquifer in the glacial till, the fractured shale immediately below the till, and a deep aquifer in the underlying competent shales and limestone. The hydraulic gradients of the shallow, unconfined aquifers tends to mirror surface topography, with measured hydraulic conductivities at the higher velocity end of the typical range for glacial tills. **Figure D-8** shows a hydrogeologic cross-section of the OB area and illustrates probable percolation and groundwater flow directions. The location of the cross-section C-C is shown on **Figure D-9**. Hydraulic characteristics of the deep, confined, bedrock aquifers are not fully understood; however, recharge is assumed to be from the north along bedding plane partings. Because of the current lack of exploration data, no accurate hydrogeologic cross-section could be prepared for the OD facility, however, it is reasonable to assume it is identical with the OB area.

All previous studies at the OB/OD site have focused on groundwater from the unconfined till. This has assumed that any groundwater in the till and the underlying fractured/weathered shales is essentially the same aquifer. The water table for the shallow aquifer is 3-6 feet deep, with the shale-till contact being 3 to 15 feet below the ground surface. Recharge to these shallow aquifers is via percolation associated with local precipitation (approximately 30 in/yr).

On-site hydraulic conductivity determinations were performed by Metcalf and Eddy (1989) on the last ten newly installed monitoring wells (MW-8 through MW-17: refer to **Figure D-9**). The data were analyzed according to a procedure described by Hvorslev (1951). The average hydraulic conductivity of the ten determinations was $5.0\text{x}10^{-1}$ ft/day ($1.8\text{x}10^{-4}$ cm/sec). The hydraulic conductivities ranged from $2.02 \text{ x } 10^{-2}$ ft/day ($7.06\text{x}10^{-6}$ cm/sec) to 1.47 ft/day ($5.19\text{x}10^{-4}$ cm/sec). These hydraulic conductivity measurements were within an order of magnitude agreement with previous results by O'Brien and Gere (1984). O'Brien and Gere determined the average hydraulic conductivity of the till material to be approximately $2.8\text{x}10^{-1}$ ft/day ($9.9\text{x}10^{-5}$ cm/sec). A comparison of the measured values with the typical range of hydraulic conductivities indicates that the glacial till at the site exists along the more permeable end of typical glacial till values. Soils were collected during the 1984 Army Environmental Hygiene Agency (AEHA) Phase IV investigation of the open buring pads. Boreholes were sampled to characterize the permeability of the pads. Soil permeabilities were measured by recompacting the soil in a mold to 95% standard proctor density. The average permeability for five measurements was $1.01\text{x}10^{-3}$ ft/day ($3.56\text{x}10^{-7}$ cm/sec). The typical range of glacial tills described by Freeze and Cherry (1979) is between $3\text{x}10^{-1}$ ft/day ($1\text{x}10^{-4}$ cm/sec) and $3\text{x}10^{-7}$ ft/day ($1\text{x}10^{-10}$ cm/sec).

Hydrogeologic data for the wells are summarized in **Table D-2**. Based on these data, interpreted groundwater contours are shown on **Figure D-9**. Local groundwater flow is to the east and northeast of the OB/OD facility toward Reeder Creek.

The groundwater at the Seneca OB/OD facility has been classified by NYSDEC as GA. The best usage of class GA waters is as a source of potable water supply. Class GA waters are fresh groundwaters found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock.

D-8d(1)(c) Land Use

The Seneca Army Depot (SEAD) is situated between Seneca Lake and Cayuga Lake and encompasses portions of Romulus Township and Varick Township. Land use in this region of New York is largely agricultural, with some forestry and public land (school, recreational and state parks).

The most recent land use report is that issued by Cornell University. This report classifies, in further detail, land uses and environments of this region (Cornell 1967). Agricultural land use is categorized as inactive and active use. Inactive agricultural land consists of land committed to eventual forest regeneration, land waiting to be developed, or land presently under construction. Active agricultural land surrounding SEAD consists of largely cropland and cropland pasture. The U.S. Geologic Survey (USGS) quadrangle maps for the Towns of Ovid and Dresden, New York (1970), New York State Department of Transportation (DOT) quadrangles for Romulus, New York (1978) and Geneva South, New York (1978) does not indicate land designated for dairy production.

The SEAD is a government-owned installation under the jurisdiction of the U.S. Army Material Command (AMC). SEAD lies immediately west of the village of Romulus, NY (refer to **Figure B-2**), 12 miles south of the villages of Waterloo and Seneca Falls, and 2.5 miles north of the village of Ovid, NY (refer to **Figure B-2**). The nearest major cities are Rochester, NY and Syracuse, NY located 60 miles northwest and northeast, respectively. The total area of SEAD is 10,587 acres, of which 8,382 are designated storage areas for ammunition, storage and warehouse, and open storage and warehouse. On-post family housing is in two parcels, a 54-acre development adjacent to Route 96 and another 69 acres situated along Seneca Lake. Additionally, troop housing is available for 270 enlisted men (Buildings 703, 704, and 708). Bachelor officer quarters are located in Building 702, which is designated for 18 men. Other land uses include Administration, Community Services and an airfield. SEAD has a swimming pool at the north end of the facility, along with tennis courts, a gymnasium, and a sports field complex. Picnic and playground areas are found on the installation at Hancock Park, the Lake Area and the Family Housing Area. There is also a skeet and trap range at the field. There are no recreational facilities located within 1,000 feet of the OB/OD facility.

The OB/OD facility is situated in the northwest corner of SEAD. The closest SEAD property boundary is approximately 3,000 feet from the OB/OD facility. Land use adjacent to and off-site of the northwestern corner of SEAD is sparse residential areas with some farmland (refer to **Figure D-10**).

Forestland adjacent to SEAD is primarily forestland under regeneration with sporadic occurrence of mature forestry. Public and semi-public land use surrounding and within the vicinity of SEAD is Sampson State Park, Willard Psychiatric Center, and Central School (at the Town of Romulus). Sampson State Park entails approximately 1,853 acres of land and includes a boat ramp on Seneca Lake.

Historically, Varick and Romulus Townships within Seneca County has developed as an agricultural center supporting a rural population. However, increased population occurred in 1941 due to the opening of SEAD. Population has progressed since then largely due to the increased emphasis on promoting tourism and recreation in this area. Records provided by the Town of Varick show approximately 15 residences adjacent to the northwestern border of SEAD which are within 4,000 feet of the OB/OD facility. These residences all obtain drinking water from private water wells. Detailed information regarding the construction of these wells was not available.

D-8d(1)(d) Existing Groundwater Quality

The following reports have provided data for the development of this preliminary environmental assessment, including:

1. Installation Assessment of Seneca Army Depot, Report No. 157, AMXTH-IR-A-157, January 1980; Conducted by the U.S. Army Toxic and Hazardous Materials Agency (USATHMA)

2. Phase 2, Hazardous Waste Management Special Study: No. 39-26-0147-83, US Army Material Development and Readiness Command (DARCOM) Open-Burning/Open Detonation Grounds Evaluation, 1983

3. O'Brien and Gere Engineers, Burning Pads B and H Closure, 1985

4. Phase 4 Evaluation of the Opening Burning/Open Detonation Grounds. Investigation of Soil Contamination, 1984; Conducted by the US Army Environmental Hygiene Agency (USAEHA)

5. Evaluation of Solid Waste Management Units, Seneca Army Depot, Interim Final Report, Groundwater Contamination Survey No. 38-26-0868-88, 1988; Conducted by USAEHA.

6. Metcalf & Eddy, Criteria Development Report for Closure of Nine Burning Pads, 1989.

7. Phase 5, Hazardous Waste Study No. 37-26-0593-86, Summary of AMC Open-Burning/Open-Detonation Grounds Evaluation; March 1981-March 1985.

8. Closure of Open-Burning/Open Detonation Grounds Burning Pads, Seneca Army Depot Hazardous Waste Study No. 37-26-0778-86, 6-7 January 1986. Conducted by AEHA.

The US Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an evaluation of the Seneca Army Depot beginning in May 1979. This Initial Installation Assessment of the Seneca Army Depot was "to assess the environmental quality of Seneca Army Depot (SEAD) with regard to the use, storage, treatment, and disposal of toxic and hazardous materials." It was to "define any conditions which may adversely affect (human) health and welfare or result in environmental degradation." Following a review of existing documents and site investigations of potential areas of concern (AOC) this study concluded: (1) geological conditions are such that chemical constituents of concern, if present, could migrate in surface or subsurface waters and (2) the OB/OD facility environmental media potentially contain chemical constituents, such as heavy metals and explosives. The USATHAMA Report No. AMXTH-IR-A-157 recommends additional investigations to determine if chemical constituent migration exists.

Subsequent to the SEAD assessment conducted by USATHAMA, a four phased DARCOM Open Burning/ Open Detonation Ground Evaluation was begun in 1981. Seven groundwater monitoring wells (MW-1 through MW-7) were installed in 1981. Six monitoring wells were installed along the perimeter of the OB/OD facility. One well, MW-1, was located between the OD area and the OB area. The wells were screened in the glacial till at, or just above, the till-shale (bedrock) contact. Groundwater monitoring began in January 1982. Metals and explosives were analyzed quarterly during 1982. No EP toxic metals or explosives were detected in the 27 samples analyzed in that first year.

However, during 1982 wells MW-1 and MW-7 exceeded the New York State groundwater standard for iron on three occasions and wells MW-5, 6, and 7 exceeded manganese standards. Presumably, because of early high values, these elements, plus fluoride and nitrogen, were analyzed a total of 65 times through 1987. **Table D-3** summarizes groundwater monitoring data from the 7 wells during the period of 1982 through 1987. Included in this extended monitoring were pH, TOC, pesticides, specific conductivity, and TOX. The pH was slightly acidic to moderately basic over the monitoring period. MW-1 registered both the most acidic and most basic values. Monitoring of these original wells continued on an annual basis through 1987 for explosives, metals, TOC, TOX, pH, pesticides, nitrates, and specific conductivity. These results are summarized in USAEHA Groundwater Contamination Survey No. 38-26-0868-88, Interim Final Report on the Evaluation of Solid Waste Management Units (SWMU), Seneca Army Depot.

The Phase II study (No. 39-26-0147-83) was performed in 1982 in order to characterize the environmental hazards associated with the Open Burn area. This study concentrated on attempting to determine total explosive and metal content in soils and residues. This program was to determine if the OB area soils and residues were hazardous wastes, based on Extraction Procedure (EP) Toxicity. The study is based on 24 soil samples collected from 0-6 inches, from Burn Pads B through H. Pads A and J were not sampled. Pad B was found to contain Ba (to 508 ppm) in excess of the EP Toxicity standard for Ba (100 ppm). Pad H exceeded the standard for lead (24.6 ppm, standard 5 ppm). Pad F had one soil sample containing 9,270 ppm (0.9%) 2,4,6-TNT. These data are summarized in **Table D-4**).

The Phase II report concluded that the areas were not hazardous by characteristic EP Toxicity for heavy metals, although two of three samples from pad B exceeded the barium standard and two of the three pad H samples exceeded Pb standards. This study recommended that no additional studies be conducted.

Based on the data from the Phase II investigation, O'Brien & Gere Engineers, Inc. were contracted in 1984 to review previous studies and recommend procedures for the environmentally sound closure of Burning Pads B and H, following RCRA guidelines. The Phase II report had identified only pads B and H as having soil concentrations in excess of allowable EP Toxicity Limits. The report was prepared under Contract DAC87-84-C-0077, dated November 1984. The report was based on analytical data from previous studies and a magnetics survey of the two pads. The magnetics survey indicated high anomalies at the pad berms. Pad B has moderate magnetic anomalies in the northwest berms and in the southern berms. Pad H has a magnetic anomaly extending from the pad to the south. O'Brien and Gere recommended closure of pads B and H by soil excavation, on-site treatment, and disposal of treated soil to an off-site TSDF landfill. The excavated areas at pads B and H were to be capped. There were no recommendations made regarding the remaining seven pads, as these were not included in this study.

During 1984, in a study nearly coincident with the O'Brien and Gere study, the U.S. Army Environmental Hygiene Agency conducted an additional investigation of the soils at Burn Pads B, F, and H (Phase 4 Evaluation, Hazardous Waste Study No. 37-26-0479-85, USAEHA). Presumably, pad F was included for further investigation along with pads B and H due to the high concentration of 2,4,6-TNT, (0.9%), obtained in one sample, as previously mentioned. The study confirmed the presence of EP Toxic heavy metals and explosives and determined the vertical and horizontal extent of these constituents. A total of 47 samples were collected from the pads, berms, and adjoining soils and drainage areas. A total of eight soil borings were completed in the three pads for a total of 41 feet of borings. Three borings were completed in pad F, two borings in pad B, and three borings in pad H. In addition, four borings were completed in areas adjacent to pads B, H, and F. Two borings were performed adjacent to pad H, one adjacent to pad F, and one adjacent to pad B. Three composite berm samples were collected from each pad. There are three berms per pad yielding a total of nine composite samples. Additionally, three ditch sediment samples were collected.

Phase IV soil data are summarized on **Table D-5**. Sample locations and data results from the Phase IV program are summarized in Figures **D-11, -12 and -13**, respectively. Soils at pad B were found to contain Pb (101 ppm) and Ba (424 ppm) values in excess of the EP Toxicity limits of 5 ppm and 100 ppm. Pad F has one soil sample (Pb 10.7 ppm) exceeding the standards for lead (5 ppm). Pad H had one sample (Pb, 5.64 ppm) which exceeded lead standards and detected small amounts of 2,6-

DNT and 2,4-DNT. Borehole water samples contained lead concentrations up to 112 ppb at pad F which exceed the 25 ppb New York State groundwater standards for lead. The data are summarized in **Table D-6**. Near pad B ten approximately ten intact 50 mm tracer bullets were removed during the boring operations (all borings were done with remote boring equipment).

A Phase V summary report (Hazardous Waste Study No. 37-26-0593-86) was prepared by AEHA in 1985 which concluded that soil contamination at Pad B was significant, although a small number of samples at other pads exceeded limits/guidelines. Further, AEHA indicated that surface migration of contaminants due to runoff is not significant. THe primary constituents of concern was identified as lead and barium.

Under RCRA guidelines, in 1989, Metcalf and Eddy Engineers (M&E) was contracted to evaluate previous studies, conduct further investigations as necessary, and develop a closure plan at the OB area. Their program included: (1) two types of geophysical surveys to safely locate monitoring wells: (2) auger and core drilling and well development of ten new monitoring wells and (3) sampling and analyses of groundwater from ten new wells and six of the seven existing wells (MW-7 is virtually dry). The report reviewed closure procedures made by O'Brien and Gere for in-place containment, and made recommendations for alterations to containment procedures (installation of an additional grout curtain to contain shallow groundwater). The M&E study conducted magnetic and EM geophysical surveys prior to siting monitoring wells. These data indicated that metallics were not generally dispersed from the pads with the exception of an area between pads D and E. Consequently, monitoring well MW-12 was not positioned in an advantageous location to determine if groundwater dispersal of contaminants had occurred at pad E. Monitoring wells at pads B and H were not positioned to evaluated the magnetic highs detected by O'Brien and Gere.

During the installation of the ten additional monitoring wells, M&E collected soil samples for sieve analysis. The sieve analyses, performed in accordance with ASTM methods, characterized the till as poorly sorted sands with some silt and clay. Upper zones contained a greater percentage of material passing the 200- mesh sieve than those samples collected from the deeper zones. Core samples were collected from the upper fracture zones in the shale. The Rock Quality Designations (RQD) ranged from 0-37%. Vertical joints are oriented in one direction. Field observations suggest that this should be approximately N-65° to 75° E. The current location of these core samples is unknown.

The ten new monitoring wells were completed in holes offset from the original borings. These holes were completed 6 inches into the fractured shales, with screens set at the shale/till contact. The shallow water table is 3 to 5 feet below the surface. Hydraulic conductivity measurements ranged from 0.02 to 1.47 feet per day. These conductivities are in general agreement for tabulated ranges in glacial tills and fractured shale. The hydraulic gradient is generally to the east.

Following the development of the ten new wells and six of the seven previous wells (MW-7 was virtually dry), water well samples were collected for EP Toxicity metals and explosive analysis. The analytical results of groundwater sampling from wells MW-1 through -6 and MW-8 through -17 are presented on **Table D-7**. None of the new wells contained metals or explosives greater than New York groundwater standards. While several of the previous six wells had elevated metals, this was attributed to poor well development as evidenced by high water turbidity. None of the well samples were filtered prior to acidification.

D-8d(1)(e) Potential for Contaminant Migration

The previous section presented the current database for the site. This section integrates and interprets the previously presented information yielding a conceptual understanding or model which defines the current site conditions at the site. The conceptual site model for the OB/OD facility combines both site conditions and expected constituent behavior into a cohesive understanding of the site. The model was developed by evaluating the following:

1. Physical site characteristics: Physical characteristics of environmental media and the effect these media may have on migration of chemical constituents.

2. Environmental fate of constituents: Expected behavior of chemical constituents in environmental media based upon chemical properties of the constituents.

Erosion, dissolution, degradation, and biodegradation allow constituents to disperse into the soils beneath, and downslope from, the pads and berms. Surficial erosion may have transported dissolved and suspended materials along drainage paths, potentially into surface waters (Reeder Creek) and off the site. Relatively level topography and indirect drainage paths with intermittent poor draining areas decreases potential surface dispersion of constituents by erosion or surface water. Clay content of soil and underlying till will reduce percolation of surface water into the bedrock aquifers but will encourage run-off, particularly during large storm events such as thunderstorms.

Activities associated with OB/OD maintenance and construction, such as bulldozer and other earth moving, can increase the possibility of constituent dispersion. During a preliminary inspection of the site, metallic objects were observed in the OB/OD area, including some detonated ordnance. Chemical constituent concentrations in the OB berms may be the most significant area of accumulation, as field evidence and previous reports suggest the OB pads were cleared by dozing ash/residual into the berms. The berms are potentially more permeable due to being disturbed by heavy equipment and digging activities by rodents.

Because the possibility exists for dispersal during OB/OD processes, precautions are taken. Planning for OB/OD treatment includes consideration of environmental factors. This consideration tends to reduce the possibility of constituents leaving the treatment site. Requirements include OB/OD treatment only during low wind conditions and during times of no precipitation. Such restrictions reduce the risk of constituent dispersion during treatment operations via wind or surface erosion. Additionally, enclosed cages are used on the OB tray and formerly on the OB pads to minimize the risk of projectiles being ejected. The OB/OD area is policed after each treatment process is completed to recover unreacted material. This is collected and reacted in a subsequent treatment process.

This section discusses the expected behavior of the chemical constituents of concern (PEPs and ash/residue) in environmental media. This assessment is based upon information acquired from the several studies performed by SEAD and described earlier. In addition, information has been incorporated that identifies the chemical/physical properties of some of the primary PEPs treated at the SEAD OB/OD.

The focus of previous investigations at this site has been upon two chemical groups. These are:

- Explosives - HMX (octahydro-1,3,5,7-tetranitro-1,3,5,7 tetrazocine), RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine), tetryl (n-methyl-2,4,6-trinitrophenylnitramine), TNT (1,3,5-trinitrotoluene), 2,4-DNT (2,4-dinitrotoluene) 2,6-DNT (2,6-dinitrotoluene)

- Heavy metals - (arsenic, barium, cadmium, chromium, mercury, lead, selenium and silver)

Explosives

Table D-8 presents certain chemical and physical properties of constituents. This serves as a basis for understanding the likely environmental fate of these organics in environmental media. The compounds identified in **Table D-8** are considered to be semi-volatile. This is based upon the high molecular weights of these compounds and relatively low vapor pressures, typical of semi-volatile compounds. The most volatile of the five explosives being considered at this site is 2,6-dinitrotoluene (2,6 DNT), with a vapor pressure of 0.018 torr (24 ppm). Compared to benzene (considered volatile with a vapor pressure of 95.2 torr (125,000 ppm)), it is apparent that volatilization of this compound is expected to be low, especially in soils which have a high clay content. Furthermore, soils with a high clay content generally have a high ratio of water filled to air filled porosity (>50%). Consequently, there is a small amount of air space through which vapor can migrate. Compounds such as RDX and HMX have relatively low vapor pressures and would essentially not volatilize through these soils. Therefore, volatilization of RDX and HMX are not expected to represent a significant environmental pathway.

The potential for explosives to leach to the groundwater is a complicated consideration and is influenced by many factors such as solubility, cation exchange capacity (CEC), clay content and percolation rate. For this evaluation, solubility will be considered as the most representative parameter for leaching potential. Of the six explosives considered, the most soluble are di and trinitrotoluene. Their solubilities range from approximately 130 mg/l to 270 mg/l. These are similar to the solubilities of other organic hydrocarbons such as toluene (500 mg/l) or the xylenes (150 mg/l). This range of solubilities, 100 mg/l to 500 mg/l, is considered to represent a relatively moderate degree of leaching potential. Compounds which would represent a relatively high degree of leachibility, i.e., high solubility, are methylene chloride (30,000 mg/l), benzene (1,780 mg/l) and trichloroethylene (1,100 mg/l). The solubilities of HMX and RDX are approximately four times less than that for the di and trinitrotoluenes and therefore represent a smaller potential for leaching.

A review of the melting points of these compounds indicates that these compounds are solids at room temperature and therefore would not migrate through soil as separate phases. Instead what would appear to be more likely, as precipitation interacts with these solid residues a small portion would dissolve or erode away. Complete leaching would require a long interaction period.

Field studies have confirmed the long-term potential for leaching of explosives into the groundwater. A 1985 USATHAMA evaluation of the critical parameters affecting the migration of explosives through soils indicated that at a former propellant manufacturing facility, 2,4-DNT leached from affected soil (affected by smokeless powder) for over 35 years after cessation of operations. At another facility, leaching of 2,4-DNT into groundwater from a former OB facility has been documented to occur for as long as 10 years after operations had been discontinued.

The adsorption of organic chemicals is a function of the chemical and the media with which it is in contact. The organic carbon adsorption coefficient, K_{oc}, defines the ability of a chemical to adsorb onto the surface of organic carbon. The higher the K_{oc}, the better the potential for the chemical to be adsorbed. Consequently, those chemicals with high K_{oc} will tend to remain bound to the soil to the extent that the soil contains organic (carbon) matter and/or clay. The compounds considered in this evaluation show adsorption coefficients ranging from approximately 100 to 500. The OB site soils have been shown to possess a high percentage of fines including clay, thereby increasing the adsorption potential of these compounds to the soil. **Table D-9** provides a basis for evaluating the relationship between mobility in the soil and K_{oc}. For the range of K_{oc} exhibited by the compounds considered here, i.e., 100-500, these compounds are considered to be intermediately mobile in clay soils.

Environmental degradation of these explosives have been shown to occur by various investigators. The information available on this subject is substantial and beyond the scope of this assessment. However, MAIN has performed a review of the available information. This database shows that nitroaromatic and nitramine compounds are susceptible to environmental transformations. It is noteworthy that some of the byproducts of these transformations may be relatively persistent in the environment.

Much of the available research has been conducted on the environmental transformation of TNT. **Figure D-14** provides a summary of byproducts resulting from environmental degradation of TNT. **Figure D-15** presents byproducts from the breakdown of 2,4-DNT. The environmental fate of RDX is less defined. **Figure D-16** provides an overview of the expected degradation pathways and the byproducts produced as a result of this degradation. Clearly, the number of byproducts which have been identified is diverse. Analytical methods have only recently been developed which are capable of accurately detecting these compounds. The widespread application of these analytical techniques are greatly limited by the availability of standards which are essential for the analyses. Responding to the need for accurate analytical procedures and recognizing that standards for every breakdown product is unavailable, USATHAMA has developed Method 8330. This method is intended for the analysis of explosive residues in water, soils and sediments.

The behavior of heavy metals in soil is unlike organic compounds in many aspects. For example, volatilization of metals from soil is not considered a realistic mechanism for pollutant migration. Leaching of heavy metals from soil is controlled by numerous factors. Most importantly is its chemical form (base metal or cation) in the soil. The leaching of metals from soils is substantial if the metal exists as a soluble salt. The use of metallic salts has been identified as a component of such items as tracer ammunition, ignitor compositions, incendiary ammunition, flares, colored smoke and primer explosive compositions. In particular, barium nitrate, lead styphinate, lead azide, and mercury fulminate are likely heavy metal salts or complexes which were burned on the pads and could be burned on the trays. During the burning of these materials, a portion of these salts were likely oxidized to their metallic oxide forms. In general, metal oxides are considered less likely to leach metallic ions than metallic salts. Upon contact with surface water or precipitation, the heavy metals, either as metal oxides or unburned metal salts, can be solubilized, eventually leaching to the groundwater. Heavy metals may also exist in the base metallic form as a component of the projectile itself. Bullets are composed mainly of lead, which may contain trace amounts of cadmium and selenium. Metals which exist in metallic form, i.e.,as bullets or projectiles, will tend to dissolve more slowly versus the metallic salts.

The results of monitoring well (MW-1 to MW-17) sampling and borehole water sampling are presented previously in **Tables D-3 and -6**. The monitoring wells MW-1 to MW-7 contained no EP Toxicity metals in excess of EPA's MCLs or New York Drinking Water Standards when originally sampled. Wells MW-1 to MW-7 were originally sampled in 1982. During M&E's evaluation, drinking water standards were exceeded in MW-1 (Cr, Pb), MW-2 (Pb), MW-3 (Pb), MW-4 (Cd, Cr, Pb), MW-9 (Cr, Pb, Se), and MW-6 (Cr, Pb). Well MW-1 lies between the detonation ground and the burn pads and could reflect the result of activities conducted at either area. Verbal communication with USAEHA suggests that the collected groundwater samples were invalid due to high turbidity.

The data suggest that leaching of metals from pad F, pad H, and possibly pad B has occurred due to the presence of heavy metals in the filtered groundwater samples collected from several boreholes at the pads. These samples are considered to reflect the highest concentration of constituents at the pads since the boreholes were installed directly in the pads and not adjacent to the pads as are the monitoring wells. The groundwater sample taken from Borehole 1 in pad F, which was filtered, showed the presence of Pb at 76 and 112 ug/l. The sample from borehole 3, also in pad F, showed the presence of Pb at 96.2 ug/l. Additionally, Pb was detected in the borehole water sample from pad B at 13 ug/l. Only the borehole samples collected from pad F (76.1, 112 and 96.2 ug/l) exceeded the drinking water standard for Pb which is 50 ug/l. Selenium (Se) was detected in the borehole water samples of pads B and H at 28 ug/l and 8 ug/l, respectively. Only the sample from pad B exceeded the drinking water standard of 10 ug/l (EPA MCL) and 20 ug/l (NYSDWS). Barium (Ba) was detected in the borehole water of pad B at 374 ug/l. Both the EPA and New York State drinking water standard for Ba is 1000 ug/l.

A small amount of leaching of explosives into groundwater has been documented at each pad tested, specifically pads F, B and H. Of the explosives present, only 2,4-DNT has an established federal guideline for water. This is the Federal water quality criteria for protection of human health. Although measurable, the observed groundwater concentrations barely exceeded the water quality criteria for 2,4-DNT of 1.1 ug/l for a 10^{-5} risk. For example, pad B which overall had the highest concentration of explosives, indicated the presence of 2,4-DNT at 4.2 ug/l.

Although no water criteria has been established for the other explosives found on site, concentrations of other explosives in the groundwater directly below and adjacent to the pads have been documented. HMX has been detected as high as 167 ug/l near pad B. 2,4,6 TNT was detected at 90 ug/l in the groundwater below pad H. No concentrations of RDX have been detected above 30 ug/l in any samples collected from any of the pads.

As a group, the organic explosives at this site are considered to be moderately mobile. Of the explosives found at the site, 2,4-dinitrotoluene and 2-6,dinitrotoluene are considered to be the most mobile in the soil. The mobility of these compounds is influenced by soil and environmental factors. The high percentage of material passing the 200 mesh sieve which ranges between 47% to 93%, provides a large amount of sorptive potential, thereby retarding the movement of pollutants through the soil column. This will tend to decrease the vertical movement of these pollutants since the soil permeability is low, and the actual volumetric rate is slow.

These prior groundwater studies did not analyze soils for the degradation products of explosives and, therefore any questions regarding the presence of these compounds can not be answered.

D-8d(1)(f) Potential Health Risks

Substantial sampling and analyses efforts have been undertaken by the U.S. Army over the last several years. The result of these efforts indicates that although environmentally present, both the concentration and number of samples which detected explosives and heavy metals have failed to indicate that a substantial environmental problem exists at the site. The evaluation of the information collected to date has indicated that leaching of heavy metals and explosives are occurring. However, off-site groundwater migration of these materials does not appear likely, due to the slow groundwater velocity, the groundwater flow direction and the sorptive capacity of the subsurface soils.

The groundwater beneath the OB/OD facility is not used as a drinking water source and connection to other potable groundwater aquifers has not been demonstrated. **Figure B-5** provides a location of private wells used as a source of drinking water. It is not anticipated that there will be direct exposure to the groundwater from the OB/OD facility under current uses. Groundwater beneath the site flows generally toward Reeder Creek and may be recharging the creek. The potential groundwater contribution to the surface water could result in the exposures identified for surface water and sediments above.

D-8d(1)(g) Performance Standards

Any impact which may have occurred to the area surrounding the OB tray as a result of previous burnings on the ground surface will be addressed as part of the OB Grounds CERCLA site remediation. Since this permit application is only for the operation of the burning tray which is located at the former burn pad area the impacts to the groundwater will be minimal. This is because the materials burned in the tray will be completely removed following the burn. Any material which may be released from the tray will be prevented from interacting with the groundwater by the concrete pad which the tray rests upon. Any material on the concrete pad is removed and handled in accordance with SEAD's SOP's. Since no material will be available to leach to the groundwater, groundwater impacts will be minimal.

Due to the nature of open detonation, it is impractical and a safety problem to detonate munitions in a container. Instead, soil is placed upon the wastes to be detonated and destroyed. During this process, the organic portion of the waste is consumed in the fireball and little, if any, material remains. The process of open detonation, as it is currently practiced by SEAD, is considered by the Army to be the safest and most practical method of disposing of munitions. Groundwater impacts will be monitored following methods described in Section E.

If, as a result of the groundwater detection monitoring program, a release has been detected than a groundwater compliance monitoring program will become active. If necessary, a response to a detected release could involve several options which may involve groundwater recovery and some form of treatment.

D-8d(2) Protection of Surface Water, Wetlands and Surface Soil [40 CFR 264.601(b)]

D-8d(2)(a) Topography

SEAD lies on the western side of a series of north to south trending rock terraces which separate Cayuga Lake on the east and Seneca Lake on the west. The rock terraces range in elevation from 490 feet above Mean Sea Level (MSL) in northern Seneca County to as much as 1600 feet above MSL at the southern end of the lakes. Elevations on SEAD range from 450 feet above MSL on the western boundary to 760 feet above MSL in the southeast corner. The depot's surface generally consists of a west and north sloping surface. Refer to the regional topography map, **Figure D-17.**

A topography map of the OB/OD area is presented in **Figure B-2**. This figure includes (1) 1-foot surface contours, (2) 1" = 200' scale, (3) an area within a 1,000-foot radius of the OB and OD areas, (4) tree lines, (5) protective dirt mounds, and (6) protective bunkers. The OB/OD area is situated on gently sloping terrain, vegetated with grasses and brush. Drainage is generally to the east-northeast via a series of drainage ditches and culverts into Reeder Creek. There are several seasonal poor drainage areas where water collects. Low surface gradients, less than 40 ft. in 2,500 ft., a high fine content in the surface soil and underlying till contribute to poor drainage conditions. These poor draining soil conditions made burning difficult and was the reason why the pads, originally constructed on the soil surface, were built up with crushed shale quarried from an area at SEAD.

D-8d(2)(b) Hydrology

SEAD is located in an uplands area of New York State (generally over 600 feet in elevation), approximately 40 miles south of Lake Ontario, near Romulus, New York. The upland area forms a divide separating two of the New York Finger Lakes, Cayuga Lake on the east and Seneca Lake on the west.

In the southern portion of the depot, the surface drainage flows through ditches and streams into Indiana and Silver Creeks. These creeks then flow into Seneca Lake just south of the SEAD airfield. The central part and administration area of SEAD drain into Kendaia Creek. Kendaia Creek discharges into Seneca Lake near the Army's lake housing area. The majority of the northwestern and north-central portion of SEAD drain into Reeder Creek. The northeastern portion of the depot, which includes a marshy area called the Duck Ponds, drains into Kendig Creek and then flows north into the Cayuga-Seneca Canal and to Cayuga Lake.

The OB/OD facility is located in the northwest portion of SEAD. Area surface drainage at SEAD appears to flow westward into Seneca Lake via several small creeks, including Reeder Creek. Local surface drainage from the site is to the northeast into Reeder Creek. **Figure B-2** presents likely surface drainage routes into Reeder Creek. Reeder Creek eventually drains into Seneca Lake. Overall site relief is low, approximately 20 feet in 2,500 feet (<1%). Annual rainfall is approximately 30 inches. Winds are primarily from the west and west-southwest.

Reeder Creek is the only perennial surface water in the OB/OD area. There are no intermittent streams in the OB/OD area. The drainage basin for Reeder Creek is shown on **Figure D-18.**

Reeder Creek, in the vicinity of the OB/OD facility, is a relatively narrow stream which, for the most part, is confined by steep banks up to eight feet high. What were formerly the headwaters of Reeder Creek were directed to nearby Kendig Creek in approximately 1980 to facilitate the use of wetlands on Kendig Creek as a tertiary sewage treatment system. Now surface runoff flows east into a complex network of drainage swales shown on **Figure B-3.**

The total drainage basin of Reeder Creek is 3,211 acres (5.02 square miles). Approximately 71 percent (of the drainage basin) is within the confines of the Depot. The drainage area upgradient of the OB/OD Grounds is approximately 1,503 acres. The 29 acre OB grounds comprises 0.9 percent of the total Reeder Creek drainage basin.

The normal width of Reeder Creek is from 4 to 10 feet, and typical maximum depths range from 1 to 7 inches. Width and depth of sections of the stream influenced by beaver dams is up to 15 feet side and 3 feet deep. During high flow events width and depth increase, although the steep banks along much of the stream adjacent to the OB/OG grounds limits the width of the flood plain.

The substrate of Reeder Creek is heavily influenced by the occurrence of shale near and at the surface. Most of the stream bottom consists of coarse, angular gravel as well as angular cobbles. There is some deposition of interstitial silt and also a small amount of sand. In some places, the stream bed consists of exposed bedrock. Nearly all components of the substrate are dark grey. The average depth of sediment, including gravel, is approximately 3 inches. In general, the stream bottom which usually comes in contact with the stream water of Reeder Creek is characteristic of mountain streams with loose cobbles. Such streams usually have Manning's N values (a measure of "stream resistance") of 0.040 to 0.050.

During the preliminary site characterization physical measurements of stream width, depth, and flow were completed. This information was presented in the Preliminary Site Characterization Report (MAIN, 1992). The velocity of water in a stream is a function of width, depth, and gradient. The minimum depth at which velocity measurments could be obtained with the Marsh McBirney flowmeter was approximately 3 inches, so velocity in shallow, riffle areas could not be determined.

Figure D-18A shows the locations where stream cross-section and stream flow were measured. **Figures D-18B and D-18C** show the cross-sectional area of Reeder Creek. Transects where stream velocity was measured were chosen because stream flow was laminar. The highest water velocity measured at any transect was 0.11 feet per second (fps) stream. The lowest stream velocity of 0.03 fps was measured at the widest segment while the average stream velocities ranged from 0.02 FPS to 0.06 fps.

Stream discharges were measured on November 19 and 20, 1991. The discharge measured at each transect was 0.1 cubic feet per second (cfs). Rainfall during and prior to these measurements was sparse. This suggest that there is little discharge of groundwater or surface water via tributaries into Reeder Creek near the OB/OD Grounds during the relatively dry base flow conditions.

The surface water elevation of Reeder Creek showed little variability. The maximum change in surface water elevations that was directly measured at any station was 2.90 inches. Since the drainage area upstream of the OB/OD grounds in relatively small (1,503 acres or 2.35 square miles), Reeder Creek is likely to return to base flow conditions shortly after any precipitation event.

Peak stream flow calculations have been made for Reeder Creek based upon a 25 year 24 hour maximum rainfall of 4.5 inches as reported by the Aurora Research Farm precipitation station. The peak discharge has been calculated at stream transect E as shown on **Figure D-18A**. The Soil Conservation Services (SCS) has developed a method for the computation of stream flow based upon rainfall data, soil types, and the watershed size. For Reeder Creek the computations assumed a peak 24 hour rainfall of 4.5 inches. The soil types were defined using the surface soil map presented in **Figure D-6**. The drainage basin up stream of Transect E was defined as being 1874 acres. Three sub areas were used to define the drainage basin up stream of Transect E. These sub areas included the steep slope areas at the top of the drainage basin (633 acres), the flat slope areas surrounding the ammunition bunkers (691 acres), and the moderate slope areas to the west and east of the OB grounds. Two cover types were defined within each of the sub-areas, these being fully developed areas comprised of roads, peaking lots, roofs, etc. and agricultural lands comprised of small brush, weeds, and grass. Based upon these input data a peak discharge of 790 cfs was calculated at Transect E. This is considered to be a very conservative estimate.

From the mouth of Reeder Creek to a point 2 miles upstream, the surface water at the site has been classified as C(T). From this point to the source of the creek, Reeder Creek is classified as D. The best use of Class C waters is for fishing and fish propagation. These waters shall be suitable for fish propagation and survival, including trout (the (T) designation of the surface water classification refers to this stream as being a trout stream). The water quality shall also be suitable for primary and secondary contact recreation although other factors may limit the use for these purposes. Class C(T) reflects water quality standards for dissolved oxygen, e.g., the minimal daily average may not be less than 6.0 mg/l for trout; the minimum single value is 5 mg/l). Class C(T) waters must also meet criteria for coliform, pH, and TDS. Class D waters are suitable for fishing. The water quality shall be suitable for primary and secondary contact recreation, even though other factors may limit the use for that purpose. Due to such natural conditions as intermittency of flow and stream bed conditions not being conducive to the propagation of game fishery, Class D waters may not support fish propagation. However, Class D waters must meet criteria set for coliform, pH, and dissolved oxygen.

D-8d(2)(c) Wetlands

Area wetlands are shown on **Plate 1**. There are numerous small (less than 12 acres) wetlands in the OB/OD area.

D-8d(2)(d) Existing Soil, Surface Water and Sediment Quality

A Preliminary Site Characterization Report (PSCR) on the OB Grounds was submitted to EPA by MAIN in April of 1992. This report describes the soil, groundwater, surface water and sediment, sampling completed at the Open Burning Grounds during the site characterization investigation completed by MAIN. The complete results of the analytical program are also included within this report.

The presence of heavy metals have been measured in the soils. The disposal of heavy metals at the pads (Pb, Se, Cd, Cr and Ba) was either as nitrate salts or as organometallic complexes. During the combustion of these materials, a portion of these salts and complexes were likely transformed to their oxide forms. As metallic oxides, their potential to leach is less than if they remained as the previously mentioned salts and complexes. However, under acidic conditions, such as acid rain percolation, a portion of these metals will dissolve and leach to the groundwater.

Geophysical studies, used to site wells MW-8 to -17, found evidence of metallics in the upper 5.5 feet of soil downgradient from pads D and E. The magnetic survey around pads B and H found magnetic highs in the berms and in areas adjacent to the berms.

Soil borings at pad B found tracer bullets at the contact between the upper 5 feet of crushed shale and the underlying soils. These data suggest that other pads may have residual materials buried beneath the current pad surface. Since there are no data for pads A, C, D, E, G, or J for soils buried beneath the pads, it is uncertain as to the status of these pads. There is visible metallic material in most berms (aluminum, shell casings, bullets, and steel).

EP toxicity tests detected barium (pad B), cadmium (pads E, F, G) and lead (pads B, F, H) in the soils. pad B exceeded the EP toxicity limit of 100 ppm for barium and pads F, B, and H exceeded the EP toxicity limit of 5 ppm for Lead. The high sample in pad B was at the interval where the bullets were intersected. Heavy metals analyses of soils are summarized in **Table D-4**.

Surficial soil contamination has been documented in all the pads tested. Pads B, F, and H appear to have more surficial impacts than the other pads tested. Since percolation of rainfall is minimal, surface water transport of soil appears to be a significant pathway by which contaminants found in the surficial soils and berms surrounding the pads can migrate. These materials will likely be deposited in the drainage channels and streams which drain the area. Further, windblown migration of the surficial soils may also occur since these materials are at the surface of the pads.

D-8d(2)(e) Potential Health Risks

The source areas in the OB facility are the burn pads and the berms which surround them. These areas contain various heavy metals, explosive compounds, and shell casings. All of the pads tested have shown elevated concentrations of heavy metals and explosive compounds in the surface soils. The primary transport mechanism from the source areas is surface soil erosion and surface water run-off. Leaching of metals and explosive compounds has been demonstrated at some of the burn pads; however, the relatively low permeability of the soils suggests that leaching is a less important transport mechanism, both with respect to mass and distance, than surface run-off and erosion. These sources and mechanisms have the potential to affect groundwater beneath the site, sediments and surface water in the drainage areas on the OB/OD facility, sediments and surface water of Reeder Creek and surface soils in and around the OB/OD facility.

There are two receptor populations that could potentially receive constituents transported by surface water or air from the OB/OD facility:

1. Area residents who may use Reeder Creek for recreational purposes
2. SEAD personnel who work on or near the OB/OD facility

The exposure pathways and media of exposure are described below as they may affect the various receptors are ingestion and dermal exposure due to surface water run-off and erosion and incidental soil ingestion and dermal contact.

Surface water run-off migrates to the small low lying areas that have formed in depressions within the site and the two drainage ditches to Reeder Creek. Reeder Creek discharges into Seneca Lake about 3 miles downstream of the site. Surface soils eroded from the site deposit within the on-site drainage ditches and Reeder Creek. Dermal exposure may result from wading or other recreational use of off-site areas of the creek.

Incidental ingestion is a potential exposure pathway for SEAD personnel who may be working in the OB/OD facility or other nearby areas. Constituents may be absorbed dermally or ingested.

D-8d(2)(f) Performance Standards

The design and operating requirements of the OB/OD facility are intended to protect the surrounding soils/sediments and surface water bodies. For open burning operations, materials are burned in steel trays and covered with a steel cage to prevent "kickouts." Following the burn, all materials including ash residue are removed and disposed of. The steel tray is covered with a stainless steel cover when not in use to prevent the accumulation of precipitation. Further, the tray has been placed upon a reinforced concrete pad which will collect any residue produced during the burn operation. Any material on the concrete pad is also removed following the burn. As a result, no residue from the burn tray or concrete pad would be available to runoff into the surface water or interact with the surrounding soils. Unlike open burning operations, open detonation cannot be performed within enclosed structures due to the detonation forces produced. However, the munitions are covered with soil to dissipate the explosive force and minimize noise. The fireball produced during this high order detonation reaches temperatures near 1000°C. The combination of high temperature and explosive force destroys all organic materials. No residue remains following this operation. The OD grounds are frequently scraped with a bulldozer to obtain soil cover for the detonations. This has caused the land surface adjacent to the detonation mound to be lower than the access roadways, which surround the area, to become raised (see Plate 1). The raised access roadways act as a dike, diverting all surface water runoff to the low point near a culvert pipe. As surface water is collected in these low areas, and the velocity is decreased and sediments are allowed to settle. The surface water then passes through the culvert pipe to another low point in an area which drains the OB grounds. Additional sedimentation occurs in this area. This water is then discharged to Reeder Creek through a concrete pipe which runs below the main access road. The process prevents direct surface runoff into Reeder Creek by collecting surface runoff, allowing sediments to settle and discharging the collected water through a series of pipes.

As part of the groundwater detection monitoring program, described in Section E, surface water and sediment samples will also be collected and will be sampled for the same constituents that the groundwater samples and sampled for. Table E-3 presents a list of parameters which will be analyzed for. Plate 1 provides an indication of the approximate sample locations where surface water samples will be collected. One location is considered to represent downgradient concentration and the other is representative of upgradient concentrations.

A release from the unit will be addressed as any other emergency under the SOP's for the facility. A detailed description of the emergency response procedures is presented in Section G-4.

D-8d(3) **Protection of the Atmosphere [40 CFR 264.601(c)]**

D-8d(3)(a) Climatology

Table D-10 summarizes climatological data for the SEAD area. The nearest source of climatological data is in Cornell University, in New York, which is approximately 27 miles southeast of the army depot. However, only precipitation and temperature measurements are available from this location. The remainder of the data reported in **Table D-10** have been taken from isopleth drawings from a climatic atlas, or from data collected at Syracuse, New York, 40 miles northeast of the SEAD. Meteorological data collected from 1965 to 1974 at Hancock International Airport in Syracuse, New York, were utilized in preparation of the wind rose. The airport is located approximately 60 miles northeast of SEAD, and the data can be considered representative of wind patterns at SEAD. The wind rose is presented in **Figure D-19.**

A cool climate exists in the locality of SEAD with temperatures ranging from an average of 23°F in January to 69°F in July. Marked temperature differences are found between daytime highs and nighttime lows during the summer and portions of the transitional seasons. Precipitation is uncommonly well-distributed, averaging approximately 3 inches per month. This precipitation is derived principally from cyclonic storms which pass from the interior of the county through the St. Lawrence Valley. Lakes Seneca, Cayuga, and Ontario provide a significant amount of the winter precipitation and moderate the local climate. The annual average snowfalls is approximately 100 inches. Wind velocities are moderate, but during the winter months, there are numerous days with sufficient winds to cause blowing and drifting snow. The most frequently occurring wind directions are westerly and west-southwesterly.

In general, climatological conditions which will tend to promote good dispersions during OB/OD activities are high and ambient temperatures, high wind speeds, low precipitation amounts, and a preponderance of clear skies. As **Table D-10** shows, temperature tend to be highest from June through September. Precipitation and relative humidity tend to be rather high throughout the year. The months with the most amount of sunshine are June through September. Mixing heights tend to be lowest in the summer and during the morning hours. Wind speeds also tend to be lower during the morning, which suggests that dispersion will often be reduced at those times, particularly during the summer. However, no episode-days are expected to occur with low mixing heights (less than 500 m) and light wind speeds (less than or equal to 2 m/s).

Daily precipitation data measured at the Aurora Research Farm in Aurora, New York for the period (1957-1991) were obtained from the Northeast Regional Climate Center at Cornell University. The maximum 24-hour precipitation event during this 35-year period of record is summarized in **Table D-31** for each month. The maximum 24-hour precipitation measured at this station during this period was 3.91 inches on September 26, 1975. Values of 35 inches mean annual pan evaporation and 28 inches for annual lake evaporation were already reported in **Table D-10**. An independent value of 27 inches for mean annual evaporation from open water surfaces was estimated from an isoplethed figure in "Water Atlas of the United States" (Water Information Center, 1973).

Information on the frequency of inversion episodes for a number of National Weather Service stations is summarized in "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States" (George C. Holzworth, US EPA, 1972). The closest stations for which inversion information is available for Albany, New York and Buffalo, New York. The Buffalo station is nearer to SEAD but almost certainly exhibits influences from Lake Erie. These influences would not be expected to be as noticeable at SEAD. **Tables D-32 and D-33** provide information concerning inversion episodes and episode-days at Albany and Buffalo, respectively, for the five year period (1960-1964). Frequency information is provided for each station for various combinations of maximum mixing height, wind speed ranges, and minimum episode duration.

SEAD is located in the Genesee-Finger Lakes Air Quality Control Region (AQCR). The AQCR is designated as non-attainment for ozone and attainment or unclassified for all other criteria pollutants. Data for existing air quality in the immediate area surrounding the SEAD, however, can not be obtained since the nearest state air quality stations are 40 to 50 miles away from the army depot (Rochester or Monroe County or Syracuse of Onondaga County). A review of the data for Rochester, which is in the same AQCR as the SEAD, indicates that all monitored pollutants (sulfur dioxide, particulates, carbon monoxide, lead, ozone) are below state and federal limits, with the exception of ozone. In 1987, the maximum ozone concentration observed in Rochester was 0.127

ppm. However, this value may not be representative of the SEAD area which is a more rural environment.

A one mile radius around the OB/OD grounds is shown on Figure D-21. The only existing air emission source within this 1 mile radius is a classified document incinerator located approximately 0.9 miles north-northeast of the OB/OD grounds.

D-8d(3)(b) Potential for Dispersal of Gases, Aerosols and Particulates

Materials that are treated by Open Burning are stored and only delivered to the burning tray just prior to the actual treatment oepration. Materials are typically containerized (rocket motors, or canisters) or pellitized solids. No gases or liquids are treated. In addition, a stainless steel tray is used to cover the materials prior to treatment. Treatment is not conducted during periods of high wind. (See SOPs, Appendix 4)

Based on the above, the potential for the emission and dispersion of gases, aerosols and particles is exceedingly small prior to treatment.

D-8d(3)(c) Emission Characteristics

Although open burning and open detonation operations are often considered as a single method for disposal of obsolete munitions and explosive munitions and explosives, the thermochemistry of burning is distinctly different from that of detonation, which in turn results in the generation of different combustion products. Therefore, quantification of air pollutant emissions from each activity must be done independently.

Burning entails the rapid oxidation of a fuel with the release of heat and products of combustion. When waste munitions are open burned, there is a rapid conversion of solid materials to gaseous end products, particulate matter, and some nonvolatized residue. Combustion times for munitions vary somewhat, but are typically only a few minutes. The composition of the effluent plume depends on the type of propellant, explosives, or pyrotechnics (PEP) being burned; combustion parameters (i.e., temperature, turbulence); and prevailing atmospheric conditions.

Materials that are burned in open air at OB/OD sites consist primarily of bulk propellants, propellant-filled munitions, explosive-contaminated wastes and large propellant-filled munitions (e.g. rocket motors). Current direction from Army Headquarters, U.S. Army Material Command (AMC) AMCR

755-8, requires open burning of these materials in pans or trays so that ashes and residues can be collected and disposed of properly.

Open detonation differs from open burning, in that reaction temperatures and pressures are considerably greater. Open detonation is also characterized by less available oxygen for combustion. Detonation is characterized as a process in which the explosive material undergoes a chemical reaction with a certain type of shock wave, commonly referred to as a detonation wave. Open detonation of munitions produces effluent gases, particulate matter, shock, noise, and some nonvolatilized residue. The particular end products of detonations are primarily a function of the explosive reactions. Emissions from open detonation operations are dependent on such factors as explosive composition, product expansion, method of priming, and degree of confinement. In most cases, explosive items are buried to suppress the sound level and shock waves generated by the detonation. Although large quantities of particulate matter are hurled into the air as a result of the explosion, most of this material will settle out quickly, depending on the type of soil overburden used.

The types of materials being detonated often include bulk high explosives (HE); small HE-filled munitions such as projectiles, cartridges or grenades; and large HE-filled munitions, such as bombs, rockets or warheads. The quantity of explosives detonated at one time generally varies from installation to installation, depending on proximity to inhabited areas. The explosive limits at individual open detonation sites have been established and vary from 50 to 10,000 pounds. Open detonation is also limited by local meteorological conditions and other factors which are installation-specific, such as effects that wind direction and upper air inversion levels have on detonation sound levels and shock waves. In some cases, state air quality permits for OB/OD place restrictions on the weather conditions under which these activities may be conducted. Detonation methods are developed for each explosive item to ensure complete destruction. These methods are published in Depot Maintenance Work Requirements (DMWRs) and are used as standard operating practices (SOPs) for destroying each specific item.

A comprehensive review of available technical literature was performed in order to develop the methodology for estimating air pollutant emissions from OB/OD operations. The factors which influence the character of emissions from open burning and open detonation include temperature, time, turbulence, atmospheric conditions, and the type and quantity of the material disposed of through OB/OD. Unfortunately, these factors cannot be controlled during an OB/OD operation, nor are they consistent from one OB/OD operation to the next. As a result, there are little data available in the literature quantifying these combustion products. Nevertheless, OB/OD emission data have been reported for a selected number of propellants, explosives, and ammunition types. These emissions data were derived either experimentally or theoretically from thermodynamic considerations. The following provides a brief description of each emission data source.

1. Consolidated Report on the Test Program for the Identification and Characterization of Products and Residues from the OB/OD of Munitions

   This study was conducted recently by the U.S. Army Armament Munitions Chemical Command to determine the extent of pollution created by OB/OD operations, and to ascertain whether any such generated pollutants fall outside acceptable standards developed by the federal state governments. Controlled OB/OD of selected conventional bulk explosives, propellants, and munitions that are normal disposed of by OB/OD at various Army depots were conducted. Measurement of ambient concentrations of various pollutants were taken from airborne sampling platforms (UH-1H helicopter). The cloud volume was determined using cameras in conduction with the airborne pollutant sampling program. Emissions of air pollutants were then quantified in terms of mass loading by integrating the measured concentrations over the entire cloud volume. Mass loading refers to the mass of pollutant per mass of OB/OD materials, including the mass of materials used as initiator and donor.

   Emission factors were calculated for only some of the criteria pollutants (CO, NO_2, SO_2, and H_2S) in this study. No emission data were obtained for the criteria pollutants, PM-10 and lead, or for noncriteria pollutants. Observations from this study indicated that for most OD operations, the emission factors (i.e., pounds of pollutants per pounds of material destroyed) generally vary with the amount of material detonated. For most substances, it was observed that the emission factor varies inversely with the quantity of material detonated. This is especially true for the case of CO, where the emission factor decreases several-fold as the amount of material detonated increases. In using the emission data from this study to estimate emissions from OB/OD operations, the following reservations must be taken into consideration:

   a. Since the reactions generating ambient or pollutants are strongly influenced by meteorological conditions (e.g., affecting mixing time and quantity), emissions from OB/OD at different locations are generally different.

   b. Since the dispersion of pollutant within the cloud volume is not uniform, the mass loading derived from integration of the pollutant concentrations over the cloud volume may be overestimated or underestimated. In addition, errors may be introduced in the determination of the cloud volume.

In spite of these shortcomings, this study represents a credible data source for estimating emission from OB/OD operations.

2. 1986 Computer Predictions of Pollution Products from Open Burning and Open Detonation of Army Explosives and Propellants

In this computer program (POLU10) developed by the U.S. Navy, the combustion products (i.e., emission from OB/OD operations) are calculated from thermodynamic considerations and high temperature chemical equilibria. The program is a modification of the Propellant Evaluation Program (PEP), written at the China Lake Naval Weapons Center, to calculate combustion products under the special conditions encountered in OB/OD of explosives and propellants.

For open burning, the material is assumed to mix with air and burn together at above 3500°K and 1000 psi. The composition of the combustion products will change as the mixture expands from 1000 psi to atmospheric pressure and a corresponding temperature normally referred to as the "frozen" temperature (1200°K-1500°K). From this point on, the composition of the products remains constant, even though they continue to cool to ambient temperature. The emission factors are expressed as mass of product (in grams) per mass of materials burned, including the mass of materials used as initiator or donor (100g).

For open detonation, the material is assumed to explode first, forming combustion products that do not initially react with the surrounding air. In addition, during explosion, the hot gases expand and shock waves are created that cause an energy loss of the combustion products. The loss of energy is assumed to be 25% plus or minus 5%, depending on the explosive. The combustion products at the reduced energy state are then reacted with the surrounding air at 1000 psi, and the calculation is performed as in the case of open burning. The final emission factor is expressed in terms of mass of combustion products (in grams) per mass of material detonated, including mass of materials used as initiator or donor (100 g).

A major factor influencing the calculation of combustion products from both OB and OD operations is the material to air weight ratio of the reaction. Since the quantity of material to be disposed of, the location, and meteorological conditions will dictate the material/air weight ratio, this parameter will vary from site to site. The output from this computer program reports pollutant emissions data for a series of material/air weight ratios from 100/0 to 10/90 in increments of 10/10. Based on a comparison of the amount of pollutants generated from the computer program and the experimentally measured values reported in the Army field study discussed above, it was found that the theoretically derived emissions matched best with the experimental values when the material/air weight ratio is between 30/70 and 40/60. Since the pollutant emission estimates are generally higher when the material/air weight ratio is 40/60, this ratio is chosen to conservatively estimate emission from OB/OD operations.

The following precautions and limitations are applicable for using the POLU10 computer program to estimate emission from OB/OD operations.

a. Since the program uses an auxiliary data file for the thermodynamic data which include over 1400 species, any product formed at the burn site which is not in this file cannot appear in the calculation. In addition, the file does not include a large number of species contained in the metallic additives that are used in military explosives. Therefore, there will probably be some products formed from metals that are not predicted from this computer model. Also, since the PEP program is designed to calculate combustion products at high temperatures, the file does not include organic solvents or other organic compounds that can not survive high temperatures.

b. Since the actual energy consumed in shock waves cannot be calculated, the program assumes an energy loss of 25% ±5%. Therefore, the program will not accurately predict the formation of pollutant products if the energy loss at a specific OB/OD site is significantly different than the assumed value.

c. Since the predicted pollution products differ significantly with variation in material/air weight ratio, and since this ratio is often site-specific, the assumption of a single material/air weight ratio will introduce error in estimating emissions from different OB/OD sites, or even from different OB/OD episodes at the same site.

Notwithstanding these shortcomings, this computer program is considered the best available tool at this time for estimating emission from OB/OD, due to its capability to simulate a wide variety of materials often encountered in the OB/OD of military munitions. In addition, the program is capable of predicting both criteria and non-criteria pollutants. To the extent that similar energetic materials were used in the Army field study described above, comparisons between empirical emission factors and computer predictions were found to be reasonable.

3. "Emissions from the Open Burning or Detonation of Explosive"

This reference, a paper presented by R.V. Carterin 1978, provides a literature review of the available data which can be used to estimate emissions from OB/OD operation. The emissions data presented includes results obtained from theoretical calculations which are based on thermodynamic considerations, as well as experimentally measured air emissions from OB/OD for a selected groups of bulk explosive and propellants.

4. 1988 Detailed Analysis of Selected Propellants, Explosives and Pyrotechnics to be Open Burned/Open Detonated at Department of the Army Thermal Treatment Facilities

This report, prepared by the Army Hygiene Agency, to support air quality assessments for OB/OD activities, provides OB/OD emission data for a selected number of Army munitions. The emission factors were calculated using the same computer program as described previously (POLU10).

5. 1987 Computer Predictions of Pollution Products from Open Burn and Open Detonation of Navy Explosives and Propellants

This report by the U.S. Naval Ordinance Station provides OB/OD emission data for several Navy explosives and propellants. The emission factors were calculated using the computer program POLU10 described previously.

Although the emission data summarized in the five references described above are not all-inclusive, or may even contain inherent errors and/or limitations in their prediction capability and applicability, they represent the best available data for estimating OB/OD emissions at the present time. **Tables D-11** provides the composition, "frozen" temperature, and specific volume of combustion products for different OB/OD materials. **Tables D-12** through **D-16** summarize the emission factors for CO, NO_2, SO_2, H_2S and other pollutants for OD operations.

The corresponding emission data for OB operations are presented in **Tables D-17** through **D-21.** In addition, **Tables D-22** and **D-23** provide the calculated OB/OD emission data for a selected group of ammunitions and propellants of known composition. These emission factors were calculated based on the composition of the munition and the known emission factors of the bulk explosives or propellants contained in the munition. The specific volumes for this munitions were derived in the same manner. To conservatively model the impact of air pollution from OB/OD, the "frozen" temperature for those munitions or propellants that are made up from a mixture of components were taken as the lowest temperature among the explosives or propellants contained in the munition with a weight percentage greater than 10%. The lower temperatures corresponds to a lower calculated plume rise and more conservative (higher) predicted air quality impacts at ground level.

Based on observations of OB/OD operations as several army depots, a high level of particulate emission is often associated with OB/OD activities.

For OB operations, particulate matter emissions data are available only for the burning of smoke obscurants such as white phosphorus cartridges, red phosphorus wedges, or hydrocarbon canisters. Empirical relationships have been developed for phosphorus smokes to calculate particulate matter emissions based on the initial mass of phosphorus in the material. Emission measurements have also been made for the burning of hydrocarbon canister.

However, there are no data available on emissions of particulate matter from the open burning of propellants, which is the principal material present in the waste munitions. Measurements cannot be readily made because of the nature of the open burning process, which involves rapid burning under very turbulent conditions. Also, particulate matter emissions cannot be calculated as they have been for gaseous pollutants, since they are not as dependent on thermodynamics. Due to the lack of reliable data sources, the emissions of particulate matter from OB operations cannot be quantified at the present time.

For OD operations, particulate matter emissions can be calculated based on the assumptions used in the COMBIC model (Hoock, et al, 1987). In this model, it is assumed that the major source of particulate matter emissions would occur from the high explosive-generated dust that is entrained by the shock wave. Based on comparison of experimentally measured concentrations of particulates generated from OB and OD operations (Consolidated Report, 1987), it was observed that particulate emissions were significantly less for OB operations. Since there is no physical reason for a significant difference in the amount of carbonaceous particulates formed from burning of propellants and that formed by detonation of explosives (unless the chemical disposed of by OB is a smoke obscurant such as white phosphorous), smoke generated by the explosive products alone amounts to only a small fraction of the total particulate matter generated by OD.

Particulate matter emissions are a portion of the high explosive-generated dust in the crater volume that is created by the detonation of the waste munitions. The crater volume is dependent on the explosive yield, which is measured in terms of the equivalent yield of TNT, the depth of the burst, and the soil type. The apparent crater volume is assumed to scale for any explosive yield W as:

$$V = SW^{1.111}$$

where: V is the apparent crater volume in cubic meters, W in in pounds of equivalent TNT, and S is the apparent crater scaling factor which contains all other dependent factors based on empirical measurements. This relationship was based on a polynomial fit of measured scaled carter depth and radius as a function of burst depth and soil conditions.

The total lifted fraction of particulate matter from the apparent carter is only a small fraction of the apparent crater volume. Preliminary measurements have shown a wide range of values dependent principally on soil type. **Table D-24** summarizes the soil dependent parameters that can be used to calculate the apparent crater volume and to estimate the fraction of apparent carter mass contained in the small particle size range (less than 20 microns).

By using the crater volume equation and the parameters identified in **Table D-24**, particulate matter emissions can be calculated for site specific OD operations. The emission of particulates which are less than 10 microns (PM-10) can be conservatively estimated using the fraction of apparent crater mass tabulated in **Table D-24**. These emissions can be used in the atmospheric dispersion model to estimate particulate matter air quality impacts.

In order to estimate air pollutant emissions from a typical OB/OD operation at a particular installation using the emission factors compiled in **Table D-12** through **D-24**, the following general assumptions were made:

a. The maximum explosive limit cited at the specific OB/OD site is assumed to include the weight of all applicable donor charges, fuses, detonation cords, and blasting caps required to initiate the OB/OD operation. Therefore, the quantity of a specific air pollutant generated is assumed to equal the maximum allowable explosive limit multiplied by the corresponding emission factor for that pollutant.

b. Since almost none of the references cited above provide emission factors for lead, even though lead is often used in the blasting caps to initiate the OD, emission of lead from a specific OD operation is estimated from the assumed number of blasting caps required to detonate the material, and the known composition of a blasting cap. In cases where an emission factor for lead is presented, the amount of lead produced resulting from the use of blasting caps is added to the value calculated from the emission factors.

It should be noted that, in order to estimate the emission of lead from OB/OD operations, it has been assumed that a particular lead-containing munition would be detonated or burned to the maximum allowable limit, even though the actual amount of such materials disposed of by OB/OD at the site is unknown. Therefore, the calculated lead emission rate represents the worst-case scenario and generally tends to overestimate the level of lead generated at the site. This point should be kept in mind when interpreting the impact modeling results.

c. Since heavy metals may exist on both solid and gaseous states, and, therefore, may not necessarily be all air pollutants, the value of metals calculated represent the maximum amount of metal that can potentially become airborne. The actual amount of airborne metals cannot be estimated from the data available at this time.

d. For an OB/OD site in which specific data on the type and quantity of materials commonly burned or detonated are not available, or if the composition of the specified munitions are not known, a worst-case estimate has been derived using the munition, explosive or propellant having the highest emission factor associated with a specific pollutant amount the available data presented in Tables **D-11** to **D-23**. For OD operations, the emission factors associated with the lowest quantity of material detonated was used, since most materials tend to emit more pollutant per unit mass detonated as the amount of material detonated decreases. The actual emission rate, however, was based on the emission factor of the chosen material associated with a recorded quantity closest to the actual maximum allowable exposure limit detonated at a given site.

In estimating the worst-case scenario, more than one type of bulk explosive, propellant, or munition must usually be chosen to represent conditions leading to maximum emission of different pollutants (e.g. OB of propellant M1 may give the highest CO emission but OB of propellant SPCF will give the highest NO_2 emission). In selecting the types of material for worst-case emission estimation, the materials cited in the fifth reference listed above were not considered, because these are Navy-type munitions and a cross-referencing between Navy and Army munitions was not available. Since the Navy munitions are the only type of materials which were seen to contain significant amounts of chlorine, the present methodology for estimating emission from OB/OD operations may underestimate the level of chlorinated air pollutant emissions, if there exist Army-type munitions which are compatible to Navy-type munitions.

e. For OD operations, emissions from OD pits were modeled as volume sources. Therefore, it was necessary to calculate the plume rise associated the detonation. In cases where more than one type of material was chosen for the worst-case emission scenarios, only one plume rise was calculated to represent all volume sources if the volumes are within 25% of each other. This plume rise would be calculated using the smallest volume and the lowest temperature to conservatively model the pollutant impacts. Calculated plume rise is used to determine the initial height of the volume of pollutants generated for purposes of the dispersion modeling.

f. For OB operations, emissions from OB pans (trays, or pads) are modeled as point sources. In calculating the corresponding "stack diameters" for these sources, pans located less than 10 feet apart are grouped together as a single point source, and the stack diameter for this source is calculated from the total surface area of these pans. Otherwise, the stack diameter would be calculated from the dimensions of a single pan.

g. In calculating emissions from the emission factors presented in **Tables D-12** through **D-22**, the highest emission factors reported among the different references for the chosen material were used to conservatively estimate the pollutant impact from OB/OD operations.

h. To calculate particulate (PM-10) emissions from OD operations, the amount of equivalent yield of TNT corresponding to a specific type of explosive or munition can be estimated from tabulated TNT equivalency values or from the relative energy output (or performance) in the sand test of the principal explosives contained in the munition or explosive (Kirth-Othmer Encyclopedia, 1979). For example, the equivalent yield of TNT for 100 lbs of 105 mm projectile, which is composed of 48.58% TNT and 51.42% Comp-B, would be calculated as follows:

Equivalent yield of TNT = (.4858)(100) + (.5142)(125)
= 113 lbs TNT equivalent yield/100 lbs of 105 mm projectile

D-8d(3)(d) Emission Rates

Emissions of air pollutants from typical OB/OD operations at SEAD were estimated based on available information concerning the types of materials generally disposed of by OB/OD, the maximum weight of munitions destroyed per OB/OD operation, the number of OB/OD units utilized per operation, and the OB/OD operating schedule. Since OB/OD of different materials may result in differences in the types of criteria or toxic pollutants generated and/or the quantities of pollutants emitted, several emission scenarios were developed to ensure that maximum impacts from each pollutant would be addressed. The following describes the various emission scenarios associated with typical SEAD OB/OD operations.

Open burning at SEAD is generally used to dispose of bulk propellants, high explosive (HE) projectiles, and explosive-contaminated combustible materials from demilitarization operations. OB of bulk propellants and HE projectiles are performed in pans 40' long x 4' wide which are equipped with precipitation covers for suppression of fugitive ash emission. Typically, only one pan is burned at a given time, with an imposed limit of 1000 pounds (lbs) of propellants, or HE projectiles, per pan. As a maximum, OB of propellants and HE projectiles is performed 3 times a day, 180 days per years.

Since detailed information on the specific types of propellants or HE projectiles disposed of by OB at SEAD are not currently available, emissions from OB operations at SEAD were estimated from the data on propellants and propellant filled munitions listed in **Tables D-11** through **D-23**. Four emission scenarios (Scenarios 1 through 4) were developed to adequately represent potential worst case impacts for specific pollutants due to OB operations at SEAD. Total emission amounts associated with the various OB emission scenarios are summarized in **Table D-25.**

In order to model impacts associated with the various pollutants, separate sets of modeling conditions were used to simulate operations with significantly different burn temperatures. Cases in which the reaction temperatures are within 10 percent of each other were modeled together, and the lower temperature was used in this case to conservatively estimate plume rise (and, therefore, impacts) for these pollutants. The modeling conditions assumed for OB operations at SEAD are as follows:

1. To model CO, NH_3, HF and H_2S

Basis = OB 1 pan per burn
Stack Diameter = 6.14 m (determined from area of single pan)
Temperature = 1117°K
Exit Velocity = = 1.0 m/sec (nominal value - plume rise dominated by temperature)

2. To model other pollutants

Basis = OB 1 pan per burn
Stack Diameter = 6.14 m
Temperature = 984°K
Exit Velocity = = 1.0 m/sec

b. OD Activity

Open detonation at SEAD is used to dispose of high-explosive (HE)-filled munitions such as projectiles, warheads, and rockets. OD is performed in ten pits in which the munitions are covered with dirt to suppress noise. The maximum allowable limit of net explosive weight (NEW) is set at 100 lbs per pit (1,000 lbs per detonation). On the average, OD is performed up to 20 times per day approximately 180 days per year.

Emissions from OD operations at SEAD were calculated for a selection of the munitions known to be detonated at the site and for which emission factors are available. Two emission scenarios (Scenarios 5 and 6) were developed to simulate worst-case pollutant impacts from OD operations at SEAD. Total emission amounts associated with these OD emission scenarios are summarized in **Table D-25.** In addition to the pollutants listed in **Table D-25,** emissions of metals (aluminum) were also estimated based on OD of 1000 lbs of HEAT rifle grenades M31. The emission amount of aluminum was calculated as 90,755 g. Since there is no short-time are exposure limit for aluminum, impacts on ambient levels of this pollutants were not modeled.

Since the combustion product volumes associated with OD of the munitions used in Scenarios 5 and 6 are within 25 percent of each other, only one set of modeling conditions was used to estimate potential impacts for all pollutants. The smaller volume was chosen to conservatively estimate pollutant impacts. The OD modeling conditions are as follows:

Basic = OD pits as separate sources which are initiated sequentially at 30-second intervals.

Volume = 297 m^3 (calculated for a single pit and used to determine volume source dimensions for modeling)

Temperature = 888°K

Plume Rise = 52 m (calculated conservatively for stable atmospheric conditions)

D-8d(3)(e) Air Quality Modelling

The air quality impacts from open burning and open detonation (OB/OD) of waste munitions can be estimated by carrying out dispersion modeling of the emission sources. Modeling of OB/OD emissions must include a number of complex processes that are significantly different than emissions from conventional stack sources. In OB/OD operations, the release of pollutants is instantaneous or semi-continuous as opposed to stack sources that are usually continuous. The simulation of pollutant fate and transport should incorporate these unique processes in order to accurately predict acute and chronic exposure levels at downwind receptors. The simulations performed in this study include several assumptions which introduce a significant degree of uncertainty. In all cases, the assumptions used are designed to be conservative in order to avoid underestimating potential impacts. However, to the extent possible, model predictions have been verified through comparison of test simulations against measured field data.

The Industrial Source Complex Model (ISC) is used in this analysis to calculate air quality impacts from OB/OD operations. This model, which was developed for EPA, has the capability of simulating emissions from a detonation fireball or from open burning activities when the special nature of these types of sources is taken into consideration. The ISC model uses site-specific hourly meteorological data to calculate pollutants transport and diffusion from a source. Because the ISC model is typically used for continuous emission sources, special procedures were developed to apply the model for the special circumstance of non-continuous OB/OD emissions. These procedures were followed to better simulate the initial fireball, to calculate plume rise, and to calculate acute and chronic exposure from the model output.

The USEPA Guideline On Air Quality Models (Revised) identifies air quality models and modeling techniques which USEPA considers acceptable for use for regulatory applications. Specific models are identified as preferred and recommended for use for particular modeling situations.

The ISC model is identified by USEPA in the Guideline Air Quality Models as the preferred model for assessing impacts from compliacted sources in simple terrain. Complicated sources include area and volume sources. The emissions from OB/OD activities at SEAD are modeled as area and volume sources. (See also the letter from Andrew Belling, Chief Hazardous Waste Facilities Branch to Randall Battaglia, dated March 19, 1992 in Appendix 6).

The emissions of pollutants from open burning and open detonation of propellants and munitions can be represented as semi-continuous or instantaneous releases, respectively. For purposes of this assessment using the ISC model, OB activities were represented as one or more point sources, and OD activities were represented as volume sources, with specialized dimensional and plume rise characteristics. These specialized characteristics and the methods used to develop ISC emissions input data for dispersion modeling are discussed below.

- Modeling Assumptions for OB Emissions

As discussed in Section D-8d(3)(c), a variety of literature sources and field data were used to develop reasonable emissions estimates for OB activities. A limitation of the information presently available is the lack of data to characterize particulate emissions. Photographs taken at various open burns indicate this is a more serious deficiency for sites where OB is used to destroy rocket motors and small munitions than for locations where propellants are the main category of materials destroyed.

Individual OB activities take place in relatively small areas (i.e., burn pans or pits) at or just below the ground surface. The effluent plume rising from a burn site can thus be reasonably represented for purposes of the ISC model in the same manner as a ground-level point source. The model incorporates the standard Briggs (1969) plume rise formula to calculate plume centerline height based on the initial temperature and vertical velocity of the discharged gases and particulate matter. For OB sources, there is no direct analog to the exit velocity of a sustained discharge from an industrial stack. However, this is not a serious problem in terms of applying ISC as with stack sources; the intense heat of the reactions occurring in OB activities ensure that buoyancy, rather than vertical momentum, will be the dominant mechanism governing plume rise. Thus, in modeling OB operations, a nominal "exit velocity:" of 1 m/s was used. The equivalent "stack diameter" was calculated from the known area of the burn pan or pit. If OB activities at more than one pan or pit were included in the modeling scenario for a given facility, the following convention was adopted. If the physical spacing between pans or pits was greater than 10 feet, then each pan or pit was represented as a separate source. Otherwise, the emissions from individual pans were combined and a stack diameter representative of the total pit/pan area was calculated. Temperatures of the waste gases at ambient pressure were taken for different OB materials from the POLU10 computer program described in **Section D-8d(3)(c).**

It is recognized that representation of plume rise and atmospheric dispersion of OB materials by the means normally employed for continuous stack sources may not be entirely valid. For this reason, a number of assumptions have been made to ensure that errors in the reported emission will be in the direction of over-prediction.

- Modeling Assumptions for OD Emissions

  No readily available information or documented experience on the modeling of air quality impacts for OD activities has been reported in the technical literature. Even more than for OB operations, the physics of the processes that produce OD emissions lend themselves poorly to available modeling methods. Features of OD activities that are not normally encountered in air quality dispersion model applications include:

  - Extremely rapid (essentially instantaneous) release of source emissions with temperature and pressure changes occurring over millionths of seconds.
  - Detonation velocities in all directions of 20,000 ft/sec or higher.
  - Decomposition of explosive molecules through very rapid progressive chemical degradation until the final detonation products are performed.
  - Burial of detonating materials under several feet of soil.

A number of assumptions and approximations were required in the use of a model like ISC to compute short-term and long-term effects of OD operations. As described in **Section D-8d(3)(c),** the POLU10 computer model, used to develop emission factors for various PEP materials, provides an estimate of the temperature and volume of waste gases produced by detonation after the fireball pressure is reduced to the ambient level. Typical theoretical values of gas volumes generated by detonation of 100 pounds of explosive range from about 250 m^3 to 350 m^3, and temperatures are between 800°K and 1200°K. For purpose of modeling with ISC, the emissions are assumed to be contained within a cube-shaped volume with the center of this volume placed at the height computed by a plume rise calculation, as described in the following test. The temperature estimate given by the emissions model is not used directly as a model input parameter. Rather, the temperature was used to compute a plume rise which was used to set the initial height of the volume source above local ground level, as allowed by ISC. Once the size and the location of the initial volume have been established and input to the ISC, the subsequent transport and dispersion algorithms contained in the model can be used to estimate effects on air quality at downwind locations.

Pollutants released into the atmosphere from OB/OD operations are contained in a volume of gas having a net velocity and a buoyancy relative to the surrounding air. The behavior of the volume will differ, depending on whether the release is from an instantaneous detonation or from a semi-continuous burning source.

A semi-continuous emission source from an individual open burning operation can last up to 10 minutes. One can assume that this type of source will follow the rules governed by a conventional ground-level point source, except that the exhaust volume per time would be considerably greater because of the rapid burning. Thus, the standard plume rise algorithm for continuous point sources which is contained in the ISC model, may be used.

The rise of an instantaneous cloud from open detonation is similar to the rise of a continuously emitting plume, except that the cloud will diffuse in three dimensions rather than two. After the initial explosion, the cloud will rise principally because of buoyancy. Entrainment of atmospheric air will initially occur, because of the cloud's relative motion in the air. Later, entrainment will occur because of the atmosphere's own turbulence. In stable air a limiting height is reached when buoyancy is zero; but in unstable air the cloud will rise until a stable layer is reached.

The rise of an instantaneous cloud has been examined theoretically and experimentally (Morton et.al., 1956). Experiments in a stably stratified fluid revealed a formula with a point source atmospheric equivalent of:

$$h = 2.66 \quad \frac{F^{1/4}}{S^{1/4}}$$

where: F is the vertical flux of the buoyant force (determined from the cloud temperature and geometry) and S is a stability parameter.

The plume rise for an instantaneous cloud from a detonation can be calculated by incorporating the cloud volume and temperature parameters that were determined by the pollution products model (POLU10) in the above formula. Since the formula is applicable for stable atmospheric conditions, the plume rise will be underpredicted when actual meteorological conditions are neutral or unstable. As a result, the pollutant concentrations predicted by the ISC model are probably somewhat overestimated for unstable cases. Following calculations of plume rise, the open detonation source can then be modeled by means of ISC as an elevated volume source.

The ISC model was used with a year of hourly meteorological data to produce a sequence of hourly average concentrations at each specified model receptor. However, these estimates correspond to continuous emissions at the levels input to the model throughout each hour of the simulation. In fact, the duration of OB/OD emissions are generally very short. Thus, some adjustment of the values determined by the model must be undertaken to account for the associated reduction in receptor exposure time. This procedure is described below.

For open burn events, the total mass of emissions from the burn was assumed to be emitted over a burn time of one minute per pile or pan (for large rocket motor burns, the durations were assumed to be five minutes per burn). For burn events with more than one pile or pan, each pan was assumed to begin burning one at a time, one following another so that the total burn time is increased. Because the model allows at a minimum, a 1-hour continuous emission rate, the emission rate (in grams per second) input to the model was the total mass emissions divided by the burn time. Thus, the 1-hour model concentrations reflect this emission rate occurring over an entire 1-hour period rather than merely the time it takes the propellant to burn. To correct these results, the 1-hour concentrations were divided by the fraction of an hour during which the burn actually takes place. For noncriteria pollutants, the short-term exposure level used to protect health may be associated with a shorter averaging time than one hour (e.g., 15 minutes). For these pollutants, the above procedures were modified to obtain estimates for the appropriate averaging times.

For example, for four 1000-lb propellant burns, the total emissions might be 15 kg of NO_x. The emission rate input to ISC would be 15 kg/4 minutes or 62.5 grams/sec. The model predicted concentration for this case might be 1,655 $\mu g/m^3$, but this result would be corrected by multiplying by 4 min/60 min or 0.067 to give a true 1-hour average concentration of 1,655 $\mu g/m^3$ x 0.067 or 110 $\mu g/m^3$.

For open detonations, the emission duration is assumed to be one second. If more than one pit is detonated, detonations are assumed to be spaced one minute apart, which gives a duration in minutes equal to the number of pits detonated. The same procedures were used for adjusting OD model inputs and results as were described above for open burning.

Estimation of meaningful long-term (e.g., 30-day or annual average) pollutant concentrations is difficult for OB/OD sources. The ISC model provides an annual average concentration for each application using a one-year sequence of hourly input data. However this result would grossly overstate long-term exposure, since it is based on the premise that emissions are continuous at the rates input for estimating short-term impacts. In fact, OB/OD emissions at a facility typically occur during only a few hundred hours during the year, at most. In this circumstance, a rough estimate of the annual average exposure attributable to these activities may be obtained by scaling the annual concentration predicted by ISC (for uninterrupted emissions) to reflect the intermittent nature of the source, i.e.

$$C_{AVG} = C_{ISC} \times \frac{N}{8760}'$$

where:

C_{AVG} is the estimated annual average concentration, taking into account source intermittence;
C_{ISC} is the annual average concentration for continuous emissions; and
N is the number of hours per year when OB/OD emissions occur.

The exponential function mentioned in Comment #50 is not referenced or identified clearly. An exponential function for relating concentrations for different averaging periods is provided i the "Workbook of Atmospheric Dispersion Estimates" (Bruce Turner, USEPA, 1970) and is referenced in other USEPA documents. This exponential relationship applies to concentrations monitored from individual continuous sources. Since the OB/OD emissions at SEAD are intermittent and not continuous, this relationship is inappropriate for use.

The rationale for the "linear" correction factors used in the analysis is that the OB/OD activities at SEAD do not represent a continuous source of emissions; rather, they are short-term, intermittent events. The approach accounts to some extent for the short-term or instantaneous nature of these activities. The modeling approach employed herein is conservative in that it overestimates the duration and the amount of emissions associated with these events by assuming that they persist for a full hour at the short-term rate characteristic of the actual emission period. Therefore, the 1-hour during which emissions actually occur. Similarly,the annual concentrations yielded by the model have been scaled to reflect impacts only for the number of hours for which OB/OD emissions occur. This approach assumes that the predicted concentrations apply during the period of OB/OD emissions and that impacts from OB/OD emissions are zero for the fraction of the averaging period for which there are no emissions from OB/OD activities.

Other Model Inputs

Emission date used in the impact assessment modeling for the facility are discussed in Section 8d(3)(c). Model receptors (i.e., locations at which concentrations of pollutants were calculated by the model) were initially deployed at 1-km intervals in a 10 km x 10 km grid centered at the OB or

OD site. An initial model run was made to identify the receptor with the highest predicted pollutant concentrations. A full year of hourly meteorological data was modeled to determine the highest short-term pollutant concentrations. A second run was then made with the one year of meteorological input data, using a refined 2 km x 2 km receptor grid with 250 m spacing centered on the maximum receptor from the first run. This approach was considered necessary to ensure that the analysis would yield credible maximum pollutant concentrations associated with OB/OD activities. If locations of potentially important sensitivity to air pollutants were identified in the vicinity of the modeled sources, additional discrete receptor points at these locations were included in the simulations.

The modeling used a 1-year set of hourly meteorological data based on observations from Geneva Air Force Base and from Rome, New York. This was the most representative and complete data set available for the area near SEAD. Incorporating additional years of meteorological data in the analysis would required the use of data less representative of the area near SEAD. This would be counterproductive. Although USEPA prefers the use of five years of representative meteorological data when estimating concentrations with an air quality model, language in the USEPA Guideline On Air Quality Models makes it clear that the use of five years of NWS data is required only if the source is large (e.g., a 500 MW power plant). The main purpose of using multiple years of meteorological data is to increase the likelihood that "worst-case" meteorological conditions will be represented in the data base and in the model results. Experience has shown that predictions of maximum short-term concentrations using multiple years of meteorological data typically vary by less than a factor to two. The interannual variability in model results decreases as averaging time is increased.

Elevations for receptor points were obtained from 7.5 minute USGS topographic maps of the facility areas. Note that the ISC model only makes use of terrain elevations for receptor locations at or below the effective height of the source(s) in question, i.e., base elevation plus plume rise.

All model runs were made with unit emission rates for the OB or OD activities under evaluation. The resulting nominal concentrations predicted by the model were then scaled to reflect emission rates for specific pollutants species and adjusted to take into account the non-continuous nature of OB and OD sources, as described in the previous section.

D-8d(3)(f) Potential Health Risks

Operations at open burning (OB) and open detonation (OD) sites are regulated under the Federal Resource Conservation and Recovery Act (RCRA), Title 40 CFR 264, Subpart X, Regulations for

Miscellaneous Units. Section 264.601(c) of the Subpart X regulations provides for the prevention of any releases that may have adverse effects on air quality. In addition, federal environmental statutes (1977 Clean Air Act Amendments and Executive Order 12088) require Department of Defense (DOD) installations to comply with all federal, state, and local air pollution rules, regulations and standards, with the most stringent taking precedence. These rules, regulations and standards normally define: (1) the maximum allowable incremental and/or cumulative ambient air quality impacts of the project (expressed in terms of ambient air quality standards); (2) maximum allowable emission limits for specified pollutants; and in certain cases (3) the maximum acceptable emission control technology requirements for various sources. The numerous applicable requirements are discussed separately below for each governmental level of authority.

Federal Government

- National Ambient Air Quality Standard (NAAQS)

  The national primary and secondary ambient air quality standards have been established by the U.S.Environmental Protection Agency (EPA) to define maximum acceptable concentration levels for selected atmospheric pollutants over specified averaging times (40 CFR 50). Primary standards are designed to protect the public health by providing an adequate safety margin in pollution levels. Secondary levels are established to provide for the public welfare. Public welfare includes impacts on soil, water, vegetation, animals, weather, visibility, and personal comfort and well being. These standards are summarized in **Table D-26**, along with the analytical method required to determined the ambient concentrations of the specified pollutants. The short-term average concentration (i.e., standards for averaging times less than one year) may be exceeded no more that once per year.

- National Emission Standards for Hazardous Air Pollutants (NESHAP)

  National emission standards have been developed by the EPA to define the maximum allowable emission limits for a selected list of hazardous air pollutants (40 CFR 61). The substances most recently designated as hazardous air pollutants include asbestos, benzene, beryllium, coke oven emissions, inorganic arsenic, mercury, radionuclides, and vinyl chloride. Of these, beryllium is the only hazardous air pollutant associated with emissions from OB/OD operations. The standard for emission of beryllium from stationary sources is set at a limit of 10 grams of beryllium over a 24-hour period, or an ambient concentration limit of 0.01 $\mu g/m^3$, averaged over a 30-day period in the vicinity of the stationary source.

The following rules and regulations of the state of New York are applicable to OB/OD operations.

- Ambient Air Quality Standards

  The state of New York has the same ambient air quality standards for sulfur dioxides, carbon monoxides, and nitrogen dioxide as the national standards specified in **Table D-26** (New York Ambient Air Quality Standard, Part 257). Additional ambient air quality standards which have been promulgated by the state of New York are summarized in **Table D-27**. The short-term average concentrations may be exceeded no more than once per year.

- Emission Standards for Hazardous Air Pollutants

  The state of New York does not have any formal rules or regulations governing the control of air toxics emissions beyond its delegated authority to enforce NESHAPs. The state of New York's ambient air quality standard for beryllium is the same as that specified by NESHAPs.

- Other Applicable Rules and Regulations

  a) Control of Open Fire (New York Air Pollution Control Regulations, Part 215): This regulation prohibits open fires except in specified cases such as burning at an appropriate designated site of toxic, explosives, or dangerous materials, provided that such burning is done only in accordance with a permit which will be issued by the commissioner after written application if he determines that there is no other safe or economical method of disposal.

  b) Permit Requirements (New York Air Pollution Control Regulations, Part 201). OB/OD activities are conducted under an annually renewable permit (No. 8B-45309-8707) issued by the state of New York. The permit prohibits burning of hazardous wastes (other than explosives); restricts open fires when winds are heavy and/or blowing toward populated areas; prohibits activities during any air pollution episodes; and requires periodic evaluation of alternative disposal methods.

The current New York State open burning permit is included in Appendix G.

Local Government

The county of Seneca follows the same rules and regulations as the state of New York.

The area surrounding SEAD is sparsely populated farmland. The population density in the two towns which surround the SEAD facility, Romulus and Varick, is 67 people per square mile (1990 U.S. Census Bureau). There are two areas within one mile of the site where the population density is slightly higher: residences on the western boundary of SEAD along Route 96A, and residences within SEAD boundaries at the McGrane Road entrance. No sensitive receptors are known in these areas. The nearest sensitive receptor location is the Central School in Romulus Village, approximately 3.5 miles southeast of the OB/OD site.

The total population of the towns of Varick and Romulus is 4693, including the population residing on SEAD property (1990 U.S. Census Bureau). This represents the total population within an approximate five mile radius of the OB/OD site. Emissions from the OB/OD site are not likely to result in significant exposures beyond five miles down range and 4700 people thus constitutes an upperbound estimate of the population that is likely to be exposed to air emissions from the OB/OD grounds.

The modeling methodology described in the previous section was implemented to obtain estimates of air quality impacts associated with OB/OD activities at SEAD. Concurrent surface and upper air data from the National Weather Service (NWS) observation stations at Geneva Air Force Base and Rome, New York, respectively, were used to support the modeling effort. A full year of hourly surface observations and twice-daily mixing heights generated by the National Climatic Center for the year 1954 were used. This was the most recent year for which complete data sets from both locations were available, and these data were considered more representative of conditions at SEAD than more recent observations at other more distant stations. Although the data set utilized was the best available, some mixing height values were missing from the Rome upper air data. Because the modeling software requires a complete data set, the missing mixing heights were filled in with the average of all available heights for the particular month and time period (morning or afternoon) in which the missing values occurred. One hour of the Geneva surface wind direction data was missing and was replaced with the direction value for the preceding hour.

Emissions data developed to characterize typical SEAD OB/OD operations were described in Section D-8d(3)(c). Based on this information, model calculations were performed to estimate maximum short-term concentrations of carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ammonia (NH_3), hydrogen sulfide (H_2S), lead (Pb), and hydrogen fluoride (HF) due to open burning.

For open detonation activities, the model was used to calculate impacts on ambient levels of NO_2, H_2S, CO, SO_2, fine particulates (PM-10), ammonia (NH_3) and lead (Pb). Because burning and detonation of various types of munitions produce differences in the types of pollutants that are emitted in significant quantities, several simulations were performed to ensure that, to the extent possible with available information, maximum impacts for each pollutant would be addressed. Differences in the composition of explosives also affect the volume of pollutant gases produced, as well as the temperature of the mixture. Thus, separate model runs were made for the different OB and OD activities typically conducted at SEAD. The OB/OD scenarios modeled and the corresponding pollutants of interest are given below:

Scenario	Activity	Assumed Munitions (Pollutants)
1	OB	1,000 lbs of propellant M1 (CO, NH_3)
2	OB	1,000 lbs of propellant M15 (HF)
3	OB	1,000 lbs of propellant SPCF (NO_2, SO_2, Pb)
4	OB	1,000 lbs of propellant M6 (H_2S)
5	OD	1,000 lbs of HEAT rifle grenades M31 (NO_2, H_2S, NH_3, Pb, PM-10)
6	OD	1,000 lbs of 90 mm projectiles (CO, SO_2)

It should be recognized that each of these scenarios has been purposely selected to maximize the emissions of one or more pollutants for a burn or detonation involving the maximum allowable weight of energetic materials. In practice, these materials are often combined, such that the effect on ambient levels for particular pollutants would be less than the values derived from this impact analysis. On the other hand, there is no reasonable way to simulate all the possible combinations of propellants and explosives that could be destroyed simultaneously. In any event, the air quality impacts discussed below should be considered as the maximum possible values for each pollutant, given the operational OB/OD limitations currently in effect.

Table D-28 shows the predicted maximum short-term pollutant concentrations. These results represent, for each scenario, the highest one-hour values calculated by the ISC model from a full year of hourly meteorological input data. Due to the short duration and intermittent nature of OB/OD operations, results are shown only for the one-hour averaging time. For reference, applicable National Ambient Quality Standards (NAAQS) and/or short-term ceiling values adopted for the various pollutants by the National Institute for Occupational Safety and Health (NIOSH) or the American Congress of Governmental Industrial Hygienists (ACGIH) are included in the table footnotes. All peak concentrations shown in **Table D-28** are predicted to occur well within SEAD boundaries, 200-400 meters from the OB/OD operations areas.

Maximum predicted fine particulate levels are very high, but fairly consistent with measurements conducted in OD plumes during the Army's field studies. No PM-10 standard exists for averaging times of less than 24-hours, but even one hour of the impact level shown for Scenario 5 would constitute an exceedance of this standard. This is particularly true in that only dust emissions (i.e., not carbonaceous smoke emissions) were included in the calculations. In addition, the model predictions indicate only the contribution of OD sources; no data were available to allow PM-10 impacts from OB operations to be computed.

Based on observation of OD operation, it is obvious that large quantities of particulate matter do become airborne during detonation, and, despite the uncertainties inherent in the modeling methods used, it does appear likely that violations of the 24-hour standard may occur. However, it should be noted that hours of poor atmospheric dispersion conditions were not eliminated from the modeling runs, even though SEAD facility's Standard Operating Procedures (SOPs) prevent OB/OD activities under such conditions, i.e., approaching electrical storm.

The only ambient air quality standard for lead is a 90-day (quarterly) concentration of 1.5 ug/m_3. The modeling predicted a maximum annual average lead concentration of only 0.16 ug/m_3. Although 90-day average lead concentrations were not explicitly obtained from the modeling, predicted maximum 90-day average concentrations do not typically exceed the annual average by more than 50%. Even if the annual concentration is doubled to produce a conservative estimate of the maximum 90-day lead concentration, the resulting estimate is still far below the corresponding standard.

Table D-29 shows maximum modeled one-hour concentrations for various pollutants at the nearest potentially sensitive receptor, the Central School in the village of Romulus. While only about one-third of the maximum concentrations predicted to occur within the SEAD, the results for the Romulus receptor indicate that the 24-hour PM-10 standard is likely to be exceeded at this location.

If we take the emission scenario described above to be typical of OB and OD events at SEAD throughout the year, then approximate annual average concentrations can be calculated from the model results generated for these cases. The results for pollutants regulated by annual NAAQS are listed in **Table D-30**. Data provided by the SEAD facility indicate that OB/OD activities occur on about 180 days per year. The modeling data presented in **Table D-30** reflect this assumed operational frequency, although we have conservatively assumed that each of the scenarios discussed above occurs

180 times during a year to provide estimates of the maximum possible long-term average values for each pollutant.

The predicted maximum annual average concentrations are well below applicable long-term air quality standards. All predicted annual maximum for the four pollutants are expected to occur within a few hundred meters of the OB/OD operations site. The nearest location of a potentially sensitive receptor (that is, a location at which the public may be exposed to pollutants) is in the town of Romulus. All predicted concentrations at this location were far lower than the respective air quality standards for the pollutants listed **in Table D-30.**

The modelled air concentrations of lead which result from releases from OB/OD operations are less than the primary NAAQS values. The NAAQS values are established to protect human health and include a margin of safety to allow for populations which may be more sensitive to the air contaminant than the general population. Exposure concentrations less than the NAAQS are protective of the health of the general population and sensitive sub-populations. Since there is no predicted exceedance of the lead NAAQS for the OB/OD operations, no assessment of the potential health effects of lead are necessary for the permit application.

The modelled air concentrations of lead which result from releases from OB/OD operations are also less than the secondary NAAQS values. The secondary NAAQS values are established to protect public welfare. Effects which are considered public welfare issues are effects on structures, soiling of surfaces, aesthetic considerations, effects on plants and other possible effects not directly related to human health. Since there is no predicted exceedance of the lead secondary NAAQS, no additional assessment of potential effects on physical structures vegetation, and crops is necessary.

The low levels of lead that are predicted from the modelling indicate that other secondary effects, such as those on domestic animals and livestock, and potential secondary exposures to humans, such as soil ingestion and ingestion subsequent to the uptake of the lead to crop plants, are not likely. While these potential effects are not directly accounted for in the establishment of NAAQS values for lead, the standards are protective with regard to these effects. Historically, levels of lead in the soil that are potentially harmful to humans through these secondary mechanisms are only achieved where large sources of lead, such as uncontrolled lead smelters or lead battery manufacturing, have been present. Even in urban areas, where historical ambient air levels of lead were well in excess of the current standard, potentially harmful levels of soil lead are found only where leaded paints have been deposited or very near the edges of streets where ambient air lead levels were much higher than the present standard. It is not likely that the low levels of lead predicted for the OB/OD emissions will have secondary effects in the surrounding areas.

The modelled concentrations of PM10 exceed the NAAQS 24-hour standard by less than a factor of one under the assumptions of the model, but do not exceed the annual PM10 standard. The modelled exceedance of the 24-hour NAAQS is not likely to result in health effects, however, due to differences between the nature of the particulate released from the OB/OD and the conditions under which it is released and the nature of the particulate and conditions upon which the NAAQS is based.

The PM10 NAAQS, and the Total Suspended Particulate (TSP) NAAQS from which the PM10 standard is derived, are based in part on the ability of particulates to potentiate the effects of other air pollutants which generally occur with the particulate. In particular, the irritant effects of sulfur oxides are enhanced in the presence of high particulate concentrations. The particulate provides an additional vehicle for delivery and retention of the sulfur oxides in the lung. The potentiation is based upon epidemiological observations in urban areas where there is a rich mixture of air contaminants. Also, the particulate matter in urban aerosols is composed of potentially harmful compounds (metals, PAH's, organics), in addition to its role in potentiating the irritant effects of other contaminants.

The modelled PM10 concentrations resulting from OB/OD operations which exceed the 24-hour NAAQS are not accompanied by elevated levels of sulfur oxides or other contaminants and the potentiating effects of the particulate are not operative. Further, the PM10 which is produced from operations at the OB/OD site consists native soil particles which do not contain the potentially toxic compounds present in a typical urban aerosol.

The PM10 released from the OB/OD operations are not likely to result in effects on domestic animals, wildlife, crops, vegetation, and physical structures and are not likely to result in exposures via non-inhalation pathways. The PM10 emissions are consist of native soil particles and the deposition of PM10 downrange would not alter the uptake of soil components by humans, animals or crop plants.

The ISC modeling approach incorporates a large number of conservative assumptions and elements which likely overestimate actual concentrations. In fact, it is likely that the maximum predicted concentrations reported in Appendix VII are attributable at least in part to meteorological conditions for which OB/OD activities do not occur (stable conditions at night, e.g.) or are explicitly prohibited by the OB/OD SOP at SEAD (very light wind conditions, e.g.). IN order to address any concerns regarding the 24-hour NAAQS for PM-10, it might be more productive to estimate maximum short-term concentrations from OD activities through the use of a different modeling approach.

"A Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants" [USEPA, 1988(draft)] contains numerous recommended screening techniques for estimating impacts of releases of substances to the air. The recommended techniques for specifying dispersion parameters and for estimating dispersion from instantaneous sources are based on "Estimating Concentrations Downwind from an Instantaneous Puff Release" (William Petersen, USEPA, 1982). Since the OD emissions are instantaneous and not continuous, maximum PM-10 impacts from the OD activities can be estimated using the techniques recommended by USEPA in the documents referenced above. These calculations yield maximum estimates of PM-10 concentrations from OD activities which are significantly below those reported in Appendix VII. The maximum 24-hour PM-10 impact to 98 ug/m_3 for a single series of ten detonations estimated via these techniques at the nearest sensitive receptor (identified in Appendix VII as the Central School in Romulus, New York) is below the 24-hour NAAQS for PM-10.

D-8d(4) Noise Considerations

A study, to evaluate the effects of noise associated with open detonation, has been conducted at SEAD by AEHA. This study is currently in draft form and should be completed in the next month at which time the results will be made available to the EPA. This report concludes that although noise from single events could create annoyance and some possible complaints the predicted and measured zone II noise contours for the demolition activities do not extend beyond the installation boundary. There is no evidence the worst-case blast noise levels propagating to the Wilson and Little residences could cause damage. Since there is a remote chance that minor damage could occur during an inversion, SEAD should consider delaying demolition operations during inversion conditions.

Although the report is still in draft, significant noise and vibrational data has been obtained and is summarized herein. Monitoring of noise and vibrational effects caused by the open detonation of explosive munitions by the AEHA was performed during the period of October 30, 1992 thru May 7, 1992 at the Seneca Army Depot. Measurements were made a five (5) locations, including two (2) local residences the Wilsons and the Littles along Rt. 96A and are shown on Figure D-20. The purpose of this effort was to establish noise contours for demolition operation. This information will be used by SEAD in resolving issues which may arise as a result of normal base operations. SEAD will continue to monitor noise in an effort to be sensitive to the needs and concerns of local residents. Further, SEAD will initiate an Installation Compatible Use Zone (ICUZ) Program which will manage noise and vibration complaints.

The ICUZ is a concept of achieving compatible land use in nongovernment areas around military installations. The purpose of ICUZ is to prevent incompatible development in high noise exposure areas, and to protect the operational capability of the installation.

The best way to prevent incompatible development in the existing high noise exposure areas is to continue to coordinate with local planning and zoning agencies. This continued coordination will assure that these agencies consider the noise environment when making their decisions and through the use of the zoning process, plan for only compatible new developments near high noise areas such as airfields and ranges.

In addition to achieving land use compatibility through public involvement, other elements of the ICUZ program, as established by AR 200-1 include:

a. Quantification of Existing and Future Noise Environments. This consultation provides the noise contours for the existing and future noise environments. If the noise environment is projected to change significantly in the future, contours for these noisy operations will need to be generated.

b. Review of Installation Master Plan. The installation master plan needs to be reviewed to ensure that existing and future facility siting is consistent with the noise environment. Also, the siting of noise producing facilities, such as ranges, should be compatible with the neighboring land uses.

c. Identification of Facilities/Operations that create a Noise Impact. Once a noise impact has been identified, it is necessary to determine the cause of this impact, and investigate possible mitigation. Mitigation can include moving the noise source, limiting its hours of operations or constructing a barrier around the source.

d. Establishment of an ICUZ Committee. Since the ICUZ program requires knowledge in many varied fields of expertise, a committee with the membership listed in AR 200-1, paragraph 7-5b (1) is needed to administer the program. The committee will review noise complaints, investigate and recommend mitigative actions, coordinate with the public, assess installation activities for possible noise impacts, monitor land development plans, programs and projects, and review development of on-post facilities.

e. Preparation of an ICUZ Study. The ICUZ study is directed toward officials of local governments, civic and business leaders, and other interested parties. The study explains the purpose of the ICUZ program, and discusses the mutual concerns and responsibilities of the military and civilian communities regarding the quality of the noise environment. The study addresses the interdependency of the military and civilian communities, the ramifications of encroachment, and the need for compatibility between military and community interests. The study examines present and future conditions within the military community environs and offers conclusions and recommendations regarding issues which need to be resolved. Failure to resolve the issues can only lead to situations which are detrimental to a harmonious relationship between the military and the citizens who live in the surrounding areas.

The primary means of assessing environmental noise is through computer simulations since direct measurement of noise levels is often impractical, expensive and installation land use maps to be incorporated into the installation master plan and National Environmental Policy Act documentation.

The process of developing a noise contour map for SEAD involved collecting on-site noise data which will serve as input to a computer simulation program that will determine the allowable noise contour.

The noise simulation program used to assess impulsive (heavy weapon) noise is MicroBNOISE. The MicroBNOISE program requires operational data concerning type of weapons fired from each range or firing point including demolitions, the number and type of rounds fired from each weapon, the location of targets for each range or firing point and the amount of propellant used to reach the target. Existing records on range utilization along with reasonable assumptions are used as MicroBNOISE inputs.

The impulsive noise environment at SEAD was sampled at the locations listed in **Table D-34** and **Figure D-20** from 30 October 1991 to 7 May 1992. The noise was monitored using the Metrosonics sound level analyzer with a real time detector (model db604), Bruel and Kjaer (B&K) preamplifier (model 2619) and a B&K calibrated before each use with a B&K acoustical calibrator (model 4230). The stored data were printed with the Metrosonics printer (model dp421).

The analyzer samples the C-weighted sound level at a rate of 65,500 samples per second. When the selected threshold of 95 dBC is exceeded, the analyzer computes the sound exposure level (SEL) of the event that exceeds the threshold. The analyzer stores in its memory the time the threshold was exceeded, the duration of the threshold exceedence, the peak level, and the SEL of the event. The analyzer continuously computes the 1/16 second average of the sound level and stores the distribution of these averages. The printer is used to read the analyzer memory and print a permanent record of the event data and the 1/16 second average distribution. Appendix D-A describes the procedure used for distinguishing blast noise events from other high level noise sources or wind. The CDNL's were computed using from the SEL data using the procedure described in Appendix D-B.

Of the measures available from the sound level analyzer, we were primary interested in the CSEL. The CSEL is the level which, if a noise event lasted 1 second, would produce the same sound energy as the actual event. According to the Bureau of Mines research, a "safe maximum airblast level" will be maintained "based on a minimal probability of the most superficial type of damage in residential-type structures" if the CSEL does not exceed 105 dB.

The inputs used to generate the noise contours for the monitoring period are summarized in **Table D-35**. The noise contours were developed based upon activity during the monitoring period at SEAD.

Table D-36 represents the current consensus regarding acceptable noise land use guidelines. In preparing the noise contours AEHA has used the CDNL limits as applicable guidelines.

A characteristic of environmental noise is that it is not steady, but varies in amplitude from one moment to the next. To account for these variations and to assess environmental noise in uniform manner, the U.S. Environmental Protection Agency (EPA) endorsed the day-night level (DNL) as the acceptable noise evaluator. This evaluator is used by many Federal and state agencies, including the Department of Defense, Department of Housing and Urban Development, and the Federal Aviation Administration (FAA) as the standard for describing environmental noise impact.

Military noise environments are generally characterized by three types of noise. These are:

1. Transportation noise resulting from aircraft and vehicle activities is best described in terms of the A-weighted DNL (ADNL). The A-weighing scale closely resembles the frequency response of human hearing and, therefore, provides a good indication of the impact of noise produced by transportation activities. The compatibility levels for ADNL were developed through social surveys conducted by many government and private organizations.

2. High amplitude impulsive noise resulting from armor, artillery and demolition activities is described in terms of the C-weighted DNL (CDNL). The C-weighing scale measures more of the low frequency components that can cause buildings and windows to rattle and shake. This is an important ingredient in a person's perception of the annoyance from blast activities. The compatibility levels for CDNL were developed through studies performed by the FAA and the U.S. Army Construction Engineering Research Laboratory (CERL).

3. Currently, AEHA does not use the DNL to evaluate noise from small arms ranges. Instead, linear peak sound level (dBP) is used to define these noise zones. The dBP weights all frequencies of the noise equally and was found to give the best correlation between the noise from small arms ranges and the percent of the population highly annoyed. The difference in weighting scales reflects the difference in the mechanisms underlying annoyance. Transportation noise annoys people because it is heard; blast noise annoys people because it shakes their homes.

Vibration Measurements

Vibration measurements were conducted at the Wilson's and Little's residence using a Larson-Davis (model 800B) sound level meter attached to a B&K (model 4223) accelerometer. The meter was set for linear frequency weighing and peak continuous. This system was calibrated before and after each monitoring session using a B&K (model 4291) calibrator. The calibration signal gave a velocity of 0.5 inches per second.

The engineering technician at the monitoring site recorded the linear peak level of each event from the day's demolition activity at SEAD.

According to Bureau of Mines research an earlier vibration limit of 2.0 inches per second "provided sufficient annoyance." (A peak velocity of 2.0 inches per second equates to a value of 87 decibels (dB) on the system which AEHA used). The Bureau of Mines recommended lowering the limit to 0.5 inches per second. The limit of 0.5 inches per second equates to a value of 75 dB. This is the limit which AEHA adopted for the purpose of this assessment. The measurement system allowed a range of measurements from 25 to 100 (0.01 to 8.9 inches per second).

Measurements were made on January 29, 30, 31, February 3, 10, and March 18, 1992.

Noise Contours

Unlike a topographic contour, noise contours are not intended to be precise representations of the noise zones. Geographic features, meteorology, the receiver's perception of the source, etc. can influence the impact of noise. Noise contours do not clearly divide noise zones with one side of the line compatible and the other side incompatible. However, the use of noise contour maps have proven to be a reliable planning tool in noise affected areas through-out the Untied States.

The noise contours for the demolition ground are for the monitoring period and are shown in **Figure D-20**. The normally unacceptable (zone II) noise zones does not extend beyond the installation boundary. The noise contours show that land uses around SEAD are compatible with the existing noise environment; however, the possibility exists that an individual demolition detonation could lead to noise complaints.

Noise Monitoring

Automated monitoring of the impulsive noise environment was conducted at the sites listed in **Table D-37** and **Figure D-20**. The CDNL and the number of events judged valid are listed in **Table D-37**.

The C-weighted peak levels are summarized in **Table D-38**. Automated noise monitoring of the impulsive noise environment and computer generated noise contours for the monitoring period are in reasonable agreements, since the measured Zone II would have fallen in between site 2 and 3, just as the computer generated Zone II did.

Vibration Measurements

Vibration is defined as a motion in which an object moves back and for the from its rest position when it is acted upon by an external force. Noise from explosive detonations can cause buildings to vibrate, which is perceived by the occupants as shaking of the structure and rattling of the windows. This shaking of houses is commonly blamed on ground borne vibration. These vibrations are also perceived by the residents as the cause of existing or potential structural damage. As discussed in the following paragraphs, the shaking is caused by the structure responding to the airborne sound wave and not the ground wave vibration. The probability of the shaking causing structural damage is nil.

The maximum vibration level recommended by the U.S. Bureau of Mines to prevent threshold damage is 0.5 inches per second peak particle velocity (PPV). The level at which minor structural damage may occur is set at 2 inches per second PPV.

Vibration measurements were made on the walls facing the demolition grounds at both the Wilson's and Little's house.

Measurements for the monitoring period were between 28.0 and 60.4 dB. These measurements equate to .002 to .09 inches per second. **Table D-39** contains the vibration measurement data for the Little and Wilson residences. **Table D-40** provides the meteorological data collected during the measurement program.

Annoyance for Noise

Annoyance can be viewed as the expression of negative feelings resulting from interference with activities, as well as disruption of one's peace of mind and the enjoyment of one's environment. Although this reaction can run the gamut of mild irritation to extreme distress, only responses categorized as "highly annoyed" (and greater) have been used to measure the impact of noise on communities.

Even though the noise contours show a minimal impact, people living near SEAD may be annoyed and could complain about the noise environment. The amount of annoyance also depends on the time of day the noise takes place, the background noise environment, and whether the person is indoors or outdoors at the time. The annoyance and complaint potential from single events, such as a demolition blast, is highly subjective and limited data exist in this area.

The usual complaint pattern is that economic activity unrelated to the installation stimulates increased population and development in the vicinity. Segments of the new population are not economically dependent on the installation, and tend to be annoyed by the noise or other aspects of the government presence. The noise from the ranges provides a specific and undeniable object to complain about. As time goes on, the complainers become more articulate and eventually address their complaints to higher levels of command and government. When the situation becomes political, the installation's ability to perform the mission can be impaired.

When contemplating noise limit criteria for impulse noise one finds very little objective guidance available. Factors to be considered include the possibilities of structural damage to buildings and physiological damage to humans, and the likelihood of receiving noise complaints. Studies have shown that homeowners become concern about structural rattling and possible damage when the level exceeds 120 dBP. It appears that the first structural damage to occur as impulse sound intensity increases is window breakage. The threshold is approximately 150 dBP to crack a poorly mounted window pane. The threshold for physiological damage is approximately 140 dBP. The threshold for annoyance is lower than 140 dBP, and varies greatly among individuals.

Individual response of community members to noise depends on many factors. Some of these factors are the characteristics of the noise, including the intensity and spectral characteristics, duration, repetitions, abruptness of onset or cessation, and the noise climate or background noise against which a particular noise event occurs. Social surveys have shown that other factors include the degree of interference of the noise with activity, the previous experience of the community with the particular noise, the time of day during which the intruding noise occurs, fear of personal danger associated with the activities of the noise sources, socioeconomic status and educational level of the community, and the extent the people believe that the noise output could be controlled.

To evaluate the complaint potential from impulsive noise, AEHA uses a set of guidelines developed by the Naval Surface Warfare Center, Dalhgren. These guidelines for delaying tests at Dalhgren are based on over 10 years of experience using meteorological forecasts. The guidelines are shown in **Table D-41**. These levels resulted from the best compromise between cost, efficiency of range operations, and good community relations.

Comparing Table **D-38** and **D-41**, and adding 5 db to **Table D-38**, there was a 5 percent chance of high risk noise complaints at the Wilson Residence and 2 percent at the Little residence during the monitoring period. (The reason for the 5 db adjustment is that there is more acoustic energy taken into account with the linear sale than the C-scale. We have found that 5 db is good approximation for our equipment.

Figure D-20 is the noise contour map. This figure shows four zones (Red II, Red III, Blue II, Blue III) related to the activities at the OD facility. The red zone contours represent noise levels associated with the detonation of 150 pounds of total explosive weight, while the Blue zone contours represent noise levels associated with the detonation of 250 pounds, total explosive weight.

Zone II is defined as being normally incompatible for noise-sensitive land use, while Zone III is defined as being incompatible. Zone I, which is not shown, is defined as compatible. From this preliminary analysis, no sensitive receptors have been identified as being within Zone II or Zone III from either size detonation.

The noise contour map has been developed in accordance with the Army's Noise Abatement Program, described in the Army Regulations, AR-200-1 Chapter 7, which is included in Appendix 9. This regulation also discusses program requirements, noise complaints, standards, installation compatible use zone program and noise assessment.

While not specifically addressed, air blast pressure and ground vibration complaints would be addressed as if they were noise complaints under AR-200-1, Chapter 7-3.

As a result of this monitoring program AEHA concludes the following:

a. The predicted and measured Zone II for the demolition activity at SEAD do not extend beyond the installation boundary.

b. Noise from single events could create annoyance and possible complaints.

c. There is no evidence that the worst-case blast noise levels propagating to the Wilson and Little residences could cause damage.

d. Because there is a remote chance that minor damage (i.e., cracking of a pre-stressed pane of glass) could occur during inversion, SEAD should consider delaying demolition operations during inversion conditions.

Further, the report recommends the following:

a. Initiate an ICUZ program to include coordinating with local planning and zoning agencies.

b. Initiate a noise complaint management system.

c. During inversion conditions, SEAD should consider delaying demolition operations.

Table D-34

Location of Monitoring Sites

Site Number	Location	Instrumentation
1	566 feet West of demolition ground	dB604
2	1132 feet West of demolition ground	dB604
3	2264 feet West of demolition ground	db604
4	Wilson House 2648 feet West of demolition ground	db604 & LD 800B
5	Little House 3390 feet North of demolition ground	db604 & LD 800B

Table D-35

Summary of MicroBNOISE Inputs

Weight of Explosives	Number of Shots	Burial Depth (Feet)
60	1	10
100	11	8
100	17	8-10
100	11	10
110	7	8
110	10	8-10
120	5	8
130	5	8
140	10	8
150	32	8-10
150	13	10
150	9	12
160	5	8-10
160	3	8-12
170	2	12
180	1	12

Note: All demolition activity was between 0700-2200 hours

Table D-36

Land Use Planning Guidelines

Noise Zone	Population Highly Annoyed	Transportation ADNL	Noise Limits Impulsive CDNL	Small Arms dBP
I	< 15	< 65 dBA	< 62 dBC	< 87 dBP
II	15-39	65-75 dBA	62-70 dBC	87-104 dBP
III	> 39	> 75 dBA	> 70 dBC	> 104 dBP

dBA = decibels, A-weighted
dBC = decibels, C-weighted
< = less than
> = greater than

Table D-37

CDNL and Number of Events Judged Valid at Each Site

Site	CDNL (dBC)	Total Number of Events Valid at Each Site
1	68.6	88
2	64.0	100
3	57.1	81
Wilson Residence	61.7	78
Little Residence	58.5	25

Table D-38

Summary of C-Weighed Peak Level Distributions

Percent of C-Weighed Peak Levels				
Site Number	<110	110-125 dBC	125-135 dBC	>135 dBC
1	42	45	10	3
2	39	55	4	2
3	79	18	3	0
Wilson Residence	77	20	3	0
Little Residence	92	6	2	0
Note: Percentages are based on 142 impulsive noise events				

Table D-39

Vibration Measurement Data
at
Wilson and Little Residence

Site	Date	dBP
Little Residence	January 29, 1992	35.1 33.2 38.6 37.2 41.9 46.1 38.9
Little Residence	January 30, 1992	45.9 57.5 55.4 52.5 48.3 45.4
Wilson Residence	January 31, 1992	37.4 30.3
Little Residence	February 3, 1992	32.9 35.1 34.1 36.4 43.1 42.1 50.7 39.4 33.0

Table D-39
(continued)

Site	Date	dBP
Little Residence	February 10, 1992	45.6 47.4 44.5 53.9 58.5 60.4
Little Residence	March 18, 1992	29.1 28.4 29.3 36.5 29.1 28.5 29.0 28.0 29.1 28.3

Table D-40

Weather Data

Date	Temperature (degrees)	Wind Direction	Wind Speed (knots)	Humidity (percent)	Ceiling (feet)
10/30/91	55	South	6	50	Clear
10/31/91	57	South	6-10	32	Clear
11/6/91	51	North-Northeast	8-10	29	4,500
11/8/91	40	South	5	39	4,000
12/3/91	40	South-Southwest	8	48	5,000
12/5/91	37	Northeast	4	42	5,000
1/7/91	43	Southeast	10-12	52	3,500
1/21/92	29	Northwest	12	53	3,000
1/22/92	26	Southeast	4-6	56	8,000
1/29/92	44	South-Southwest	7	46	Clear
1/30/92	35	South-Southwest	6	50	5,000
1/31/92	34	South-Southeast	10	58	2,500
2/3/92	32	Southeast	6	58	Clear
2/10/92	23	Southwest	10	45	Clear
3/18/92	44	West	3	40	10,000

Table D-40
(continued)

Date	Temperature (degrees)	Wind Direction	Wind Speed (knots)	Humidity (percent)	Ceiling (feet)
3/24/92	41	Southeast	10-12	42	3,000
3/25/92	53	North	10-12	45	6,000
4/28/92	60	Southeast	10	58	10,000
5/7/92	65	Northeast	6	55	8,500

Table D-41

Impulse Noise Guidelines

Predicted Sound Level, dBP	Risk of Complaints	Action
<115	Low risk noise of complaints	Fire all programs
115-130	Moderate risk of noise complaints	Fire important tests. Postpone non-critical testing, if feasible.
130-140	High risk of noise complaints, possibility of damage.	Only extremely important tests should be fired.
>140	Threshold for permanent physiological damage to unprotected human ears. High risk of physiological and structural damage claims.	Postpone all explosive operations.
Note: For rapid fire test programs and/or programs that involve many repetitions of impulse noise, reduce allowed sound levels by 15 dBP.		

Appendix D-A

Procedure for Distinguishing Impulsive Noise Events From Other High Level Noise Sources or Wind

The following steps were used when reducing the db604 outputs to distinguish impulsive noise events from other noise sources or wind:

a. The threshold was set at 100 dBC. The high threshold eliminated most non-impulsive noise sources and normal wind.

b. If the duration of the event was greater than 1 second, the event was judged not to be caused by impulsive noise.

c. If there were more than two events per second and more than 20 events in that minute, the data for that minute were judged not to be caused by impulsive noise.

d. If the difference between the peak level and the SEL of the event was less than 15 dBC or greater than 22 dBC, the event was judged not to be caused by impulsive noise.

Appendix D-B

Procedures used to Compute Day-Night Levels

1. <u>Decibel Addition</u>. Since decibels are a logarithmic number, they cannot be added using standard arithmetic. That is, 65 decibels plus 60 decibels is not equal to 125 decibels. To add decibels, it is first necessary to convert the sound levels to acoustic energy by dividing the decibels by 10 and computing the inverse logarithm (base = 10) of this number. For example, 65 decibels is equal to 10 to the 6.5 power, which is equal to 3,162,278. Likewise, 60 decibels is equal to 1,000,000. These acoustic energies are summed (3,162,278 + 1,000,000 = 4,162,278). Next, the common logarithm is taken (log 4,162,278 = 6.6) and this number is multiplied by 10 (6.6 x 10 = 66) to obtain the decibel sum.

2. ADNL From 10-Minute LEQ's

   a. The ADNL is computed by summing, using decibel addition, the 144 10-minute LEQ's for the day. Before summing, the 54 10-minute LEQ's for the hours between 2200 and 0700 are penalized to decibels. The total energy is divided by 144. The ADNL is equal to 10 times the common lorgithm of this number.

   b. As an example, the 10-minute LEQ's between 0700 and 2200 hours consist of 19 values of 46, 2 values of 47, 10 values of 48, 8 values of 49, 12 values of 50, 8 values of 51, 6 values of 52, 5 values of 53, 5 values of 54, 4 values of 55 and 1 value of 56. The 10-minute LEQ's between 2200 and 0700 hours consist of 43, and 1 value of 44. The total energy (19 x 39,811 + 12 x 50,119 + 10 x 63,096 + 8 x 79,433 + 12 x 100,000 + 8 x 125,893 + 6 x 158,489 + 5 x 199,526 + 5 x 251,189 + 4 x 316,228 + 398,107 + 22 x 100,000 + 18 x 125,893 + 10 x 158,489 + 3 x 199,526 + 251,189) is equal to 16, 599,644. Dividing this energy by the 144 samples (115,275), taking the common logarithm (5.06) and multiplying by 10 gives the ADNL of 50.6 dBA.

3. CDNL From SEL's

a. The CDNL is computed by summing the acoustic energy of the SEL's using decibel addition. The events occurring between 2200 and 0700 hours are penalized by adding 10 decibels to the SEL's before summing. The total energy is divided by the number of seconds in the monitoring period. The CDNL is equal to 10 times the common logarithm of this quantity.

b. As an example, during a 24-hour period, SEL's of 115.3, 117.1, 112.1 and 114.7 were measured between 0700 and 2200 hours. The SEL's between 2200 and 0700 hours were 118.1 and 111.6. With the 10 decibel penalty, these levels are 128.1 and 121.6. The total acoustic energy is equal to 10 to the 11.53 power plus 10 to the 11.71 power plus 10 to the 11.21 power plus 10 to the 11.47 power plus 10 to the 12.81 power plus 10 to the 12.16 power. The total energy is equal to 9,211,000,000,000. The total number of seconds in a 24-hour period is 86,400. Dividing 9,211,000,000,000 by 86,400 (106,609,000), taking the common logarithm (8.03) and multiplying by 10 gives a CDNL for the day of 80.3 dBC.

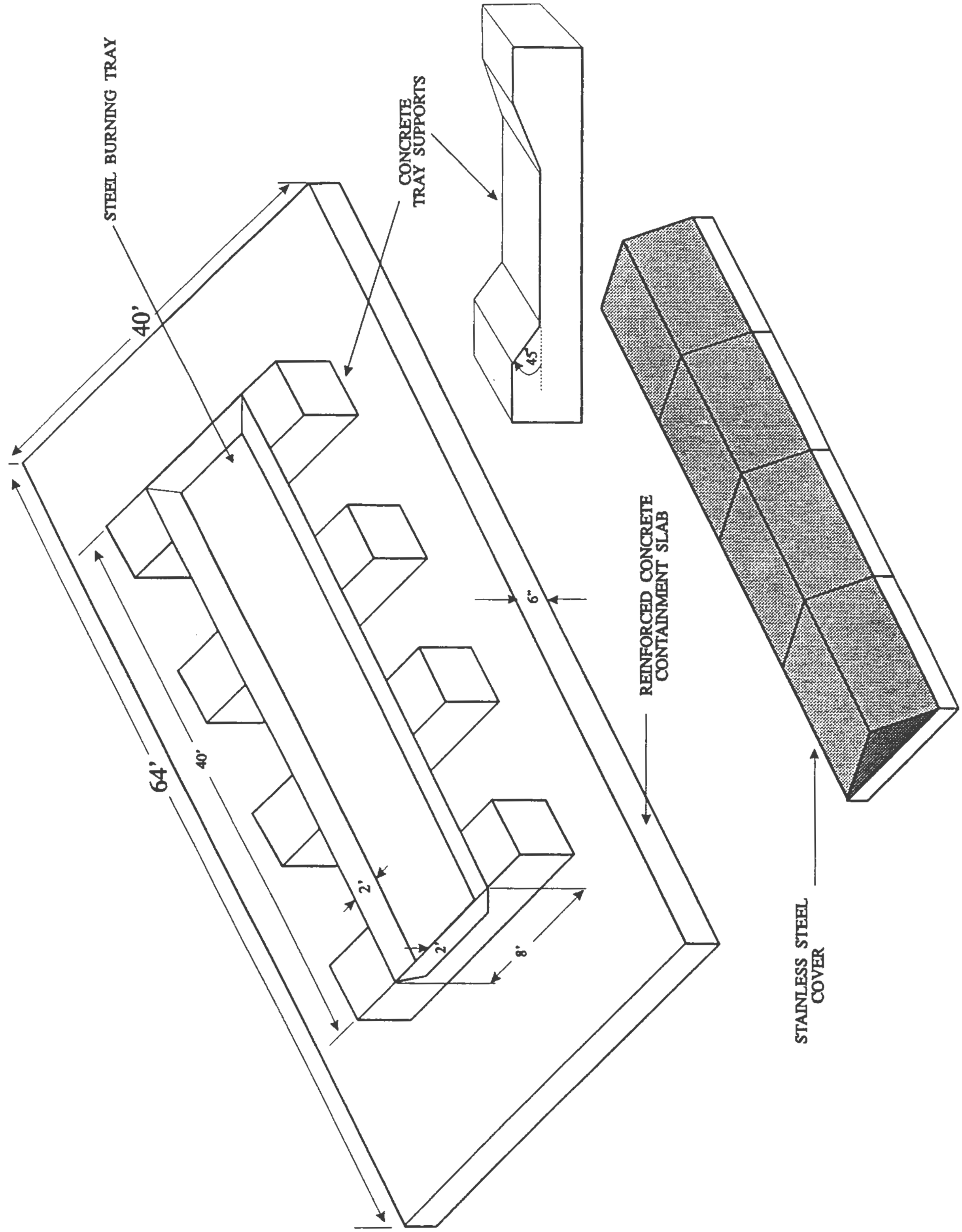


FIGURE D-1 BURN TRAY CONSTRUCTION DETAILS

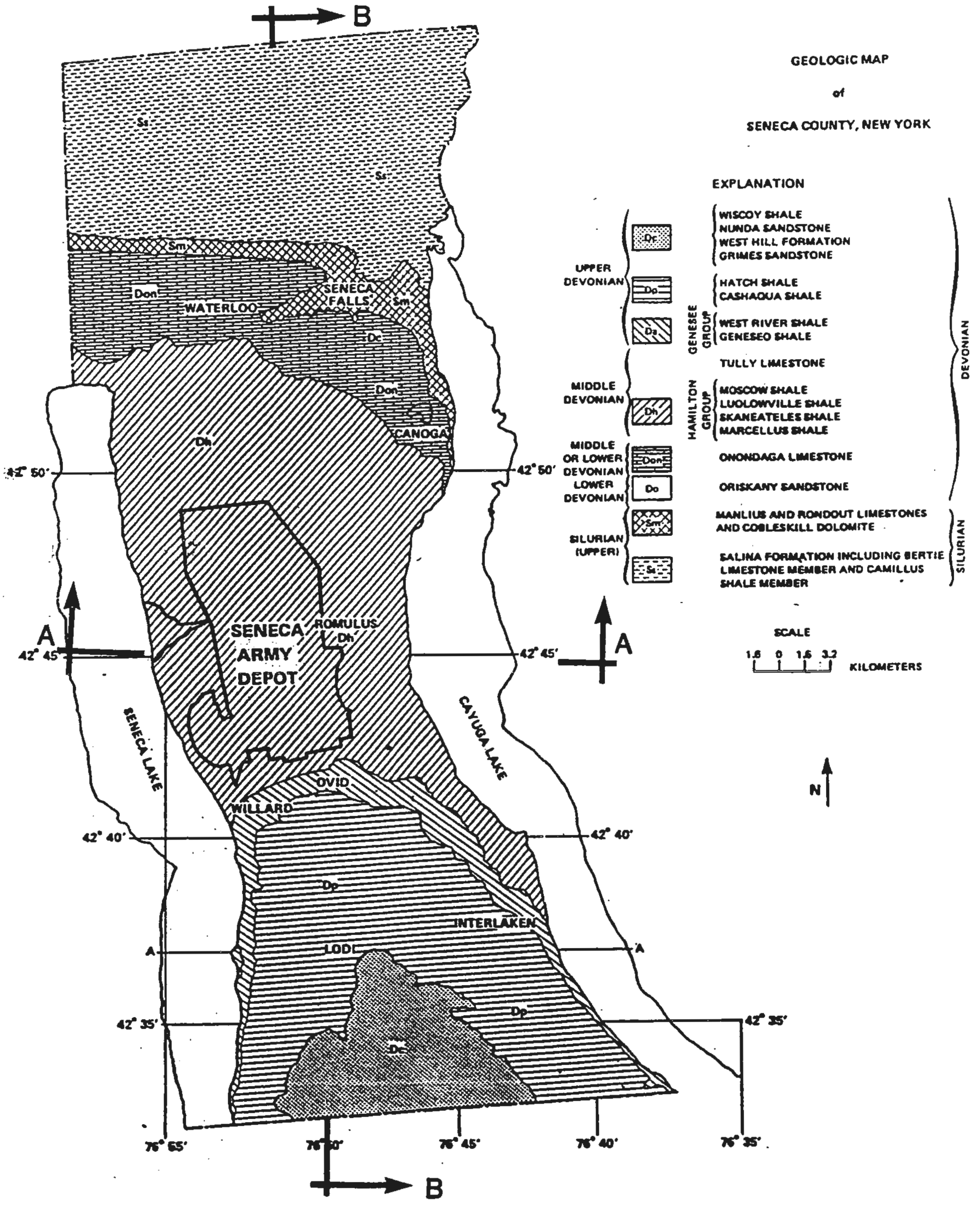


FIGURE D-2 REGIONAL GEOLOGY MAP

MESOZOIC

Lower Cretaceous

MESOZOIC INTRUSIVES

Kimberlite and alnoite dikes and diatremes.

PALEOZOIC

Upper Devonian

CONNEAUT GROUP
600-1000 ft. (180-300 m.)

Germania Formation—shale, sandstone; Whitesville Formation—shale, sandstone; Hinsdale Sandstone; Wellsville Formation—shale, sandstone; Cuba Sandstone.

CANADAWAY GROUP
800-1200 ft. (240-370 m.)

Machias Formation—shale, siltstone; Rushford Sandstone; Caneadea, Canisteo, and Hume Shales; Canaseraga Sandstone; South Wales and Dunkirk Shales; In Pennsylvania: Towanda Formation—shale, sandstone.

JAVA GROUP
300-700 ft. (90-210 m.)

Wiscoy Formation—sandstone, shale; Hanover and Pipe Creek Shales.

WEST FALLS GROUP
1100-1600 ft. (340-490 m.)

Nunda Formation—sandstone, shale.

West Hill and Gardeau Formations—shale, siltstone; Rorlcks Glen Shale; upper Beers Hill Shale; Grimes Siltstone.

lower Beers Hill Shale; Dunn Hill, Millport, and Moreland Shales.

Nunda Formation—sandstone, shale; West Hill Formation—shale, siltstone; Corning Shale.

"New Milford" Formation—sandstone, shale.

Gardeau Formation—shale,. siltstone; Roricks Glen Shale.

Slide Mountain Formation—sandstone, shale, conglomerate.

Beers Hill Shale; Grimes Siltstone; Dunn Hill, Millport, and Moreland Shales

SONYEA GROUP
200-1000 ft. (60-300 m.)

In west: Cashaqua and Middlesex Shales.

In east: Rye Point Shale; Rock Stream ("Enfield") Siltstone; Pulteney, Sawmill Creek, Johns Creek, and Montour Shales.

GENESEE GROUP AND TULLY LIMESTONE
200-1000 ft. (60-300 m.)

West River Shale; Genundewa Limestone; Penn Yan and Geneseo Shales; all except Geneseo replaced eastwardly by Ithaca Formation—shale, siltstone and Sherburne Siltstone.

Middle Devonian

Oneonta Formation—shale, sandstone.

Unadilla Formation—shale, siltstone.

Tully Limestone.

HAMILTON GROUP
600-1500 ft. (180-460 m.)

Moscow Formation—In west: Windom and Kashong Shales, Menteth Limestone Members; In east: Cooperstown Shale Member, Portland Point Limestone Member.

Ludlowville Formation—In west: Deep Run Shale, Tichenor Limestone, Wanakah and Ledyard Shale Members, Centerfield Limestone Member. In east: King Ferry Shale and other members, Stone Mill Sandstone Member.

Skaneateles Formation—In west: Levanna Shale and Stafford Limestone Members; In east: Butternut, Pompey, and Delphi Station Shale Members, Mottville Sandstone Member.

Marcellus Formation—In west: Oakta Creek Shale Member; In east: Cardiff and Chittenango Shale Members, Cherry Valley Limestone and Union Springs Shale Members.

Panther Mountain Formation—shale, siltstone, sandstone.

ONONDAGA LIMESTONE AND ORISKANY SANDSTONE
75-150 ft. (23-45 m.)

Onondaga Limestone—Seneca, Morehouse (cherty) and Nedrow Limestone Members, Edgecliff cherty Limestone Member, local bioherms.

Lower Devonian

Oriskany Sandstone.

HELDERBERG GROUP
0-200 ft. (0-60 m.)

Coeymans and Manlius Limestones; Rondout Dolostone.

Upper Silurian

AKRON DOLOSTONE, COBLESKILL LIMESTONE, AND SALINA GROUP
700-1000 ft. (210-300 m.)

Akron Dolostone; Bertie Formation—dolostone, shale.

Camillus and Syracuse Formations—shale, dolostone, gypsum, salt.

Cobleskill Limestone; Bertie and Camillus Formations—dolostone, shale.

Syracuse Formation—dolostone, shale, gypsum, salt.

Vernon Formation—shale, dolostone.

LOCKPORT GROUP
80-175 ft. (25-55 m.)

Oak Orchard and Penfield Dolostones, both replaced eastwardly by Sconondoa Formation—limestone. dolostone.

CLINTON GROUP
150-325 ft. ~~(40-100 m.)~~

Decew Dolostone; Rochester Shale.

Lower Silurian

Irondequoit Limestone; Williamson Shale; Wolcott Furnace Hematite; Wolcott Limestone; Sodus Shale; Bear Creek Shale; Wallington Limestone; Furnaceville Hematite; Maplewood Shale; Kodak Sandstone. Herkimer Sandstone; Kirkland Hematite; Willowvale Shale; Westmoreland Hematite; Sauquoit Formation—sandstone, shale; Oneida Conglomerate.

MEDINA GROUP AND QUEENSTON FORMATION
0-900 ft. (0-270 m.)

Medina Group: Grimbsy Formation—sandstone, shale.

Queenston Formation—shale, siltstone.

Upper Ordovician

Undifferentiated Medina Group and Queenston Formation.

LORRAINE GROUP
700-900 ft. (210-270 m.)

Oswego Sandstone.

Pulaski and Whetstone Gulf Formations—siltstone, shale.

TRENTON GROUP
100-300 ft. (30-90 m.)

Middle Ordovician

Utica Shale.

Hamilton group	Moscow shale	43±	Lower two-thirds of section is a fossiliferous, soft gray calcareous shale; upper third highly friable but less calcareous and fossiliferous. Staining by iron oxide very common. Concretions present in greater abundance in lower beds, but irregular calcareous masses occur throughout section. Joints parallel, tightly sealed, trending N.65°E. and N.25°-30°W.
	Ludlowville shale	43±	Lower beds are thinly laminated, light-colored, fossiliferous, shaly passage beds; overlain by hard calcareous black shales 13 to 30 centimeters thick and rich in corals and brachiopods; hard layers responsible for falls and cascades. Middle beds are less fossiliferous, soft gray arenaceous shales, rich in concretions, calcareous lenses, and occasional thin sandstone layers. Upper beds (Tichenor limestone member) are thin, irregularly bedded gray shales becoming light blue gray upon exposure, calcareous, coarsely textured, and fossiliferous. Joints parallel 5 to 50 centimeters apart, well developed but tight.
	Skaneateles shale	56±	Basal beds composed of dark fissile shale. Upper shale more calcareous, grayish to bluish impure limestone layers. Joint pattern N.75°E. and N.30°W.; diagonal joints N.50°E. Joints sealed, parallel and spaced 15 centimeters to 1.2 meters apart.
	Marcellus shale	15	Black, slatelike, bituminous shale with occasional limestone layers in sequence, and containing zones rich in iron sulfides or calcareous concretions, often with septarian structures; very fissile, iron-stained and gray when weathered. Joint pattern N.25°W., N.65°E., 2.5 centimeters to 1.2 meters apart.

SOURCE: RICKARD AND FISHER
GEOLOGIC MAP OF NEW YORK,
FINGER LAKES SHEET,1970

SENECA ARMY DEPOT, ROMULUS, NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

BEDROCK STRATIGRAPHIC COLUMN

APRIL 1992

MAIN

FIGURE D-3

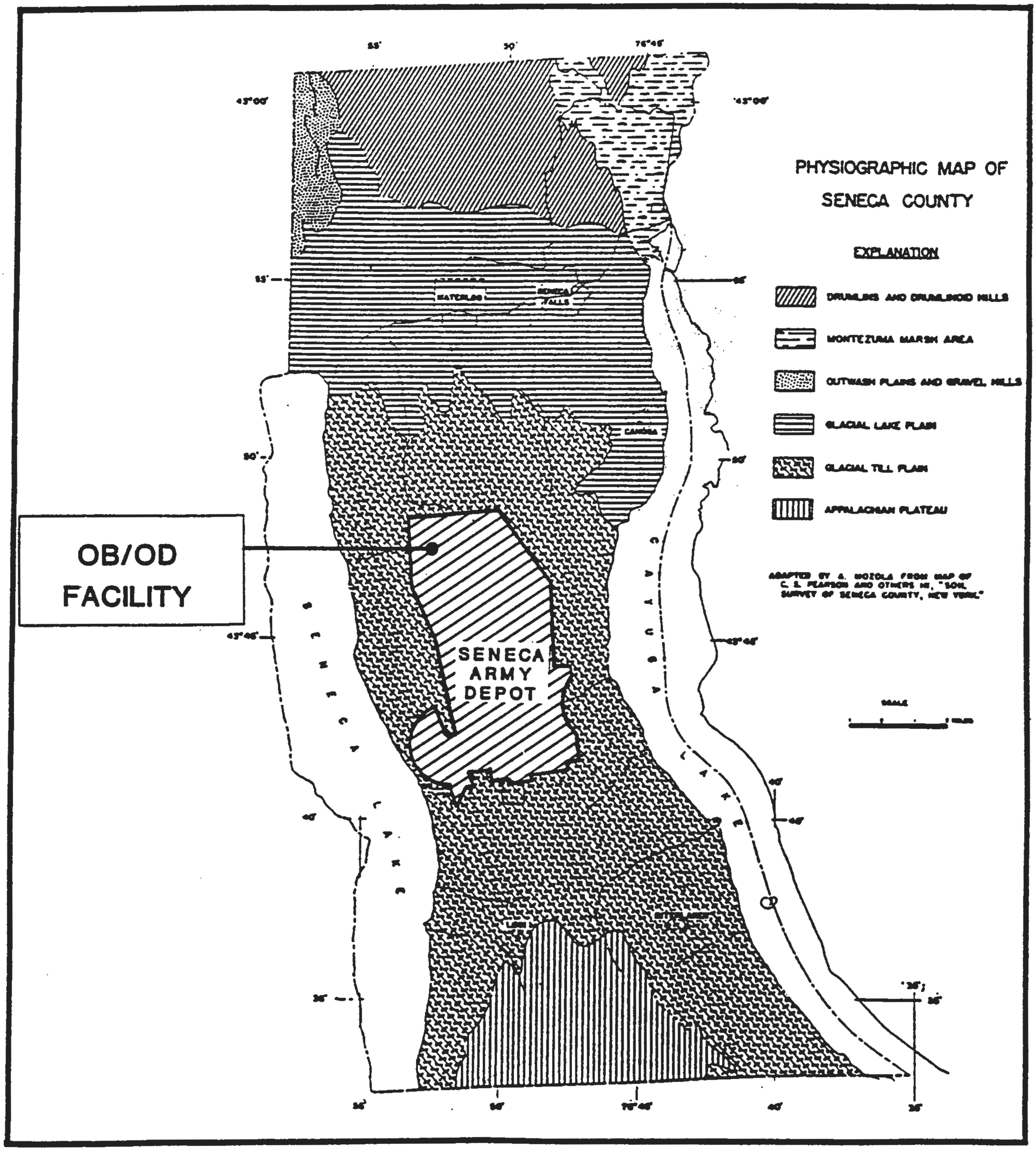
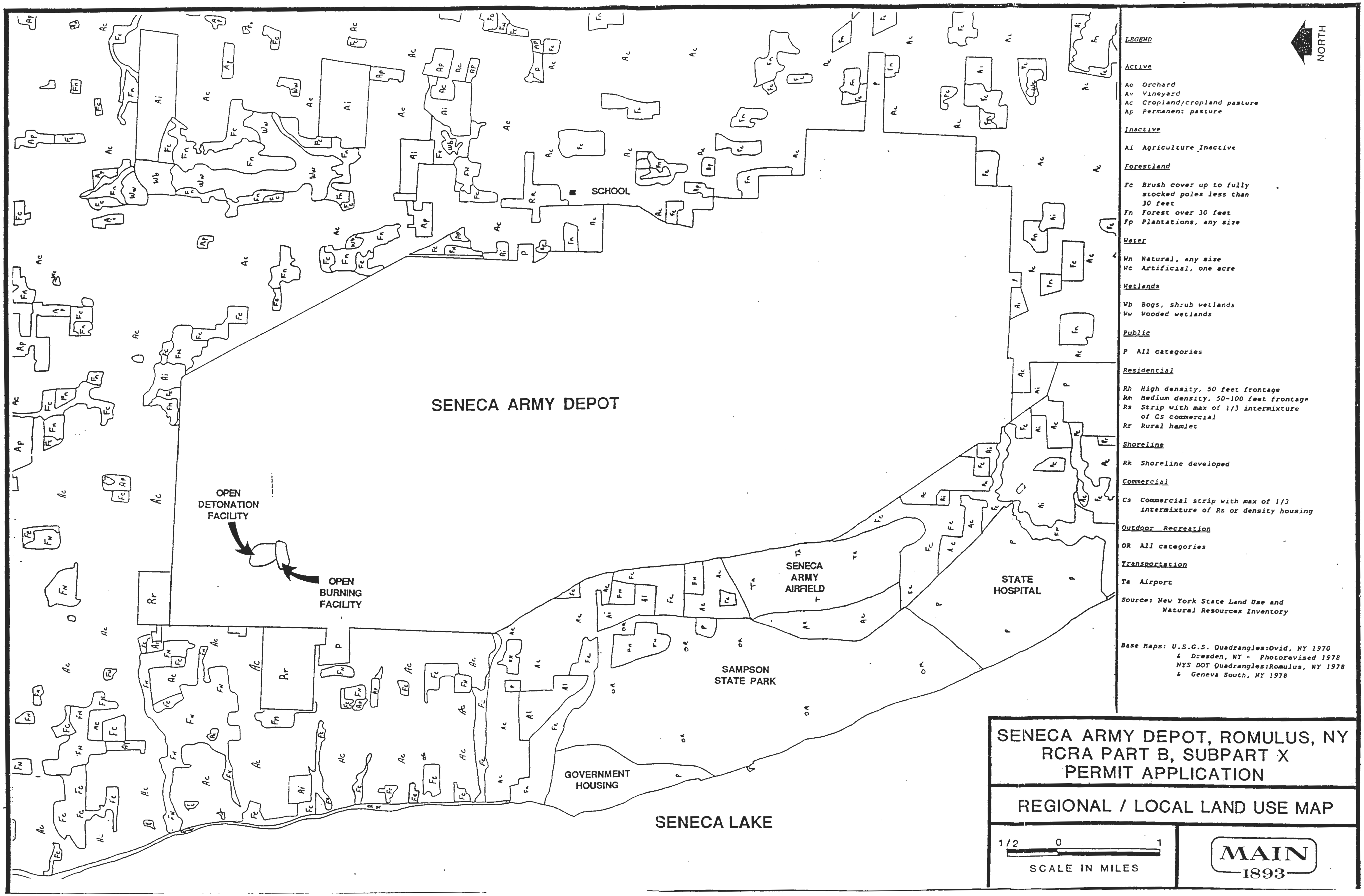


FIGURE D-4 PHYSIOGRAPHIC MAP OF SENECA COUNTY

FIGURE D-10



LEGEND

Active

Ao	Orchard
Av	Vineyard
Ac	Cropland/cropland pasture
Ap	Permanent pasture

Inactive

Ai	Agriculture Inactive

Forestland

Fc	Brush cover up to fully stocked poles less than 30 feet
Fn	Forest over 30 feet
Fp	Plantations, any size

Water

Wn	Natural, any size
Wc	Artificial, one acre

Wetlands

Wb	Bogs, shrub wetlands
Ww	Wooded wetlands

Public

P	All categories

Residential

Rh	High density, 50 feet frontage
Rm	Medium density, 50-100 feet frontage
Rs	Strip with max of 1/3 intermixture of Cs commercial
Rr	Rural hamlet

Shoreline

Rk	Shoreline developed

Commercial

Cs	Commercial strip with max of 1/3 intermixture of Rs or density housing

Outdoor Recreation

OR	All categories

Transportation

Ta	Airport

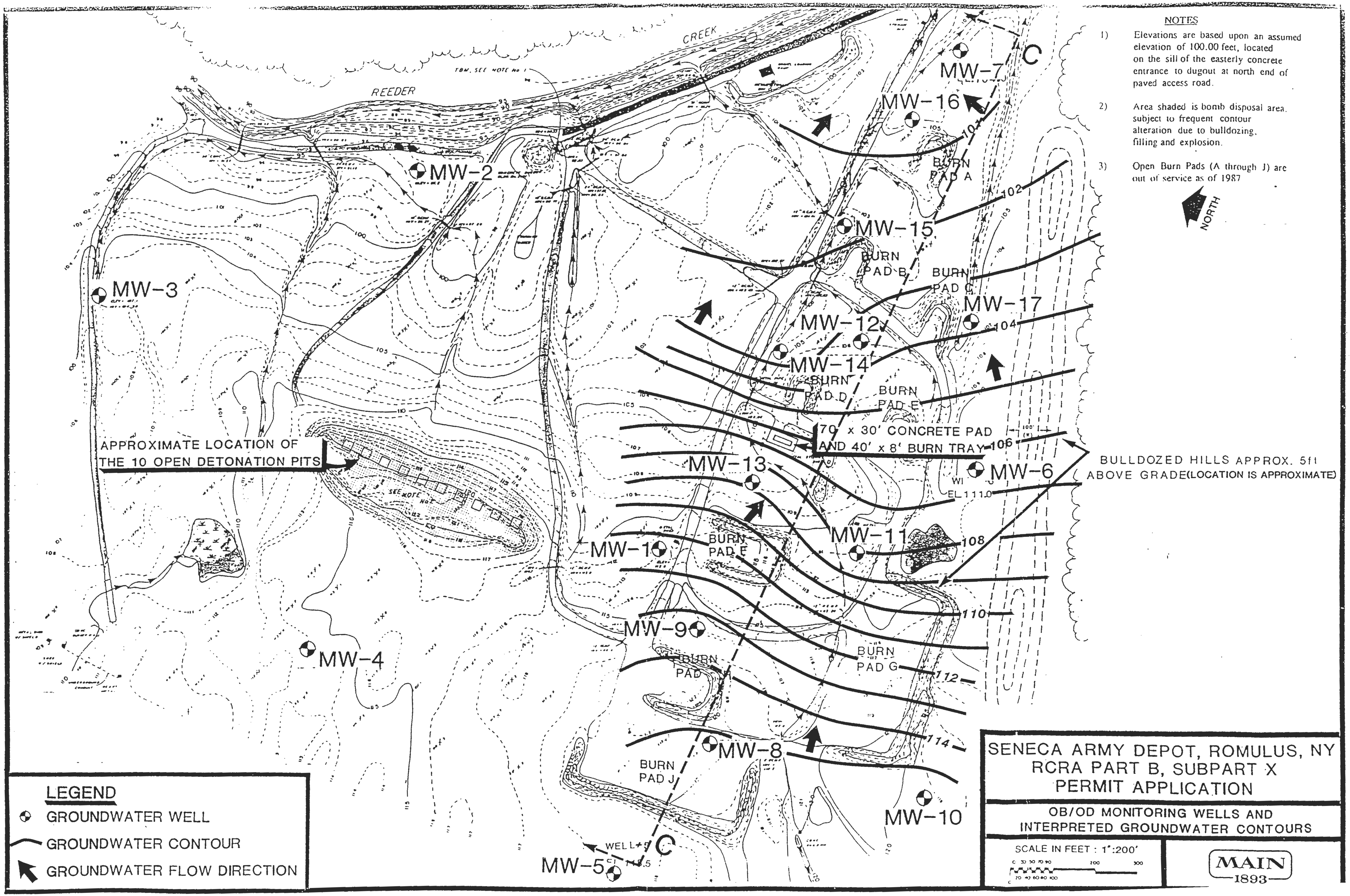
Source: New York State Land Use and Natural Resources Inventory

Base Maps: U.S.G.S. Quadrangles:Ovid, NY 1970
& Dresden, NY - Photorevised 1978
NYS DOT Quadrangles:Romulus, NY 1978
& Geneva South, NY 1978

SENECA ARMY DEPOT, ROMULUS, NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

REGIONAL / LOCAL LAND USE MAP

MAIN
1893



NOTES

1) Elevations are based upon an assumed elevation of 100.00 feet, located on the sill of the easterly concrete entrance to dugout at north end of paved access road.

2) Area shaded is bomb disposal area, subject to frequent contour alteration due to bulldozing, filling and explosion.

3) Open Burn Pads (A through J) are out of service as of 1987

LEGEND

- GROUNDWATER WELL
- GROUNDWATER CONTOUR
- GROUNDWATER FLOW DIRECTION

SENECA ARMY DEPOT, ROMULUS, NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

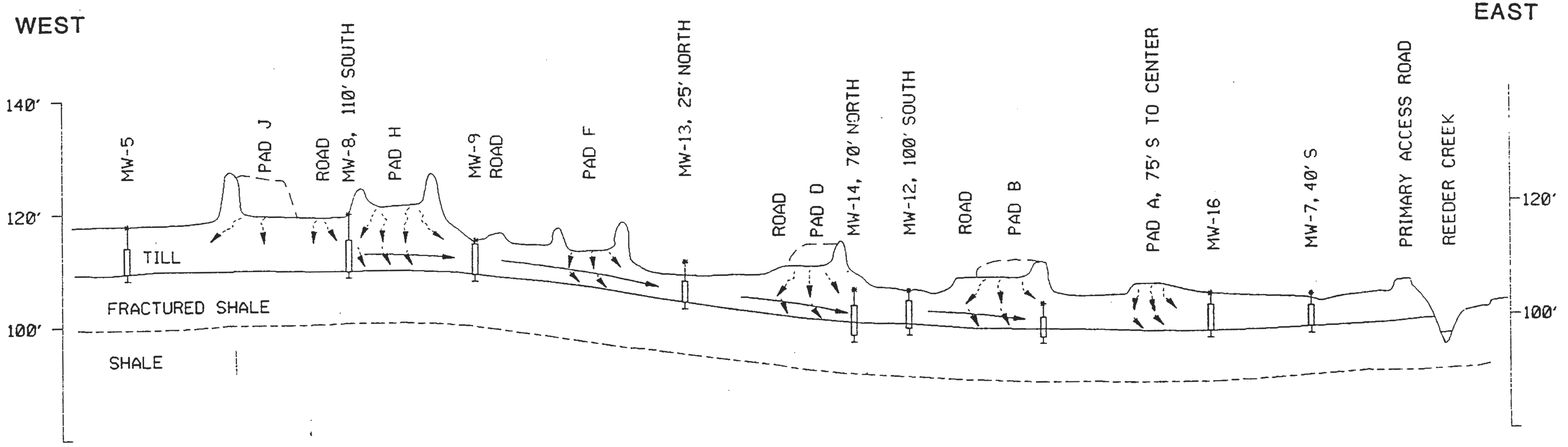
OB/OD MONITORING WELLS AND
INTERPRETED GROUNDWATER CONTOURS

LOOKING NORTH
ELEVATIONS BASED ON ASSUMED 100′ ELEVATION
FOR POINT ESTABLISHED BY TRIPI AND ASSOCIATES
JUNE, 1981, ON CONTOUR MAP PREPARED FOR SEAD.

PREPARED BY C.R. LIPPITT, CPG, OCT. 31, 1990

LEGEND:

- DIRECTION OF SURFACE WATER FLOW
- PERCOLATION OF SURFACE WATER
- MONITOR WELL TOP
- SCREENED ZONE
- BOTTOM



SECTION C–C′ LOOKING NORTH
(refer to Figure D–9 for cross-section location)

(VERTICLE EXAGGERATION: 10X)

SENECA ARMY DEPOT, ROMULUS, NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

OB AREA CROSS-SECTION, C–C′

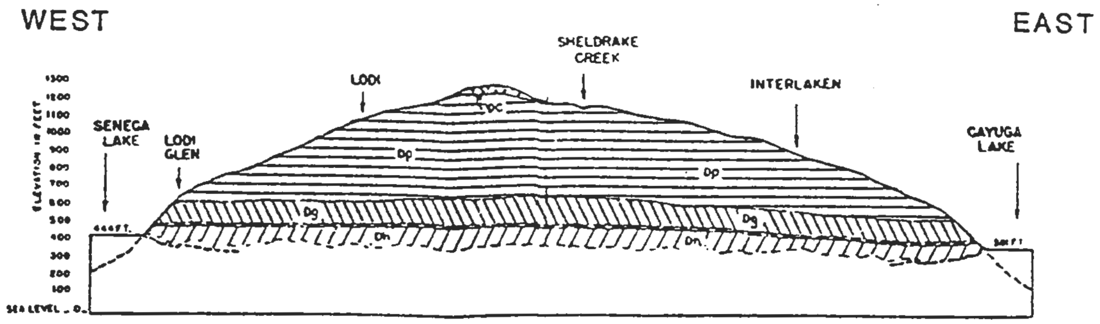
SCALE IN FEET
100 0 100 200

MAIN
1893

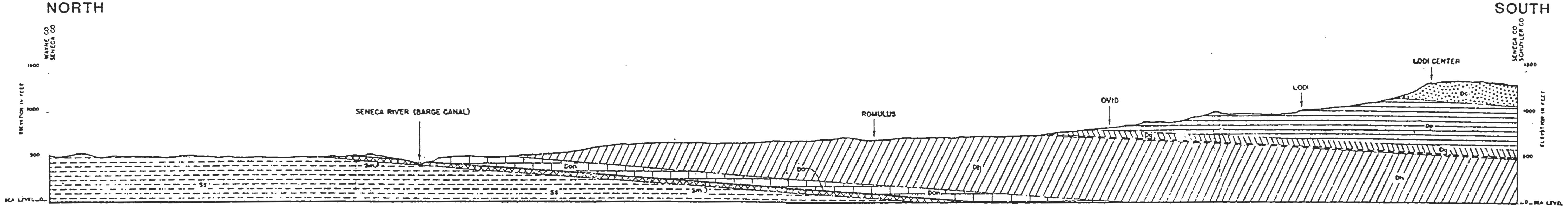
UNITED STATES GEOLOGICAL SURVEY

NEW YORK WATER POWER AND CONTROL COMMISSION

GEOLOGIC SECTIONS ACROSS SENECA COUNTY, NEW YORK



EAST-WEST SECTION ALONG LINE A-A' SHOWN ON FIGURE D-2



NORTH-SOUTH SECTION ALONG LONGITUDE 76°50' LINE B-B' ON FIGURE D-2

EXPLANATION

WISCOY SHALE
NUNDA SANDSTONE
WEST HILL FORMATION
GRIMES SANDSTONE
HATCH SHALE
CASHAQUA SHALE
WEST RIVER SHALE
GENESEO SHALE
DEVONIAN

MIDDLE DEVONIAN
TULLY LIMESTONE
Dh HAMILTON GROUP
MOSCOW SHALE
LUDLOWVILLE SHALE
SKANEATELES SHALE
MARCELLUS SHALE

MIDDLE OR LOWER DEVONIAN
Don ONONDAGA LIMESTONE

LOWER DEVONIAN
Do ORISKANY SANDSTONE
DEVONIAN

SILURIAN (UPPER)
Sm MANLIUS AND RONDOUT LIMESTONES AND COBLESKILL DOLOMITE
Ss SALINA FORMATION INCLUDING BERTIE LIMESTONE MEMBER AND CAMILLUS SHALE MEMBER
SILURIAN

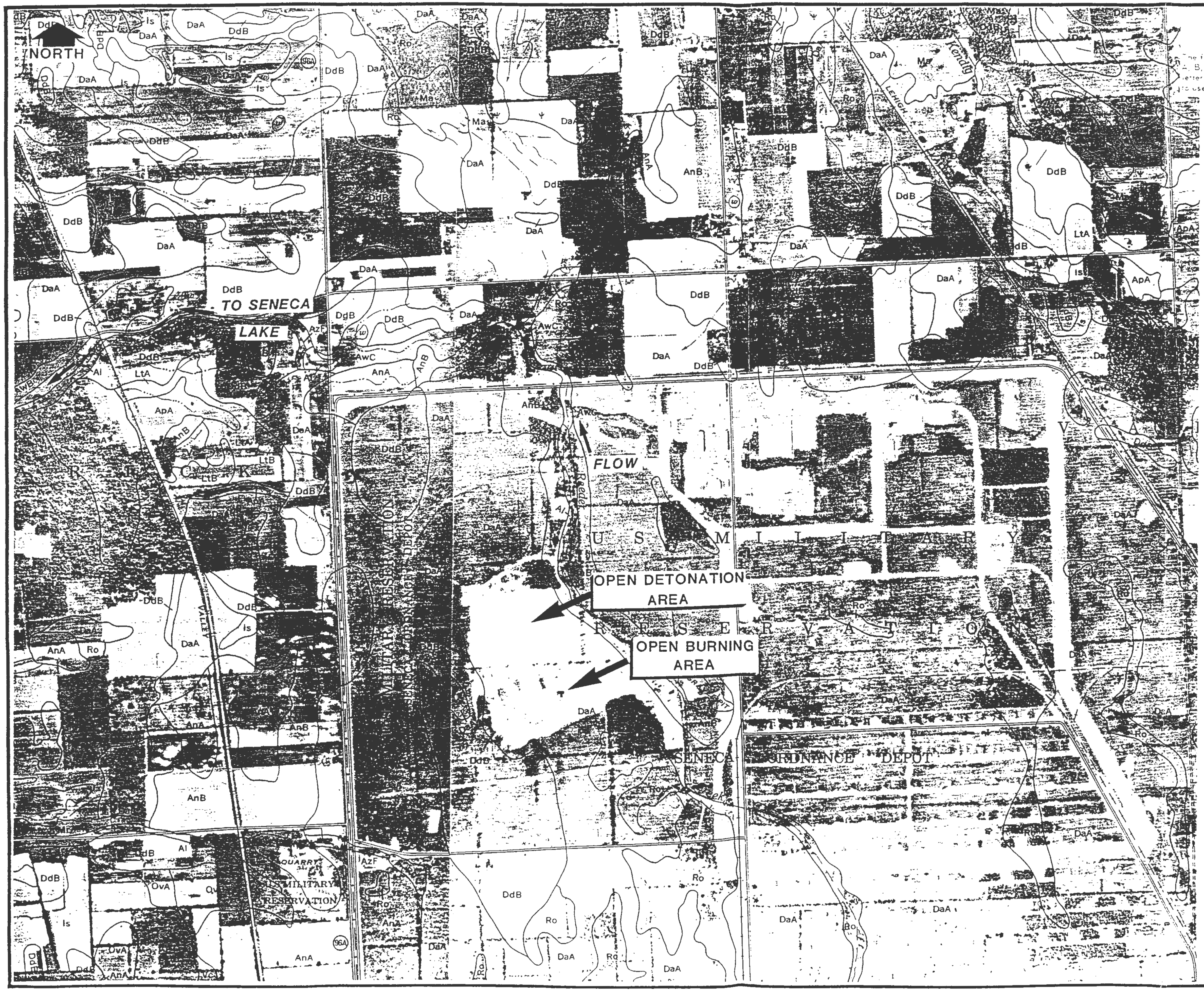
SENECA ARMY DEPOT, ROMULUS, NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

REGIONAL GEOLOGY CROSS SECTIONS

SCALE
1 0 1 2 3 MILES

MAIN
1893

FIGURE D-6



SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, is a general guide to the slope class. Symbols without a slope letter are for those miscellaneous land types or soils where slope is not significant to use and management. A final number, 3, in the symbol shows that the soil is eroded.

SYMBOL	NAME
Ac	Alden mucky silt loam
Ad	Alden mucky silt loam, till substratum
Al	Alluvial land
AnA	Angola silt loam, 0 to 3 percent slopes
AnB	Angola silt loam, 3 to 8 percent slopes
AoA	Appleton gravelly silt loam, 0 to 3 percent slopes
AoB	Appleton gravelly silt loam, 3 to 8 percent slopes
ApA	Appleton silt loam, 0 to 3 percent slopes
ApB	Appleton silt loam, 3 to 8 percent slopes
ArB	Arkport loamy fine sand, 1 to 6 percent slopes
ArC	Arkport loamy fine sand, 6 to 12 percent slopes
ArD	Arkport loamy fine sand, 12 to 20 percent slopes
AuD	Arnot channery silt loam, 15 to 25 percent slopes
AwB	Aurora silt loam, 3 to 8 percent slopes
AwC	Aurora silt loam, 8 to 15 percent slopes
AwD	Aurora silt loam, 15 to 25 percent slopes
AzF	Aurora and Farmington soils, 25 to 75 percent slopes
Co	Canandaigua silt loam
CeB	Cazenovia silt loam, 3 to 8 percent slopes
CeB3	Cazenovia silt loam, 3 to 8 percent slopes, eroded
CeC	Cazenovia silt loam, 8 to 15 percent slopes
CeC3	Cazenovia silt loam, 8 to 15 percent slopes, eroded
ChD	Cazenovia soils, 15 to 25 percent slopes
ChE	Cazenovia soils, 25 to 40 percent slopes
CkA	Claverack loamy fine sand, 0 to 2 percent slopes
CkB	Claverack loamy fine sand, 2 to 6 percent slopes
ClA	Collamer silt loam, 0 to 2 percent slopes
ClB	Collamer silt loam, 2 to 6 percent slopes
ClC	Collamer silt loam, 6 to 12 percent slopes
CoA	Collamer silt loam, moderately shallow variant, 0 to 2 percent slopes
CoB	Collamer silt loam, moderately shallow variant, 2 to 6 percent slopes
CsA	Conesus gravelly silt loam, 0 to 3 percent slopes
CsB	Conesus gravelly silt loam, 3 to 8 percent slopes
Cu	Cosad loamy fine sand
DaA	Darien silt loam, 0 to 3 percent slopes
DdB	Darien-Danley-Cazenovia silt looms, 3 to 8 percent slopes
DuB	Dunkirk silt loam, 1 to 6 percent slopes
DuC3	Dunkirk silt loam, 6 to 12 percent slopes, eroded
DuD	Dunkirk silt loam, 12 to 20 percent slopes
DwB	Dunkirk silt loam, limestone substratum, 1 to 6 percent slopes

SOURCE:
U.S. DEPT. OF AGRICULTURE SOIL SURVEY,
SENECA COUNTY, NEW YORK
APRIL, 1972

SENECA ARMY DEPOT
RCRA PART B, SUBPART X
PERMIT APPLICATION

SURFICIAL SOIL MAP
FOR OB/OD GROUNDS

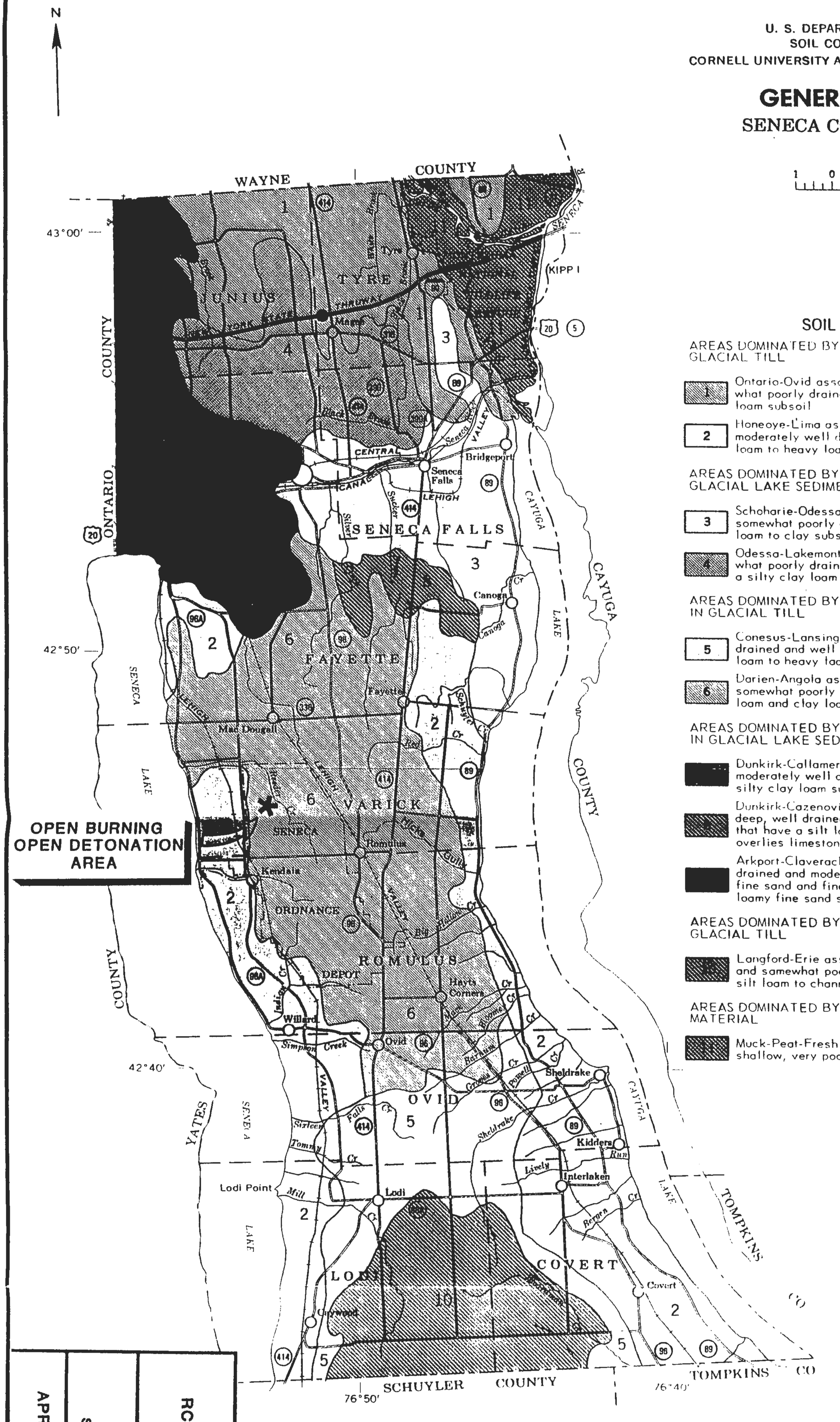
APRIL 1992

MAIN
1893

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
CORNELL UNIVERSITY AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
SENECA COUNTY, NEW YORK

Scale 1:190,080
1 0 1 2 3 4 Miles



SOIL ASSOCIATIONS

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL TILL

1	Ontario-Ovid association: Deep, well-drained to somewhat poorly drained soils that have a loam to silty clay loam subsoil
2	Honeoye-Lima association: Deep, well drained and moderately well drained soils that have a heavy silt loam to heavy loam subsoil

AREAS DOMINATED BY HIGH-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

3	Schoharie-Odessa association: Deep, well-drained to somewhat poorly drained soils that have a silty clay loam to clay subsoil
4	Odessa-Lakemont association: Deep, dominantly somewhat poorly drained and poorly drained soils that have a silty clay loam to silty clay subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL TILL

5	Conesus-Lansing association: Deep, moderately well drained and well drained soils that have a heavy silt loam to heavy loam subsoil
6	Darien-Angola association: Deep and moderately deep, somewhat poorly drained soils that have a silty clay loam and clay loam subsoil

AREAS DOMINATED BY MEDIUM-LIME SOILS DEVELOPED IN GLACIAL LAKE SEDIMENTS

■	Dunkirk-Collamer association: Deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil
▨	Dunkirk-Cazenovia association: Moderately deep and deep, well drained and moderately well drained soils that have a silt loam to silty clay loam subsoil that overlies limestone
■	Arkport-Claverack association: Deep, dominantly well drained and moderately well drained soils that are loamy fine sand and fine sandy loam throughout or that have a loamy fine sand subsoil over silty clay or clay

AREAS DOMINATED BY LOW-LIME SOILS DEVELOPED IN GLACIAL TILL

▨	Langford-Erie association: Deep, moderately well drained and somewhat poorly drained soils that have a channery silt loam to channery loam fragipan

AREAS DOMINATED BY SOILS DEVELOPED IN ORGANIC MATERIAL

▨	Muck-Peat-Fresh Water Marsh association: Deep to shallow, very poorly drained organic soils

February 1971

NOTE—
This map is intended for general planning. Each delineation may contain soils having ratings different from those shown on the map. Use detailed soil maps for operational planning.

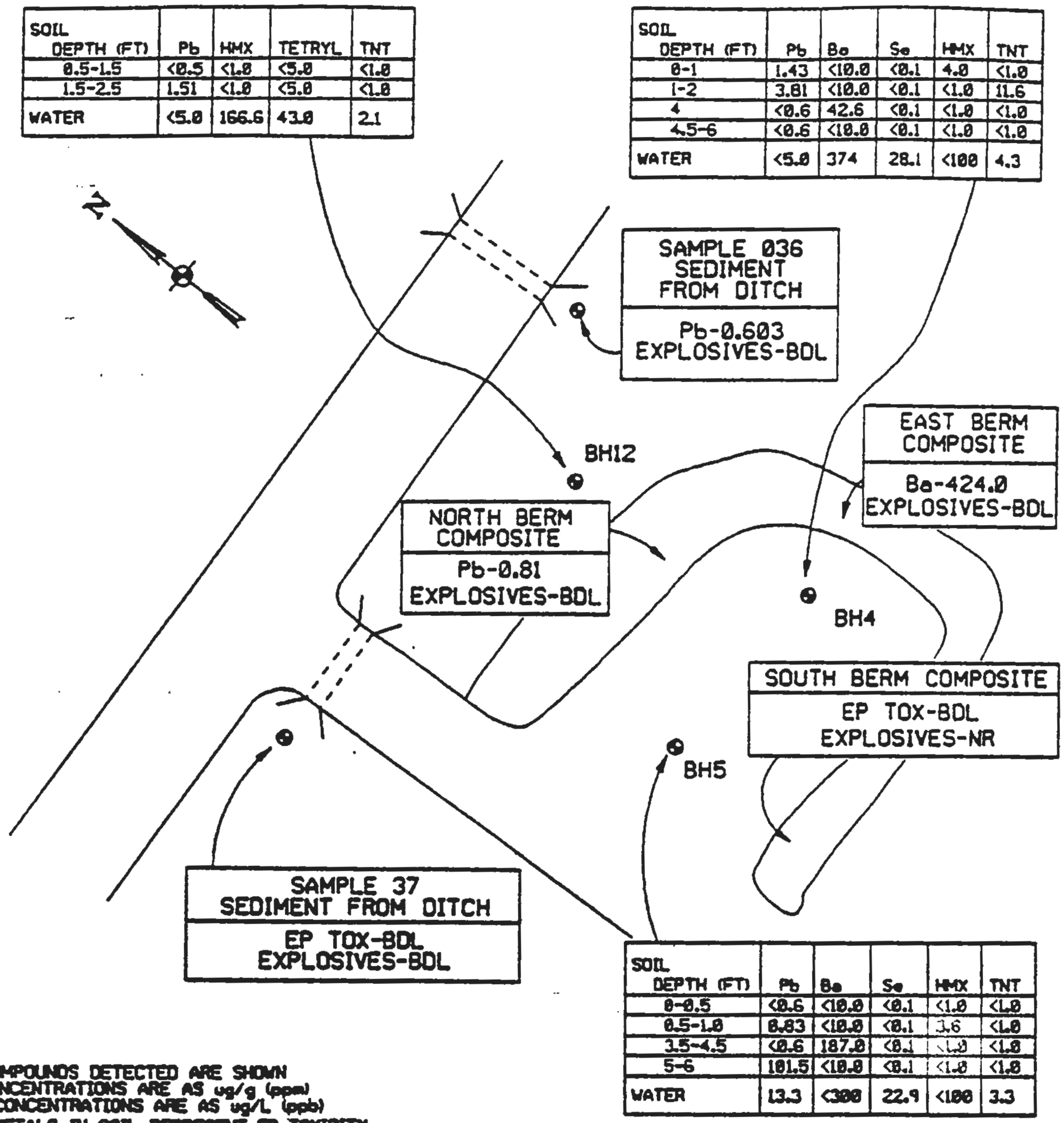
SENECA ARMY DEPOT
RCRA PART B, SUBPART X
PERMIT APPLICATION

GENERAL SOIL MAP
SENECA COUNTY, NEW YORK

APRIL 1992

MAIN
1893

FIGURE D-5



SOIL DEPTH (FT)	Pb	HMX	TETRYL	TNT
0.5-1.5	<0.5	<1.0	<5.0	<1.0
1.5-2.5	1.51	<1.0	<5.0	<1.0
WATER	<5.0	166.6	43.0	2.1

SOIL DEPTH (FT)	Pb	Ba	Se	HMX	TNT
0-1	1.43	<10.0	<0.1	4.0	<1.0
1-2	3.81	<10.0	<0.1	<1.0	11.6
4	<0.6	42.6	<0.1	<1.0	<1.0
4.5-6	<0.6	<10.0	<0.1	<1.0	<1.0
WATER	<5.0	374	28.1	<100	4.3

SOIL DEPTH (FT)	Pb	Ba	Se	HMX	TNT
0-0.5	<0.6	<10.0	<0.1	<1.0	<1.0
0.5-1.0	0.83	<10.0	<0.1	3.6	<1.0
3.5-4.5	<0.6	187.0	<0.1	<1.0	<1.0
5-6	101.5	<10.0	<0.1	<1.0	<1.0
WATER	13.3	<300	22.9	<100	3.3

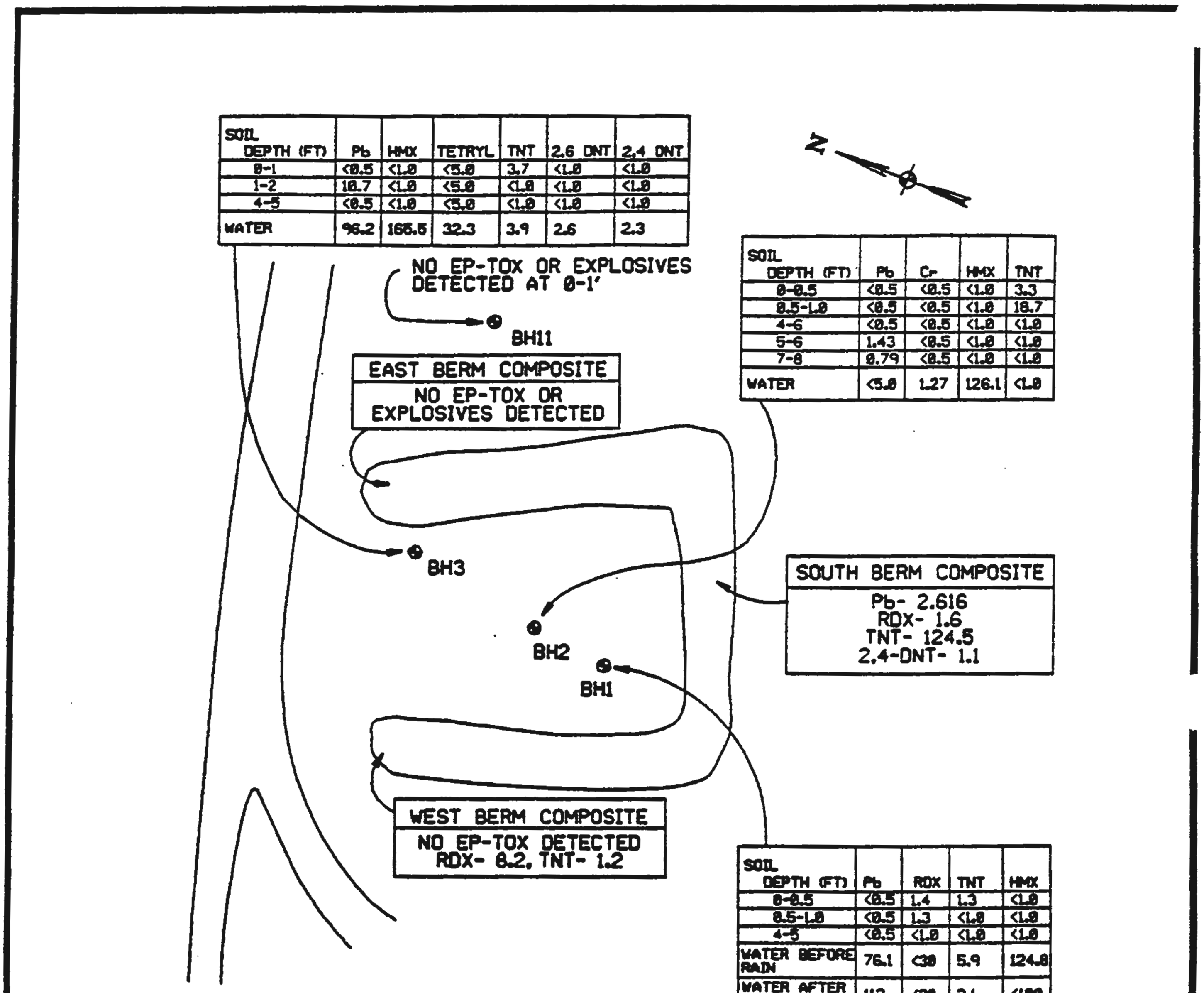
NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

FIGURE D-11 SOIL AND GROUND WATER DATA FROM BURNING PAD B



SOIL DEPTH (FT)	Pb	HMX	TETRYL	TNT	2,6 DNT	2,4 DNT
0-1	<0.5	<1.0	<5.0	3.7	<1.0	<1.0
1-2	10.7	<1.0	<5.0	<1.0	<1.0	<1.0
4-5	<0.5	<1.0	<5.0	<1.0	<1.0	<1.0
WATER	96.2	166.5	32.3	3.9	2.6	2.3

SOIL DEPTH (FT)	Pb	Cr	HMX	TNT
0-0.5	<0.5	<0.5	<1.0	3.3
0.5-1.0	<0.5	<0.5	<1.0	18.7
4-6	<0.5	<0.5	<1.0	<1.0
5-6	1.43	<0.5	<1.0	<1.0
7-8	0.79	<0.5	<1.0	<1.0
WATER	<5.0	1.27	126.1	<1.0

SOIL DEPTH (FT)	Pb	RDX	TNT	HMX
0-0.5	<0.5	1.4	1.3	<1.0
0.5-1.0	<0.5	1.3	<1.0	<1.0
4-5	<0.5	<1.0	<1.0	<1.0
WATER BEFORE RAIN	76.1	<30	5.9	124.8
WATER AFTER RAIN	112	<30	2.1	<100

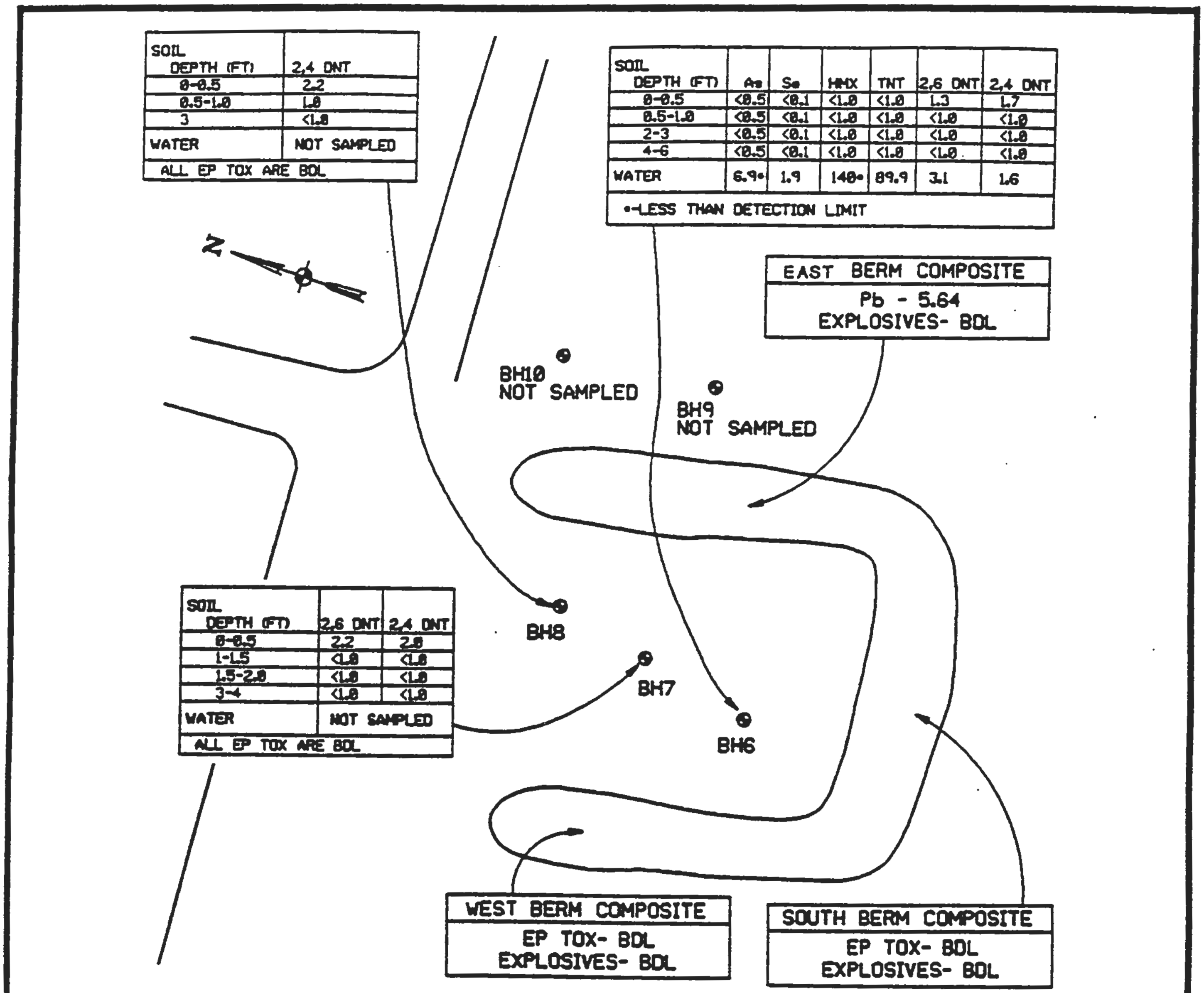
NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

FIGURE D-12 SOIL AND GROUND WATER DATA FROM BURNING PAD F



SOIL DEPTH (FT)	2,4 DNT
0-0.5	2.2
0.5-1.0	1.0
3	<1.0
WATER	NOT SAMPLED

ALL EP TOX ARE BDL

SOIL DEPTH (FT)	As	Se	HMX	TNT	2,6 DNT	2,4 DNT
0-0.5	<0.5	<0.1	<1.0	<1.0	1.3	1.7
0.5-1.0	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
2-3	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
4-6	<0.5	<0.1	<1.0	<1.0	<1.0	<1.0
WATER	6.9•	1.9	140•	89.9	3.1	1.6

•-LESS THAN DETECTION LIMIT

EAST BERM COMPOSITE
Pb - 5.64
EXPLOSIVES- BDL

SOIL DEPTH (FT)	2,6 DNT	2,4 DNT
0-0.5	2.2	2.0
1-1.5	<1.0	<1.0
1.5-2.0	<1.0	<1.0
3-4	<1.0	<1.0
WATER	NOT SAMPLED	

ALL EP TOX ARE BDL

WEST BERM COMPOSITE
EP TOX- BDL
EXPLOSIVES- BDL

SOUTH BERM COMPOSITE
EP TOX- BDL
EXPLOSIVES- BDL

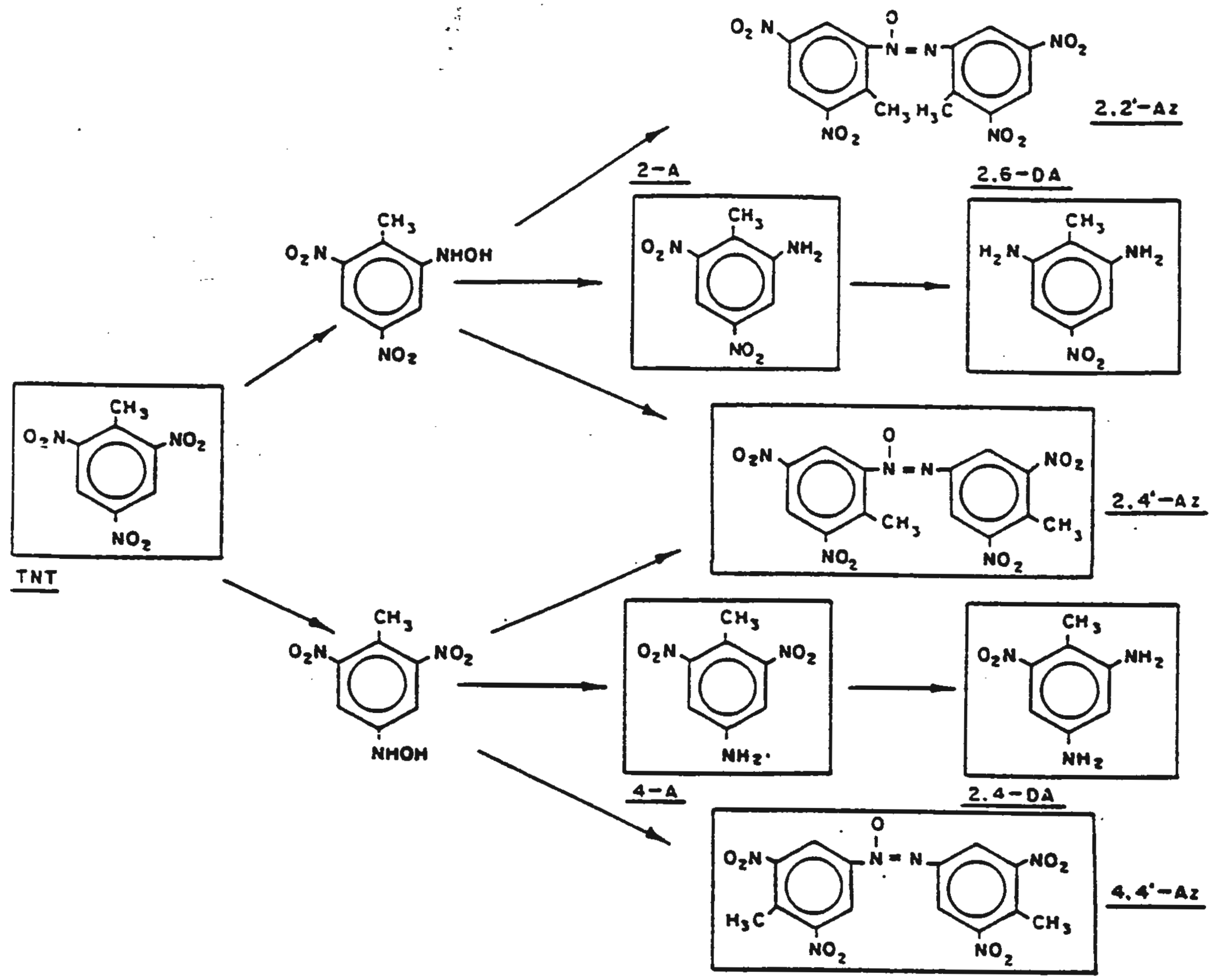
NOTES:

1. ONLY COMPOUNDS DETECTED ARE SHOWN
   SOIL CONCENTRATIONS ARE AS ug/g (ppm)
   WATER CONCENTRATIONS ARE AS ug/L (ppb)
2. HEAVY METALS IN SOIL REPRESENT EP TOXICITY CONCENTRATIONS
3. HEAVY METALS IN WATER ARE DISSOLVED (FILTERED SAMPLES)
4. WATER WAS OBTAINED FROM BOREHOLES USING TEMPORARY WELLS WHICH ARE CURRENTLY NON-EXISTANT
5. BDL - BELOW DETECTABLE LIMITS
6. NR - NOT REPORTED BY LABORATORY

REF: HAZARDOUS WASTE STUDY NO. 37-26-0479-85
PHASE 4 OF AMC OPEN BURNING/
OPEN-DETONATION GROUNDS
EVALUATION INVESTIGATION OF SOIL
CONTAMINATION AT THE OPEN BURNING GROUNDS

SENECA ARMY DEPOT, ROMULUS, NEW YORK
AUGUST 13-19, 1984.

FIGURE D-13 SOIL AND GROUND WATER DATA FROM BURNING PAD H



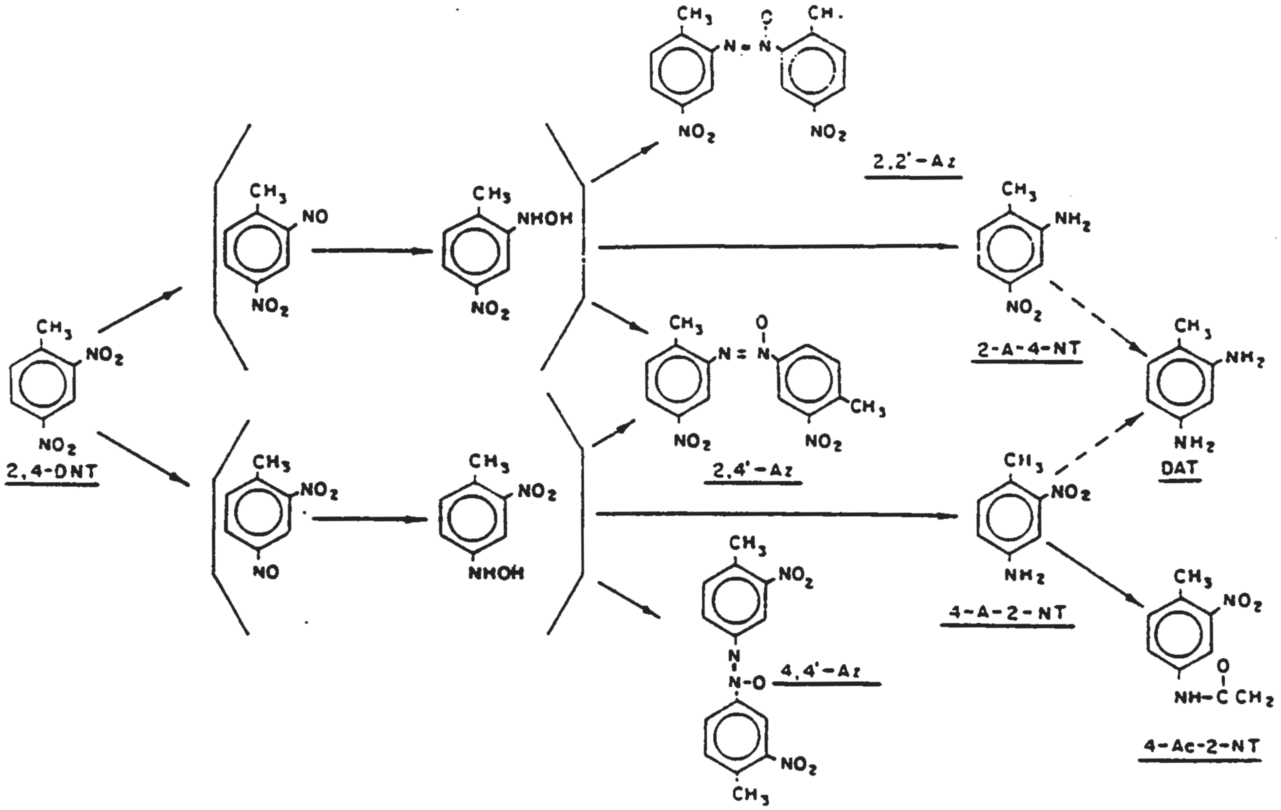
NOMENCLATURE:

2-A - 2-amino-4,6-dinitrotoluene
4-A - 4-amino-2,6-dinitrotoluene
2,2'-AZ - 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ - 2'4-dinitro2,4'-azoxytoluene
4,4'-AZ - 2,2'-dinitro-4,4'-azoxytoluene
2,6-DA - 2,6-diamino-4-nitrotoluene
2,4-DA - 2,4-diamino-6-nitrotoluene

SOURCE:

Special Report 90-2: Environmental Transformation Products of Nitroaromatics and Nitramines: Literature Review and Recommendations for Analytical Method Development; U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

FIGURE D-14 TRANSFORMATION PATHWAYS AND PRODUCTS FOR TNT



NOMENCLATURE:

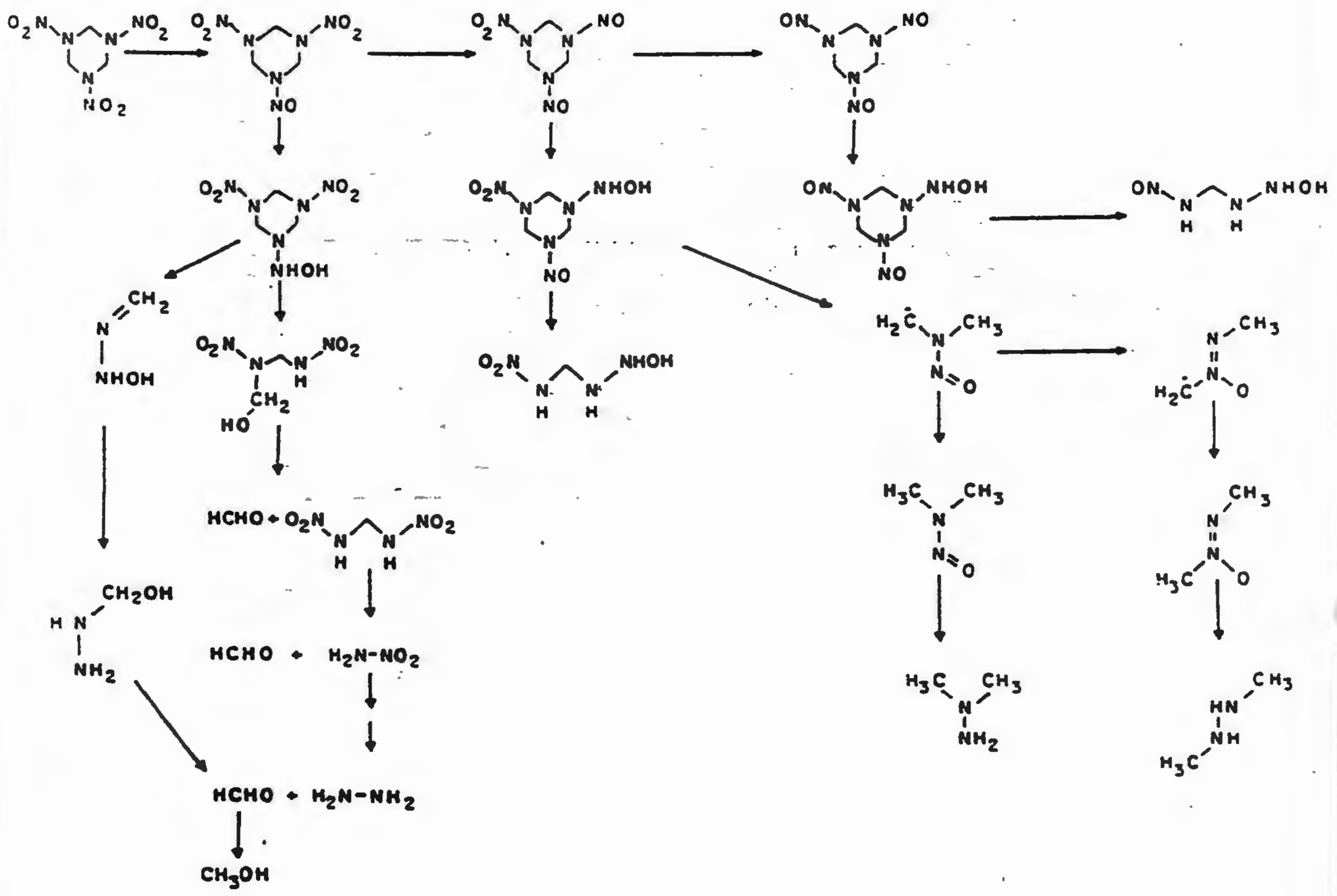
2,2'-AZ - 4,4'-dinitro-2,2'-azoxytoluene
2,4'-AZ - 2',4-dinitro-2,4'-azoxytoluene
4,4'-AZ - 2,2'-dinitro-4,4'-azoxytoluene
DAT - Diaminotoluene
2-A-4-NT - 2-amino-4-nitrotoluene
4-A-2-NT - 4-amino-2-nitrotoluene
4-AC-2-NT - 4-acetamide-2-nitrotoluene

SOURCE:

Special Report 90-2: Environmental Transformation Products of Nitroaromatics and Nitramines: Literature Review and Recommendations for Analytical Method Development;

U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

FIGURE D-15 TRANSFORMATION PATHWAYS AND PRODUCTS FOR 2,4-DNT



SOURCE:
Special Report 90-2; Environmental Transformation Products of Nitroaromatics and Nitramines; Literature Review and Recommendations for Analytical Method Development;
U.S. Army Corps of Engineers, Cold Regions Research and Engineering Laboratory, Feb. 1990

FIGURE D-16 TRANSFORMATION PATHWAYS AND PRODUCTS FOR RDX

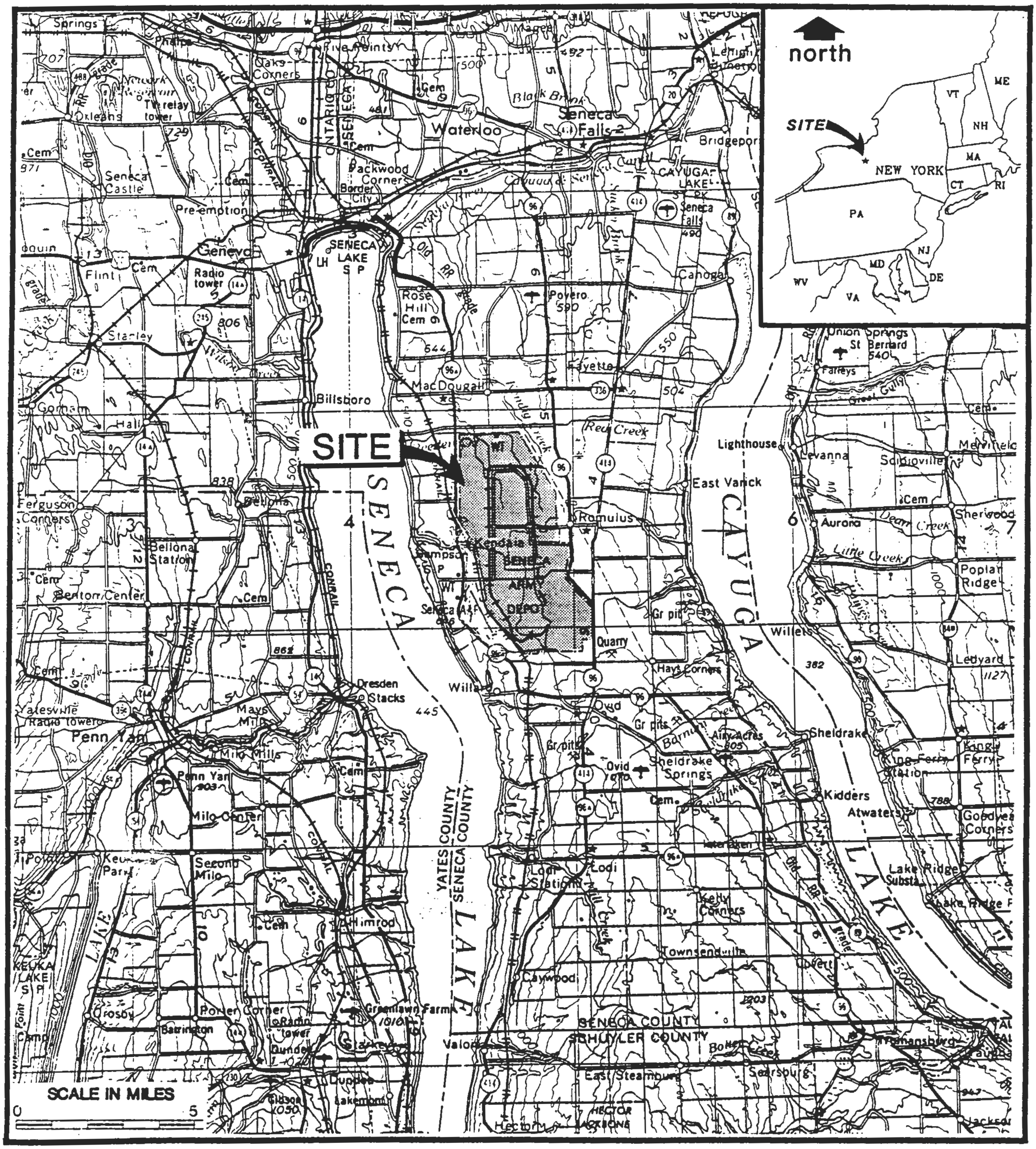
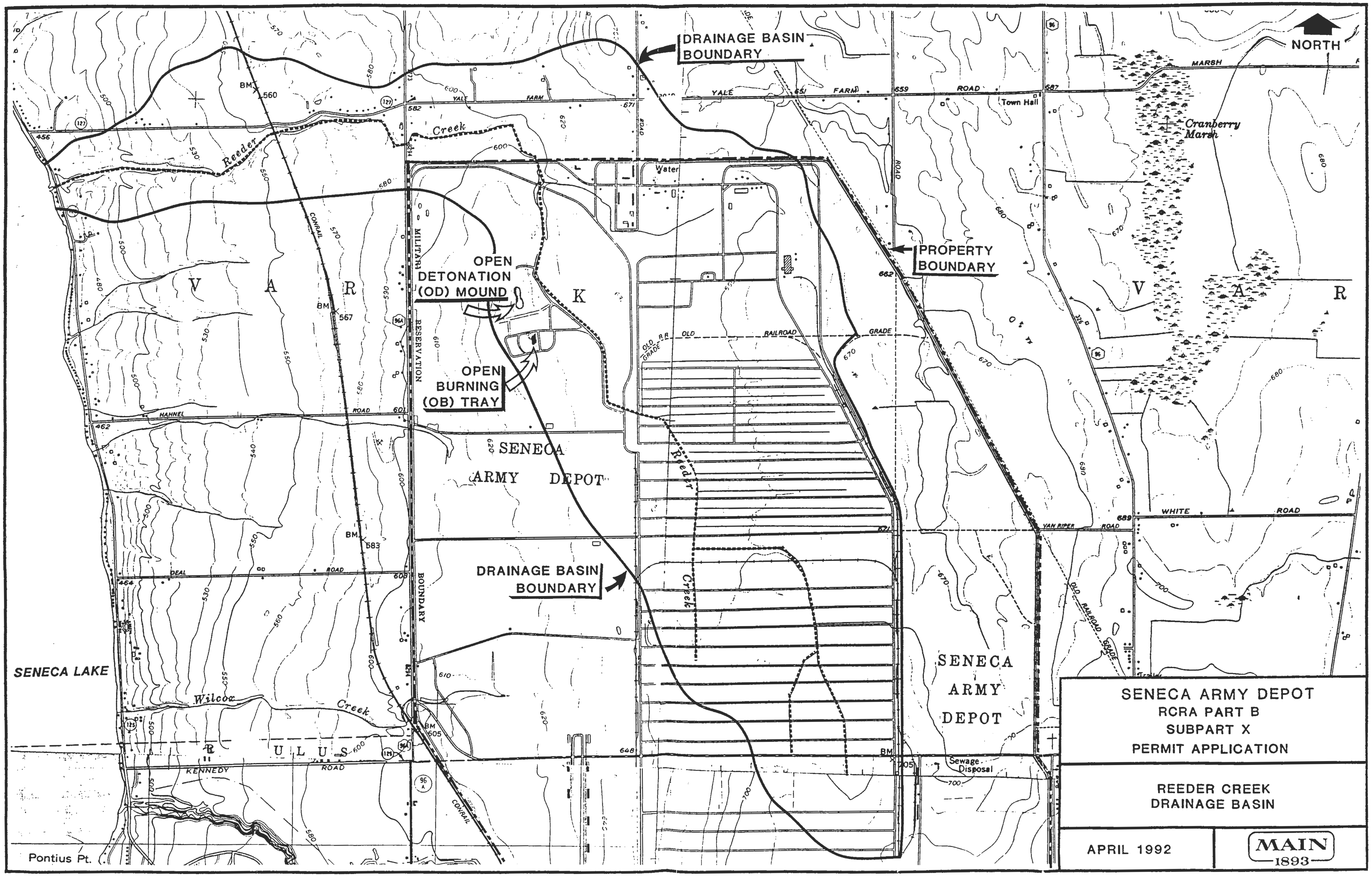


FIGURE D-17 REGIONAL TOPOGRAPHY MAP

FIGURE D-18

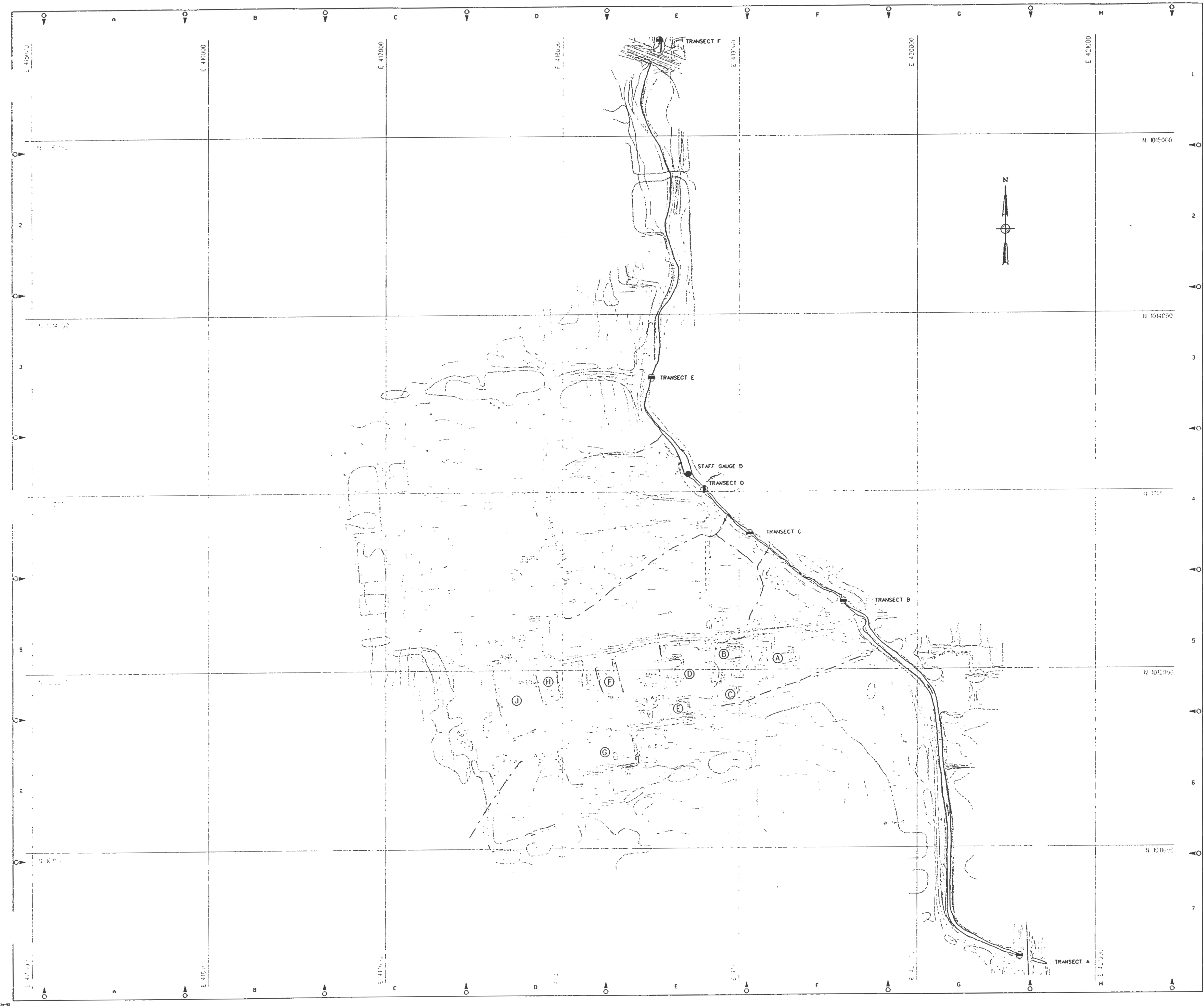


SENECA ARMY DEPOT
RCRA PART B
SUBPART X
PERMIT APPLICATION

REEDER CREEK
DRAINAGE BASIN

APRIL 1992

MAIN
1893



NOTES:

LEGEND:

- TRANSECT & STAFF GAUGE
- TRANSECT
- ● STAFF GAUGE
- PAVED ROAD
- DIRT ROAD
- GROUND CONTOUR AND ELEVATION
- UTILITY POLE
- TREE
- BRUSH
- WETLAND & DESIGNATION
- RUNOFF SWALE
- Ⓓ BURNING PAD DESIGNATION
- CULVERT

REV	DATE	DESCRIPTION	DRAWN	CHECKED	DES.SUPV.	RESP.ENGR.	CH.DISC.ENG.	PROJ. MGR.		MF

DRAWN BY G.A.KAEUN
CHECKED BY D.A.NORTH
DESIGN SUPV. G.A.KAEUN
RESP. ENGR. W.K.DUCHESNEAU
CHIEF DISC. ENGR.
MGR. OF ENGR. L.P.SULLIVAN
PROJECT MANAGER W.K.DUCHESNEAU
MGR. OF PROJECTS J.P.CHAPLICK
IN CHARGE W.D.PATTERSON

MAIN
1893
CHAS. T. MAIN, INC.
BOSTON • CHARLOTTE • PASADENA

CLIENT/PROJECT TITLE
SENECA ARMY DEPOT
RCRA PART B
SUBPART X
PERMIT APPLICATION

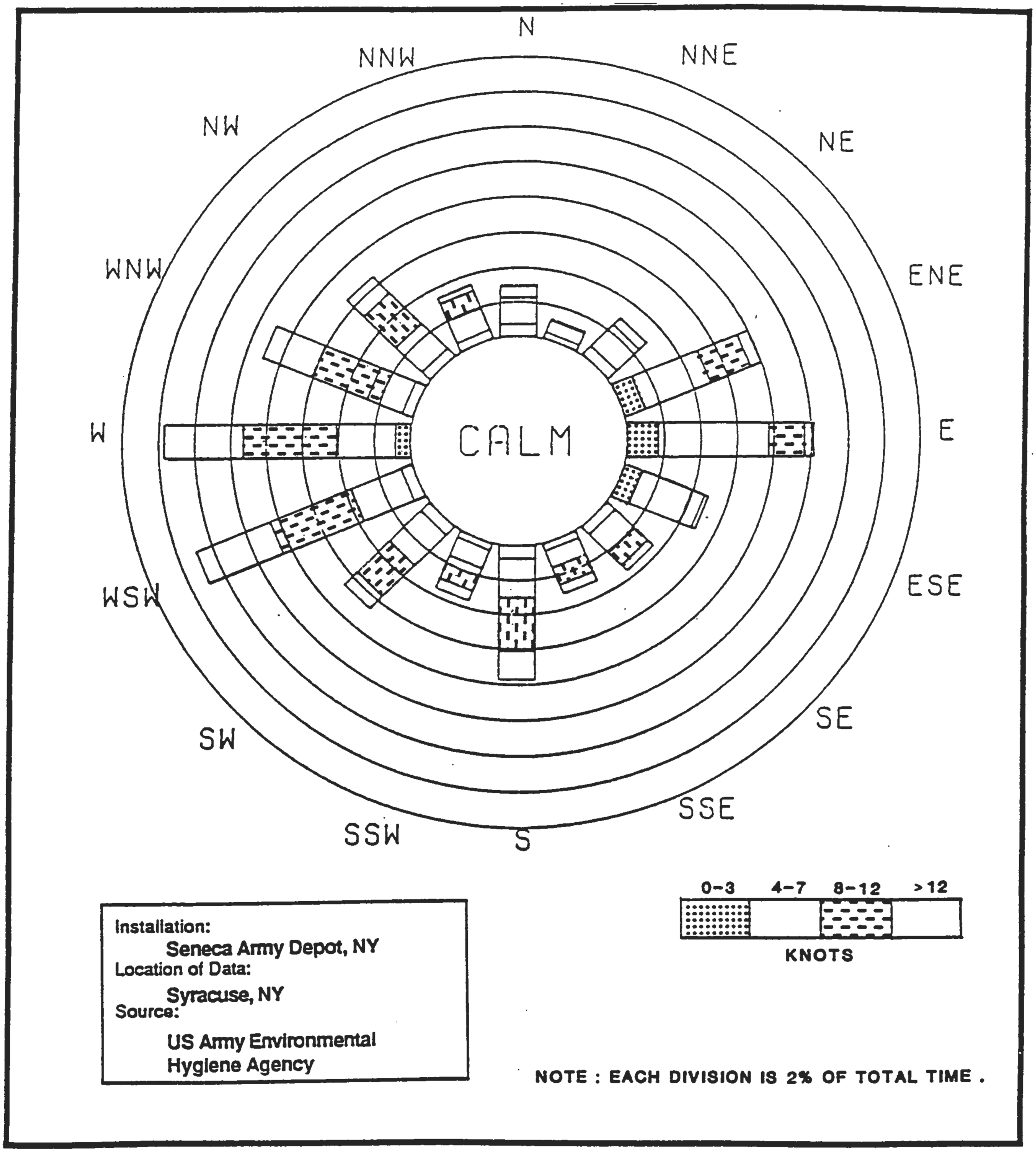
DEPT. ENVIRONMENTAL ENGINEERING
NO. 720229-06000

LOCATION OF
REEDER CREEK
STREAM CROSS SECTIONS

SCALE 1" = 200'-0"
MAIN'S DWG. NO. 720229-06000-C4
REV A

environ/env/misc/sen16.dgn

FIGURE D-18A

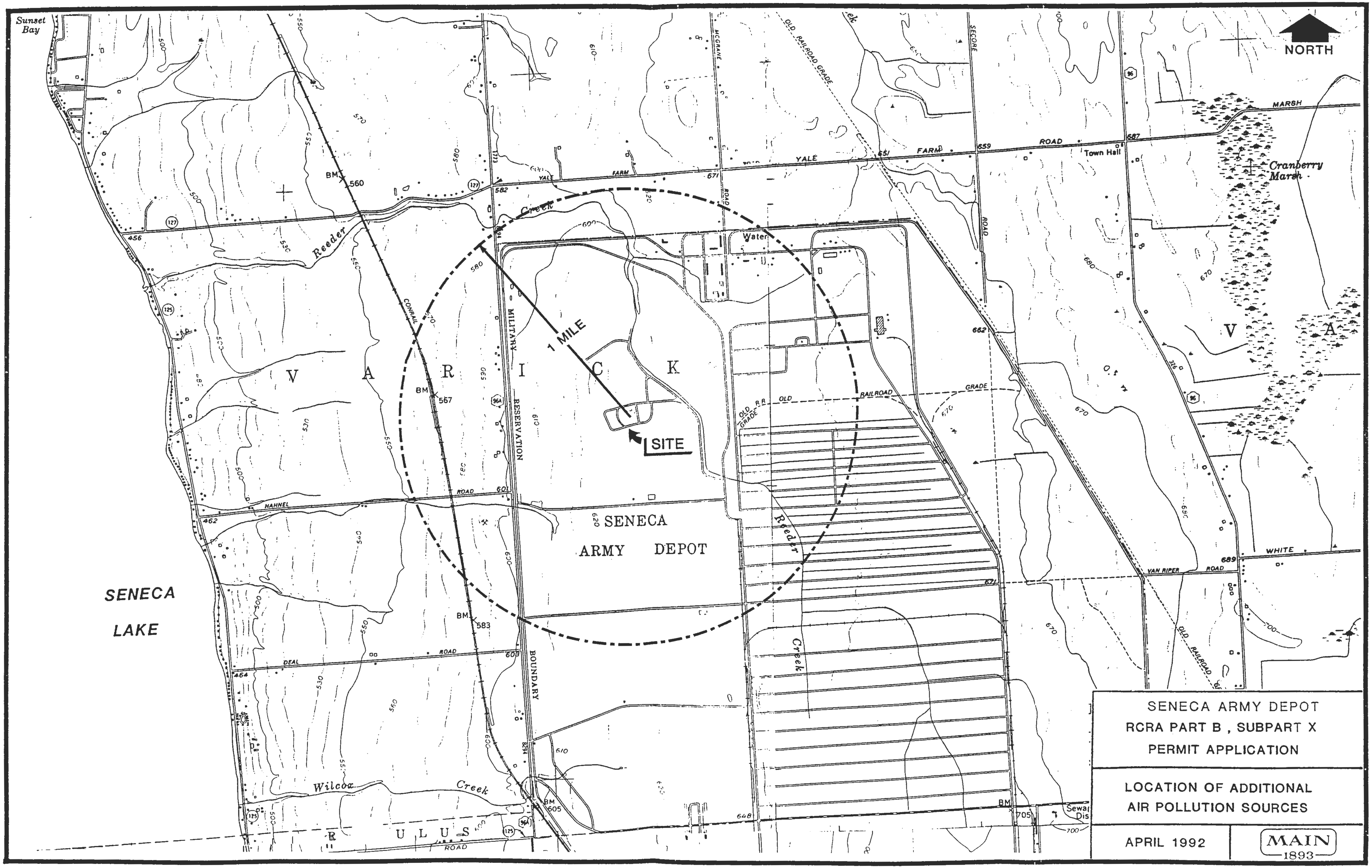


Installation:
Seneca Army Depot, NY
Location of Data:
Syracuse, NY
Source:
US Army Environmental
Hygiene Agency

NOTE : EACH DIVISION IS 2% OF TOTAL TIME .

FIGURE D-19 WIND ROSE

FIGURE D-21

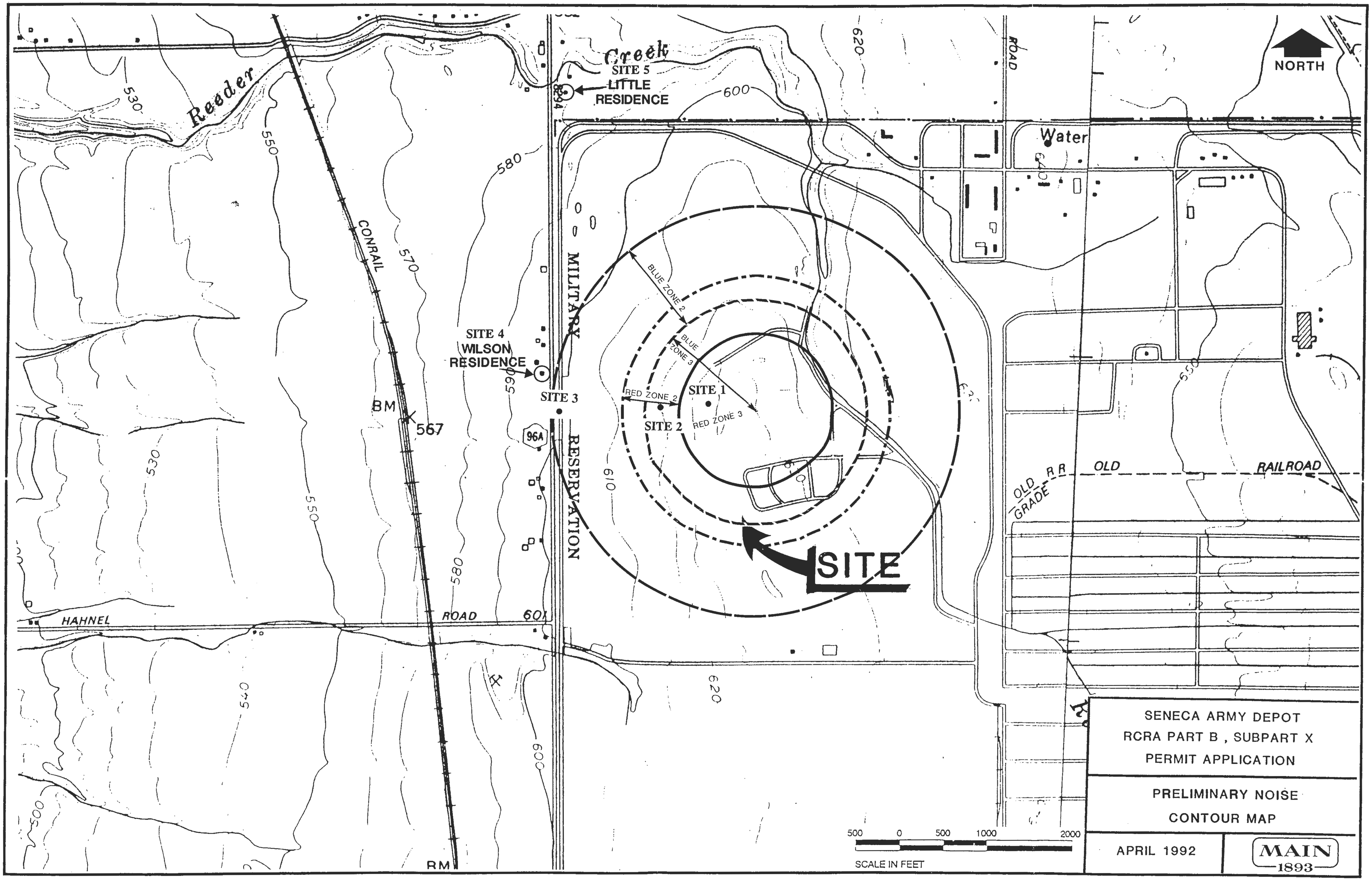


SENECA ARMY DEPOT
RCRA PART B , SUBPART X
PERMIT APPLICATION

LOCATION OF ADDITIONAL
AIR POLLUTION SOURCES

APRIL 1992

MAIN
1893



SENECA ARMY DEPOT
RCRA PART B , SUBPART X
PERMIT APPLICATION

PRELIMINARY NOISE
CONTOUR MAP

APRIL 1992

MAIN
1893

TABLE D-1

AVERAGE BACKGROUND CONCENTRATIONS OF SELECTED HEAVY METALS IN ROCKS, SOILS, AND SEDIMENTS

Metal	Shale	Sandstone	Limestone	Soils	Sediment[4]
Arsenic	15	1	2.5	5	12
Barium	700	50	100	500	NA
Cadmium	0.2	<0.1	0.1	1	2.5
Chromium	100	35	10	50	75
Mercury	0.5	0.07	0.05	0.03	0.0
Lead	40	7	8	20	55
Selenium	0.6	NA	0.08	0.02	NA

NOTES:

1. Source: Levinson 1980, unless otherwise noted.
2. All concentrations as total metals in ppm.
3. Values are an average of samples from earth's crust, which can vary significantly.
4. From MOE (1988): Upper 95% confidence limit of pre-industrial concentrations in Great Lakes sediments.

TABLE D-2

OB/OD FACILITY MONITORING WELL DATA

Well ID	Total Depth of Boring	Depth to Weathered Rock	Depth Cored	Depth to Top of Screen	Screen Length (ft)	% Rec.	% RQD	Elev. of Casing Top[2]	Depth to Water[3]	Elev. of Water[3]
MW-1	13.0	12.0	NA	7	5	NA	NA	NA	NA	NA
MW-2	7.0	6.5	NA	1	5	NA	NA	NA	NA	NA
MW-3	11.0	9.5	NA	4.5	5	NA	NA	NA	NA	NA
MW-4	10.0	9.5	NA	4.5	5	NA	NA	NA	NA	NA
MW-5	10.0	9.0	NA	4.0	5	NA	NA	NA	NA	NA
MW-6	9.0	9.0	NA	4.0	5	NA	NA	NA	NA	NA
MW-7	6.5	6.0	NA	1.0	5	NA	NA	NA	NA	NA
MW-8	18.5	9.0	13.5-18.5	4.5	5	100	0	122.08	6.96	115.12
MW-9	15.0	10.0	10-15	3.0	4	100	0	117.89	4.30	113.59
MW-10	18.5	15.0	13.5-18.5	4.0	5	100	0	122.24	6.40	115.84
MW-11	17.5	9.0	12.5-17.5	4.0	5	100	37	113.95	6.30	107.64

TABLE D-2
(Cont.)

Well ID	Total Depth of Boring	Depth to Weathered Rock	Depth Cored	Depth to Top of Screen	Screen Length (ft)	% Rec.	% RQD	Elev. of Casing Top[2]	Depth to Water[3]	Elev. of Water[3]
MW-12	15.0	7.5	10-15	3.0	4	100	0	107.74	3.98	103.76
MW-13	17.0	6.5	12-17	3.0	5	100	17	114.00	4.90	109.10
MW-14	16.5	9.0	11.5-16.5	3.5	5	100	0	107.43	5.47	101.96
MW-15	13.5	6.5	8.5-13.5	3.0	3.5	100	0	105.01	3.18	101.83
MW-16	13.5	6.5	8.5-13.5	3.0	3.5	100	0	105.73	3.18	100.41
MW-17	19.0	8.0	14-19	4.5	5	100	0	107.89	5.32	103.77

NA = Not available

[1] All depths are relative to the ground surface, all depths in feet.

[2] Temporary Bench Mark (TBM) was assumed to be 100.00 and is located at the doorway of the bunker in northwestern corner of the OB/OD facility.

[3] Measured in January 1988.

TABLE D-3

SUMMARY OF GROUNDWATER ANALYSES WELLS MW-1 THROUGH MW-7 (1981 THROUGH 1987)

Chemical	EPA Maximum Contaminant Level (ug/l)	New York State Groundwater Standard (ug/l)	Method Detection Limit (ug/l)	Concentration Range Detected (ug/l)	Total Number of Samples	Number of Samples Exceeding Detection Limit	Number of Samples Exceeding NYSGWS	Number of Wells Exceeding NYSGWS
Inorganics								
Arsenic	50	25	10	ND	26	0	0	
Barium	1,000	1,000	100	ND	26	0	0	
Cadmium	10	10	5	ND	26	0	0	
Chromium	50	50	10	ND	26	0	0	
Mercury	2	2	0.2	ND	26	0	0	
Lead	50	25	10	ND	26	0	0	
Selenium	10	20	5	ND	26	0	0	
Silver	50	50	10	ND	26	0	0	
Iron	NA	300	2-100	ND-1,020	65	40	3	1,7
Manganese	NA	300	1-30	ND-320	65	02	17	2,5,6,7
Fluoride	4,000	1,500	100	100-300	27	27	0	5
Nitrate	10,000[a]	10,000[a]	50	ND-10,000	27	23	1	5
Explosives								
HDX	NA	(35)[b]	100	ND	46	0	0	
RDX	NA	(35)[b]	30	ND	46	0	0	

TABLE D-3
(Cont.)

Chemical	EPA Maximum Contaminant Level (ug/l)	New York State Groundwater Standard (ug/l)	Method Detection Limit (ug/l)	Concentration Range Detected (ug/l)	Total Number of Samples	Number of Samples Exceeding Detection Limit	Number of Samples Exceeding NYSGWS	Number of Wells Exceeding NYSGWS
Tetryl	NA	(1)[b]	10	ND	46	0	0	
2,4,6-TNT	NA	(1)[b]	1	ND	46	0	0	
2,6-DNT	NA	(1.1)[c]	1	ND	46	0	0	
2,4-DNT	NA	(1)2[b]	1	ND	46	0	0	
pH	NA	(6.5-8.5)[d]		6.7-8.1[d]	300	300	0	
TOC	NA	NA	100	1,000-54,000	340	340	NA	
TOX	NA	NA	10	ND-130	335	133	NA	

NOTES:

[a] Groundwater standard is for nitrate only.
[b] Guidelines proposed from "Criteria Development Report for the Closure of Nine Burning Pads" (M&E, October 1989).
[c] EPA Water Quality Criteria for 10^{-5} risk.
[d] Units are pH.

NA Not Available
ND Not Detected

Data summarized from the 1987 USAEHA Groundwater Contamination Survey

TABLE D-4

SUMMARY OF SOIL ANALYSIS DATA
USAEHA PHASE II (1982) REPORT FOR BURN PADS B THROUGH H

Chemical	EP Toxicity Concentration Limit (mg/l)	Method Detection Limit	Range of Sample Concentrations	Total Number of Samples	No. of Samples Exceeding Detection Limit	No. of Samples Exceeding EP Toxicity Limit	Pads Exceeding Detection Limit	Pads Exceeding EP Toxicity
Metals								
Arsenic	5	0.5 mg/l	ND	24	0	0	0	0
Barium	100	10 mg/l	ND - 508 mg/l	24	2	2	All from B	B
Cadmium	1	0.1 mg/l	ND - 0.17 mg/l	24	3	0	F,E,G	0
Chromium	5	0.5 mg/l	ND	24	0	0	0	0
Mercury	0.02	0.02 mg/l	ND	24	0	0	0	0
Lead	5	0.5 mg/l	ND - 24.6 mg/l	24	2	2	All from H	H
Selenium	1	0.1 mg/l	ND	24	0	0	0	0
Silver	5	0.5 mg/l	ND	24	0	0	0	0
Explosives								
HMX	NA	1 ug/g	ND	24	0	NA	0	NA
RDX	NA	1 ug/g	ND - 7 ug/g	24	18	NA	B,C,D,E,F,G,H	NA
Tetryl	NA	1 ug/g	ND - 2.7 ug/g	24	1	NA	D	NA
2,4,6-TNT	NA	1 ug/g	ND - 9270 ug/g	24	6	NA	F[4],D,G	NA
2,6-DNT	NA	1 ug/g	ND - 23.0 ug/g	24	4	NA	F,H	NA
2,4-DNT	NA	1 ug/g	ND - 45.0 ug/g	24	5	NA	F,H	NA

NOTES:
1. All samples collected from 0 to 6 inches below ground surface
2. NA: Not Applicable
3. ND: Not Detected
4. Pad F sample contained the high value.

TABLE D-5

SUMMARY OF SOIL ANALYSIS DATA
USAEHA PHASE IV (1984) REPORT FOR BURN PADS B, F AND H

Chemical	EP Toxicity Concentration Limit (mg/l)	Method Detection Limit	Range of Sample Concentrations	Total Number of Samples	Number of Samples Exceeding Detection Limit	Number of Samples Exceeding EP Toxicity Limit	Pads Exceeding Detection Limit	Pads Exceeding EP Toxicity
Metals								
Arsenic	5	0.5 mg/l	ND	47	0	0	0	0
Barium	100	10 mg/l	ND - 424 mg/l	47	3	2	B	B
Cadmium	1	0.1 mg/l	ND	47	0	0	0	0
Chromium	5	0.5 mg/l	ND	47	0	0	0	0
Mercury	0.02	0.02 mg/l	ND	47	0	0	0	0
Lead	5	0.5 mg/l	-	47	12	3	F,B,H	F,B,H
Selenium	1	0.1 mg/l	ND	47	0	0	0	0
Silver	5	0.5 mg/l	ND	47	0	0	0	0
Explosives								
HMX	NA	1 ug/g	ND - 4.0 ug/g	47	0	NA	B	NA
RDX	NA	1 ug/g	ND - 8.2 ug/g	47	4	NA	F,B	NA
Tetryl	NA	1 ug/g	ND	47	0	NA	NA	NA
2,4,6-TNT	NA	1 ug/g	ND - 1245 ug/g	47	7	NA	F,B	NA
2,6-DNT	NA	1 ug/g	ND - 2.2 ug/g	47	2	NA	H	NA
2,4-DNT	NA	1 ug/g	ND - 2.2 ug/g	47	5	NA	F,H	NA

NOTES: 1. NA: Not Applicable
2. ND: Not Detected

TABLE D-6

SUMMARY OF BOREHOLE WATER ANALYSES FROM 7 BOREHOLES (1984, PHASE IV REPORT)

Chemical	EPA Maximum Contaminant Level (ug/l)	New York State Groundwater Standard (ug/l)	Method Detection Limit (ug/l)	Concentration Range Detected (ug/l)	Total No. of Samples	No. of Samples Exceeding Detection Limits	No. of Samples Exceeding Standards or Guidelines	Pads Exceeding Detection Limit	Pads Exceeding Standard
Inorganics									
Arsenic	50	25	10	ND - 6.9	9	0	0	NA	NA
Barium	1,000	1,000	300	ND - 374	9	1	0	B	NA
Cadmium	10	10	1	ND	9	0	0	NA	NA
Chromium	50	50	1	ND - 1.27	9	1	0	F	NA
Lead	50	25	5	ND - 112	9	4	3	F,B	F
Selenium	20	20	5	ND - 28.1	9	3	2	B,H	B
Explosives									
HMX9	NA(35)[a]	NA	100	ND - 166.6	9	5	NA	B,F,H	NA
RDX	NA(35)[a]	NA	30	ND	9	0	NA	NA	NA
Tetryl	NA(1)[a]	NA	10	ND - 43	9	2	NA	B,F	NA
2,4,6-TNT	NA(1)[a]	NA	1	ND - 89.9	9	7	NA	B,F,H	NA
2,6-DNT	NA	NA	1	ND - 8.5	9	2	NA	F,H	NA
2,4-DNT	NA(1.1)[b]	NA	1	ND - 4.2	9	3	NA	B,F,H	NA

NOTES: [a] Proposed Guidelines from Criteria Development Report for the Closure of the Nine Burning Pads (M&E, October 1988)
[b] EPA Water Quality Criteria for 1x10^{-5} Risk of Nine Burning Pads (M&E, October 1988).

TABLE D-7

GROUNDWATER ANALYSIS DATA
(M&E, 1989)

Chemical	EPA Maximum Contaminant Level (ug/l)	New York State Groundwater Standard (ug/l)	Method Detection Limit (ug/l)	Detection Range		No. of Times Greater Than Detected		Times Detected Greater Than Standards	
				Wells 1-6 (ug/l)	Wells 8-17 (ug/l)	Wells 1-6	Wells 8-17	Wells 1-6	Wells 8-17
Inorganics									
Arsenic	50	25	10	ND - 19.3	ND	1	0	0	0
Barium	1000	1000	200	ND - 859	ND	5	0	0	0
Cadmium	10	10	5	ND - 18.8	ND	1	0	1(4)	0
Chromium	50	50	10	21.5-152	ND	6	0	4(1,4,5,6)	0
Mercury	2	2	0.2	ND - 0.58	ND	2	0	0	0
Lead	50	25	5	38.9-206	ND - 9.9	6	3	6(1,2,3,4,5,6)	0
Selenium	10	50	5	ND - 14.3	ND - 5.6	2	1	1(5)	0
Explosives									
PETN	NA	NA	4.5	ND - 45	ND	2	0	NA	NA
HMX	NA(35)[a]	NA	1.3	ND	ND	0	0	NA	NA
RDX	NA(35)[a]	NA	0.63	ND - 1.84	ND - 0.71	2	1	NA	NA
Tetryl	NA(1)[a]	NA	0.66	ND - 0.96	ND	1	0	NA	NA
2,4,6-TNT	NA(1)[a]	NA	0.78	ND	ND - 5.6	0	2	NA	NA
2,6-DNT	NA(1.1)	NA	0.55	ND	ND	0	0	NA	NA
2,4-DNT	NA	NA	0.6	ND	ND	0	0	NA	NA

NOTE: [a] Proposed Guidelines from Criteria Development Report for the Closure of the Nine Burning Pads (M&E, October 1988)

TABLE D-8

CHEMICAL AND PHYSICAL PROPERTIES OF EXPLOSIVES

Chemical	Molecular Weight (g/gmole)	Density g/cm^3 (20°C)	Solubility (mg/l)	Henry's Constant (torr/M)	Volatilization Half-Life (days)	Melting Point (°C)	K_{OC} Adsorption Partition Coefficient	Vapor Pressure (torr,(ppm))
2,4,6-trinitrotoluene (TNT)	227	1.654	130 117 200	0.18	990 300	80	190	1x10^{-4},(0.13)
2,6-dinitrotoluene (DNT)	182	1.283	182 140	18	9 249	64-66	100	0.018,(24)
2,4-dinitrotoluene (DNT)	182	1.52	270 410	3.4	47 201	71	87	0.005,(6.7)
RDX	222	1.82	50 44	2.0x10^{-5}	9.0x10^{6}	204	420 538	4.1x10^{-9},(5.4x10^{-6})
HMX	296	2.90	66 50	Negligible	NA	273	508	3.9x10^{-9},(5.1x10^{-6})
Tetryl	-	-	-	-	-	-	-	-

Source: Evaluation of Critical Parameters Affecting Contaminant Migration Through Soils, Report No. AMXTH-TE-CR-85030, Final Report. Prepared by: Environmental Science and Engineering, Inc., prepared for U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), July 1985.

NA - Not Available

TABLE D-9

RELATIVE RELATIONSHIPS BETWEEN K_{oc} AND MOBILITY

K_{oc}	Mobility Class
>2000	I - Immobile
500-2000	II - Low Mobility
150-500	III - Intermediate Mobility
50-150	IV - Mobile
<50	V - Very Mobile

Source: <u>The Soil Chemistry of Hazardous Materials</u>; James Dragun, Ph.D.; The Hazardous Materials Control Research Institute; 1988.

Table D-10

CLIMATOLOGICAL DATA FOR SENECA ARMY DEPOT

Month	Temperature (°F)[1] Max.	Min.	Mean	Precip.[1] Mean (in)	RH[3] Mean (%)	Sunshine[3] (%)	Sky Cover[3] (tenths)	Mean No. of Days[4] Clear	Partly Cloudy	Cloudy
Jan.	30.9	14.0	22.5	1.88	70	35	7.5	3	7	21
Feb.	32.4	14.1	23.3	2.16	70	50	7.0	3	6	19
Mar.	40.6	23.4	32.0	2.45	70	50	7.0	4	7	20
Apr.	54.9	34.7	44.8	2.86	70	50	7.0	6	7	17
May	66.1	42.9	54.5	3.17	70	50	6.5	6	10	15
June	76.1	53.1	64.6	3.70	70	60	6.5	8	10	12
July	80.7	57.2	69.0	3.46	70	60	6.0	8	13	10
Aug.	78.8	55.2	67.0	3.18	70	60	6.0	8	11	12
Sept.	72.1	49.1	60.7	2.95	70	60	6.0	7	11	12
Oct.	61.2	39.5	50.3	2.80	70	50	6.0	7	8	16
Nov.	47.1	31.4	39.3	3.15	70	30	7.5	2	6	22
Dec.	35.1	20.4	27.8	2.57	70	30	8.0	2	5	24
Annual	56.3	36.3	46.3	34.33	70	50	6.5	64	101	200

Period	Mixing Height (m)[2]	Wind Speed (m/s)[2]
Morning (annual)	650	6
Morning (winter)	900	8
Morning (spring)	700	6
Morning (summer)	500	5
Morning (autumn)	600	5
Afternoon (annual)	1400	7
Afternoon (winter)	900	8
Afternoon (spring)	1600	8
Afternoon (summer)	1800	7
Afternoon (autumn)	1300	7

Mean Annual Pan Evaporation (in.)[3]: 35

Mean Annual Lake Evaporation (in.)[3]: 28

No. of episodes lasting more than 2 days (No. of episode-days)[2]:
Mixing Height < 500 m, wind speed < 2 m/s: 0 (0)
Mixing Height < 1000 m, wind speed < 2 m/s: 0 (0)

No. of episodes lasting more than 5 days (No. of episode-days)[2]:
Mixing Height < 500 m, wind speed < 4 m/s: 0 (0)

REFERENCES:

[1] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Ithaca Cornell Univ., NY.

[2] Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution throughout the Contiguous United States. George C. Holzworth, Jan. 1972

[3] Climatic Atlas of the United States. U.S. Department of Commerce, 1983.

[4] Climate of New York Climatography of the United States No. 60. National Oceanic and Atmospheric Administration, June 1982. Data for Syracuse, NY.

Table D-11

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

		Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
Material	Composition	OD	OB	OD	OB
TNT	TNT - 100%	888	1005	202.392	203.361
Explosive D	Ammonium picrate - 100%	862	1086	194.610	195.016
5"/38 Projectile (Explosive D)*	Explosive D - 100% (7.5 lb/projectile)	862	—	194.610	—
Dynamite	Dynamite - 100% (.43 lb/stick)	—	—	—	—
175mm Projectile (TNT)*	TNT - 100% (30.3 lb/projectile)	888	—	202.392	—
3.5" Rocket (Comp B)*	Comp B - 84% (1.88 lb/rocket)	938	—	194.655	—
	Propellant - 16% (.36 lb/rocket)				
500 lb Bomb MK82H6*	H6 - 100% (192 lb/bomb)	1205	—	190.713	—
Comp-B	RDX - 59.4%	938	1280	194.655	194.661
	TNT - 39.6%				
	Candella wax - 1%				
5"/38 Projectile (Comp B)*	Comp B - 100% (7.5 lb/projectile)	938	—	194.655	—
250 lb Bomb MK81H6*	H6 - 100% (100 lb/bomb)	1205	—	190.713	—
90 mm Projectile (TNT)*	TNT - 100% (2.15 lb/projectile)	888	—	202.392	—
Depth Bomb MK54-1 (HBX)*	HBX - 100%	1107	—	193.595	—
Torpedo Warhead MK16-6 (HBX)*	HBX - 100% (643 lb/warhead)	1107	—	193.595	—
Depth Charge MK4-0 (TNT)*	TNT - 97.7% (33.4 lb/charge)	888	—	202.392	—
	Double-based propellant - 2.3% (0.8 lb/charge)				
500 lb Bomb (Tritonal)*	Tritonal - 100%	888	—	202.392	—
PETN	PETN - 100%	667	1120	187.961	187.961
Lead Styphnate	Lead styphnate - 100%	848	1144	151.721	151.721
HMX	HMX - 100%	808	1259	192.749	192.749
RDX	RDX - 100%	811	1266	192.749	192.749
NC (12.6%N)	Nitrocellulose - 100%	984	1315	185.353	185.353
NQ	Nitroguanidine - 100%	772	1035	203.228	203.228
NG	Nitroglycerine - 100%	492	927	188.621	188.621
Tetryl	Tetryl - 100%	970	1316	188.506	188.510
Tritonal	TNT - 80%	1135	1498	189.983	189.991
	Aluminum - 20%				

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Comp-A3	RDX - 91.0% Candellia wax 9.0%	895	1230	203.569	203.615
C4	RDX - 91.0% Poly-isobutlene - 9.0%	876	1191	206.124	206.284
HBX-1	RDX - 39.8% TNT - 37.8% Aluminum - 16.9% Candellia wax - 5.0% Calcium chloride - 0.50%	1107	1497	193.595	193.605
Low Velocity Dynamite*	RDX - 17.4% TNT - 67.8% Pentaerithritol - 8.6% R-45M - 2.8% Droctyl sebacate - 1.3% Cellulose acetate - 8.0%	868	—	212.158	—
H6	RDX - 44.8% TNT - 29.9% Aluminum - 19.9% Candellia wax - 5.0% Calcium chloride - 0.50%	1205	1611	190.713	190.724
Medium Velocity Dynamite*	RDX - 75.0% TNT - 15.0% Sucrose - 5.0% JP-4 - 4.0% Poly-isobutlene - 1.0%	883	—	202.569	—

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Propellant M26E1 (Double-based)	NC - 68.7% NG - 25.0% Ethyl Centralite - 6.0%	976	1286	186.049	186.050
Propellant SPDF (Single-based)*	NC - 97.7% Diphenylamine - 0.49% Lead carbonate - 0.74% Polarniun sulfate - 1.0%	—	1315	—	181.090
Propellant SPCF (Single-based)*	NC - 94.0% Ethyl centralite - 1.0% N-butyl stearate - 3.0% Lead carbonate - 1.0% Potassium sulfate - 1.0%	—	1315	—	174.232
Propellant M15	NC - 20.0% NG - 19.0% NQ - 54.7% Ethyl centralite - 6.0% Cryolite - 0.30%	861	1117	196.261	196.341
Propellant M6	NC - 85.3% Dinitrotoluene - 9.8% Dibutylphthalate - 2.9% Potassium sulfate - 0.98% Diphenylamine - 0.98%	898	1147	193.994	194.080
Propellant M10	NC - 85.3% Dinitrotoluene - 9.8% Dibutylphthalate - 2.9% Potassium sulfate - 0.98% Diphenylamine - 0.98%	898	1147	193.994	194.080

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Propellant SPD	NC - 99.0% Diphenylamine - 1.0%	969	1285	186.834	186.834
Propellant M30A2	NC - 27.0% NG - 22.5% NQ - 46.25% Urea - 1.50% Potassium nitrate - 2.75% Water - 0.15%	749	1087	193.289	193.296
Black Powder	Potassium nitrate - 74% Charcoal - 15.6% Sulfur - 10.4%	—	—	—	—
20 mm HEI M97 (Fuse M75)	TNT - 46.7% NC - 41.59% Magnesium-aluminum alloy - 1.48% Barium nitrate - 1.56% Tetryl - 7.47% Mercury fulminate - 0.52% Diphenylamine - 0.36% Lead azide - 0.26%	908	—	193.792	—
20 mm HEI M97 (Fuse M505A3)	NC - 33.92% NG - 4.13% Dibutyl phthalate - 3.26% RDX - 6.12% Aluminum - 3.72% Diphenylamine - 0.49% HMX - 0.53% Barium nitrate - 0.13% TNT - 47.7%	911	—	195.778	—
NOWTH-80-1 (MK 23)	R-45M-14.22% Aluminum - 80%	873	1247	191.877	192.128
X256 (MK12)	NC - 49.89% NG - 33.6% Lead - 1.74%	1042	1405	183.244	183.244

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
N-60 (Smokey Sam)	R-45M - 11.97% Zinc - 40% AP - 44%	1034	1213	172.363	172.302
N-50 (5" Gun Projectile)	R-45M - 11% Aluminum - 18% AP - 65%	1363	1831	182.785	182.934
N-5 (ASROC and MK22)	NC - 50% NG - 34.9% Lead - 1.03%	934	1220	190.913	190.917
AA2 (MK 90)	NC - 51% NG - 38.6% Lead - 0.44%	990	1348	185.334	185.251
AA6 (ZUNI)	NC - 49% NG - 38.8% Lead - 0.30%	1029	1404	184.060	184.061
HEN-12 (RAPEC/SEAGNAT)	NC - 49% NG - 40.6% Lead - 1.37%	1001	1366	183.739	183.676
BX-180/BX185 (MK18 Booster)	Butarez - 17% AP - 79%	907	1280	191.354	191.489
BX-180/BX185 (MK18 Sustainer)	Butarez - 15% AP - 79%	802	1173	190.099	190.663
BX-180H (CKU-5/A Sustainer)	Butarez - 12.4% AP - 80%	842	1218	192.051	192.411
TPH-9001 (CKU-7/A Sustainer)	Butarez - 14% AP - 80%	818	1197	191.596	192.084
PBXN-106 (MK115)	RDX - 75%	938	1300	196.208	196.209
NOSIH (BC-10) (MQM-107)	R-45M - 8.4% Aluminum - 44% AP - 43.1b	2059	2321	170.256	170.656
XM39 (LOVA)	Cellulose acetate butyrene - 12% RDX - 76% NC - 4%	863	1133	202.818	203.065

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
PBXN-103	NC - 6% AP - 40% Aluminum - 27% Metriol Trinitrate - 23%	1602	2138	166.513	167.065
PBX (AF)-108	RDX - 82% PPG - 10.7% Isodecyl pelargonate - 5.3%	840	1068	210.517	212.954
20mm HEI-T Cartridge M246*	Lead styphnate - 0.17% Barium carbonate - 0.17% NC - 70% NG - 7.05% Aluminum - 5.49% Strontium nitrate - 1.94% Magnesium - 1.02% Tetryl - 10.3%	970	—	161.952	—
20mm HEI-T Cartridge M599*	Lead styphnate - 0.15% Barium nitrate - 0.14% NC - 77.58% NG - 7.81% Zinc stearate - 3.38% Strontium nitrate - 0.82% Magnesium - 0.49% Tetryl - 6.94% Lead azide - 0.16% Potassium chlorate - 0.04%	984	—	171.611	—

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
20mm HEI-T Cartridge M242*	Lead styphnate - 0.17% NC - 68.4% NG - 6.9% RDX - 12% Aluminum - 6.4% Strontium nitrate - 1.83% Magnesium - 0.94% Polyvinyl chloride - 0.57% Barium nitrate - 0.17%	811	—	162.926	—
20mm HEI Cartridge M56A3*	Lead styphnate - 0.12% Barium nitrate - 0.14% NC - 56.48% NG - 5.69% Tetryl - 18.23% Lead azide - 0.42% Potassium chlorate - 0.13% Lead sulfocyanate - 0.04% RDX - 10.78% Aluminum - 6.09%	811	—	170.374	—
20mm HEI Cartridge M97A2*	Lead styphnate - 0.14% Barium nitrate - 0.16% NC - 56% NG - 5.65% Tetryl - 30.83%	970	—	172.571	—

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
	Lead azide - 0.49%				
	Potassium chlorate - 0.15%				
	Lead sulfocyanate - 0.05%				
	Aluminum - 5.18%				
20mm HEI Cartridge M210*	Lead styphnate - 0.04%	970	—	170.545	—
	Barium nitrate - 0.02%				
	NC - 73.71%				
	NG - 7.43%				
	Tetryl - 10.56%				
	Aluminum - 5.78%				
20mm API Cartridge M53*	Lead styphnate - 0.20%	984	—	175.72	—
	Barium nitrate - 0.22%				
	NC - 85.98%				
	NG - 8.67%				
	Potassium chlorate - 1.57%				
	Magnesium-alluminum alloy - 1.57%				
Fuze M66	Total weight - 3.34 lb/fuse	—	—	—	—
	Lead azide - 8.98%				
	Black powder - 1.2%				
	Strontium nitrate - 49.4%				
	Magnesium - 25.15%				
	Polyvinyl chloride - 15.27%				
Fuze M502	Total weight - 0.55 lb/fuse	—	—	—	—
	Lead azide - 83.63%				
	Black powder - 7.27%				
	Antimony sulfide - 3.64%				
	Potassium chlorate - 3.61%				

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Fuze M557	Total weight - 0.30 lb/fuse Lead azide - 70% Black powder - 13.33% Antimony sulfide - 6.67% Potassium chlorate - 6.67%	—	—	—	—
20mm HET Cartridge MK4*	Tetryl - 13.67% NC - 84.95% Lead azide - 0.52%	970	—	183.226	—
20mm INC Cartridge Model 96*	Lead styphnate - 0.17% Barium nitrate - 0.13% Lead peroxide - 0.04% Zirconium - 0.04% Antimony sulfide - 0.04% NC - 65.64% NG - 6.62% Potassium perchlorate - 12.76% Magnesium-alluminum alloy - 12.76%	984	—	134.152	—
40mm HE-M406A*	Lead styphnate - 0.06% Antimony sulfide - 0.01% Barium nitrate - 0.03% Aluminum - 0.01% Lead azide - 0.17% RDX - 59.26% TNT - 38.45%	811	—	192.043	—
Booster M21A4-DOTA*	Tetryl - 98.88% Lead azide - 0.23%	970	—	186.395	—

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
57mm HE Cartridge M306A1-DOTA*	RDX - 20.39% TNT - 13.26% NC - 60.58% Potassium sulfate - 0.62% Tetryl - 1.59% Lead azide - 0.03% Potassium chlorate - 0.01% Black powder - 2.52% Lead styphnate - 0.0094%	811	—	181.423	—
40mm APT-(M81) DOTB*	Black powder - 1.39% Lead styphnate - 0.01% NC - 83.48% Dinitrotoluene - 9.8% Barium peroxide - 0.35%	984	—	154.733	—
20mm API-T Cartridge M601*	Lead styphnate - 0.12% Barium nitrate - 0.09% NC - 73% NG - 9.53% Strontium nitrate - 1.05% Polyvinyl chloride - 0.33% Potassium perchlorate - 0.33% Magnesium - 0.53%	984	—	153.283	—

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[*] Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
20mm HEI-T Cartridge M599*	Lead styphnate - 0.05% Barium nitrate - 4.84% NC - 35.66% NG - 4.59% Strontium nitrate - 0.52% Magnesium - 0.26% Polyvinyl chloride - 0.17% Magnesium - 22.38%	984	—	74.755	—
30mm HEI Projectile CTG*	TNT - 100%	888	—	203.392	—
152mm HEAT Projectile CTG*	Comp B-100%	938	—	194.655	—
30mm TP Projectile CTG*	Black powder - 100%	—	—	—	—
Rifle Grenade Heat M31(A)*	Comp B - 100%	938	—	194.655	—
Burster (A) w/ Initiator*	Tetryl - 68.24% TNT - 29.24% Lead styphnate - 2.52%	888	—	187.816	—
Grenade MK3 w/ Fuze (M206A2)*	TNT - 75.57% RDX - 18.65% Lead azide - 4.81% Lead styphnate - 0.96%	811	—	192.943	—
75mm Projectile*	TNT - 100%	888	—	202.392	—
105mm Projectile*	TNT - 48.58% Comp B - 51.42%	888	—	198.41	—
Grenade MK3*	TNT - 100%	888	—	202.392	—
Propellant M1	NC - 84% Dinitrotoluene - 10% Dibutylphthalate - 5% Diphenylamine - 1%	—	1139	—	196.070

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Propellant N5	NC - 50% NG - 35% Diethyl phthalate - 10.5% Dimtrodiphenylamine - 2% Lead salicylate - 1% Lead-2-ethylhexoate - 1.3% Candellia wax - 0.2%	—	—	—	—
JATO Rocket Motor MK6-1	AN583F - 99.83% Black power - 0.17%	—	1181	—	192.071
Propellant AN583F	Ammonium perchlorate - 75% Polyester resin - 14.7% Steryne - 9% t-Butyl catechol solution - 0.6% Cumene hydroperoxide - 0.25% Copper chromite - 0.15% Lecithin - 0.3%	—	—	—	—
Propellant M17*	NC - 22% NG - 21.5% NQ - 54.7%	—	927	—	192.497
Propellant M30A1*	NC - 28% NG - 22.5% NQ - 47% Potassium sulfate - 1%	—	927	—	189.856
Propellant M30*	NC - 28% NG - 22.5% NQ - 44.7%	—	927	—	191.278

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* Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-11 (Cont'd)

COMPOSITION AND PROPERTY OF OB/OD MATERIALS

Material	Composition	Temperature (°K)		Combustion Product Volume (l/100g of Munition @ STP)	
		OD	OB	OD	OB
Rocket Motor*	NC - 89.3% NG - 9% Diphenylamine - 0.9% Sodium sulfate - 0.15%	—	1315	—	182.496
Detent*	Tetryl - 100%	970	1316	188.506	188.510
MK 117, 118	Black powder - 100%	—	—	—	—
MK125-5	Black powder - 100%	—	—	—	—
4.5" Gun M7	M13 propellant - 100%	—	—	—	—
4.5" Gun M8	M16 propellant - 100%	—	—	—	—
120mm Gun M15A2*	M15 propellant - 100%	—	861	—	196.261
120mm Gun M45*	M17 propellant - 100%	—	927	—	192.497
120mm Gun M46*	M17 propellant - 100%	—	927	—	192.497
155mm HOW M3*	M1 propellant - 100%	—	1139	—	196.070
155mm HOW M4A1*	M1 propellant - 100%	—	1139	—	196.070
155mm Gun M19*	M6 propellant - 100%	—	898	—	193.994
175mm M86*	M6 propellant - 100%	—	898	—	193.994
175mm M124*	M6 propellant - 100%	—	898	—	193.994
8" Gun M9	Smoke powder - 100%	—	—	—	—
8" Gun M10	Smoke powder - 100%	—	—	—	—
8" Gun M13*	M6 propellant - 100%	—	898	—	193.994
8" HOW M1*	M1 propellant - 100%	—	1139	—	196.070
8" HOW M2*	M1 propellant - 100%	—	1139	—	196.070
8" HOW M188*	M30A1 propellant - 100%	—	927	—	189.856
240mm HOW M26*	M6 propellant - 100%	—	898	—	193.994
105mm HOW*	M6 propellant - 100%	—	898	—	193.994
105mm HOW*	M1 propellant - 100%	—	1139	—	196.070

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[*] Note: Temperature and combustion product data are derived from reported values calculated using computer programs (1986 Army Computer Program, 1988 Army Computer Program, and 1987 Navy Computer Program).

Table D-12

EMISSION FACTORS FOR OD OPERATIONS - CO

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
TNT	37.567	–	16.253	14.854	11.048	8.207	–	–	17.730	36.1892	15.25	39.80	–	–
Explosive D	36.761	–	4.080	6.635	2.856	4.523	–	–	9.038	17.6597	–	–	–	–
5"/38 Projectile (Explosive D)	17.906	–	11.932	–	2.278	1.268	–	–	2.346	–	–	–	–	–
Dynamite	37.847	–	20.470	33.255	28.815	10.032	–	–	25.484	–	–	–	–	–
175 mm Projectile (TNT)	31.488	–	10.362	16.284	4.785	.832	–	–	10.953	–	–	–	–	–
3.5" Rocket (Comp-B)	6.112	–	6.646	6.711	4.600	–	–	–	6.043	–	–	–	–	–
500 lb Bomb MK82H6	–	6.084	9.433	13.801	3.424	–	–	–	7.613	–	–	–	–	–
Comp-B	11.561	–	6.969	10.733	5.482	5.295	–	–	7.757	11.8113	22.40	–	–	–
5"/38 Projectile (Comp-B)	17.590	–	6.215	8.841	75.980	7.407	–	–	9.043	–	–	–	–	–
250 lb Bomb MK81H6	22.694	–	–	19.881	32.873	3.659	–	–	23.000	–	–	–	–	–
90 mm Projectile (TNT)	31.760	–	26.906	19.525	7.822	2.760	–	–	17.078	–	–	–	–	–
Depth Bomb MK54-1 (HBX)	23.923	–	6.391	5.128	5.209	3.312	–	–	8.155	–	–	–	–	–
Torpedo Warhead MK16-16 (HBX)	–	–	86.476	58.681	26.976	9.294	–	–	57.017	–	–	–	–	–
Depth Charge MK4-0 (TNT)	28.233	–	36.509	57.658	63.994	17.201	-	-	41.267	–	–	–	–	–
Propellant M26E1 (Double-based)	–	–	–	–	–	–	–	–	–	6.9672	–	–	–	–

Table D-12 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - CO

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
500 lb Bomb (Tritonal)	6.547	–	16.030	4.582	3.245	1.321	–	–	6.915	–	–	–	–	–
Tritonal	–	–	–	–	–	–	–	–	–	58.6569	15.65	–	–	–
PETN	–	–	–	–	–	–	–	–	–	0	5.30	14.85	–	–
Lead Styphnate	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HMX	–	–	–	–	–	–	–	–	–	0	14.25	22.80	–	–
RDX	–	–	–	–	–	–	–	–	–	0	9.80	–	–	–
NC (12.6% N)	–	–	–	–	–	–	–	–	–	2.5028	–	32.00	–	–
NQ	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NG	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Tetryl	–	–	–	–	–	–	–	–	–	18.2577	26.20	30.40	–	–
Comp-A3	–	–	–	–	–	–	–	–	–	9.9176	–	–	–	–
C4	–	–	–	–	–	–	–	–	–	10.9450	–	–	–	–
HBX-1	–	–	–	–	–	–	–	–	–	38.5471	–	–	–	–
Low Velocity Dynamite	–	–	–	–	–	–	–	–	–	28.2661	–	–	–	–
H6	–	–	–	–	–	–	–	–	–	36.5344	–	–	–	–
Medium Vel. Dynamite	–	–	–	–	–	–	–	–	–	12.1818	–	–	–	–
Propellant M15	–	–	–	–	–	–	–	–	–	3.9579	–	–	–	–
Propellant M6	–	–	–	–	–	–	–	–	–	14.9512	–	–	–	–
Propellant M10	–	–	–	–	–	–	–	–	–	14.9512	–	–	–	–

Table D-12 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - CO

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Propellant SPD	–	–	–	–	–	–	–	–	–	4.6201	–	–	–	–
Propellant M30A2	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-B3	–	–	–	–	–	–	–	–	–	–	0	–	–	–
PBX 9404	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-07-2	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-09	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 80/20	–	–	–	–	–	–	–	–	–	–	0.28	4.13	–	–
Amatol 50/50	–	–	–	–	–	–	–	–	–	–	9.60	–	–	–
Ammonal 72/23.5/4.5	–	–	–	–	–	–	–	–	–	–	0	2.40	–	–
Ammonia Dynamite	–	–	–	–	–	–	–	–	–	–	–	3.16	–	–
Ammonia Gelatin	–	–	–	–	–	–	–	–	–	–	0.58	1.21	–	–
AN/AL Mix	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN/AL/H_2O	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN Dynamite	–	–	–	–	–	–	–	–	–	–	0.44	–	–	–
Black Powder	–	–	–	–	–	–	–	–	–	–	–	8.50	–	–
Blasting Gelatin	–	–	–	–	–	–	–	–	–	–	–	7.95	–	–
DNT	–	–	–	–	–	–	–	–	–	–	15.10	–	–	–
1,2 DP	–	–	–	–	–	–	–	–	–		0	–	–	–
FEFO	–	–	–	–	–	–	–	–	–	–	7.40	16.50	–	–
Gelatin Dynamite	–	–	–	–	–	–	–	–	–	–	–	3.60	–	–

Table D-12 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - CO

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Gun powder	–	–	–	–	–	–	–	–	–	–	–	3.84	–	–
Lead Azide	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-11-0	–	–	–	–	–	–	–	–	–	–	19.15	24.10	–	–
Mercury Fulminate	–	–	–	–	–	–	–	–	–	–	1.12	–	–	–
Nitromethane	–	–	–	–	–	–	–	–	–	–	8.35	2.65	–	–
Nitromanite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitrostarch Powder	–	–	–	–	–	–	–	–	–	–	0.32	–	–	–
Picric Acid	–	–	–	–	–	–	–	–	–	–	–	37.45	–	–
RDX/TNT/AL	–	–	–	–	–	–	–	–	–	–	10.45	–	–	–
RX-23	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Straight Dynamite	–	–	–	–	–	–	–	–	–	–	12.20	14.05	–	–
Straight Gelatin	–	–	–	–	–	–	–	–	–	–	5.15	–	–	–
XTX-8003	–	–	–	–	–	–	–	–	–	–	–	36.00	–	–
BTF	–	–	–	–	–	–	–	–	–	–	25.30	30.15	–	–
20 mm HEI M97 (Fuse M75)	–	–	–	–	–	–	–	–	–	–	–	–	23.1961	–
20mm HEII M97 (Fuse M505A3)	–	–	–	–	–	–	–	–	–	–	–	–	28.4603	–
NOWIH-80-1 (MK23)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
X256 (MK12)	-	–	–	–	–	–	–	–	–	–	–	–	–	3.9846

Table D-12 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - CO

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
N-60 (Smokey Sam)	-	–	–	–	–	–	–	–	–	–	–	–	–	5.7727
N-50 (5" G.P.)	-	–	–	–	–	–	–	–	–	–	–	–	–	0.0002
N-5 (ASROC and MK22)	-	–	–	–	–	–	–	–	–	–	–	–	–	9.6393
A-A-2 (MK90)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-6 (ZUNI)	-	–	–	–	–	–	–	–	–	–	–	–	–	1.1619
HEN-12 (RAPEC/SEAGNAT)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180/BX 185 (MK18 Booster)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-100/BX185 (MK18 Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180 H (CKU-5/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
TPH-9001 (CKU-7/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-106 (MK115)	-	–	–	–	–	–	–	–	–	–	–	–	–	4.7000
NOSIII (BC-10) (MQM-107)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
XM39 (LOVA)	-	–	–	–	–	–	–	–	–	–	–	–	–	11.3678
PBXN-103	-	–	–	–	–	–	–	–	–	–	–	–	–	0.0027
PBX(AF)-108	-	–	–	–	–	–	–	–	–	–	–	–	–	15.3227

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-13

EMISSION FACTORS FOR OD OPERATIONS - NO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
TNT	5.119	-	3.904	2.306	1.908	1.156	-	-	2.909	0	-	-	-	-
Explosive D	8.081	-	1.166	4.288	1.147	1.276	-	-	2.662	0	-	-	-	-
5"/38 Projectile (Explosive D)	3.512	-	3.513	-	.815	.419	-	-	2.065	-	-	-	-	-
Dynamite	3.994	-	3.369	3.256	4.271	1.555	-	-	3.289	-	-	-	-	-
175 mm Projectile (TNT)	4.320	-	1.195	3.283	.734	.201	-	-	1.777	-	-	-	-	-
3.5" Rocket (Comp-B)	1.664	-	2.180	2.471	1.520	-	-	-	2.018	-	-	-	-	-
500 lb Bomb MK82H6	-	1.308	3.458	2.444	.930	-	-	-	1.837	-	-	-	-	-
Comp-B	2.545	-	1.519	2.245	.711	.753	-	-	1.655	0	-	-	-	-
5"/38 Projectile (Comp-B)	2.549	-	3.597	5.859	2.264	5.976	-	-	4.413	-	-	-	-	-
250 lb Bomb MK81H6	6.853	-	-	5.214	9.262	1.228	-	-	6.522	-	-	-	-	-
90 mm Projectile (TNT)	.088	-	.085	.227	.163	.031	-	-	.145	-	-	-	-	-
Depth Bomb MK54-1 (HBX)	4.300	-	.977	.741	.623	.366	-	-	1.277	-	-	-	-	-
Torpedo Warhead MK16-16 (HBX)	-	-	10.976	7.697	7.003	2.103	-	-	8.247	-	-	-	-	-
Depth Charge MK4-0 (TNT)	.123	-	.215	.640	.510	.188	-	-	.347	-	-	-	-	-
Propellant M26E1 (Double-based)	-	-	-	-	-	-	-	-	-	0	-	-	-	-

Table D-13 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - NO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
500 lb Bomb (Tritonal)	1.099	–	2.027	.555	.438	.184	–	–	.861	–	–	–	–	–
Tritonal	–	–	–	–	–	–	–	–	–	0	–	–	–	–
PETN	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Lead Styphnate	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HMX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
RDX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NC (12.6% N)	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NQ	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NG	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Tetryl	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-A3	–	–	–	–	–	–	–	–	–	0	–	–	–	–
C4	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HBX-1	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Low Velocity Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
H6	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Medium Vel. Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M15	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M6	–	–	–	–	–	–	–	–	–	.1862	–	–	–	–
Propellant M10	–	–	–	–	–	–	–	–	–	.1862	–	–	–	–

Table D-13 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - NO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Propellant SPD	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M30A2	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-B3	–	–	–	–	–	–	–	–	–	–	0	–	–	–
PBX 9404	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-07-2	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-09	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 80/20	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 50/50	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonal 72/23.5/4.5	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonia Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Ammonia Gelatin	–	–	–	–	–	–	–	–	–	–	–	0	–	–
AN/AL Mix	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN/Al/H_2O	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN Dynamite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Black Powder	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Blasting Gelatin	–	–	–	–	–	–	–	–	–	–	–	0	–	–
DNT	–	–	–	–	–	–	–	–	–	–	0	–	–	–
1,2 DP	–	–	–	–	–	–	–	–	–	–	0	–	–	–
FEFO	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Gelatin Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–

Table D-13 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - NO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Gun powder	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Lead Azide	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-11-0	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Mercury Fulminate	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromethane	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromanite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitrostarch Powder	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Picric Acid	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RDX/TNT/AL	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RX-23	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Straight Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Straight Gelatin	–	–	–	–	–	–	–	–	–	–	0	–	–	–
XTX-8003	–	–	–	–	–	–	–	–	–	–	0	–	–	–
BTF	–	–	–	–	–	–	–	–	–	–	0	–	–	–
20 mm HEI M97 (Fuse M75)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
20mm HEII M97 (Fuse M505A3)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
NOWIII-80-1 (MK23)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
X256 (MK12)	-	–	–	–	–	–	–	–	–	–	–	–	–	0

Table D-13 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - NO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
N-60 (Smokey Sam)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-50 (5" G.P.)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-5 (ASROC and MK22)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-2 (MK90)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-6 (ZUNI)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
HEN-12 (RAPEC/SEAGNAT)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180/BX 185 (MK18 Booster)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-100/BX185 (MK18 Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180 II (CKU-5/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
TPH-9001 (CKU-7/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-106 (MK115)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
NOSIII (BC-10) (MQM-107)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
XM39 (LOVA)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-103	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBX(AF)-108	-	–	–	–	–	–	–	–	–	–	–	–	–	0

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-14

EMISSION FACTORS FOR OD OPERATIONS - SO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
TNT	.441	–	.092	.022	.067	0	–	–	.130	0	–	–	–	–
Explosive D	2.647	–	.373	1.305	.220	.248	–	–	.764	0	–	–	–	–
5"/38 Projectile (Explosive D)	0	–	.014	–	0	0	–	–	.004	–	–	–	–	–
Dynamite	.051	–	0	0	.171	0	–	–	.044	–	–	–	–	–
175 mm Projectile (TNT)	.218	–	.095	.030	.035	.037	–	–	.065	–	–	–	–	–
3.5" Rocket (Comp-B)	.232	–	.042	.023	.132	–	–	–	.076	–	–	–	–	–
500 lb Bomb MK82H6	–	.080	0	.301	.027	–	–	–	.096	–	–	–	–	–
Comp-B	.034	–	0	0	0	.010	–	–	.008	0	–	–	–	–
5"/38 Projectile (Comp-B)	1.060	–	.894	1.083	.875	1.163	–	–	.027	–	–	–	–	–
250 lb Bomb MK81H6	0	–	–	0	0	0	–	–	0	–	–	–	–	–
90 mm Projectile (TNT)	1.724	–	1.793	.663	.612	.079	–	–	.886	–	–	–	–	–
Depth Bomb MK54-1 (HBX)	3.408	–	.862	0	4.762	.140	–	–	1.849	–	–	–	–	–
Torpedo Warhead MK16-16 (HBX)	–	–	1.830	.343	.191	.193	–	–	.862	–	–	–	–	–
Depth Charge MK4-0 (TNT)	.706	–	1.095	1.621	1.477	.377	-	-	1.057	–	–	–	–	–
Propellant M26E1 (Double-based)	–	–	–	–	–	–	–	–	–	0	–	–	–	–

Table D-14 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - SO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Army Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
500 lb Bomb (Tritonal)	11.353	–	26.772	3.992	5.460	1.746	–	–	9.865	–	–	–	–	–
Tritonal	–	–	–	–	–	–	–	–	–	0	–	–	–	–
PETN	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Lead Styphnate	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HMX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
RDX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NC (12.6% N)	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NQ	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NG	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Tetryl	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-A3	–	–	–	–	–	–	–	–	–	0	–	–	–	–
C4	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HBX-1	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Low Velocity Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
H6	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Medium Vel. Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M15	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M6	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M10	–	–	–	–	–	–	–	–	–	0	–	–	–	–

Table D-14 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - SO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Propellant SPD	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M30A2	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-B3	–	–	–	–	–	–	–	–	–	–	0	–	–	–
PBX 9404	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-07-2	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-09	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 80/20	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 50/50	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonal 72/23.5/4.5	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonia Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Ammonia Gelatin	–	–	–	–	–	–	–	–	–	–	12.8	–	–	–
AN/AL Mix	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN/AL/H_2O	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN Dynamite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Black Powder	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Blasting Gelatin	–	–	–	–	–	–	–	–	–	–	–	0	–	–
DNT	–	–	–	–	–	–	–	–	–	–	0	–	–	–
1,2 DP	–	–	–	–	–	–	–	–	–	–	0	–	–	–
FEFO	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Gelatin Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–

Table D-14 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - SO_2

Material	Emission Factors (lb/100 lbs of Material) Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Gun powder	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Lead Azide	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-11-0	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Mercury Fulminate	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromethane	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromanite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitrostarch Powder	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Picric Acid	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RDX/TNT/AL	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RX-23	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Straight Dynamite	–	–	–	–	–	–	–	–	–	–	–	0	–	–
Straight Gelatin	–	–	–	–	–	–	–	–	–	–	0	–	–	–
XTX-8003	–	–	–	–	–	–	–	–	–	–	0	–	–	–
BTF	–	–	–	–	–	–	–	–	–	–	0	–	–	–
20 mm HEI M97 (Fuse M75)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
20mm HEII M97 (Fuse M505A3)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
NOWIII-80-1 (MK23)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
X256 (MK12)	-	–	–	–	–	–	–	–	–	–	–	–	–	0

Table D-14 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - SO_2

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
N-60 (Smokey Sam)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-50 (5" G.P.)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-5 (ASROC and MK22)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-2 (MK90)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-6 (ZUNI)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
HEN-12 (RAPEC/SEAGNAT)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180/BX 185 (MK18 Booster)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-100/BX185 (MK18 Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180 H (CKU-5/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
TPH-9001 (CKU-7/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-106 (MK115)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
NOSIH (BC-10) (MQM-107)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
XM39 (LOVA)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-103	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBX(AF)-108	-	–	–	–	–	–	–	–	–	–	–	–	–	0

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-15

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
TNT	2.343	–	2.161	1.114	.797	.696	–	–	1.249	0	–	–	–	–
Explosive D	2.079	–	.269	.525	.211	.359	–	–	.584	0	–	–	–	–
5"/38 Projectile (Explosive D)	1.343	–	.996	–	.155	.092	–	–	.647	–	–	–	–	–
Dynamite	.502	–	.141	.523	.739	.393	–	–	.460	–	–	–	–	–
175 mm Projectile (TNT)	1.376	–	.481	.995	.379	.062	–	–	.611	–	–	–	–	–
3.5" Rocket (Comp-B)	.370	–	.489	.587	.419	–	–	–	.489	–	–	–	–	–
500 lb Bomb MK82H6	–	.339	.748	1.007	.249	–	–	–	.518	–	–	–	–	–
Comp-B	.551	–	.441	.758	.403	.214	–	–	.497	0	–	–	–	–
5"/38 Projectile (Comp-B)	.120	–	.438	.515	.218	.464	–	–	.543	–	–	–	–	–
250 lb Bomb MK81H6	1.432	–	–	1.568	2.439	.239	–	–	1.656	–	–	–	–	–
90 mm Projectile (TNT)	.524	–	.722	.425	.157	.065	–	–	.387	–	–	–	–	–
Depth Bomb MK54-1 (HBX)	.888	–	.214	.168	.139	.088	–	–	.274	–	–	–	–	–
Torpedo Warhead MK16-16 (HBX)	–	–	2.051	.997	.673	.350	–	–	1.260	–	–	–	–	–
Depth Charge MK4-0 (TNT)	.648	–	.912	1.615	1.253	.568	-	-	1.008	–	–	–	–	–
Propellant M26E1 (Double-based)	–	–	–	–	–	–	–	–	–	0	–	–	–	–

Table D-15 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
500 lb Bomb (Tritonal)	.276	–	.466	.134	.094	.046	–	–	.203	–	–	–	–	–
Tritonal	–	–	–	–	–	–	–	–	–	0	–	–	–	–
PETN	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Lead Styphnate	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HMX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
RDX	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NC (12.6% N)	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NQ	–	–	–	–	–	–	–	–	–	0	–	–	–	–
NG	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Tetryl	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-A3	–	–	–	–	–	–	–	–	–	0	–	–	–	–
C4	–	–	–	–	–	–	–	–	–	0	–	–	–	–
HBX-1	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Low Velocity Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
H6	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Medium Vel. Dynamite	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M15	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M6	–	–	–	–	–	–	–	–	–	.1862	–	–	–	–
Propellant M10	–	–	–	–	–	–	–	–	–	.1862	–	–	–	–

Table D-15 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Propellant SPD	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Propellant M30A2	–	–	–	–	–	–	–	–	–	0	–	–	–	–
Comp-B3	–	–	–	–	–	–	–	–	–	–	0	–	–	–
PBX 9404	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-07-2	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-09	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 80/20	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Amatol 50/50	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonal 72/23.5/4.5	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Ammonia Dynamite	–	–	–	–	–	–	–	–	–	–	–	1.55	–	–
Ammonia Gelatin	–	–	–	–	–	–	–	–	–	–	–	0.29	–	–
AN/AL Mix	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN/Al/H_2O	–	–	–	–	–	–	–	–	–	–	0	–	–	–
AN Dynamite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Black Powder	–	–	–	–	–	–	–	–	–	–	–	1.22	–	–
Blasting Gelatin	–	–	–	–	–	–	–	–	–	–	–	0	–	–
DNT	–	–	–	–	–	–	–	–	–	–	0	–	–	–
1,2 DP	–	–	–	–	–	–	–	–	–	–	0	–	–	–
FEFO	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Gelatin Dynamite	–	–	–	–	–	–	–	–	–	–	–	0.20	–	–

Table D-15 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
Gun powder	–	–	–	–	–	–	–	–	–	–	–	1.03	–	–
Lead Azide	–	–	–	–	–	–	–	–	–	–	0	–	–	–
LX-11-0	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Mercury Fulminate	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromethane	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitromanite	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Nitrostarch Powder	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Picric Acid	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RDX/INT/AL	–	–	–	–	–	–	–	–	–	–	0	–	–	–
RX-23	–	–	–	–	–	–	–	–	–	–	0	–	–	–
Straight Dynamits	–	–	–	–	–	–	–	–	–	–	–	0.28	–	–
Straight Gelatin	–	–	–	–	–	–	–	–	–	–	0	–	–	–
XTX-8003	–	–	–	–	–	–	–	–	–	–	0	–	–	–
BTF	–	–	–	–	–	–	–	–	–	–	0	–	–	–
20 mm HEI M97 (Fuse M75)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
20mm HEII M97 (Fuse M505A3)	–	–	–	–	–	–	–	–	–	–	–	–	0	–
NOWIII-80-1 (MK23)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
X256 (MK12)	-	–	–	–	–	–	–	–	–	–	–	–	–	0

Table D-15 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
N-60 (Smokey Sam)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-50 (5" G.P.)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-5 (ASROC and MK22)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-2 (MK90)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-6 (ZUNI)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
HEN-12 (RAPEC/SEAGNAT)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180/BX 185 (MK18 Booster)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-100/BX185 (MK18 Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180 H (CKU-5/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
TPH-9001 (CKU-7/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-106 (MK115)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
NOSIH (BC-10) (MQM-107)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
XM39 (LOVA)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-103	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBX(AF)-108	-	–	–	–	–	–	–	–	–	–	–	–	–	.1046

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-15 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - H_2S

Material	Emission Factors (lb/100 lbs of Material)													
	Consolidated Report Amount Detonated (lb)									1986 Amy Computer Program (a)	RV Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
	100	200	500	1000	2000	5000	10,000	15,000	Average		Calculated	Experimental		
N-60 (Smokey Sam)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-50 (5" G.P.)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
N-5 (ASROC and MK22)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-2 (MK90)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
A-A-6 (ZUNI)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
HEN-12 (RAPEC/SEAGNAT)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180/BX 185 (MK18 Booster)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-100/BX185 (MK18 Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
BX-180 II (CKU-5/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
TPH-9001 (CKU-7/A Sustainer)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-106 (MK115)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
NOSIH (BC-10) (MQM-107)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
XM39 (LOVA)	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBXN-103	-	–	–	–	–	–	–	–	–	–	–	–	–	0
PBX(AF)-108	-	–	–	–	–	–	–	–	–	–	–	–	–	.1046

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-16

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PETN	------	-------	NH_3 (.65), CH_3OH (1.79), CH_2O_2 (17.35)	NH_3 (.13)	-------	-------
Lead Styphnate	------	Pb (44.2450)	------	------	------	------
HMX			NH_3 (.20), HCN (.0001)	NH_3 (.49), HCN (.030), C_2H_6 (.010)		
RDX	------	-------	NH_3 (2.18), CH_3OH (6.85), C_2H_5OH (0.30)	------	------	------
TNT	------	NH_3 (0.0035)	NH_3 (1.20), HCN (1.95), CH_3OH (10.70), C_2H_5OH (5.05), C_2N_6 (1.68), CH_2O (.90), C_2H_4 (.28), CH_2O_2 (.92)	NH_3 (1.44), HCN (1.38), C_2H_2 (6.05), C_2H_6 (.053)	------	------
NC	------	NH_3 (.0001)	------	------	------	------
NQ	------	NH_3 (.0096)	------	------	------	------
Tetryl	------	NH_3 (.0006)	NH_3 (1.79), HCN (9.05)	HCN (1.62), C_2H_2 (3.12)	------	------
Explosive D	------	NH_3 (.0034)	------	------	------	------

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Tritonal	------	Al (20.0011), HCN (.0002), NH_3 (.0008)	NH_3 (0.34), HCN (3.87),CH_3OH (1.50), C_2H_5OH (4.14)	------	------	------
Comp-A3	------	NH_3 (.0029)	------	------	------	------
Comp-B	------	NH_3 (.0011)	NH_3 (0.34), CH_3OH (16.0), CH_2O_2 (4.15), C_2H_6 (2.18)	CH_2O_2 (1.38), C_2H_2 (1.49), Al (19.99)	------	------
C4	------	NH_3 (.0043)	------	------	------	------
HBX-1	------	Al (16.9159), HCN (.0001), NH_3 (.0011), HCl (.0002), CaOH (.0001), $CaCl_2$ (.4966)	------	------	------	------
Dynamite (LV)	------	NH_3 (.0067)	------	------	------	------
H6	------	Al (19.9011), HCl (.0010), CaOH (.0008), NH_3 (.0006), $CaCl_2$ (.4897)	------	------	------	------
Dynamite (MV)	------	NH_3 (.0035)	------	------	------	------
Propellant M26E1	------	NH_3 (.0003)	------	------	------	------

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Propellant M15	------	HF (.0953), Al (.0643), NH_3 (.0014), $NaAlF_4$ (.0001),Na_3AlF (.1666)	------	------	------	------
Propellant M6	------	CSO (.0098), NH_3 (.0023)	------	------	------	------
Propellant M10	------	CSO (.0098), NH_3 (.0023)	------	------	------	------
Propellant SPD	------	NH_3 (.0002)	------	------	------	------
Amatol 50/50	------	------	NH_3 (3.06), HCN (2.80), CH_3OH 9.60), CaO (0.56), CH_2O_2 (5.70)	------	------	------
Amatol 80/20	------	------	------	NH_3 (.61), HCN (.24)	------	------
Ammonal 72/23.5/4.5	------	------	------	Al (22.35)	------	------
Ammonia Gelatin	------	------	CaO (0.28)	------	------	------
AN/AL Mix	------	------	NH_3 (1.13)	------	------	------
AN/AL/H_2O	------	------	NH_3 (9.00), Al (14.40)	------	------	------
AN Dynamite	------	------	CaO (0.26)	------	------	------

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
BTF	------	------	NH_3 (0.0085), HCN (.051), HCl (.34)	NH_3 (.024), HCN (.065)	------	------
DNT	------	------	NH_3 (1.70), HCN (2.70), CH_3OH (8.00), CH_2O_2 (0.48)	------	------	------
1,2 DP	------	------	NH_3 (0.31), HF (54.60), CF_4 (0.28)	NH_3 (.32), HF (49.05), C_2H_2 (.19), C_2H_6 (.04)	------	------
FEFO	------	------	NH_3 (0.12), HF (11.65), CF_4 (0.60)	NH_3 (.12), HF (11.70),	------	------
Lead Azide	------	------	Pb (70.4)	------	------	------
LX-11-0	------	------	NH_3 (0.29), HCN (.0010), HF (2.65), CF_4 (6.95)	NH_3 (.79), HCN (.044), HF (13.40), CF_4 (.44)	------	------
Mercury Fulminate	------	------	Hg (74.00)	------	------	------
Nitromethane	------	------	NH_3 (0.63)	NH_3 (3.40), HCN (.36), C_2H_6 (.050)	------	------
Picric Acid	------	------	NH_3 (.46), HCN (1.12), C_2H_2 (4.19)	------	------	------

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
			R.V. Carter			
	Consolidated Report	1986 Army Computer Program (a)	Calculated	Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
RDX/TNT/AL	------	------	NH_3 (.40), CH_3OH (1.65), C_2H_5OH (5.70), C_2H_6 (1.28), C_2H_4 (1.21), CH_2O_2 (1.53), Al (24.98)	------	------	------
RX-23	------	------	NH_3 (19.25)	NH_3 (15.90)	------	------
Straight Dynamite	------	------	NH_3 (0.34), CaO (1.40)	------	------	------
Straight Gelatin	------	------	NH_3 (0.80), CH_3OH (1.28), CaO (0.66)	------	------	------
XTX-8003	------	------	------	NH_3 (.68), HCN (0.026), SiO_2 (16.20), C_2H_2 (0.042), C_2H_6 (.060)	------	------
20mm HEI M97 (Fuse M75)	------	------	------	------	Pb (.1850), Ba (.8196), Hg (.8665), Al (.9250), MgO (.6911), Ba (.8196), NH_3 (.0025)	------
20mm HEI M97 (Fuse M505A3)	------	------	------	------	Al (3.7202), Ba (.0683), NH_3 (.0031)	------

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
NOWIH-80-1 (MK23)	------	------	------	------	------	Al (2.0013), Fe (.3886), P (.0647) HCl (23.1067) $FeCl_3$ (.0013) Cl_2(1.7488), HOCl (.0058), Cl (.0007)
X256 (MK12)	------	------	------	------	------	Al (3.7802), Pb (1.7418)
N-60 (Smokey Sam)	------	------	------	------	------	Fe(.6996), Zn (40.0120) $ZnCl_2$ (22.8093), HCl (1.4511) NH_3 (.0005), $FeCl_2$ (.0056)
N-50 (5" G.P.)	------	------	------	------	------	Al (18.9964), Fe (.1476), HCl (21.0568), $FeCl_2$ (.3348) NH_3 (.0001),

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter		1988 Army Computer Program (a)	1987 Navy Computer Program (a)
			Calculated	Experimental		
						Fe_2Cl_4 (.0001), $FeCl_3$(.0002) Cl (.0003)
N-5 (ASROC and MK 22)	------	------	------	------	------	Pb (1.0328), NH_3 (.0047)
AA2 (MK 90)	------	------	------	------	------	Cu (.9445), Pb (.4441)
AA6 (ZUNI)	------	------	------	------	------	Al (1.5008), Cu (.8032), Pb (.3022)
HEN-12 (RAPEC/SEAGNAT)	------	------	------	------	------	Cu (.7298), Pb (1.3726)
BX-180/BX-185 (MK 18 Booster)	------	------	------	------	------	Al (1.4956), P (.0432), Fe (1.5387), HCl (23.4627) $FeCl_3$ (.0019),Cl_2 (.9492), HOCl (.0042) Cl (.0010)

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
BX-100/BX-185 (MK 18 Sustainer)	------	------	------	------	------	Al (1.4971), P (.0431), Fe (2.8618), HCl (20.4442), $FeCl_3$ (.0004), Cl_2 (3.9077), HOCl (.0072) Cl (.0002)
BX-180 H (CKU-5/A Sustainer)	------	------	------	------	------	Al (2.001), P (.0288), Fe (1.3988), HCl (22.2636), $FeCl_3$ (.0008), Cl_2 (2.4879), HOCl (.0066) Cl (.0005)
TPH-9001 (CKU-7/A Sustainer)	------	------	------	------	------	Al (2.0001), P (.0069), Fe (1.2589), HCl (21.3580), $FeCl_3$ (.0006), Cl_2 (3.3684), HOCl (.0071), Cl (.0003)

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PBXN-106 (MK 115)	------	------	------	------	------	Fe (.0022), NH_3 (.0006)
NOSIH (BC-10) (MQM-107)	------	------	------	------	------	Al (44.0025), Fe (.8393), HCl (12.2627), HCN (.0001), $AlCl_3$ (.0008), $FeCl_2$ (1.8222), AlOCl (.0006), FeCl (.0025), NH_3 (.0001), $FeCl_3$ (.0003), HOCl (.0007), $AlCl_2$ (.0059), AlCl (.0011), Cl (.0563)
XM39 (LOVA)	------	------	------	------	------	NH_3 (.0045)

Table D-16 (Cont'd)

EMISSION FACTORS FOR OD OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)					
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter Calculated	R.V. Carter Experimental	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PBXN-103	------	------	------	------	------	Al (27.0015), HCl (12.1715), Cl_2 (.0272), HOCl (.0036), OCl (.0010), Cl (2.053)
PBX (AF)-108	------	------	------	------	------	NH_3 (.0092), CSO (.0032)

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-17

EMISSION FACTORS FOR OB OPERATIONS - CO

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PETN	-----	0	-----	-----	-----
Lead Styphnate	-----	0	-----	-----	-----
HMX	-----	0	-----	-----	-----
RDX	-----	0	-----	-----	-----
TNT	-----	52.6555	2.80		
NC	-----	3.6013	-----	-----	-----
NQ	-----	0	-----	-----	-----
NG	-----	0	-----	-----	-----
Tetryl	-----	22.2758	-----	-----	-----
Explosive D	-----	23.4918	-----	-----	-----
Tritonal	-----	60.8801	-----	-----	-----
Comp-A3	-----	16.2577	-----	-----	-----
Comp-B	-----	16.6739	-----	-----	-----
C_4	-----	18.0681	-----	-----	-----
HBX-1	-----	42.9848	-----	-----	-----
Dynamite (LV)	-----	49.2521	-----	-----	-----
H6	-----	40.1431	-----	-----	-----

Table D-17 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - CO

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)	-----	18.8533	-----	-----	-----
Propellant M26E1	.022	9.3893	-----	-----	-----
Propellant M15	-----	6.9543	-----	-----	-----
Propellant M6	-----	20.4589	-----	-----	-----
Propellant M10	-----	20.4589	-----	-----	-----
Propellant SPD	-----	6.6205	-----	-----	-----
Propellant M30A2	-----	0	-----	-----	-----
Comp-B3	-----	-----	0.25	-----	------
PBX 9404	-----	-----	0.28	-----	-----
LX-07-2	-----	-----	0.070	-----	-----
LX-09	-----	-----	0.050	-----	-----
Propellant SPDF	1.746	-----	-----	-----	-----
Propellant SPCF	3.895	-----	------	-----	-----
Propellant M1	-----	-----	-----	22.5542	-----
Propellant M5	-----	-----	-----	.0002	-----
Propellant M8	-----	-----	-----	0	-----
Polaris 2nd Stage Rocket Motor (MK6-0)	-----	-----	-----	0.3178	-----

Table D-17 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - CO

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
JATO Rocket Motor M3A2E1	-----	-----	-----	12.3954	-----
2.75" Rocket Motor MK 40	-----	-----	-----	14.0291	-----
JATO Rocket Motor MK6-1	-----	-----	-----	0	-----
NOWIH-80-1 (MK 23)	-----	-----	-----	-----	0
X256 (MK 12)	-----	-----	-----	-----	5.4506
N-60 (Smokey Sam)	-----	-----	-----	-----	6.6915
N-50 (5" G.P.)	-----	-----	-----	-----	0.0938
N-5 (ASROC and MK 22)	-----	-----	-----	-----	13.6914
AA2 (MK 90)	-----	-----	-----	-----	0.0003
AA6 (ZUNI)	-----	-----	-----	-----	1.6507
HEN-12 (RAPEC/SEAGNAT)	-----	-----	-----	-----	0.0005
BX-180/BX185 (MK 18 Booster)	-----	-----	-----	-----	0
BX-100/BX185 (MK 18 Sustainer)	-----	-----	-----	-----	0
BX-180 H (CKU-5/A Sustainer)	-----	-----	-----	-----	0
TPH-9001 (CKU-7/A Sustainer)	-----	-----	-----	-----	0
PBXN-106 (MK 115)	-----	-----	-----	-----	7.9900

Table D-17 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - CO

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
NOSIH (BC-10) (MQM-107)	-----	-----	-----	-----	21.5448
XM39 (LOVA)	-----	-----	-----	-----	18.0189
PBXN-103	-----	-----	-----	-----	0.5167
PBX(AF)-108	-----	-----	-----	-----	10.7795

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-18

EMISSION FACTORS FOR OB OPERATIONS - NO$_2$

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PETN	-----	0	-----	-----	-----
Lead Styphnate	-----	0	-----	-----	-----
HMX	-----	0	-----	-----	-----
RDX	-----	0	-----	-----	-----
TNT	-----	0	7:50		
NC	-----	0	-----	-----	-----
NQ	-----	0	-----	-----	-----
NG	-----	.0003			
Tetryl	-----	0	-----	-----	-----
Explosive D	-----	0	-----	-----	-----
Tritonal	-----	0	-----	-----	-----
Comp-A3	-----	0	-----	-----	-----
Comp-B	-----	0	-----	-----	-----
C$_4$	-----	0	-----	-----	-----
HBX-1	-----	0	-----	-----	-----
Dynamite (LV)	-----	0	-----	-----	-----
H6	-----	0	-----	-----	-----

Table D-18 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - NO_2

Material	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)	-----	0	-----	-----	-----
Propellant M26E1	.001	0	-----	-----	-----
Propellant M15	-----	0	-----	-----	-----
Propellant M6	-----	0	-----	-----	-----
Propellant M10	-----	0	-----	-----	-----
Propellant SPD	-----	0	-----	-----	-----
Propellant M30A2	-----	0	-----	-----	-----
Comp-B3	-----	-----	1.86	-----	-----
PBX 9404	-----	-----	1.90	-----	-----
LX-07-2	-----	-----	1.40	-----	-----
LX-09	-----	-----	1.45	-----	-----
Propellant SPDF	.340	-----	-----	-----	-----
Propellant SPCF	.826	-----	-----	-----	-----
Propellant M1	-----	-----	-----	0	-----
Propellant M5	-----	-----	-----	0	-----
Propellant M8	-----	-----	-----	0	-----
Polaris 2d Stage Rocket Motor (MK6-0)	-----	-----	-----	0	-----

Emission Factor (lb/100 lb of Material)

Table D-18 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - NO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
JATO Rocket Motor M3A2E1	-----	-----	-----	0	-----
2.75" Rocket Motor MK40	-----	-----	-----	0	-----
JATO Rocket Motor MK6-1	-----	-----	-----	0	-----
NOWIH-80-1 (MK 23)	-----	-----	-----	-----	0
X256 (MK 12)	-----	-----	-----	-----	0
N-60 (Smokey Sam)	-----	-----	-----	-----	0
N-50 (5" G.P.)	-----	-----	-----	-----	0
N-5 (ASROC and MK 22)	-----	-----	-----	-----	0
AA2 (MK 90)	-----	-----	-----	-----	0
AA6 (ZUNI)	-----	-----	-----	-----	0
HEN-12 (RAPEC/SEAGNAT)	-----	-----	-----	-----	0
BX-180/BX185 (MK 18 Booster)	-----	-----	-----	-----	0
BX-100/BX185 (MK 18 Sustainer)	-----	-----	-----	-----	0
BX-180 H (CKU-5/A Sustainer)	-----	-----	-----	-----	0
TPH-9001 (CKU-7/A Sustainer)	-----	-----	-----	-----	0
PBXN-106 (MK 115)	-----	-----	-----	-----	0

Table D-18 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - NO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
NOSIH (BC-10) (MQM-107)	-----	-----	-----	-----	0
XM39 (LOVA)	-----	-----	-----	-----	0
PBXN-103	-----	-----	-----	-----	0
PBX(AF)-108	-----	-----	-----	-----	0

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-19

EMISSION FACTORS FOR OB OPERATIONS - SO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PETN	-----	0	-----	-----	-----
Lead Styphnate	-----	0	-----	-----	-----
HMX	-----	0	-----	-----	-----
RDX	-----	0	-----	-----	-----
TNT	-----	0	-----	-----	-----
NC	-----	0	-----	-----	-----
NQ	-----	0	-----	-----	-----
NG	-----	0	-----	-----	-----
Tetryl	-----	0	-----	-----	-----
Explosive D	-----	0	-----	-----	-----
Tritonal	-----	0	-----	-----	-----
Comp-A3	-----	0	-----	-----	-----
Comp-B	-----	0	-----	-----	-----
C_4	-----	0	-----	-----	-----
HBX-1	-----	0	-----	-----	-----
Dynamite (LV)	-----	0	-----	-----	-----
H6	-----	0	-----	-----	-----

Table D-19 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - SO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)		0	-----	-----	-----
Propellant M26E1	.006	0	-----	-----	-----
Propellant M15	-----	0	-----	-----	-----
Propellant M6	-----	.0001	-----	-----	-----
Propellant M10	-----	.0001	-----	-----	-----
Propellant SPD	-----	0	-----	-----	-----
Propellant M30A2	-----	0	-----	-----	-----
Comp-B3	-----	-----	-----	-----	-----
PBX 9404	-----	-----	-----	-----	-----
LX-07-2	-----	-----	-----	-----	-----
LX-09	-----	-----	-----	-----	-----
Propellant SPDF	.102	-----	-----	-----	-----
Propellant SPCF	.138	-----	-----	-----	-----
Propellant M1	-----	-----	-----	-----	-----
Propellant M5	-----	-----	-----	-----	-----
Propellant M8	-----	-----	-----	-----	-----
Polaris 2nd Stage Rocket Motor (MK6-0)	-----	-----	-----	-----	-----

Table D-19 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - SO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
JATO Rocket Motor M3A2E1	-----	-----	-----	.0150	-----
2.75" Rocket Motor MK 40	-----	-----	-----	.0001	-----
JATO Rocket Motor MK6-1	-----	-----	-----	.0131	-----
NOWIH-80-1 (MK 23)	-----	-----	-----	-----	0
X256 (MK 12)	-----	-----	-----	-----	0
N-60 (Smokey Sam)	-----	-----	-----	-----	0
N-50 (5" G.P.)	-----	-----	-----	-----	0
N-5 (ASROC and MK 22)	-----	-----	-----	-----	0
AA2 (MK 90)	-----	-----	-----	-----	0
AA6 (ZUNI)	-----	-----	-----	-----	0
HEN-12 (RAPEC/SEAGNAT)	-----	-----	-----	-----	0
BX-180/BX185 (MK 18 Booster)	-----	-----	-----	-----	0
BX-100/BX185 (MK 18 Sustainer)	-----	-----	-----	-----	0
BX-180 H (CKU-5/A Sustainer)	-----	-----	-----	-----	0
TPH-9001 (CKU-7/A Sustainer)	-----	-----	-----	-----	0
PBXN-106 (MK 115)	-----	-----	-----	-----	0

Table D-19 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - SO_2

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
NOSIH (BC-10) (MQM-107)	-----	-----	-----	-----	0
XM39 (LOVA)	-----	-----	-----	-----	0
PBXN-103	-----	-----	-----	-----	0
PBX(AF)-108	-----	-----	-----	-----	0

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-20

EMISSION FACTORS FOR OB OPERATIONS - H_2S

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PETN	—	0	—	—	—
Lead Styphnate	—	0	—	—	—
HMX	—	0	—	—	—
RDX	—	0	—	—	—
TNT	—	0	—	—	—
NC	—	0	—	—	—
NQ	—	0	—	—	—
NG	—	0	—	—	—
Tetryl	—	0	—	—	—
Explosive D	—	0	—	—	—
Tritonal	—	0	—	—	—
Comp-A3	—	0	—	—	—
Comp-B	—	0	—	—	—
C_4	—	0	—	—	—
HBX-1	—	0	—	—	—
Dynamite (LV)	—	0	—	—	—
H6	—	0	—	—	—

Table D-20 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - H_2S

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.Y. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)	—	0	—	—	—
Propellant M26E1	.001	0	—	—	—
Propellant M15	—	0	—	—	—
Propellant M6	—	.1805	—	—	—
Propellant M10	—	.1805	—	—	—
Propellant SPD	—	0	—	—	—
Propellant M30A2	—	0	—	—	—
Comp B3	—	—	0	—	—
PBX 9404	—	—	0	—	—
LX-07-2	—	—	0	—	—
LX-09	—	—	0	—	—
Propellant SPDF	.045	—	—	—	—
Propellant SPCF	.069	—	—	—	—
Propellant M1	—	—	—	0	—
Propellant M5	—	—	—	0	—
Propellant M8	—	—	—	0	—
Polaris 2nd Stage Rocket Motor (MK6-0)	—	—	—	0	—

Table D-20 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - H_2S

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)	—	0	—	—	—
Propellant M26E1	.001	0	—	—	—
Propellant M15	—	0	—	—	—
Propellant M6	—	.1805	—	—	—
Propellant M10	—	.1805	—	—	—
Propellant SPD	—	0	—	—	—
Propellant M30A2	—	0	—	—	—
Comp B3	—	—	0	—	—
PBX 9404	—	—	0	—	—
LX-07-2	—	—	0	—	—
LX-09	—	—	0	—	—
Propellant SPDF	.045	—	—	—	—
Propellant SPCF	.069	—	—	—	—
Propellant M1	—	—	—	0	—
Propellant M5	—	—	—	0	—
Propellant M8	—	—	—	0	—
Polaris 2nd Stage Rocket Motor (MK6-0)	—	—	—	0	—

Table D-20 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - H_2S

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
JATO Rocket Motor M3A2E1	—	—	—	.2857	—
2.75" Rocket Motor MK40	—	—	—	.0106	—
JATO Rocket Motor MK6-1	—	—	—	0	—
NOWIH-80-1 (MK 23)	—	—	—	—	0
X256 (MK 12)	—	—	—	—	0
N-60 (Smokey Sam)	—	—	—	—	0
N-50 (5" G.P.)	—	—	—	—	0
N-5 (ASROC and MK 22)	—	—	—	—	0
AA2 (MK 90)	—	—	—	—	0
AA6 (ZUNI)	—	—	—	—	0
HEN-12 (RAPEC/SEAGNAT)	—	—	—	—	0
BX-180/BX185 (MK 18 Booster)	—	—	—	—	0
BX-100/BX185 (MK 18 Sustainer)	—	—	—	—	0
BX-180 H (CKU-5/A Sustainer)	—	—	—	—	0
TPH-9001 (CKU-7/A Sustainer)	—	—	—	—	0
PBXN-106 (MK 115)	—	—	—	—	0

Table D-20 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - H_2S

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
NOSIH (BC-10) (MQM-107)	—	—	—	—	0
XM39 (LOVA)	—	—	—	—	0
PBXN-103	—	—	—	—	0
PBX(AF)-108	—	—	—	—	0.1031

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-21

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Lead Styphnate	—	Pb (44.24)	—	—	—
TNT	—	NH_3 (.0016), HCN (.0001)	HC_x (.050), Sooth (9.00), Ash (12.00)	—	—
Explosive D	—	NH_3 (.0004)	—	—	—
Tritonal	—	Al (20.00), HCN (.0001), NH_3 (.0002)	—	—	—
Comp-A3	—	NH_3 (.0002)	—	—	—
Comp-B	—	NH_3 (.0001)	—	—	—
C_4	—	NH_3 (.0003)	—	—	—
HBX-1	—	Al (16.92), $CaCl_2$ (.4493), CaCl (.0006), NH_3 (.0002)	—	—	—
Dynamite (LV)	—	NH_3 (.0054), HCN (.0001)	—	—	—
H6	—	Al (19.90), $CaCl_2$ (.4143), CaCl (.0014), HCl (.0540), CaOH (.0417), NH_3 (.0001)	—	—	—

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Dynamite (MV)	—	NH_3 (.0003)	—	—	—
Propellant M15	—	HF (.1891), NH3 (.0001), $NaAlF_4$ (.0003), NaF (.0022), Na_2F_2 (.0005)	—	—	—
Propellant M6	—	CSO (.0193), NH_3 (.0003), HS (.0001)	—	—	—
Propellant M10	—	CSO (.0193), NH_3 (.0003), HS (.0001)	—	—	—
PBX 9404	—	—	HCl (1.15), P_2O_5 (.65), Ash (2.95)	—	—
LX-07-2	—	—	HF (2.70), N_2O (.043), HC_x (.20), Ash (8.10)	—	—
LX-09	—	—	HF (.30), Ash (3.20)	—	—
Propellant M1	—	—	—	NH_3 (.0003)	—
Propellant SPCF	Pb (.7754)	----	----	----	----

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
Polaris 2nd Stage Rocket Motor (MK6-0)	—	—	—	Al (17.90), HCl (1.4718), Cl (.0776), $AlCl_2$ (2.5698), Cl_2 (.0001)	—
JATO Rocket Motor M3A2E1	—	—	—	Pb (.1334), CSO (.0391), NH_3 (.0001), HS (.0010), S_2 (.0042)	—
2.75" Rocket Motor MK40	—	—	—	Pb (1.0167), NH_3 (.0001), CSO (.0012)	—
JATO Rocket Motor MK6-1	—	—	—	Cu (.1205), HCl (22.9209), KCl (.1176), CaCl (.1878), Cl (.0193), Cl_2 (.1575)	—
NOWIH-80-1 (MK 23)	—	—	—	—	Cl_2 (.1796), Al (2.0013), Fe (0.3886), HCl (24.6523), $FeCl_2$ (.0286), $FeCl_3$ (.0166), HOCl (.0061), OCl (.0003), Cl (.0406), P (.0647)

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
X256 (MK 12)	—	—	—	—	Al (3.7802), Fe (1.7418)
N-60 (Smokey Sam)	—	—	—	—	Fe (.6996), Zn (40.0120), $ZnCl_2$ (23.1785), HCl (1.2510), $FeCl_2$ (.0099), NH_3 (.0001)
N-50 (5" G.P.)	—	—	—	—	Al (18.9964), Fe (.1476), HCl (20.5492), $FeCl_2$ (.3332), Cl_2 (.0140), $AlCl_3$ (.0001), $FeCl_3$ (.0021), HOCl (.0028), OCl (.0009), Cl (.5146)
N-5 (ASROC MK 22)	—	—	—	—	Pb (1.0328), NH_3 (.0001)
AA2 (MK 90)	—	—	—	—	Cu (.9445), Pb (.4441)
AA6 (ZUNI)	—	—	—	—	Al (1.5008), Cu (.8032), Pb (.3022)
HEN-12 (RAPEC/SEAGNAT)	—	—	—	—	Cu (.7298), Pb (1.3726)

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.Y. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
BX-180/BX185 (MK 18 Booster)	—	—	—	—	Al (1.4956), P (.0432), Fe (1.5387), HCl (24.2469), $FeCl_2$ (.0502), $FeCl_3$ (.0173), Cl_2 (.1069), HOCl (.0043), OCl (.0002), Cl (.0425)
BX-100/BX185 (MK 18 Sustainer)	—	—	—	—	Al (1.4971), P (.0431), Fe (2.8618), HCl (24.0596), $FeCl_2$ (.0075), $FeCl_3$ (.0118), Cl_2 (.3534), HOCl (.0083), OCl (.0003), Cl (.0264)
BX-180 H (CKU-5/A Sustainer)	—	—	—	—	Al (2.0001), P (.0288), Fe (1.3988), HCl (24.5261), $FeCl_2$ (.0165), $FeCl_3$ (.0140), Cl_2 (.2351), HOCl (.0071), OCl (.0083), Cl (.0348)

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
TPH-9001 (CKU-7/A Sustainer)	—	—	—	—	Al (2.001), P (.0069), Fe (1.2589), HCl (24.4646), $FeCl_2$ (.0114), $FeCl_3$ (.0132), Cl_2 (.3011), HOCl (.0080), OCl (.0003), Cl (.0315)
PBXN-106 (MK 115)	—	—	—	—	Fe (.0022)
NOSIH (BC-10) (MQM-107)	—	—	—	—	Al (44.0025), Fe (.8393), HCl (12.3211), HCN (.0001), AlOCl (.0107), $FeCl_2$ (1.2897), $AlCl_3$ (.0019), FeCl (.0117), NH_3 (.0001), Cl_2 (.0001), $FeCl_3$ (1.0002), Cl (.2486), AlCl (.0239), $AlCl_2$ (.0428)
XM39 (LOVA)	—	—	—	—	NH_3 (.0004)

Table D-21 (Cont'd)

EMISSION FACTORS FOR OB OPERATIONS - OTHER PRODUCTS

Material	Emission Factor (lb/100 lb of Material)				
	Consolidated Report	1986 Army Computer Program (a)	R.V. Carter	1988 Army Computer Program (a)	1987 Navy Computer Program (a)
PBXN-103	—	—	—	—	Al (27.0015), HCl (11.2204), AlOCl (.0007), $AlCl_3$ (.0001), Cl_2 (.0072), OCl (.0035), HOCl (.0032), Cl (1.1483), $AlCl_2$ (.0001)
PBX(AF)-108	—	—	—	—	NH_3 (.0014), CSO (.0057)

Note: (a) Emission factors derived from the computer programs are for a 40/60 material/air weight ratio.

Table D-22

CALCULATED OD EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Material) (a, b)				
	CO	NO_2	SO_2	H_2S	Others
Propellant M1	3.6124	0	0	0	NH_3 (.1701), HCN (.270)
20mm HEI - T Cartidge M246	3.5832	0	0	0	Pb (.0754), Ba (.0646), Al (5.49), Sr (.8032), Mg (1.02), NH_3 (.1803), HCN (.9077)
20mm HEI - T Cartridge M599	3.2088	0	0	0	NH_3 (.1251), Pb (.1804), Sr (.3395), Mg (.49), Cl (.0116), HCN (.6281)
20 mm HEI - T Cartridge M242	1.7119	0	0	0	NH_3 (.2617), Pb (.0754), Al (6.4), Sr (.7576), Mg (.94), Ba (.0646)
20 mm HEI Cartridge M56A3	4.7237	0	0	0	NH_3 (.3264), Pb (.3521), Ba (.0532), Cl (.0376), Al (6.09), HCN (1.6498)
20mm HEI Cartridge M97A2	7.0304	0	0	0	NH_3 (.5519), Pb (.4107), Ba (.0608), Cl (.0434), Al (5.18), HCN (2.7901)
20mm HEI Cartridge M210	3.7728	0	0	0	NH_3 (.1891), Pb (.0177), Ba (.0076), Al (5.78), HCN (.9557)

Table D-22 (Cont'd)

CALCULATED OD EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Material) (a, b)				
	CO	NO_2	SO_2	H_2S	Others
20mm HEI Cartridge M53	2.1519	0	0	0	NH_3 (.0001), Pb (.0887), Ba (.0836), Cl (.4542), MgAl (1.57)
Fuse M66	-	-	-	-	Pb (.2134 lb/fuse), Mg (.8400 lb/fuse), Sr (.6831 lb/fuse)
Fuse M502	-	-	-	-	Pb (.3273 lb/fuse) Cl (.0057 lb/fuse)
Fuse M557	-	-	-	-	Pb (.1494 lb/fuse), Cl (.0058 lb/fuse)
20mm HET Cartridge MK4	4.6220	0	0	0	NH_3 (.2448), Pb (.3700), HCN (1.2371)
20mm INC Cartridge M96	1.6428	0	0	0	NH_3 (.0001), Pb (.1125), Ba (.0494), Cl (.3.6915), MgAl (12.76)
40mm HE-M406-A	14.4445	1.9683	.1696	1.3885	NH_3 (1.7533), Pb (.1476), Ba (.0114), Al (.01), HCN (.7498)

Table D-22 (Cont'd)

CALCULATED OD EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Material) (a, b)				
	CO	NO_2	SO_2	H_2S	Others
30 mm TP Projectile CTG	8.50	0	0	1.22	----
HEAT Rifle Grenade M31(A)	11.8113	2.545	.034	.551	NH_3 (.34), CH_3OH (16.0), CH_2O_2 (1.38), C_2H_6 (2.18), C_2H_2 (1.49), Al ((19.99)
Burster (A) w/ Initiator	23.4436	1.4968	.1289	.6851	NH_3 (.3513), Pb (1.1176), HCN (.5702)
Grenade MK3	37.567	5.119	.441	2.343	NH_3 (1.20), HCN (1.95), CH_3OH (10.70) C_2H_5OH (5.05), C_2H_6 (1.68), CH_2O (.90), C_2H_4 (.28), CH_2O_2 (.92)
Grenade MK3 w/fuse (M206A2)	28.3894	3.8684	.3333	1.7706	NH_3 (.9068), Pb (3.8481), HCN (1.4736)
75 mm Projectile	37.567	5.119	.441	2.343	NH_3 (1.20), HCN (1.95), CH_3OH (10.70) C_2H_5OH (5.05), C_2H_6 (1.68), CH_2O (.90), C_2H_4 (.28), CH_2O_2 (.92)

Table D-22 (Cont'd)

CALCULATED OD EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Material) (a, b)				
	CO	NO_2	SO_2	H_2S	Others
105 mm Projectile	24.1947	3.7954	.2317	1.4216	NH_3 (.7578), HCN (.9473), Al (10.2789)

Notes: (a) All emission factors are derived from values reported in Tables D.8.4.3.-2 through D.8.4.3-6.
(b) Emission factors derived from Consolidated Report are for 100lb-level of material detonated.

Table D-23

CALCULATED OB EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Munition) (a)				
	CO	NO_2	SO_2	H_2S	Others
Propellant M17	.7923	.0001	0	0	—
Propellant M30A1	1.0084	.0001	.0001	.1805	CSO (.0193), HS (.0001)
Propellant M30	1.0084	.0001	0	0	—
Rocket Motor	3.2160	0	0	0	—
120 mm Gun M15A2	6.9543	0	0	0	HF (.1891), NH_3 (.0001)
120 mm Gun M45	.7923	.0001	0	0	—
120 mm Gun M46	.7923	.0001	0	0	—
155 mm HOW M3	22.5542	0	0	0	NH_3 (.0003)
155 mm HOW M4A1	22.5542	0	0	0	NH_3 (.0003)
155 mm Gun M19	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)
175 mm M86	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)
175 mm M124	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)
8" Gun M13	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)

Table D-23 (Cont'd)

CALCULATED OB EMISSION FACTORS FOR COMPOUND WITH KNOWN COMPOSITION

Material	Emission (lb/100lb of Munition) (a)				
	CO	NO_2	SO_2	H_2S	Others
8" HOW M1	22.5542	0	0	0	NH_3 (.0003)
8" HOW M2	22.5542	0	0	0	NH_3 (.0003)
8" HOW M188	1.0084	.0001	.0001	.1805	CSO (.0193), HS (.0001)
240 mm HOW M26	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)
105 mm HOW	20.4589	0	.0001	.1805	CSO (.0193), NH_3 (.0003), HS (.0001)
105 mm HOW	22.5542	0	0	0	NH_3 (.0003)
Black Powder (b)	5.8560	0	0	1.2200	Solids (62.1)

Notes: (a) Emission factors are derived from values reported in Tables D.8.4.3.-7 through D.8.4.3-11.

(b) Emission factors for black powder are taken from Kirth-Othmer Encyclopedia (1979).

Table D-24

SOIL DEPENDENT PARAMETERS - MAXIMUM CRATER SCALING FACTORS AND AIRBORNE PARTICULATE MATTER FRACTIONS OF APPARENT CRATER VOLUME

Soil Type	Bare Charge Scaled Crater Volume $\left(\frac{m^3}{\text{lb TNT}^{1.111}}\right)$	Fraction of Crater Mass as Small Particles*
Rocks	0.0175	0.00119
Dry Cohesive Soils	0.0218	0.00987
Dry Sandy Soils	0.0654	0.00571
Dry to Moist Sandy Soils	0.1550	0.00454
Wet Sand & Moist Cohesive Soils	0.3050	0.00346
Wet Cohesive Soils	0.6980	0.00089

*This is the fraction of the total apparent crater mass (1500 kg/m^3) which becomes airborne that is less than 20 µm.

Reference: Hoock, et al., 1987.

TABLE D-25

SUMMARY OF OB/OD EMISSION SCENARIOS

Scenario	Activity	Assumed Munition (Pollutants)	Emissions
1	OB	1000 lbs of propellant M1 (CO, NH_3)	CO = 102,400 g NH_3 = 1.36 g
2	OB	1000 lbs of propellant M15 (HF)	HF = 859 g
3	OB	1000 lbs of propellant SPCF (NO_2, SO_2, lead)	NO_2 = 3,750 g SO_2 = 627 g Pb = 3,520 g
4	OB	1000 lbs of propellant M6 (H_2S)	H_2S = 820 g
5	OD	1000 lbs of HEAT rifle grenades M31 (NO_2,H_2S, NH_3, Pb, PM-10)	NO_2 = 11,554 g H_2S = 2,502 g NH_3 = 1.544 g *Pb = 2.24 g **PM-10=2,570,418 g
6	OD	1000 lbs of 90 mm projectiles (CO, SO_2)	CO = 144,190 g SO_2 = 7,827 g

* Pb emissions were calculated based on the assumption that 1 non-electric blasting cap would be used to initiate detonation of each OD pit (10 caps total)

** PM-10 emissions were calculated based on the assumption of wet cohesive soil condition.

Table D-26

NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Averaging Time	National Standard Primary	National Standard Secondary	Method
Ozone	1-hour	235 μg/m^3 (0.12 ppm)	Same as primary standards	Chemiluminescent method
Carbon Monoxide	8-hour	10 mg/m^3 (9 ppm)	Same as primary standards	Non-dispersive infrared spectroscopy
	1-hour	40 mg/m^3 (35 ppm)	Same as primary standards	Non-dispersive infrared spectroscopy
Nitrogen Dioxide	Annual average	100 μg/m^3 (0.05 ppm)	Same as primary standards	Gas phase Chemiluminescence
Sulfur Dioxide	Annual average	80 μg/m^3 (0.03 ppm)	-	Paraosaniline method
	24-hour	365 μg/m^3 (0.14 ppm)	-	Paraosaniline method
	3-hour	-	1300 μg/m^3 (0.5 ppm)	Paraosaniline method
Suspended Particulate Matter	Annual geometric mean	PM-10 (*) 50 μg/m^3	60 μg/m^3	High volume sampling
	24-hour	PM-10 (*) 150 μg/m^3	150 μg/m^3	High volume sampling
Lead	Calendar quarter	1.5 μg/m^3	1.5 μg/m^3	Atomic absorption

ppm - parts per million
μg/m^3 - micrograms per cubic meter
mg/m^3 - milligrams per cubic meter

* Before 1987, the TSP primary standards were 260 μg/m^3 and 75 μg/m^3 for the 24-hour concentration and the annual geometric mean, respectively.

Table D-27

STATE OF NEW YORK AMBIENT AIR QUALITY STANDARDS

Pollutants	Averaging Time	Concentration	Methods
Sulfur Dioxide	3-hour*	0.25 ppm	West Gaeke Method
	24-hour*	0.10 ppm	
Particulates (Suspended Particulates)	24-hour	250 $\mu g/m^3$ (1)	High Volume Sampling
	Annual geo. mean	45 $\mu g/m^3$ (1)	
	30-day	80 $\mu g/m^3$ (1)	
	60-day	70 $\mu g/m^3$ (1)	
	90-day	65 $\mu g/m^3$ (1)	
Particulates (Settleable Particulates or Dustfall)	30-day**	0.30 $mg/cm^2/mo$ (1)	Glass Jar Collection
	30-day**	0.45 $mg/cm^2/mo$ (1)	
Photochemical Oxidants	1-hour	0.08 ppm	Iodine Liberation
Non-Methane Hydrocarbons	3-hour	0.24 ppm	Flame Ionization
Fluorides	12-hour	4.5 ppb (3.7 $\mu g/m^3$)	
	24-hour	3.5 ppb (2.85 $\mu g/m^3$)	
	1-week	2.0 ppb (1.65 $\mu g/m^3$)	
	1-month	1.0 ppb (0.8 $\mu g/m^3$)	
Beryllium	1-month	0.01 $\mu g/m^3$	Atomic Absorption Spectrophotometry
Hydrogen Sulfide	1-hour	0.01 ppm (14 $\mu g/m^3$)	Cadmium Hydroxite-Methylene Blue Method

NOTE: (1) Level I Limit for areas used primarily for agricultural, recreation, timber, dairy farming, etc.

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* During any 12 consecutive months, 99 percent of the average concentrations shall not exceed the specified limit.

** During any 12 consecutive months, 50 percent of the average concentrations shall not exceed the specified limit.

*** During any 12 consecutive months, 84 percent of the average concentrations shall not exceed the specified limit.

TABLE D-28

ESTIMATED MAXIMUM ONE-HOUR POLLUTANT CONCENTRATIONS (ppm) AT GROUND LEVEL

Emission Scenario No.	Activity	Munitions Type	Munitions Quantity (lb)	CO[a]	NH_3[b]	HF[c]	SO_2[d]	H_2S[e]	Lead[f]	NO_2[g]	PM-10[h]
1	OB	propellant M1	1,000	1.06	0.00002	-	-	-	-	-	-
2	OB	propellant M15	1,000	-	-	0.012	-	-	-	-	-
3	OB	propellant SPCF	1,000	-	-	-	0.003	-	43	0.024	-
4	OB	propellant M6	1,000	-	-	-	-	0.006	-	-	-
5	OD	heat rifle grenades M31	1,000	-	0.03	-	-	0.025	0.03	0.08	36
6	OD	90mm projectiles	1,000	1.73	-	-	0.04	-	-	-	-

[a] NAAQS for one-hour CO concentration is 35 ppm, NAAQS for 8 hours is 9 ppm.
[b] ACGIH short-term exposure limit is 35 ppm (27 mg/m^3) for NH_3.
[c] NIOSH 15-minute ceiling for HF is 2.5 mg/m^3 (3 ppm).
[d] NAAQS for 3-hour average SO_2 concentration is 0.5 ppm.
[e] ACGIH short-term exposure limit is 15 ppm for H_2S (21 mg/m^3)
[f] 90-day NAAQS for lead is 1.5 $\mu g/m^3$. Concentration units in table are $\mu g/m^3$.
[g] NAAQS for annual NO_2 is 0.05 ppm. ACGIH short-term exposure limit is 5 ppm (10 mg/m^3)
[h] NAAQS for 24-hour PM-10 is 150 $\mu g/m^3$. Concentration unit in table is mg/m^3.

TABLE D-29

PREDICTED MAXIMUM ONE-HOUR POLLUTANT CONCENTRATION AT NEAREST POTENTIALLY SENSITIVE RECEPTOR*

Pollutant	Estimated Peak Concentration at Receptor*	
	Due to OB	Due to OB
CO	0.08	0.6 ppm
NH_3	0.000002	0.009 ppm
HF	0.001	—
NO_2	0.002	0.03 ppm
SO_2	0.00024	0.013 ppm
Pb	3.44	0.01μg/m^3
H_2S	0.0006	0.008 ppm
PM-10	--	11.5 mg/m^3

*Receptor is the Central School in Romulus, New York

TABLE D-30

MAXIMUM PREDICTED ANNUAL AVERAGE CONCENTRATION DUE TO OB/OD ACTIVITIES

Pollutant	Estimated Annual Average Concentration		Total[e]
	OB Contribution	OD Contribution	
SO_2[a]	< .001 ppm	< 0.001 ppm	negligible
Lead[b]	0.16 $\mu g/m^3$	negligible	0.016 $\mu g/m^3$
NO_2[c]	< .001 ppm	0.04 ppm	0.04 ppm
PM-10[d]	unknown	8.8 $\mu g/m^3$	8.8 $\mu g/m^3$

[a] Annual NAAQS for SO_2 is 0.03 ppm.

[b] 90-day average NAAQS for lead is 1.5 $\mu g/m^3$

[c] Annual NAAQS for NO_2 is 0.05 ppm.

[d] Annual NAAQS for PM-10 is 50 $\mu g/m^3$.

[e] Total is calculated assuming <u>both</u> OB and OD activities occur on 180 days/year and does not take into account that OB/OD activities would not occur during restricted dispersion conditions.

TABLE D-31

MAXIMUM 24-HOUR PRECIPITATION
AURORA RESEARCH FARM (1957-1991)
AURORA, NEW YORK

Maximum 24-hour Precipitation (inches)	Month	Year
1.28	January	1958
2.24	February	1961
1.68	March	1973
1.91	April	1991
1.36	May	1988
3.70	June	1972
2.85	July	1988
2.84	August	1974
3.91	September	1975
2.36	October	1977
2.00	November	1979
1.57	December	1978

TABLE D-32

INVERSTION EPISODES IN 5 YEARS IN ALBANY DAYS WITH SIGNIFICANT PRECIPIATION NOT INCLUDE

Max. Mixing height(m)	Max. Wind Spped (mps)	Minimum Duration (days)	Episodes (1960-164)	Episode-Days (1960-1964)
500	2.0	2	1	2
500	4.0	2	1	5
500	6.0	2	2	10
1000	2.0	2	1	2
1000	4.0	2	3	13
1000	6.0	2	8	26
1500	2.0	2	2	5
1500	4.0	2	7	23
1500	6.0	2	21	66
2000	2.0	2	2	5
2000	4.0	2	11	31
2000	6.0	2	41	123
500	4.0	5	1	5
500	6.0	5	1	7
1000	4.0	5	1	8
1000	6.0	5	1	10
1500	4.0	5	1	8
1500	6.0	5	2	15
2000	4.0	5	1	8
2000	6.0	5	2	15

Forecast days of high meteorological potential for air potential in a 5-year period: ~15

TABLE D-33

INVERSTION EPISODES IN 5 YEARS IN BUFFALO DAYS WITH SIGNIFICANT PRECIPIATION NOT INCLUDE

Max. Mixing height(m)	Max. Wind Spped (mps)	Minimum Duration (days)	Episodes (1960-164)	Episode-Days (1960-1964)
500	2.0	2	0	0
500	4.0	2	1	3
500	6.0	2	1	5
1000	2.0	2	0	0
1000	4.0	2	4	11
1000	6.0	2	8	28
1500	2.0	2	0	0
1500	4.0	2	13	29
1500	6.0	2	36	103
2000	2.0	2	0	0
2000	4.0	2	16	38
2000	6.0	2	60	178
500	4.0	5	0	0
500	6.0	5	0	0
1000	4.0	5	1	6
1000	6.0	5	3	16
1500	4.0	5	1	6
1500	6.0	5	3	16
2000	4.0	5	1	8
2000	6.0	5	6	44

Forecast days of high meteorological potential for air potential in a 5-year period: ~ 15

SECTION E

GROUNDWATER MONITORING PROGRAM

INTRODUCTION

The following presents a groundwater monitoring program in accordance with the 40 CFR 264 Subparts F (Releases From Solid Waste Management Units) and X (Miscellaneous Units) requirements for the Open Burning trays and Open Detonation area.

Historically, open burn operations at the SEAD facility have been carried out using burning trays and burn pads. Of late, (since 1987) the pads have been taken out of service and open burn operations have been limited to burning trays. At the time of the previous RCRA Part B permit application submittal, Pad J was still being used when an imminent hazard existed; use of this pad for such purposes has been discontinued and the pad is no longer used. Hence, the only operational unit in the OB area are the burning trays. It should be kept in mind when reviewing the information presented in the following sections that the objective of this document is to permit the open burning trays only and not the burn pads in the OB area. The burn pads are on the CERCLA National Priority List (NPL) and are being investigated by an ongoing RI/FS.

E-1 EXEMPTION FROM GROUNDWATER PROTECTION REQUIREMENTS [40 CFR 270.14(c)]

Section 270.14 (c) addresses requirements for groundwater protection and refers to section 264.90 (b) for conditions under which owners or operators are exempt from groundwater monitoring.

The following cites from the *regulations*, conditions for exemption and explains how the OB trays fulfill these exemption requirements.

(1) The owner or operator is exempt under 264.1; or the open burning tray is not exempt under 264.1.

The open burning trays are not exempt under 264.1, but under the conditions discussed below.

(2) He operates a unit which the Regional Administrator finds:

(i) Is an engineered structure,

The OB tray assembly is an engineered structure. The unit consists of a stainless steel tray and cover which rest on concrete supports and a concrete slab.

(ii) Does not receive or contain liquid waste or waste containing free liquids,

The OB trays are not used to dispose off liquid wastes or wastes which contain free liquids. The wastes which are burned or disposed off in the trays is a powder and does not contain any liquids.

(iii) Is designed and operated to exclude liquid, precipitation and other run-on and run-off,

The open burning operations are only conducted in clear weather to eliminate exposure to precipitation. Since these operations do not have to be performed on a regular basis dependence on weather conditions does not present any operational problem. When the burning tray are not in use, covers are placed on the tray tops to eliminate any contact with precipitation. If any munition wastes are spilled onto the concrete slab when transferring the wastes from storage drums to the tray, the wastes are cleaned by a vacuum cleaner **(refer to SOPs; Appendix 4)** and, hence, contact of wastes with any future run-off is minimized. Since, the burning tray is two feet in height and rests on concrete supports and a slab **(refer to Section D-8 for design details)** the chances of any run-on coming in contact with any residual wastes left in the covered tray are minimal.

(iv) *Has both inner and outer layers of containment enclosing the waste,*

The burning trays and the underlying slab serve as the inner and outer layers of containment. Furthermore, it should be noted that wastes are not stored in this unit permanently and are only transported here just prior to incineration hence, the existing containment is believed to be adequate.

(v) *Has a leak detection system built into each containment layer,*

Periodic inspections are performed to evaluate the integrity of the open burning tray and the underlying concrete slab. Since, wastes are not stored at this unit on a permanent basis and the wastes handled do not contain any free liquids, these measures should be adequate for preventing a release and an additional leak detection system is not required.

(vi) *The owner and operator will provide continuing operation and maintenance of these leak detection systems during the active life of the unit and the closure and post-closure care periods.*

The above mentioned inspection procedures will be implemented during the active life of the unit. No inspection or maintenance will be necessary after operations are terminated at the unit because at that time the unit will be dismantled and the unit and any associated wastes will be disposed off in an appropriate manner.

(vii) *To a reasonable degree of certainty, will not allow hazardous constituents to migrate beyond the outer containment layer prior to the end of the post-closure care period.*

Once operations at the unit are terminated the possibility of migration of hazardous constituents will not exist because at that time the unit will be dismantled and contamination associated with the unit will be handled/disposed in an appropriate manner.

The above discussion applies to only the open burning trays; the exemption from groundwater monitoring does not apply to the open detonation area and a groundwater monitoring program is proposed for the open detonation area.

E-2 INTERIM STATUS GROUNDWATER MONITORING DATA [40 CFR 270.14(c)(1),265.90 to 265.94]

E-2a DESCRIPTION OF WELLS [265.91]

Figure E-1 shows the location of existing monitoring wells in the OB/OD area and groundwater flow contours for the seasonal high water table; **Figure E-2** presents the same for seasonal low water table. Wells MW-2, MW-3 and MW-4 were designated as interim status monitoring wells for the OD area. Groundwater flow contours for both the high and low water table conditions (**Figures E-1 & E-2, respectively**) indicate that well MW-4 is upgradient of the OD area, while MW-2 and MW-3 are downgradient of the OD area. **Appendix 5A** includes a copy of the boring logs and well construction diagrams and **Table D-2** in **Section D-8d** summarizes the hydrogeologic information.

Monitoring well MW-1 and wells MW-5 through MW-17 are located in the open burn area and were installed to investigate the impact of the open burn pads (pads A through J) on groundwater quality and evaluate closure options for these burn pads. These burn pads were taken out of service in 1987 and are being investigated under CERCLA by an ongoing RI/FS. The monitoring wells (MW-1, MW-5 through MW-17) associated with the burn pads are not appropriately located to monitor impact on groundwater due to activities at the open burning tray and cannot be considered as interim status wells for the open burning tray. Furthermore, due to the reasons stated in the previous section its our belief that the open burning tray is exempt from groundwater monitoring and no interim status monitoring is needed.

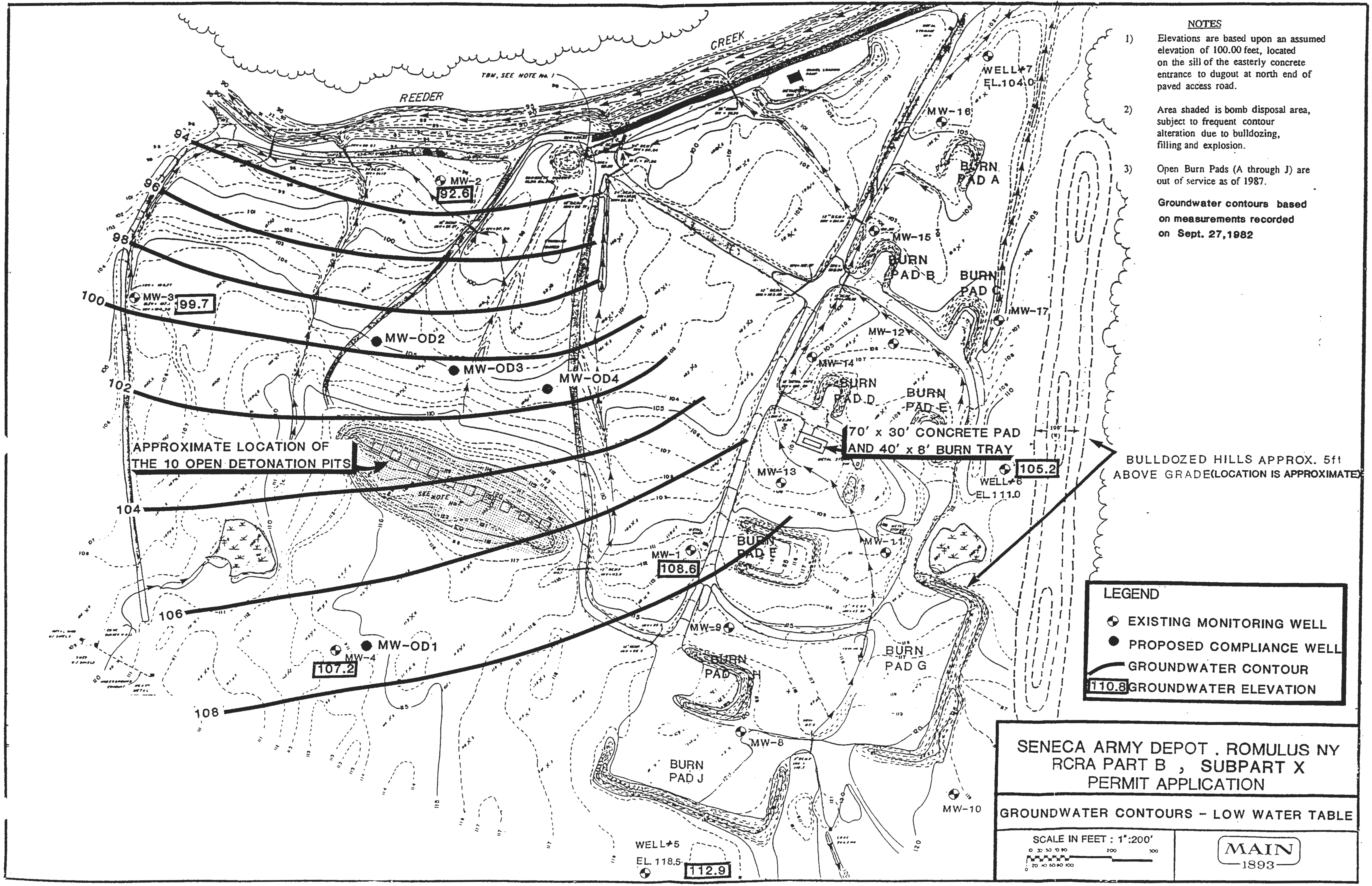
E-2b DESCRIPTION OF EXISTING SAMPLING/ANALYSIS PROCEDURES [40 CFR 265.92]

The sampling and analysis plan used for sample collection and analysis during interim status monitoring in **Appendix 5F**.

E-2c MONITORING DATA [40 CFR 265.92]

Appendix 5B includes all data collected as part of the interim status monitoring program. The sampling and analysis program conducted to-date is summarized on **Table E-1**. The table

FIGURE E-2



NOTES

1) Elevations are based upon an assumed elevation of 100.00 feet, located on the sill of the easterly concrete entrance to dugout at north end of paved access road.

2) Area shaded is bomb disposal area, subject to frequent contour alteration due to bulldozing, filling and explosion.

3) Open Burn Pads (A through J) are out of service as of 1987.

Groundwater contours based on measurements recorded on Sept. 27, 1982

LEGEND

- ⊕ EXISTING MONITORING WELL
- ● PROPOSED COMPLIANCE WELL
- GROUNDWATER CONTOUR
- 110.8 GROUNDWATER ELEVATION

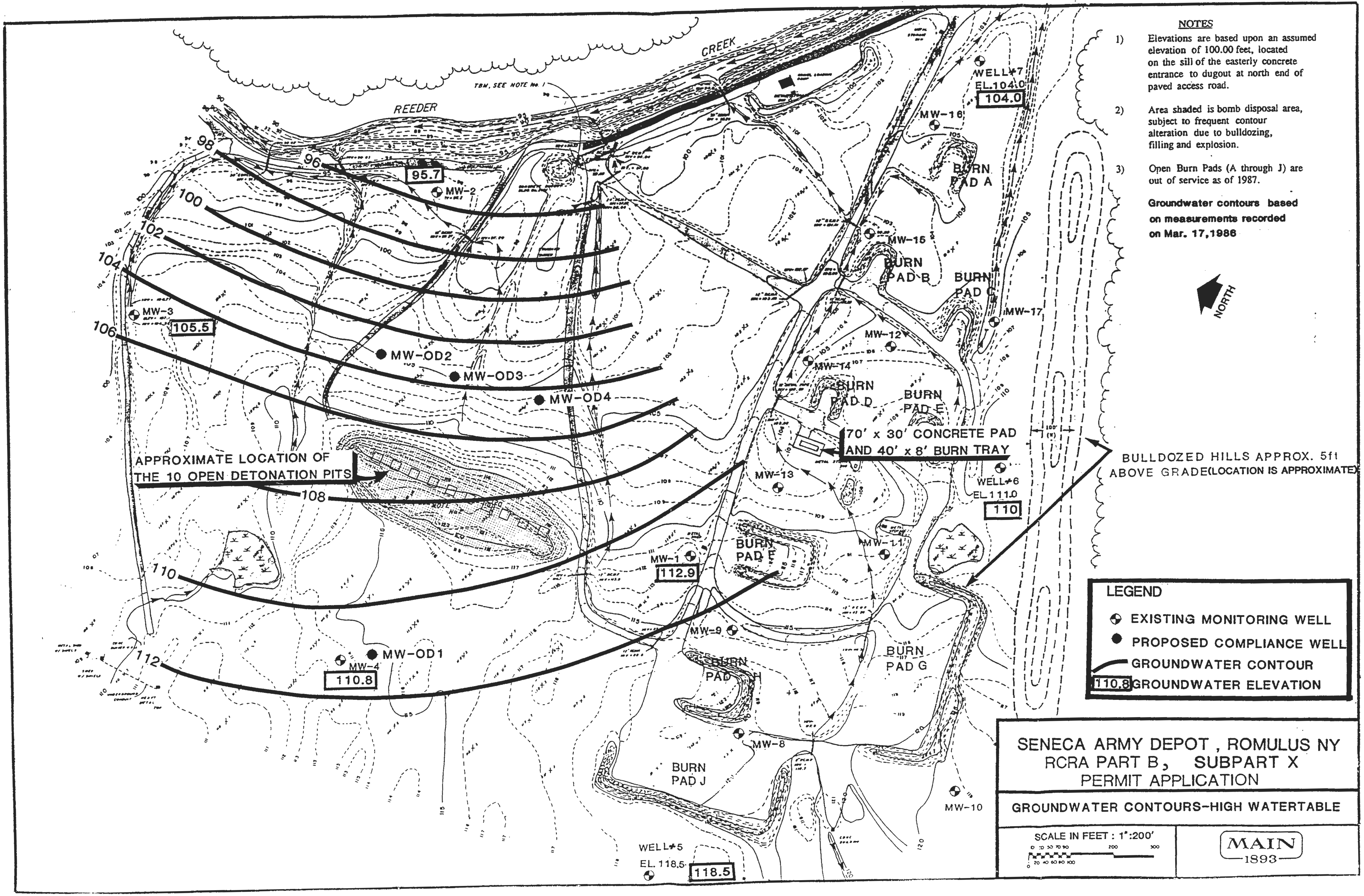
SENECA ARMY DEPOT . ROMULUS NY
RCRA PART B , SUBPART X
PERMIT APPLICATION

GROUNDWATER CONTOURS - LOW WATER TABLE

SCALE IN FEET : 1":200'

MAIN
1893

FIGURE E-1



NOTES

1) Elevations are based upon an assumed elevation of 100.00 feet, located on the sill of the easterly concrete entrance to dugout at north end of paved access road.

2) Area shaded is bomb disposal area, subject to frequent contour alteration due to bulldozing, filling and explosion.

3) Open Burn Pads (A through J) are out of service as of 1987.

Groundwater contours based on measurements recorded on Mar. 17,1986

LEGEND

- ⊕ EXISTING MONITORING WELL
- ● PROPOSED COMPLIANCE WELL
- GROUNDWATER CONTOUR
- 110.8 GROUNDWATER ELEVATION

SENECA ARMY DEPOT , ROMULUS NY
RCRA PART B, SUBPART X
PERMIT APPLICATION

GROUNDWATER CONTOURS-HIGH WATERTABLE

SCALE IN FEET : 1":200'

MAIN
1893

TABLE E-1

INTERIM STATUS MONITORING PROGRAM WELLS IN THE OD AREA

Monitoring Well: MW-2, MW-3, MW-4

Sampling Period	Parameters	Sampling Frequency
1982	A, B C	Quarterly Quarterly (4 replicates)
1983	B C	Semi-annually Semi-annually (4 replicates)
1984-1987	B C D	Annually Semi-annually (4 replicates) Semi-annually
1988	Not Available	Not Available
1989	B,C,D,E	Annually
1990-Date	B,C,D	Semi-Annually

A: Drinking Water Parameters - Arsenic, Barium, Cadmium, Chromium, Fluoride, Lead, Mercury, Nitrite and Nitrate as N, Selenium, Silver, Endrin, Lindane, Toxaphene, Methoxychlor, 2,4-D, Silver, Gross Alpha, Radium-226.
B: Water Quality Parameters - Chloride, Iron, Manganese, Phenols, Sodium, Sulfates.
C: Indicator Parameters - pH, Specific conductivity, TOX, TOC.
D: Explosives: 2,4,6-TNT, 2,4-DNT, 2,6-DNT, RDX, HMX, Tetryl.
E: Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver.

shows that drinking water parameters were monitored for the first year to establish background concentrations. Parameters defined in **Section 265.92** as water quality indicators were monitored quarterly during the first year and semi-annually thereafter. Four replicate samples of parameters indicative of contamination were sampled quarterly during the first year and semi-annually thereafter. Explosives have been monitored either semi-annually or annually since 1984.

Table E-2 presents the background arithmetic mean and variance for indicator parameters based on the first year of monitoring data.

E-2d STATISTICAL PROCEDURES [40 CFR 265.93]

The Student t-test at a significance level of 0.01 was used to analyze the data collected at wells associated with the OD area. **Appendix 5B** includes the t-test data for each of the indicator parameters for each sampling event. In this analysis, monitoring well MW-4 was used as the upgradient well while wells MW-2 and MW-3 were used as downgradient wells. A statistical comparison was conducted between concentrations in the upgradient and downgradient wells; concentrations at the upgradient well after the first year of monitoring were also compared to the first year upgradient background concentrations.

The statistical analysis data for TOC (Aug-83) and TOX (Feb-84) at downgradient well MW-3 showed a statistically significant increase above background. For the same quarters a statistically significant increase above first year background was noted for TOC (Aug-83) and TOX (Feb-84) at the upgradient well MW-4. Since the statistically significant increase at the downgradient wells was noted in the same quarters for the same parameters as the increase for the upgradient well, it could not be concluded if the increase noted in the downgradient wells was associated with a release from the unit.

E-2e EXISTING GROUNDWATER ASSESSMENT PLAN [40 CFR 265.93(d)(2)]

After the statistically significant increase was noted in downgradient wells a groundwater assessment plan was implemented. Explosives which are the primary constituents of wastes

TABLE E-2

FIRST YEAR BACKGROUND GROUNDWATER QUALITY DATA

UPGRADIENT MONITORING WELL: MW-4				
PARAMETER VALUE	pH	SPECIFIC CONDUCTIVITY umhos	TOC mg/l	TOX mg/l
Initial Mean	7.525	1007.75	28.31	0.021
Initial Variance	0.114	98,398.57	379.30	0.000565
Sample Size	16	12	16	12

disposed in the OD area and could be resulting in the elevated TOC and TOX concentration noted, were included in the sampling and analysis monitoring program from 1984 onwards.

None of the explosives analyzed for, were detected at any of the monitoring wells. Furthermore, subsequent statistical analysis did not show a statistically significant increase. Based on the analytical and statistical results it was concluded that no hazardous constituents were being released to the groundwater at the unit.

E-3 GENERAL HYDROGEOLOGIC INFORMATION [40 CFR 270.14 (c)(2)]

The uppermost aquifer at the site is glacial till, ranging in thickness from 6 to 12 ft. Glacial till is underlain by weathered shale, which ranges in thickness from 0 to 20 ft. The average hydraulic conductivity of the till deposits was estimated to be 0.48 ft/day by field recovery tests (**Refer to Appendix 5C**); no data is available for the weathered shale, but the hydraulic conductivity of the weathered shale is expected to be low (similar to the glacial till) because of the high clay content in shale. Hydrogeologic data collected at the site indicates that the weathered shale is in hydraulic communication with the glacial till. A detailed discussion of the site geology and hydrogeology is presented in **Section D-8d**.

E-4 TOPOGRAPHIC MAP REQUIREMENTS [40 CFR 270.14(c)(2),(3),(4)(i)]

Figures E-1 and E-2 show groundwater contours for the OD area for seasonal high and low water tables, respectively. It can be seen from these figures that the horizontal hydraulic gradient and flow direction does not change seasonally. Using an average hydraulic gradient for the low and high water tables, ground flow velocity was calculated to range from 0.021 to 0.053 ft/day (correspond to 25 and 10 percent porosity) in the glacial till, which is the uppermost aquifer at the site (refer to **Appendix 5C** for calculations). The compliance well locations for the OD area are shown on **Figure E-1.**

E-5 CONTAMINANT PLUME DESCRIPTION [40 CFR 270.14 (c)(2),(4),(7)(ii)]

Metals, namely Barium, Cadmium, and Mercury were the only hazardous constituents detected at wells associated with the OD area (**Refer to Appendix 5B**). Of these metals, Barium (0.072 mg/l) and Cadmium (0.001 mg/l) were detected in the upgradient well MW-4. Barium was detected at concentrations similar to upgradient concentrations at the downgradient wells MW-2 (0.078 mg/l) and MW-3 (0.058 mg/l), which seems to indicate that this is due to naturally occurring barium in soils. Mercury was detected at downgradient well MW-2 (0.002 mg/l), while cadmium was not detected at the downgradient wells. This data seems to indicate that no hazardous constituents are being released to groundwater at the unit, although, more data needs to be collected to draw a definitive conclusion.

E-6 GENERAL MONITORING PROGRAM REQUIREMENTS [40 CFR 270.14(c)(5),264.97, 264.90 (b)(4)]

The proposed groundwater monitoring program for the OD area will consist of one upgradient and three downgradient wells. The existing monitoring wells are not best suited for detecting a release from the OD are and hence a new set of wells is proposed. **Figure E-1** shows the proposed monitoring well locations.

Proposed monitoring wells MW-OD1, MW-OD2, MW-OD3 and MW-OD4, shown on **Figure E-1**, will be used as compliance wells for the OD area. MW-OD1 will be installed close to existing well MW-4 and will serve as the upgradient well for the OD area. Groundwater quality at this proposed well should be representative of background quality since no known waste management units are located upgradient of this proposed well location. Wells MW-OD2 through MW-OD4 will serve as downgradient wells for the OD area. It should be noted that the proposed downgradient monitoring wells could not be placed any closer to the OD activity area since the explosion associated with the detonation of munitions could possibly jeopardize the integrity of the wells if they were placed any closer than the proposed locations.

The proposed monitoring wells will be 2-inch stainless steel (Standard Strength) with slot size of the screen being determined based on the grain size distribution of the screened unit.

Borings for monitoring well installation will be terminated at the glacial till/weathered shale interface with screens placed across the glacial till deposits, which constitute the topmost aquifer at the site. The screen lengths are expected to vary from 5 to 10 feet depending on the saturated thickness encountered, with the top of the water table always being screened. The proposed monitoring wells will be installed in accordance with the standard operating procedures for drilling and monitoring well installation included in **Appendix 6D.**

E-6b DESCRIPTION OF SAMPLING/ANALYSIS PROCEDURES [40 CFR 264.97(d),(e),(f)]

E-6b(1) Sample Collection and Handling Procedures

A sequence of four samples will be collected at equal intervals of 10 days at the both the upgradient and downgradient wells as part of the monitoring program. As discussed in **Section E-4**, the groundwater flow rate within the glacial till at the site ranges from 0.031 to 0.053 ft/day; based on this velocity, the travel time for groundwater across the well diameter is approximately 8 days and sample collection 10 days apart will result in an independent sample being collected (refer to **Appendix 5C**). These four samples will constitute one data set and such sample collection will be conducted on a semi-annual basis.

The following is a brief description of the main tasks which will be performed as a part of sample collection:

Groundwater level measurement
Monitoring well purging
Sample collection and preservation
Field Measurements (pH, Temperature and Specific Conductivity)
Chain of custody
Packaging and Shipping

The above mentioned tasks will be performed in accordance with the Standard Operating Procedures included in **Appendix 5E.**

E-6b(2) Analysis Parameters and Test Methods

Analysis parameters for monitoring have been selected keeping in mind the wastes disposed in the OD area. A review of the composition of wastes disposed in the OD area indicate that the primary hazardous constituents in these wastes are explosives and metals. Hence, explosives and metals will be monitored in addition to the indicator parameters (pH, Specific Conductance, TOC, TOX). Table E-3 lists the analysis parameters and the test methods to be followed; each of the four samples collected as part of a sampling event will be analyzed for these parameters.

E-6c PROCEDURES FOR ESTABLISHING BACKGROUND QUALITY[40 CFR 264.97(a)(1),(g)]

Its expected that the proposed background monitoring well MW-OD1 will provide representative background groundwater quality data. During the course of the monitoring program, if its determined that the groundwater quality at this well is being affected by a release from the regulated unit then other wells believed to be representative of background groundwater quality will be proposed for subsequent monitoring.

The proposed monitoring program will collect the required background groundwater quality data for conducting the proposed statistical analysis (discussed in **Section E-6d**) in accordance with Section 264.97 (h).

E-6d STATISTICAL PROCEDURES [264.97 (h); (i)(1), (5) AND (6)]

A combination of the statistical methods specified in 264.97 (h) are proposed for analyzing the monitoring data. The following specifies the different data types expected to be collected and the method of data analysis for each type.

- The parametric analysis of variance (ANOVA) will be the method of choice and will be applied whenever technically feasible in order to compare upgradient well concentrations to compliance well concentrations. The test is recommended only when less than 15% of nondetects are present in the database. As part of the statistical analysis, nondetects will be replaced by half the detection limit when less

TABLE E-3

DETECTION MONITORING PROGRAM ANALYSIS PARAMETERS AND TEST METHODS

PARAMETER		ANALYSIS METHOD
Indicator Parameters		
pH		Field
Specific Conductivity		Field
Total Organic Carbon (TOC)		EPA 415.1
Total Organic Halogens (TOX)		EPA 450.1
Hazardous Constituents		
o	Metals (Total and Dissolved)	
	Antimony	EPA 6010 or 7040
	Arsenic	EPA 6010 or 7060
	Barium	EPA 6010 or 7080
	Beryllium	EPA 6010 or 7090
	Cadmium	EPA 6010 or 7130
	Chromium	EPA 6010 or 7190
	Cobalt	EPA 6010 or 7200
	Copper	EPA 6010 or 7210
	Lead	EPA 6010 or 7420
	Mercury	EPA 6010 or 7470
	Nickel	EPA 6010 or 7520
	Selenium	EPA 6010 or 7740
	Silver	EPA 6010 or 7760
	Thallium	EPA 6010 or 7840
	Vanadium	EPA 6010 or 7910
	Zinc	EPA 6010 or 7950
	Tin	EPA 7870
o	Explosives	
	HMX	EPA 8330
	RDX	EPA 8330
	1,3,5-Trinitrobenzene	EPA 8330
	1,3-Dinitrobenzene	EPA 8330
	Tetryl	EPA 8330
	Nitrobenzene	EPA 8330
	2,4,6-Trinibrotoluene	EPA 8330
	4-Amino-2,6-dinitrotoluene	EPA 8330

TABLE E-3 (Continued)

PARAMETER		ANALYSIS METHOD
o	Explosives (Con't)	
	2-Amino-4,6-dinitrotoluene	EPA 8330
	2,6-Dinitrotoluene	EPA 8330
	2,4-Dinitrotoluene	EPA 8330
	2-Nitrotoluene	EPA 8330
	3-Nitrotoluene	EPA 8330
	4-Nitrotoluene	EPA 8330

than 15% nondetects are noted in the database. A multiple well comparison procedure will be used as part of the proposed ANOVA analysis and hence a significance level of 0.05 is proposed.

- If nondetects are between 15% and 50% of the database, the Tolerance Limits method will be used in conjunction with Cohen's adjustment. For this method of analysis, a coverage of 95% and a tolerance coefficient of 95% is proposed.

- If nondetects are more than 50% of the database, the Test of Proportions will be used.

A review of the interim status monitoring data indicated that typically the indicator parameters (pH, Specific Conductance, TOX and TOC) have been quantifiable with less than 15% nondetects, hence, the ANOVA analysis would be appropriate for these parameters. Metals have been detected sporadically and the tolerance limits methods will be appropriate for metals. Explosives have never been detected in the past at on-site wells and the test of proportions is expected to be applied to these parameters. The selection of the appropriate statistical method is a function of the data and one of the methods mentioned above will be selected based on the percentage of nondetects in the database.

E-7 & E-8 DETECTION/COMPLIANCEMONITORING PROGRAM[270.14(c)(6), 264.91(a)(4), 264.98, 270.14(c)(7),264.99]

As discussed in the previous sections, there is no evidence which suggests that a release is occurring/has occurred from the OD area. Hence, a detection monitoring program outlined in **Section E-6**, rather than a compliance monitoring program is proposed for the OD area.

SECTION F

PROCEDURES TO PREVENT HAZARDS

This section describes the procedures and structures at SEAD which have been created to prevent and/or mitigate hazards associated with the thermal treatment of reactive hazardous wastes. The information is submitted in accordance with 40 CFR 270.14(b)(4), (5), (6), (8), and (9). This Section includes general security procedures, inspection schedules, preventive procedures, and procedures for the management of reactive hazardous wastes.

F-1 SECURITY [*40 CFR 270.14(b)(4)*]

SEAD is an active military installation, therefore, entry and exit are monitored 24 hours a day by armed Department of Defense (DOD) personnel. Access to SEAD is limited to military personnel and civilians with temporary military clearance. The 90-acre OB/OD facility is surrounded by an eight-foot high chain link fence topped with barbed wire. Additionally, entry to the OB/OD facility is restricted via a locked gate and is patrolled by armed DOD personnel. All employees must present identification badges to a security police officer when entering the facility and wear the badge throughout the day. All visitors must produce identification at the main gate and provide the following information: name, home address, business address, citizenship, date of birth, sex, eye color, hair color, height, weight, and duration of visit. Visitors must also wear identification badges while on-site and check in and out with security personnel at the main gate. The depot is surrounded by a 6-feet high chain link fence topped with barbed wire. Armed guards are posted at all active access points.

Upon arriving at the OB/OD gate guard station, visitors must present their ammunition area access badge along with a valid picture identification. The guard will request that all lighters, matches, etc., be left at the guard gate until the visit is over.

F-1a(1) <u>24-Hour Security System</u>

Entry and exit to and from SEAD is monitored 24 hours a day seven days a week by armed security personnel. Two gates, the north gate and the main gate (on the east side), are active at all times.

Mobile, internal security police patrol SEAD grounds 24 hours a day, 7 days a week. Periodic external inspections are made of the OB/OD facility to ensure against entry by unauthorized personnel and to provide advance warning of any unusual occurrences.

F-1a(2) Barrier and Means to Control Entry

The entire depot is enclosed by a 6-feet high chain link fence topped by barbed wire. Entrance to the facility is strictly controlled through the two gates discussed above. Employees must show identification badges when entering the facility and wear them while on base. Visitors must register with the security office and check in and out at the main gate each day of their visit. Security personnel are armed and carry communication devices. The OB/OD facility is in compliance with the security requirements by having controlled access at all times as discussed above.

F-1a(3) Warning Signs

The entire SEAD perimeter is posted with signs warning against unauthorized entry. In addition, signs reading "Danger - Unauthorized Personnel Keep Out" are posted at the access roads to the OB/OD area. In addition, signs reading "No Smoking" are also posted at the access roads. All signs are legible from a distance of 25 feet and are written in the predominant language, English.

F-1b Waiver

A waiver of the requirements of 40 CFR 264.14 (a) (1) and (2) regarding injury to intruder and violation by intruder is not required for SEAD.

F-2 INSPECTION SCHEDULE [*40 CFR 270.14(b)(5)*]

The OB/OD facility will be inspected on a regular basis for equipment deterioration and operator error, and discharges which may be causing or may lead to; (1) a release of hazardous waste constituents to the environment or, (2) a threat to human health. The operator at the OB/OD facility will conduct these inspections often enough to identify problems and correct them before they harm human health or the environment.

The only structure associated with the OB/OD facility is the burning tray. The tray is inspected on a weekly basis to ensure that: (1) all welds are in good condition, (2) that the tray does not show significant signs of deterioration which would allow the explosive or initiating liquid to migrate to the underlying soil, (3) there is no unreacted PEP or ash/residue in the tray, and (4) ensure that the burning tray cover is in good condition and will prevent precipitation from entering the burning tray.

In addition to inspecting the burning tray, the operator will inspect the area around the burning tray after each burning operation to ensure that all unreacted PEP or any "pop outs" are collected and disposed of in a proper manner. Disposal constituting "proper" would be to either; (1) collect the material and reburn it during the next burning operation or, (2) to containerize it with any collected residual ash and ship the waste off-site to a properly permitted treatment, storage or disposal facility (TSDF).

The open detonation facility shall be inspected after each detonation operation. The purpose of this grounds inspection is to detect and dispose of any unexploded materials which may pose as a safety hazard for future OD treatment operations. The inspection consists of walking the entire OD facility, e.g., walking the entire area within a safe distance of the OD earth mound. Any unreacted PEP will be picked up and treated during the next detonation operation. In addition, any solid waste materials such as metal fragments will be picked up and disposed of as solid waste.

Daily inspections shall be conducted of the motor vehicles used at the OB/OD facility. The inspection purpose is to ensure that: (1) fire extinguishers are present and serviceable, (2) electric wiring is in good condition and properly attached, (3) fuel tanks and piping are secure and not leaking, (4) brakes, steering, and other equipment are in good condition, (5) the exhaust system is not exposed to accumulation of grease, oil, gasoline, or other fuels, and has ample clearance from fuel lines and other combustible materials, and (6) radios in the vehicle are functioning properly, and the first aid kits are available and in the vehicles and are adequately supplied.

In addition, quarterly inspections shall be conducted on the security systems at SEAD. The security patrol shall be responsible for conducting these inspections and shall include the following: a visual inspection of the chain link fence to check for corrosion, damaged or missing links, damaged barbed wire, (2) a visual inspection of the gates and locks to check for corrosion, damaged or missing links, damaged barbed wire, and sticking or corroded locks, and (3) all radios shall be inspected on a quarterly basis to ensure proper functioning of all available channels.

It is the responsibility of the environmental engineer at SEAD to ensure that all problems noted on the inspection log sheet are remedied before thermal treatment operations are conducted at the OB/OD facility. This is strictly for the purpose of personnel safety. In addition, the environmental engineer or appointed alternate is responsible for maintaining the inspection logs at the appropriate facility and maintaining the records for at least three years from the date of the inspection. At a minimum the inspection records must include the date and time of the inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions. A sample inspection log sheet is included as **Figure F-1**. SEAD may adopt this inspection log sheet or develop a similar one which may more suitably meet their needs.

F-3 PREPAREDNESS AND PREVENTION REQUIREMENTS [*40 CFR 170.14(b)(7)*]

SEAD has facility-wide documentation of onsite preparedness and prevention measures. The procedures for hazardous waste management facilities are addressed in the Hazardous Waste Contingency Plan (HWCP). For additional details regarding the HWCP, see **Section G.**

SEAD operates many industrial processes, some of which generate hazardous waste or hazardous waste constituents. It is the policy of SEAD to control pollution of the environment through the operation and maintenance of the facility in such a manner as to comply with all applicable federal, state, interstate, or local requirements, regulations, and standards, including those contained in Subpart C of Part 264, Chapter 40, of the Code of Federal Regulations (CFR).

To implement this policy, SEAD has prepared a HWCP that sets forth the procedures that will be used to minimize or prevent damage to human health and the environment from any sudden or non-sudden discharges of hazardous waste or hazardous waste constituents. Though the likelihood of a release of hazardous wastes or substances in minimized by implementation of operating and emergency procedures, the possibility of a release can never be completely eliminated. Due to the nature of the substances used and managed at the facility, a likely cause of a sudden release, if a release were to occur, would be through fire and/or explosion.

Because of the potential for fire or explosion, SEAD operates and maintains its own fire department. The SEAD fire department is trained in managing emergencies that could occur due to the explosive potential and nature of the materials, products, and byproducts handled at the facility. The fire department is on alert at all times to handle the types of fires that could occur during the management of hazardous wastes at the facility.

SEAD has implemented a set of explicit fire-fighting instructions that have been formulated to protect the health and safety of installation employees and prevent the spread of fire into adjoining areas. Major provisions of these procedures are as follows:

FIGURE F-1

OB/OD INSPECTION LOG SHEET

Inspector's Name/Title ____________________/____________________
Date of Inspection ______________________
Time of Inspection ______________________ (Military Time)

I. Inspection of OB/OD Grounds (Inspection Frequency: Prior to Use)

Item	Problem	Status Acceptable	 Unacceptable
Burning Tray	Broken Welds, Cracks, Residual Ash or Explosives		
OB Grounds	Unburned Materials, or Metal Fragments		
OD Grounds	Unexploded Materials, or Metal Fragments		

II. Inspection of Motor Vehicles (Inspection Frequency: Prior to Use)

Item	Problem	Status Acceptable	 Unacceptable
Fire Extinguisher	Not Present, Needs Recharged Not Working Properly		
Electrical Wiring	Exposed Wiring or Improperly Attached		
Fuel Tanks	Dents, Cracks, Leaks		
Brakes, Steering	Need Adjustment or Replacement		
Exhaust System	Exposed to Grease, or oils		
First Aid Kit	Inadequately Stocked		

FIGURE F-1
(Cont.)

III. inspection of Security Control Systems (Inspection Frequency: Quarterly)

Item	Problem	Status Acceptable	 Unacceptable
Fence	Corrosion, Damage to Chain Link Fence or Barbed Wire		
Gate and Lock	Corrosion, Damage to Chain Link Fence or Barbed Wire; Sticking or Corroding Locks		
Two-Way Radio	Malfunctioning		

Item	Problem	Status Acceptable	 Unacceptable
Burning Tray	Broken Welds, Cracks, Residual Ash or Explosives		
OB Grounds	Unburned Materials, or Metal Fragments		
OD Grounds	Unexplored Materials, or Metal Fragments		

1. All fires are reported immediately to the SEAD Fire Department. The decision whether to fight a fire or let it burn is made on a case-by-case basis, and is determined by the hazardous classification and characteristics of the materials involved in the fire. If it is adjudged too hazardous to fight a fire, the Fire Department remains at the site of the fire to contain the fire, prevent access to dangerous areas by non-authorized personnel, and keep the fire from spreading to adjacent areas.

2. All transportation vehicles, offices, and operating areas are provided with water or hand-held fire extinguishers. The type of extinguisher provided is correlated to the type of materials handled or processed in that area. Operating personnel are instructed in extinguisher use and advised of the nature of fires for which each type of extinguisher should be used.

3. Operating personnel are also instructed to use extinguishers only to fight minor fires, and only if there is no personal danger involved in so doing. In all cases, whether or not the fire is adjudged to be "minor" by those at the scene, the Fire Department is always immediately notified.

4. Hazardous waste management facility internal communications are made by direct voice contact (see **Section F-3**). Communications (internal and external), implementation of emergency or rescue procedures, and similar emergency response procedures are outlined in greater detail in the HWCP (see **Section G**).

F-3a(1) Internal Communications [*40 CFR 264.56(a)(1)*][*40 CFR 264.32(a)*][*6NYCRR Part 373-2.3 (c)(1)*]

Internal communications at hazardous waste management facilities at SEAD are made by direct voice contact. As the Standing Operating Procedures (SOPs) require that at least two people be present for all loading, unloading, or moving of hazardous waste into or out of individual hazardous waste management units, communication devices are not necessary. The hazardous materials transport vehicle ~~is equipped with a~~ two-way radio.

Fire phone, two-way radios, and telephones are located throughout the general facility for use in contacting the Coordinator, rescue squads, cleanup crews, fire department, or other disaster control agencies in the event of an emergency. The Coordinator can readily summon off site emergency assistant either from the scene or through the Guard Dispatcher.

An emergency number (X117) is used on SEAD for any emergency. All emergency responses can be initiated concurrently with this number. The two-way radio can contact the base station, which can initiate a 117-call.

The Engineering and Environmental Management Division (EEMD) is the SEAD Primary Emergency Coordinator, and oversees all movements of containers inside, to, and from Buildings 301 and 307. During shipments form Building 307, the QA representative carries a two-way radio.

F-3a(2) External Communications [*40 CFR 264.56(a)(2)*][*40 CFR 264.32(b)*][*6NYCRR Part 373-2.3(c)((2)*]

The OB/OD facility is equipped with a telephone which provides a means of external communication with all areas of the Seneca Army Depot. In addition, all personnel have two-way radios in there vehicles for notifying emergency response personnel. SEAD operates its own emergency response facilities. In addition, if support is required from external entities, SEAD has executed agreements with other fire, rescue, emergency medical, and similar facilities. If external support is required, this would be communicated from on-scene personnel to the guard dispatcher, which would contact the appropriate external agencies utilizing commercial telephone service.

F-3a(3) Emergency Equipment [*40 CFR 264.52(e)*][*40 CFR 264.32(c)*][*6NYCRR Part 373-2.3(c)(3)*]

Emergency equipment in the form of portable fire extinguishers and first aid kits will be on each vehicle used in operations at the OB/OD facility. Emergency equipment is not maintained at the OB/OD facility because, due to weather conditions or other hindering factors, this facility only operates approximately 180 days per year. Therefore, emergency equipment shall be taken to the OB/OD facility only when treatment operations are to be conducted. The SEAD fire Department and Medical personnel are notified prior to treatment operations and they are capable of responding to an emergency situation within ten minutes. Each department is responsible for ensuring that any equipment used during an emergency is cleaned and restored to pre-emergency condition and fully operational. If the equipment cannot be restored to a fully operational condition, it shall be replaced with new equipment.

Portable fire extinguishers, fire control equipment (including special extinguishing equipment, such as that utilizing foams, inert gas, or dry chemicals), spill control equipment, and decontamination equipment are available at several locations at SEAD, including the deactivation furnace, the gates of the hazardous waste storage areas and the SEAD fire department.

The HWCP contains an updated list of all emergency equipment at the facility used for response to unplanned releases of hazardous materials or wastes (see Section G). A listing of types of equipment, inspection frequency, and problem for which each type of equipment is presented in **Table F-2.**

F-3a(4) Water for Fire Control [*40 CFR 264.51(b)*][*40 CFR 264.32(d)*][*6NYCRR Part 373-2.3(c)(4)*]

Water for fire control is provided by the SEAD fire department. If a fire starts which cannot be safely contained by personnel at the OB/OD facility, the SEAD fire department shall respond. The SEAD fire department is staffed with not less than 6 duty persons who are on call 24 hours a day. The department has 2-500 gpm pumper trucks, 2-750 gpm pumper trucks, a crash truck, heavy equipment and assorted miscellaneous equipment for emergency response capabilities. The facility has fire hydrants located at convenient locations with a static pressure of 65 pounds or greater. Water is available at adequate pressure and volume to fight fires at SEAD.

F-3a(5) Equipment Requirements [*40 CFR 264.51(a)*][*6NYCRR Part 373.2.3(c)*]

As discussed above, SEAD operates and maintains its own fire department due to the explosive potential and nature of materials, products, and byproducts handled at the facility. This fire department is on alert at all times to implement fire-fighting or other appropriate procedures for any incidents involving hazardous materials or hazardous wastes.

Table F-1 contains an updated list of all emergency equipment utilized for emergencies at hazardous waste management facilities. This information is available to the installation's Emergency Coordinator and the cleanup crews for use in the containment or cleanup of a spill to prevent pollutant migration.

F-3a(6) Testing and Maintenance of Equipment [*6NYCRR Part 373-2.3(d)*]

Facility communication equipment, alarms, fire protection equipment, spill control equipment, and decontamination equipment and tested as required to assure its proper operation in time of emergency. **Table F-2** shows the inspection schedule of such emergency equipment.

F-3a(7) Access to Communications or Alarm System [*6NYCRR Part 373-2.3(e)*]

Whenever hazardous material is handled, at least two people are always present. Fire phones, two-way radios and telephones are located throughout the general facility for emergency communication. **Table F-1**

TABLE F-1

EMERGENCY EQUIPMENT

Building	Equipment	Quantity
103	Structural pumper	1
	Crash/fire/rescue trucks	2
	Portable firefighting units	2
	Rescue command vehicle	2
	Pickup truck	2
106	Ambulance	1
122	Backhoe	1
	Gradall	1
	Bulldozer	1
	Front-end loader	4
	Dump trucks	5
	Fiberglass mobile 1,000-gallon spill tank with portable sludge pump	1

Various bulk petroleum trucks are available if needed. These include the following:

1 - 1,200 gallon gasoline truck
1 - 2,000 gallon diesel fuel truck
1 - 2,400 gallon diesel fuel truck
1 - 1,200 gallon diesel fuel truck (dual, 600 gallon tanks)
1 - 1,200 gallon jet fuel truck
2 - 5,000 gallon jet fuel truck

Total Capacity 18,000 Gallons

TABLE F-2

INSPECTION SCHEDULE

Area/ Equipment	Specific Item	Types of Problems	Frequency of Inspection
Safety and emergency equipment	Standard industrial absorbents	Out of stock, low stock	Monthly/as needed
	Absorbent boom	Out of stock	Monthly/as needed
	Self-contained breathing apparatus(SCBA)	Air quantity in reserve, air delivery system, moisture in tank (in cold weather)	Monthly/as needed
	Face shields and extra protective eyeglasses	Broken or dirty	Monthly/after each use
	Fire extinguishers	Needs recharging	Monthly/after each use
	Fire alarm system	Power failure	Per NFPA
	First aid equipment and supplies	Items out of stock or inoperative	As used
	Generator	Fuel supply, spark plugs, oil	As used
	Protective clothing (impermeable full body coveralls, gloves and boots)	Holes, normal wear and tear	As used
Container storage area	Container placement and stacking	Aisle space, height of stacks container quantity	Weekly*
	Sealing of containers	Open lids	Weekly*

TABLE F-2
(Cont.)

Area/ Equipment	Specific Item	Types of Problems	Frequency of Inspection
	Contamination equipment	Inoperative	Weekly*
	Explosion meter	Calibration, power, backup	Weekly*
	Labeling of containers	Improper identification, date missing	Weekly*
	Containers	Corrosion, leakage, structural defects	Weekly*
	Segregation of incompatible wastes	Storage of incompatible wastes in same area	Weekly*
	Base or foundation	Cracks, spalling, uneven settlement, erosion, wet spots	Weekly*
	Locks and security devices	Inoperative	Weekly*
	Fire hydrant water pressure--nearest hydrant	Insufficient pressure	Annually
	Loading/unloading areas	Structural defects, contamination	Weekly*
	Telephone	Inoperative	Weekly*
	Condition of pallets	Structural defects, contamination	(1)Upon receipt (2)Weekly (3)If leak is observed (4)Daily when in use

*Daily when in use

F-4 PREVENTIVE PROCEDURES, STRUCTURES, AND EQUIPMENT [*40 CFR 270.14(b)(8)*]

F-4a LOADING/UNLOADING OPERATIONS

Specific requirements for the loading and unloading of waste PEPs are described in SOPs. Although the most up to date SOPs are on file at SEAD, those pertaining to the loading and unloading of waste PEPs are provided in this section as follows:

1. All appropriate fire and chemical hazard symbols shall be displayed in such a manner as to be easily visible from all roads of approach to the munitions storage bunkers and the OB/OD facility.

2. All loading and unloading areas shall be maintained in a neat and safe condition.

3. All tools used required for such operations shall be in good condition and shall be non-sparking when appropriate.

4. Each vehicle operator will have in their possession a valid operators permit for the particular piece of equipment to be operated.

5. Explosives-loaded ammunition, packaged ammunition or bulk explosives shall not be handled roughly, thrown about, tumbled, dropped, or walked over other explosives or ammunition. Large ammunition items, packaged in DOT-approved containers designed to permit dragging, rolling or towing may be so moved when necessary during handling for storage and transportation.

6. Leather gloves and steel toed shoes shall be worn by all personnel involved in the loading and unloading of waste PEPs.

7. Explosive materials shall be unloaded by hand or forklift as appropriate. Personnel operating the forklift(s) shall be fully trained in the handling of explosive materials and possess a valid forklift operator's license.

8. Trucks transporting explosive materials to burning grounds shall meet all applicable safety requirements. In addition, no more than two people shall ride in the cab.

9. Upon arriving at a burning or demolition ground, trucks may distribute explosive items to be treated at sites where treatment is to take place. As soon as all items have been removed, trucks shall be withdrawn from the burning or demolition area to a safe location until treatment is concluded.

10. When materials being processed at the OB/OD facility are to be handled by gasoline or diesel powered forklift truck, all applicable safety requirements shall be adhered to. All such material will be properly packaged and must not be contaminated with explosives.

11. During the loading or unloading of motor vehicles, the brake must set. In addition, when on a grade at lest one wheel must be chocked.

12. When a motor vehicle approaches within 25 feet of the doors of a structure through which a shipment is to be moved, the doors must be kept closed until the motor has been switched off unless the exhaust system is equipped with a spark arresting device or no exposed explosives are present.

13. No explosives shall be loaded into or unloaded from motor vehicles while their motors are running. Motors may be kept running when required to provide power to vehicle accessories such as mechanical handling equipment used in the loading and unloading of the vehicles, provided:

    a. The accessory is an integral part of the vehicle

    b. The exhaust gases from the motor are emitted at least six feet from the point at which the loading operations are conducted and are directed away from this point.

    c. The exhaust pipe is equipped with a spark arrestor.

    d. Materials being loaded or unloaded which may involve flammable vapors are enclosed in tightly fitting containers.

14. Trucks with end-operating platforms or pedals shall be equipped with platform guards of heavy channel iron and heavy steel plate or materials of equal strength. The guards should be at least 18 inches high on the sides and should extend a sufficient distance beyond the platform or pedal to protect the operator. Overhead guards are required for forklift trucks of all types.

Lift trucks shall be designed to prevent the sudden dropping of the load in the event of a power failure.

15. Transportation and/or moving fused ammunition, including bombs directly or indirectly on the forks of lift trucks without skids or pallets is prohibited unless such containers are so designed to be safely carried in this manner. Loaded unfused bombs may be carried directly on the forks of lift trucks. Boxes of finished ammunition when of sufficient length so as to be firmly supported on both forks my be carried directly on the forks.

16. Loads on tines of forklifts must not extend more than one-third of the height of the top tier of containers above the load back rest. When handling two low profile unitized loads together, because of low overhead clearance in the storage magazines, the package guard must extend to at least one-third the height of the top of the load.

17. The method and sequence of unloading the ammunition and explosives should be considered before loading a truck, particularly if hoisting equipment is used. Blocks should be used to separate section of the load to permit easy fastening of slings at the unloading point. If selective stacking is required at the unloading end, the material should be loaded on the truck in proper sequence. Trucks should not be loaded to a height that will obstruct visibility in both directions unless at lest two men are assigned to move the truck. Loads shall be placed to prevent tipping, shifting, or falling.

F-4b RUN-ON/RUN-OFF CONTROL STRUCTURES

Open burning operations are conducted in a burning tray which is elevated from the ground and supported by three concrete supports. This device serves to contain any initiating fluids which may be required and any ash/residue. In addition, open burning operations are not conducted under adverse weather conditions and the burning pan is kept covered when not in use. Therefore, in the event of a flood, there would be no hazardous waste at the OB facility and the threat of contaminated run-off is very minute. In addition, there is no threat of precipitation run-on.

Due to the inherent nature of treatment, open detonation operations are conducted on the ground without any form of engineered control devices which will prohibit precipitation run-on or contaminated runoff. The reason is that such devices would be destroyed under normal thermal treatment operations conditions and that ejected fragments of the devices structure would create a safety hazard to military personnel.

F-4c WATER SUPPLIES

In regards to the Open Detonation, a groundwater quality monitoring program and a surface water sampling program will be institued in accordance with Section D.

For Open Burning a double containment structure (a burning platform and a concrete pad) and a stainless steel cover are used to prevent groundwater contamination.

In addition, restrictions in the use of these facilities during precipitation events will further reduce the chance of contaminating water supplies.

F-4d EQUIPMENT AND POWER FAILURE

There are no electrical power sources at the OB/OD facility. Therefore, if there were a power outage at SEAD, treatment operations would not be hindered. Equipment failures shall be reported immediately as specified in the SOPs. Faulty equipment shall be repaired or replaced as appropriate.

F-4e PERSONNEL PROTECTIVE EQUIPMENT

The handling of waste explosives shall be conducted in a manner that minimizes contact with the waste. All handling operations and requirements for protective clothing shall be in accordance with SOPs. At a minimum protective clothing shall include but not be limited to the following: fire retardant overalls, safety shoes, and gloves. In addition, SEAD has face shields, OBA canisters, full face respirators, and Scott air packs (SCBA) available for use. However, the thermal treatment of chemical nerve gas and lachrymators is prohibited at this facility.

F-5 PREVENTION OF THE REACTION OF IGNITABLE, REACTIVE, AND INCOMPATIBLE WASTES [*40 CFR 270.14(b)(9)*]

F-5a MANAGEMENT OF IGNITABLE AND REACTIVE WASTE

All hazardous materials handled at the OB/OD facility shall be assumed to be reactive due to their chemical content. As such, personnel must take appropriate measures to prevent reactions which:

(1) Generate extreme heat or pressure, fire or explosions, or violent reactions;

(2) Produce uncontrolled toxic mists, fumes, dusts, or gases in sufficient quantities to threaten human health of the environment;

(3) Produce uncontrolled flammable fumes or gases in sufficient quantities to pose a risk of fire or explosion;

(4) Damage the structural integrity of the device or facility;

(5) Through other like means threaten human health or the environment.

The means to accomplish the aforementioned criteria are provided through the establishment of safety guidelines implemented through the SOPs. The safety guidelines include, but are not limited to, the following:

(1) No smoking signs shall be posted at the OB/OD facility.

(2) Ignition sources shall be prohibited at the OB/OD facility.

(3) Spark producing equipment and tools shall be prohibited from use near explosive materials unless specifically authorized.

(4) Incompatible materials shall not be treated or stored in the same locations.

(5) Supervisors shall perform inspections of hand tools and mechanical devices to ensure that they have not become unsafe for use as designated either to the item or to the operator.

(6) Motor vehicles used to transport waste explosives, ammunition, or other material to the destruction site shall meet all applicable safety standards.

(7) Thermal treatment operations shall not be conducted during electrical storms.

F-5c MANAGEMENT OF IGNITABLE OR REACTIVE WASTES IN CONTAINERS

The OB/OD facility is a treatment unit only. PEPs which have been designated for thermal treatment have already been disassembled at the Ammunition Disassembly Plant (Building 2108). Therefore, containers of reactive or ignitable are not handled at the OB/OD facility at this time. However, should future operations require that explosive materials be handled in containers at the OB/OD facility, it is clear from the SEAD site plan that the OB/OD facility is greater than 50 feet from the SEAD's property line.

SECTION G

CONTINGENCY PLAN

G-1 CONTINGENCY PLAN [*40 CFR 270.14(b)(7)*][*6NYCRR Part 373-2.4]*

The Resource Conservation and Recovery Act (RCRA) requires a Part B Permit applicant to submit a Contingency Plan in order to minimize hazards to human health or the environment, due to fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste or non-hazardous waste constituents. These requirements, described in 40 CFR 270.14, 264.51 through 264.56, 264.171, 264.194(c), 264.227, 264.255, and 6NYCRR Part 373-2.4, are met in the hazardous waste contingency plan (HWCP) presented in this section.

The provisions of this plan are to be carried out immediately in the event of a fire, explosion, or release of hazardous waste which could threaten human health or the environment.

In accordance with the provisions of 40 CFR 270.14 (b)(17), the HWCP is updated on a regular basis.

G-1a GENERAL INFORMATION

The Seneca Army Depot (SEAD) is located in Seneca County, New York, approximately 60 miles southwest of Syracuse. The SEAD lies immediately west of the village of Romulus, N.Y. The SEAD is bounded by NYS Route 96A on the west and NYS Route 96 on the east (see **Figure G-1**). NYS Route 336 is at the northern boundary and the southern boundary is near West Blain Road. Seneca Lake, one of the Finger Lakes, is located approximately one mile west of SEAD (refer to **Figure B-1**). The facility's mailing address is:

Commander, Seneca Army Depot
Route 96
Romulus, New York 14541-5001

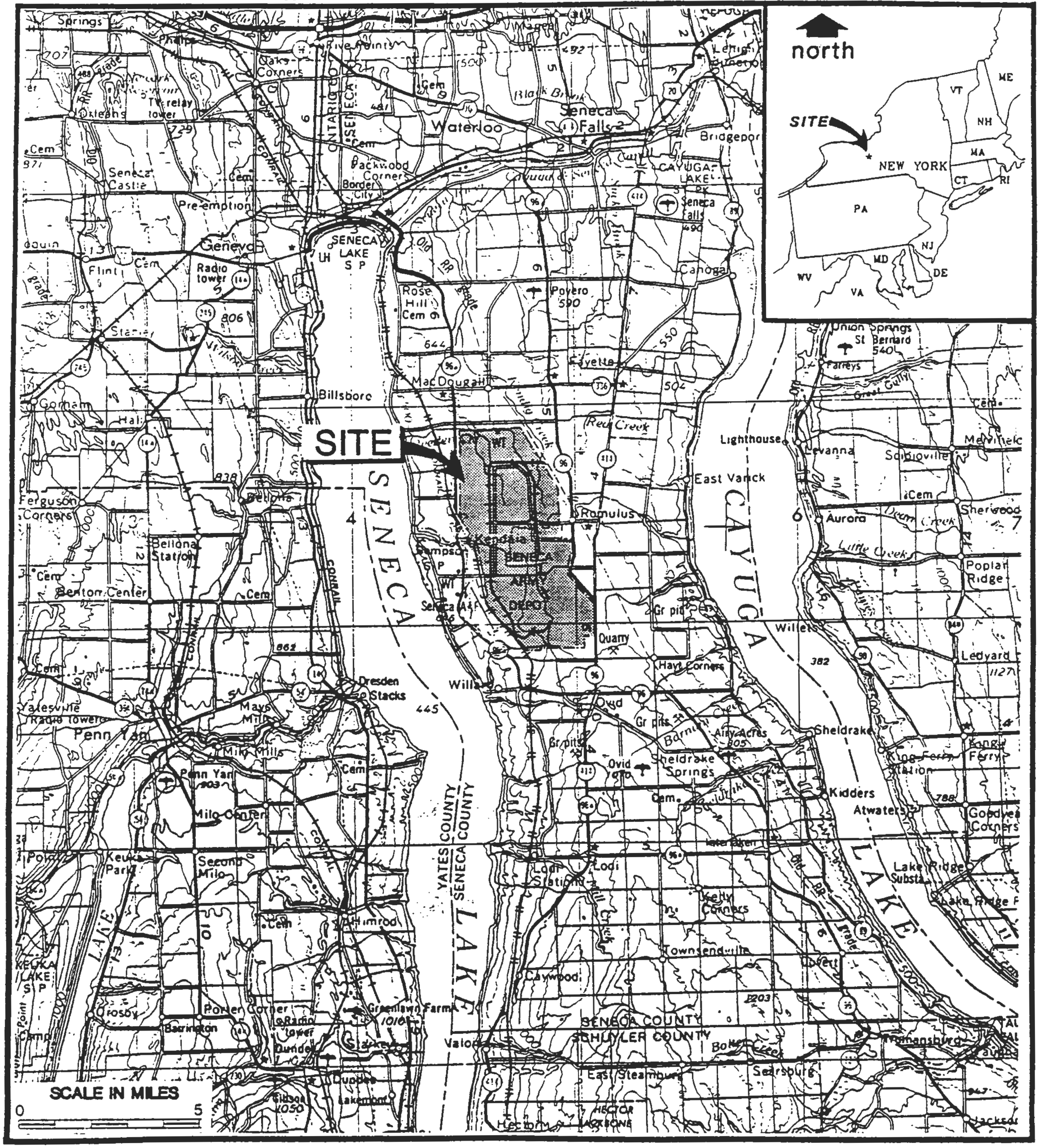


FIGURE G-1 REGIONAL TOPOGRAPHY MAP

The installation covers approximately 10,587 acres, of which 8,382 are designated storage areas for ammunition and storage and warehouse. The acreage of the site can be classified in the following groups: (1) Meadow or Brushland--200 acres; (2) Forested--7,678 acres; (3) Wetland--376 acres; and (4) Roads, buildings and other paved surfaces--360 acres. SEAD operates a sewage treatment plant; and water and electrical systems. On-post family housing is in two parcels, a 54-acre development adjacent to Route 96 and another 69-acre situated along Seneca Lake. SEAD is a government-owned, government-operated installation under the jurisdiction of the U.S. Army Depot System Command (DESCOM). The depot was constructed in 1941-1942. The primary mission of SEAD is the receipt, storage, maintenance and supply of ammunition. However, over the years SEAD's mission has broadened to include the receipt, storage, care and maintenance of general supplies, industrial plant equipment, special weapons and tank and automotive major items and assemblies. Hazardous wastes are primarily generated from machine rework operations and are stored in Building 307. These wastes include spent solvents, still bottoms from 1,1,1-trichloroethane vapor degreasers, sludge from oil/grease separators, cleaning compounds, paper filters from spray paint booths, and spent battery acids. In addition there is one building (301) designated for the storage of transformers containing oils with PCB. Another building, 367, is an incinerator with the sole function of demilitarizing obsolete and unserviceable munitions. The Open Burning/Open Detonation (OB/OD) facility is used for destroying munitions that cannot be processed in the Building 367 deactivation furnace. Building 803 is for the storage of mixed wastes including paper wipes contaminated with various solvents and low-level radioactive waste.

G-2 EMERGENCY COORDINATORS [*40 CFR 264.55[6NYCRR PART 373-2.4(f)]*]

In the event of an emergency, the primary Emergency Coordinator shall be contacted immediately. The coordinator has the responsibility and authority for supervising all cleanup and decontamination activities resulting from an accidental discharge of oil or hazardous materials within the installation's boundaries. If the primary coordinator is not available, an alternate is on call. Likewise, the alternate has the authority to commit the resources required to implement the procedures described in the contingency planning documents. The coordinator or his/her designated alternate will be available, either at the installation or at home.

The primary and alternate Emergency Coordinators, with addresses and phone numbers, are listed in **Table G-1**. Other emergency response organizations that may be contacted by the Emergency Coordinator are listed in **Table G-2.**

TABLE G-1

EMERGENCY COORDINATORS CALL DOWN LIST

Name	Duty Phone	Bldg	Home Address and Phone
Randall W. Battaglia Primary Emergency Coordinator	X450	123	4211 Shady Beach 315-539-3325 Fayette, NY
John Quill Alternate Emergency Coordinator	X451	122	P.O. Box 56 315-253-4096 Cayuga, NY
Stephen M. Absolom Alternate Emergency Coordinator	X281	123	1691 County House Road315-539-8726 Waterloo, NY 13165
Gary W. Kittell Alternate Emergency Coordinator	X309	123	Ball Diamond Road 607-546-8579 Valois, NY
James B. Cross Alternate Emergency Coordinator	X205	101	Seneca Army Depot 607-869-1616 Romulus, NY

TABLE G-2

EMERGENCY RESPONSE ORGANIZATIONS

Emergency service contractors who may be contacted for spill cleanup and removal:

CECOS International
2321 Kenmore Avenue
Buffalo, NY 14207
(716) 873-4200

OH Materials
P.O. Box 551
Findlay, OH 45839
(419) 423-3526
1-800-537-9540 (Toll Free)

New England Pollution Control Company (NEPCO)
110 Cedar Street
Batavia, NY
(716) 343-6444

Iverson Construction
Gorham, NY
(716) 526-6331

Seneca County Mutual Aid (Seneca County Sheriff)
Ovid (607) 869-3721
Waterloo (315) 539-2425

Envirosure Management Corporation, Inc.
4625 Royal Avenue
Niagara Falls, NY 14303
(716) 285-2581

If an emergency develops at the facility, the first person to discover it should contact the Emergency Coordinators listed on **Table G-1**. Mr. R. W. Battaglia is currently the primary Emergency Coordinator and should be contacted first. If he is not available, the next person on the list should be called. The primary Emergency Coordinator and the alternate have the authority to commit the resources necessary to contain and control the emergency situation. The responsibilities and operating knowledge of the Emergency Coordinator are detailed in 40 CFR 265.55 and 265.56. Other emergency response organizations that may be contacted by the Emergency Coordinator are listed on **Table G-2**.

Mr. Battaglia's selection as primary Emergency Coordinator is based on his knowledge of the wastes at SEAD, his educational background, training, and professional experience. Mr. Battaglia received a Bachelor of Science degree from Clarkson University, where he studied chemical engineering. Since he began employment at SEAD in 1985, he has taken numerous training courses through the Federal Government to enrich his knowledge of the safe handling of hazardous waste and emergency situations. He has been intimately involved with the installation's hazardous waste management operations, including the process generating the wastes, transportation, monitoring, permitting, storage facility maintenance, and inspections.

Responsibilities of the Emergency Coordinator in an emergency situation include:

1. Activate internal facility alarms or communication systems and notify all facility personnel.
2. Notify state and local agencies with designated response roles.
3. In the case of a release fire, or explosion, the Emergency Coordinator must identify the character, exact source, amount and areal extent of any released material.
4. Assess possible hazards to human health and the environment.
5. Notify local authorities concerning evacuation, etc., and report all information listed above if the assessment indicates a release which could threaten human health or the environment outside the facility.
6. Take all reasonable measures necessary to prevent releases from occurring, recurring, or spreading.
7. Provide for treating, storing or disposing of recovered waste, contaminated soil or surface water or any other material resulting from the release, fire, or explosion.
8. Ensure that no incompatible wastes with the released material are stored or treated until cleanup is complete.
9. Ensure that emergency equipment is cleaned before normal operations resume.

10. Notify appropriate state and local authorities before normal operations resume.
11. Note in the operating record the details of the incident; and within 15 days after the incident submit a report to the commissioner.

The responsibilities of the alternate Emergency Coordinator are the same as that of the primary Emergency Coordinator. The alternate coordinators are likewise highly experienced environmental professionals, qualified to perform the duties of the primary Emergency Coordinator, should he be unavailable.

The details concerning these responsibilities are provided in **Section G-4.**

G-3 IMPLEMENTATION OF THE CONTINGENCY PLAN [40 CFR 264.51] [*6NYCRR Part 373-2.4(b)*]

The decision to implement the contingency plan depends upon whether or not an imminent or actual incident could threaten human health or the environment. The purpose of this section is to provide guidance to the Emergency Coordinator in making this decision. The contingency plan for SEAD will be implemented in the following instances:

1. Fire and/or Explosion:

    a. A fire causes the release of toxic fumes.
    b. The fire spreads and could possibly cause ignition of materials at other locations on site or could cause heat induced explosions.
    c. The fire could possibly spread to off site areas.
    d. Use of water or water and chemical fire suppressant could result in contaminated runoff.
    e. An imminent danger exists that an explosion could occur, causing a safety hazard because of flying fragments or shock waves.
    f. An imminent danger exists that an explosion could ignite other hazardous waste at the facility.
    g. An imminent danger exists that an explosion could result in release of toxic material.
    h. An explosion has occurred.

2. Spills and Material Release:

    a. The spill could result in release of flammable liquids or vapors, thus causing a fire or gas explosion hazard.
    b. The spill could cause the release of toxic liquids or fumes.
    c. The spills can be contained on site, but the potential for groundwater contamination exists.
    d. The spill cannot be contained on site, resulting in off site soil contamination and/or ground water or surface water pollution.
    e. The spill could enter either of three sewer systems (two sanitary, one storm).

3. Floods:

    a. The potential exists for contamination of surface waters.

Seneca maintains a current hazardous waste inventory list in the Environmental Office (Bldg. 123) that is easily utilized by the emergency response personnel.

G-4 EMERGENCY RESPONSE PROCEDURES [*40 CFR 264.56*][*6NYCRR Part 393-2.4(g)*]

In accordance with the requirements of 40 CFR 264.56 and 6NYCRR Part 373-2.4(g), the HWCP for SEAD details the procedures to be implemented in the event of a fire, explosion, or hazardous waste release at a hazardous waste management unit which may endanger human health or the environment. The Emergency Coordinator is responsible for implementing the provisions of the HWCP. The detailed emergency procedures addressed in the HWCP are detailed in the following sections.

G-4a NOTIFICATION [*40 CFR 264.56(A)*][*6NYCRR PART 373-2.4(G)(1)*]

In the event of an emergency, the Emergency Coordinator (or alternate) is responsible for activating the Installation Response Team (refer to **Table G-3**). Then, he will relay information regarding the possible release to the following; HQDESCOM, the Coast Guard, NYSDEC, and on-site officers (refer to **Table G-4**). The installation fire department is notified in all emergency situations regardless of its fire or explosive potential. If the emergency is too severe to be handled by on-site personnel alone, appropriate state or local emergency response teams (refer to **Table G-2**) will be alerted by the Emergency

TABLE G-3

INSTALLATION RESPONSE TEAM

Name	Duty Phone	Home Phone
Col. James B. Cross	X205	607/869-1616
Gary W. Kittell	X309	607/546-8579
Stephen M. Absolom	X281	315/539-8726
Randall W. Battaglia	X450	315/539-3325
Shirley Kaufman (Contracting Officer, if needed)	X318	____________
John Quill (Roads and Grounds)	X451	315/253-4096
John Lincoln (Roads and Grounds)	X451	____________
Roads and Grounds Personnel on duty or on call during off-duty hours		

TABLE G-4

FACILITYEMERGENCY REPORTING PROCEDURE FOR ALL SPILLS OR POTENTIAL SPILLS

The SEAD Emergency Coordinator will notify the following agencies of all uncontrolled discharges, spills or potential spills that may contaminate the air, water or ground.

HQDESCOM
Chambersburg, PA 17201
AMSDS-EN-FD
DSN/AUTOVON 570-9427
Commercial 717-267-9427

AMCCOM
Rock Island, Illinois 61299
794-793-1110

National Response Center (Coast Guard)
(Required by Law)
800-424-8802

New York State Department of Environmental Conservation
Region 8
Regional Spill Engineer
Avon, New York, 14414
24-Hour Toll Free Number 800-457-7362
Regional Office Number 716-226-2466
Regional 24-Hour Pager Number 716-955-4550

Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278
Office of Pesticides and Toxic Substances Branch 212-264-2525

When time permits and, if appropriate, contact the following on-site offices:

CO/CEA	Safety	Security Police/MPI
Col. James B. Cross	Thomas Stincic	Sgt. Steven L. Eldridge
Duty Phone: X206	Duty Phone: X261	Duty Phone: X18311

TABLE G-5

EMERGENCY TELEPHONE NUMBERS

SENECA ARMY DEPOT
ROMULUS, NEW YORK

Ambulance SEAD	(607) 869-1436
Fire SEAD	(607) 869-1316
Police SEAD	(607) 869-0448
Geneva General Hospital[1] 186-198 North Street Geneva, New York	(315) 798-4222
SEAD Staff Duty Officer	(607) 869-0251
Seneca Army Depot Security	(607) 869-0274
Seneca Army Depot Clinic[2]	(607) 869-1243
On Post Calls	3-0-xxx or 4-1-xxx
Chemtrec	(800) 424-9300
National Response Center - Environmental Emergencies	(800) 424-8802
Randy Batagglia - Seneca Army Depot - Environmental Contact	(607) 869-1450

[1] Exit the north gate from the depot onto State Road 96A. North on State Road 96A to Geneva. In Geneva turn right on State Roads 5 and 20 to North Street. Turn left on North Street to Hospital.

[2] Located on post near the south (main) gate (see **Figure B-4**).

Coordinator. Emergency phone numbers including agencies to be contacted if an emergency overextends the boundaries of the facility are shown in Table G-5.

G-4b IDENTIFICATION OF HAZARDOUS MATERIALS [*40 CFR 264.56(B)*][*6NYCRR PART 373-2.4(G)(2)*]

Whenever there is a release, fire, or explosion, the Coordinator is responsible for identifying the character, exact source, amount, and extent of any released material. The Coordinator will identify and quantify the hazardous waste released by any of the following methods, as appropriate:

1. Consult the area supervisor as to the nature of the release
2. Personal visual observations
3. Review of facility records or manifests
4. Perform laboratory analysis if methods above do not completely identify released materials
5. Implement portions of the waste analysis plan applicable to the particular hazardous waste management unit at which the release has occurred

G-4c ASSESSMENT [*40 CFR 264.56(C) AND (D)*][*6NYCRR PART 373-2.4(G)(3), (4)*]

Based on engineering knowledge and the expertise of the particular hazardous waste management area personnel, the Coordinator will assess potential hazards to human health or the environment as a result of a fire, explosion, or release. If the assessment indicates that evacuation of local areas is advisable, the Coordinator will notify, as appropriate, the local authorities, the New York Department of Environmental Conservation (DEC), the Region II Environmental Protection Agency (EPA) On-Scene Coordinator, and the National Response Center. This assessment will consider both direct and indirect affects of the release, fire or explosion in accordance with the 1990 U.S. Department of Transportation (DOT) Emergency Response Guidebook. The 1990 DOT Guidebook will be used by the emergency coordinator to:

1. Identify the material(s) involved
2. Find the potential hazards associated with the material(s)
3. Initiate emergency action called for in the guidebook

This guidebook does not list the criteria upon which it bases its guidance, nonetheless, SEAD utilizes it to assess and respond to emergencies such as a release, fire or explosion. This practice meets the requirements of §264.56(c and d).

G-4d <u>CONTROL PROCEDURES [*40 CFR 264.52(A)*][*6NYCRR PART 373-2.4(C)(1)*]</u>

G-4d(1) Fire and/or Explosion

The SEAD Fire Department will be on standby during all general facility emergencies. If a fire should break out, emphasis will be on preventing the fire from spreading to nearby areas. The following action will be taken in the areas affected by the fire or explosion:

- The area will be cleared of all personnel not actively involved in fighting the fire.
- All injured individuals will be removed, and medical treatment will be administered by qualified personnel.
- All ignition sources within the area will be eliminated.

Evacuation of areas adjacent to storage areas may be necessary in the event of a major fire or explosion. An "evacuation" signal (1 blast) will be given in that case. All emergency response personnel have been trained in evacuation procedures from areas adjacent to storage areas. In the event of an emergency situation, contract personnel and guests will be cleared from the area and instructed to report to the Visitor's Reception Area.

An "all clear" signal (2 blasts) will be given when the fire has been extinguished and the safety of personnel is no longer endangered. The SEAD Fire Department Chief will consult with the Emergency Coordinator before the signal is given. All equipment utilized in the emergency must be cleaned and fit for its intended use before standard operations are resumed in the affected area.

G-4d(2) Spills and Material Release

In the event of an emergency involving a chemical spill, the following procedures will be employed for rapid, safe response and control of the incident. If an employee discovers a chemical spill, he or she will immediately report it to the area supervisor. He or she will immediately try to contain or clean up the spill using readily available spill kits which are located at all generation and storage sites **(Table G-6)**. However, personnel should not attempt to contain or clean-up a chemical spill without identifying the potential hazards and

TABLE G-6

MATERIALS AND EQUIPMENT FOR SPILL CONTAINMENT AND CLEANUP

Building	Material	Quantity	Description	Capabilities
S-131	Sorbent booms			To contain and absorb liquid spills
	Pillows			
	Bales		Hay or Straw	
	Neutralizing Agent - Nutrocit	2		
103	Structural pumper	1		
	Crash/fire/rescue trucks	2		
	Portable firefighting unit	2		
	Rescue command vehicle	2		
	Pickup truck	2		
106	Ambulance	2		
122	Backhoe	1		
	Gradall	1		
	Bulldozer	1		
	Frontend loader	4		
	Dump trucks	5		
	Fiberglass mobile 1000 gal spill tank with portable sludge pump	1		
Personal Decontamination Facility (Health Clinic)	Holding Areas			
	Air Filters			

TABLE G-6
(Cont.)

Building	Material	Quantity	Description	Capabilities
307	Spill Kit**			
	- Organic vapor respirator	1	1/2 face	
	- Air packs	2		
	- Coveralls	1 pr	Chemical resistant	
	- Gloves	1 pr	Neoprene	
	- Absorbent	1 bag	Speedi-dry clay absorbent	
	- Shovel	1		
	- Fire extinguisher	1		
	- Absorbent pads	10		

* Each satellite accumulation area is stocked with a similar spill kit. Each spill kit is contained in a 55-gallon drum which is stencilled with emergency phone numbers. Spill kits are maintained at several locations on Seneca Army Depot for spill responses for small spills of hazardous materials. The container of this kit is a DOT-approved open top steel drum to be used for residues after removal of equipment. "Small spills" are what generally can be contained and/or cleaned up with a 50-lb. bag of clay absorbent or absorbent pads. All kits have emergency call numbers stenciled on the container.

taking the necessary health and safety precautions. The area supervisor will contact the Emergency Coordinator (or his alternate). The Emergency Coordinator will then obtain information pertaining to the following:

- Type of material spilled or released
- The location of the release or spillage of hazardous material
- Estimate of quantity released and the rate at which it is being released
- Direction in which the spill or vapor release is heading (a windsock is located on Building 307)
- Any injuries involved
- Fire and/or explosion hazard, and
- Area and materials involved and the intensity of the fire or explosion, if any.

This information will aid the Emergency Coordinator in assessing the magnitude and seriousness of the spill or release. The Emergency Coordinator will contact and deploy the necessary response groups. If necessary and/or appropriate, he will contact local, state, and federal agencies for assistance.

Emergency response personnel will:

- Ensure that all unnecessary personnel are removed from the affected area.
- Don appropriate protective clothing/gear.
- Remove all ignition sources if a flammable waste is involved, and utilize spark proof equipment in containment operations.
- Remove all surrounding materials that could be specially reactive with the spilled chemicals.
- Notify the SEAD Fire Department to respond with foam equipment and hoses if the spilled materials are flammable.
- Flush the spill with large quantities of water or foam if advised by the Fire Department Chief, that this is the only means to safely mitigate a fire/explosion hazard.
- Utilize absorbent pads, booms, sandbags, sand and other inert materials to contain, divert and clean up a spill if it has not been contained by a dike or sump.
- Neutralize acid spills with bicarbonate (soda ash).

- Place all containment and cleanup materials in drums for proper disposal.
- Place all recovered wastes and/or contaminated soil in containers for removal to an approved disposal site.

If the spill results in the formation of a toxic vapor cloud by reaction with surrounding materials or by outbreak of fire, further evacuation procedures will be implemented, as appropriate.

Any leaking tank will be drained of its contents and replaced. A tank containing a flammable liquid will be filled with water or foam to eliminate the vapor hazard before proceeding with remedial actions. All above ground tanks storing a large amount of hazardous materials (petroleum) have secondary containment of bentonite dikes. The dikes contain excess volume of 10% above the capacity of the respective tank. All container storage areas have been constructed with appropriate containment areas. However, in the event that a chemical spill is not contained within the burbing, an area of isolation will be established around the release. The size of the area will generally depend on the size of the spill and the materials involved. For example, small spills or leaks from a drum or pipe may require evacuation of at least 50 feet in all directions to allow cleanup and repair. When any spill occurs, only response personnel directed by the Emergency Coordinator will be allowed within the designated hazard area. If possible, the area will be roped or otherwise blocked off. The area will be isolated by the establishment of Military Police traffic control points. In addition to the 1000-gallon mobile spill response tank, SEAD has various bulk petroleum tankers available, if needed. If the spill results in the formation of a toxic vapor cloud by reaction with surrounding materials or by outbreak of fire, further evacuation procedures will be implemented, as appropriate.

G-4e PREVENTION OF RECURRENCE OR SPREAD OF FIRES, EXPLOSIONS, OR RELEASES *[40 CFR 264.56(e)][6NYCRR Part 373-2.4(g)(5)]*

The prevention of the spread of an existing fire, explosion or release is discussed in **Section G-4d** above. To prevent recurrences, the Coordinator will, as soon as practicable, conduct an on-site evaluation of the site where the fire, explosion, or release occurred. Corrective measures will be identified and implemented as appropriate to prevent recurrence of fire, explosion, or releases at the same area. These measures are as follows:

- Ensure that the cause has been eliminated.
- For fires/explosions-ensure that all ignition sources have been eliminated.

- Collect and contain released waste.
- Recover or isolate containers.

All activities, except clean-up operations, will cease at the emergency area. Immediately after an emergency, the Emergency Coordinator will make arrangements for treatment, storage, or disposal of recovered waste, affected soil, surface water or any other material that contains chemical constituents.

Requirements for Propellant, Explosives, Pyrotechnics (PEPs) Spill Cleanup:

a. Implement the procedures of this **Section, G-4e.**

b. Fire response will include full fire protection gear with SCBA.

c. Fire responses for PEP fires will involve foaming agents to minimize PEP contamination.

d. Protective equipment will include neoprene gloves and boots, and TYVEK coveralls.

e. Immediate requirements:

   (1) Notification - As soon as possible, but no later than 24 hours, of the following:

      (a) NYSDEC Region 8 Spill Engineer (1-800-457-7362): refer to **Table G-4.**
      (b) EPA - Region II, Office of Pesticides and Toxic Substances Branch (212-264-2525).
      (c) National Response Center (1-800-424-8802).

   (2) Restrict Access - Cordon off or otherwise delineate and restrict the area encompassing any visible traces plus a minimum 3-foot buffer, and place clearly visible signs advising persons to avoid the area to minimize the spread of contamination as well as the potential for human exposure.

   (3) Records - Record and document the area of visible contamination, noting the extent of the visible trace area. if there are no visible traces, this will be

recorded and the NYS and EPA Regional Offices will be contacted for guidance in completing statistical sampling of the spill area to establish spill boundaries.

(4) Cleanup - Initiate cleanup of all visible traces of the fluid on hard surfaces and initiate removal of all visible traces of the spill on soil and other media.

A statistically based sampling scheme will be used to identify the boundaries of the spill area as soon as practicable.

f. The level of cleanup will be verified through postcleanup sampling. A statistically valid, reproducible sampling scheme (either random or grid samples) will be used provided that:

(1) The sampling area is the greater of:

(a) an area equal to the area cleaned plus an additional one-foot boundary
(b) an area of 20% larger than the original area of contamination.

(2) The sampling scheme must insure 95% confidence against false positives.

(3) The samplings of samples must be sufficient to ensure that affected areas of a radius of 2 feet or more within the sampling area will be detected except that the minimum number of samples is 3 and the maximum number of samples is 40.

(4) The sampling scheme must include calculation for expected variability due to analytical error.

g. Impervious solid surfaces, including cleanup equipment, will be decontaminated to ten micrograms PEP per one hundred square centimeters (10 $\mu g/100$ sq cm) as measured by standard wipe tests.

h. All residues from cleanup operations and decontamination operations will be managed as hazardous waste.

i. Personnel Protective Equipment (PPE) Selection:

PPE must be selected on a PPE vs. chemical basis. The degree of hazard must be accurately identified initially in any spill response.

(1) Protective Clothing:

Butyl rubber gloves and boots are adequately compatible with all of SEAD's hazardous wastes. Skin protection, including gloves, boots and clothing, should be used for any spilled hazardous waste at SEAD. TYVEK is a gas-permeable, liquid-impermeable material which is suitable for petroleum-based hazardous wastes at SEAD. TYVEK, however, may not be resistive to chlorinated hydrocarbons, acids and bases. Where a splash hazard is possible for these, a face shield, safety glasses, and rubber apron should be used as a minimum. In the vent where spill response involved a large amount of hazardous vapors, totally encapsulating (TE) suits that are resistive to the spilled chemical should be used. SEAD presently is purchasing SACONEX-laminated TYVEK and/or CHALLENGE 5100 (a propriety TEFLON/NOMEX composite material) TE suits, as part of spill response team upgrading.

(2) Respiratory Protection:

As with protective clothing, respiratory protective equipment is chosen for particular, specific respiratory hazards. Respirators used for personnel protection at SEAD include SURVIVAIR organic vapors/acid gases/HEPA chemical cartridges. SCBA presently includes Scott-Air Packs, and Mine Safety Appliances (MSA) SCBA is being purchased. (The SURVIVAIR respirator should not be used in areas where there is less than 19.5% oxygen by volume.)

(3) Response:

No TE suit will resist every known hazardous chemical. ASTM F739-81 is a standard test which will determine breakthrough time for a material versus chemical attack. Protective clothing considerations involve chemical resistance, physical properties, cost, and decontamination potential.

Identification of the chemicals and the degree of hazards is essential to choosing appropriate PPE for response personnel. TE suits with SCBA is sometimes required to perform this initial step. Choosing PPE for response personnel involves planning for appropriate PPE as well as decision making during the response actions.

G-4f Storage and Treatment of Released Material *[40 CFR 264.56(g)][6NYCRR Part 373-2.4(g)(7)]*

Material recovered from a fire explosion or release at the OB/OD facility will involve PEP, OB initiator fluid (No. 2 fuel oil), OD initiators (blasting caps and demolition material), or OB/OD ash/residue.

A spill of fuel oil is likely to be a small volume (less than 5 gallons) and will be contained utilizing absorbent materials. Fuel oil is utilized in 5 gallons safety cans, as described in Appendix 4, operation #7 in the SOP for demilitarization of munitions by burning. Since the fuel oil is handled only in 5 gallon safety cans a spill is not expected to be larger than this volume. Absorbent materials used would be collected and placed in 55-gallon drum(s) and managed as hazardous waste.

PEP or OD initiator solids recovered from a spill or ash/residue recovered from a fire or explosion (not part of the normal thermal treatment processes) will be analyzed and managed following in the same way that OB/OD ash/residue is managed, i.e., according to the facility waste analysis plan. The content of this plan is presented as follows:

a. Parameters and Rationale (40 CFR 264.13(b)(1)]. The treatment ash/residue resulting from OB/OD waste munitions shall be tested first for reactivity and second, for hazardous constituents. The rationale behind this analytical sequence is to minimize the potential for laboratory hazards associated with testing an explosive sample. The reactivity tests (Gap Test and Deflagration, Detonation, and Transition

Test) presented in **Appendix 3**, shall be used to determine if the ash/residue meets the criteria of a characteristic hazardous waste as specified per 40 CFR 261.23. If positive results are obtained from the reactivity tests, the ash/residue will be submitted for additional thermal treatment. After further thermal treatment and/or after confirming that the ash/residue is not reactive, it shall be tested for hazardous constituents. The waste analysis plan flow scheme is shown in **Figure C-1**.

b. Test Methods [40 CFR 264.13(b)(2)]. The test procedures are from Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846, 3rd edition, USEPA, 1986 unless otherwise specified. The laboratory performing these analyses is to operate in accordance with a QA/QC plan that is equivalent to Chapter 1 of SW-846.

c. Sampling Methods [40 CFR 264.13(b)(3)]. As discussed before, there is sufficient documentation on waste PEPs such that sampling and analysis of these items is not warranted. However, the ash/residue must be sampled to verify that it has been rendered non-hazardous and, therefore, does not exhibit those specific characteristics of a hazardous waste as specified per 40 CFR 261.23 and 261.24.

Ash/residue will be sampled to ensure that the treatment has been successful in rendering the waste non-hazardous. Any ash/residue generated will be removed from the burning tray it has cooled sufficiently. The ash/residue will be placed in a labeled, DOT 17H, 55-gallon drum with a bolted, ring-secured lid. When the drum is full it will be sampled and tested for reactivity and hazardous constituents. Sampling will be accomplished through the use of a thief sampler as discussed in **Table C-1, Section C**. This sampling device will provide a representative sample of the ash/residue. The drum will be sampled three times and the samples compiled into one composite sample. All appropriate protective clothing will be worn when sampling and appropriate decontamination procedures will be followed for the thief sampler. Appropriate chain of custody forms will be used by the person obtaining the sample and the form will be completed before the sample is transported to the laboratory.

d. Frequency of Analysis [40 CFR 264.13(b)(4)]. In most cases, OB operations generate relatively little ash/residue. However, any detectable ash will be collected and sampled upon generating a 55-gallon drum or annually at a minimum. In addition, sampling will be performed when the types of munitions normally treated changes significantly from past operations.

The storage and treatment of waste materials recovered from a spill will be contained by the waste container it is placed in and by secondary containment structures of the SEAD hazardous waste storage facility (Bldg. 307).

If a release of liquid hazardous waste were to take place inside a hazardous waste storage area, the release would be contained and removed as much as possible using appropriate absorbents. Solids will be swept up and stored in 55-gallon drums. The absorbents used would be collected and stored in 55-gallon drums also. Once sealed in a drum, the waste absorbents are handled similarly to other wastes in the storage area. Isolation procedures may include overpacking leaking drums.

The storage area where the release occurred will be decontaminated with a series of dilute solvent washes followed by a water rinse using a high-pressure hose. Wastewater generated during this procedure will be confined to the storage area and pumped into drums or bulk tanks. After each subsequent rinse (minimum of three), the rinsewater will be sampled and analyzed for chemical constituents stored in the hazardous waste storage facility.

The first sample will be taken after a minimum amount of solvent is used, to establish a baseline for the relative concentration of chemical constituents (large quantities of solvent rinsewater may simply dilute to non-detectable limits).

Sampling will occur after each rinse until no chemical constituents are detectable. Analysis will be performed according to the SEAD's waste analysis plan.

If a release of hazardous waste were to take place outside a hazardous waste storage area, the waste will be contained and removed as much as possible using appropriate absorbents. Solids and any absorbents used will be swept up and stored in 55-gallon drums.

In soil areas potentially affected by the releases, soil samples will be collected and analyzed for chemical constituents using GC/MS or atomic absorption laboratory analysis. Any contaminated soil will be removed with a backhoe or front-end loader and transported to a treatment storage disposal facility (TSDF) for ultimate disposal. A dump truck would be utilized to transport the soil and would be properly equipped to prevent unwanted release of the soil in transit.

If the extent of soil contamination indicates possible groundwater contamination, appropriate investigations will be performed at that time involving monitoring well installation and groundwater sampling. Surface waters would likewise be sampled if potentially affected by the release.

All personnel involved in the decontamination will be equipped with acid/solvent-resistant overalls, head protection, resistant gloves and boots, and full-face respirators fitted with organic vapor and acid gas filter cartridges. Overalls and gloves will be disposed of as hazardous waste. Pumps, hoses, containers, and equipment will be decontaminated with triple flushing/rinsing comparable to rinsing a container with a minimum of 10% of its volume with a suitable solvent. If there is a reasonable doubt of acceptable decontamination, the equipment will be disposed of as a hazardous waste.

If a spill of PEP or ash/residue occurred at the OB/OD facility, it would be cleaned up utilizing brooms, sparkproof shovels, and a HEPA, vacuum if required. Recovered PEP will be treated at the OB facility. Affected soil will be disposed of as hazardous waste.

If release, fire, or explosion were to take place at the deactivation furnace, the inside of Building 367 (if affected) will be decontaminated in the same manner as described for the storage facilities.

The areas surrounding the deactivation furnace would have to be visually inspected for whole munitions that had been released due to the incident. These whole munitions would be collected and inspected for potential reincineration or disposal if just the casing remains.

In areas surrounding the furnace where contamination is possible, soil samples will be collected and analyzed for suspected contaminants according to a list of munition components. Any contaminated soil will be removed with a backhoe or front-end loader and transported to a secure off-site facility for ultimate disposal. If the extent of soil contamination indicates groundwater contamination, an investigation will proceed as described for the storage facilities.

Affected soil and water used to decontaminate the building and equipment will be collected and removed as described for the storage facilities.

The primary hazardous constituents at SEAD are lead, barium and trinitrotoluene.

G-4g INCOMPATIBLEWASTES*[40 CFR 264.56(H)(1)][6NYCRR PART 373-2.4(G)(8)(I)]*

The Emergency Coordinator has the authority to halt or modify the treatment, storage, or disposal of hazardous wastes during the course of containment or cleanup operations and will do so if the wastes are incompatible. It is the judgement and experience of the Emergency Coordinator that will prevent incompatible wastes from being treated or stored in an area affected by a chemical release. For example, an acid container would not be allowed to be placed near a base container. Likewise the Emergency Coordinator would not allow an oxidizer to be placed near one of the many organic mixtures (PEPs) at SEAD. Since there are relatively few chemicals at SEAD that are incompatible, and since the Emergency Coordinator is cognizant of these few incompatibles, the Emergency Coordinator can ensure that incompatibles will not come into contact with each other.

There are no field tests or analyses that are done in managing wastes. At SEAD waste labeling and the Emergency Coordinator's knowledge of SEAD waste constituents is sufficient to allow proper management of these materials at all times.

G-4h POST-EMERGENCY EQUIPMENT MAINTENANCE *[40 CFR 264.56(H)(2)][6NYCRR PART 373-2.4(G)(8)(II)]*

A list of available emergency equipment for use in containing and cleaning up spilled hazardous wastes is provided in **Table G-6**, as indicated, absorbent materials and containment devices are strategically located in both buildings in which hazardous wastes are stored (Building 301 and 307). Spill incidents that might occur in hazardous materials storage areas would mobilize the appropriate personnel and equipment to contain and cleanup the spill.

Cleanup of emergency equipment is the responsibility of the Emergency Coordinator. Operations in the affected area will not be resumed until the emergency equipment is cleaned and fit for its intended use. Exhausted emergency items, such as straw or dry absorbent, will be replaced. Refer to Attachment A of this HWCP for a detailed description of decontamination procedures to be utilized for various types of emergency equipment. Refer to Attachment B for a description of maintenance procedures utilized to ensure all emergency equipment is ready to work when called on.

Equipment will be decontaminated in a contained area in which liquids used can be contained for disposal in 55-gallon drums or a bulk tank. Absorbents will be utilized when necessary. Any solids will be swept up and stored in 55-gallon drums.

The equipment will be decontaminated with a series of dilute solvent washes, followed by a clear water rinse using a high-pressure hose. After each subsequent rinse (minimum of three), the rinsewater will be sampled for constituents.

All personnel involved in decontamination will be equipped with acid/solvent-resistant overalls, head protection, resistant gloves and boots, and full-face respirators fitted with organic vapor and acid gas filter cartridges.

Supplies listed in **Table G-6**, when exhausted or near exhaustion, will be replaced.

SEAD also has an on-site fire department and fire hydrants, extinguishers and alarm boxes are located throughout the facility. Fire alarms are tested everyday at 0730, 1130, 1200 and 1600 hours 2 blasts mark the beginning of the test and 2 blasts indicate the end of the test. Should the Emergency Coordinator judge a fire to be of sufficient magnitude to warrant additional assistance, local fire departments will be contacted (**Table G-2**).

G-4i CONTAINER SPILLS AND LEAKAGE [*40 CFR 264.171(H)(2)*]

If a container holding hazardous wastes begins to leak, the wastes in the leaking container will be handled as follows:

1. If it is possible to do so safely, the wastes will immediately be transferred to another container that is in good condition.

2. If safe transfer is not possible or if the contents have already leaked from the defective container, the materials will be treated as a spill, and will be managed as described in Sections G-4.2 through G-4.8 above.

G-5 EMERGENCY EQUIPMENT

A list of available emergency equipment for use in containing and cleaning up spilled hazardous wastes is provided in **Table G-6**. As indicated, absorbent materials and containment devices are strategically located in both buildings in which hazardous wastes are stored (Buildings 307 and 301). Spill incidents that might occur in hazardous material storage areas would mobilize the appropriate personnel and equipment to contain and clean up the spill.

SEAD also has an on-site fire department, and fire hydrants, extinguishers and alarm boxes are located throughout the facility. Fire alarms are tested every day at 0730, 1130, 1200 and 1600 hours. Two blasts mark the beginning of the test and two blasts indicate the end of the test. Should the Emergency Coordinator judge a fire to be of sufficient magnitude to warrant additional assistance, local fire departments will be contacted **(Table G-2).**

G-6 COORDINATION AGREEMENTS [*40 CFR 264.52(c) and 264.37*]

Any situation which might arise at the hazardous waste treatment and storage sites can be adequately addressed by the various Depot operating sections, i.e.,security, fire department, FED or ammunition division. SEAD personnel and equipment can effectively contain, control, and initiate cleanup operations which may be experienced at the hazardous waste sites. Although outside contractors may be requested to assist in some cleanup operation, all acutely hazardous situations will be handled by Depot personnel and equipment.

A list of remedial cleanup contractors is given on **Table G-2.** A "retainer basis" for emergency disposal of spill residues is being implemented. Since Seneca Army Depot is self-sufficient for spill response, outside contractors are used for bulk hazardous waste residues/debris disposal. A retainer-basis is planned to minimize extra administrative emergency actions. This retainer will be flexible to include clean-up activities if needed or desired. By policy and practice, Seneca Army Depot is self-sufficient in spill response and clean-up.

Seneca Army Depot presently has written coordination agreements with local fire departments to provide assistance for on-site emergencies. These coordination agreements identify the contact personnel and the procedures to follow for off-site fire service coordination. At present SEAD does not have written coordination agreements with off-site police or medical authorities. SEAD does however have verbal agreements with these authorities. In addition SEAD and these external authorities (fire, medical, and police) have participated in joint emergency response exercises and SEAD has participated with local emergency planning agencies pursuant to requirements set forth under SARA.

G-7 EVACUATION PLAN [*40 CFR 264.52(f)*]

In the event of a major emergency, an established set of procedures must be followed. SEAD employees warning system with a specific alarm signal to initiate evacuation of all facility areas. In addition to the alarm, the internal telephone systems is used to notify key personnel as to the nature of the emergency and recommended plan of action. Facility evacuation is initiated only by the Emergency Coordinator. The evacuation routes for the entire facility in case of an emergency are shown on the General Site and Building Plan in the map pocket of this section.

In the event facility evacuation is called for by the Emergency Coordinator, the following actions will be taken:

1. The signal for evacuation will be activated (1 blast).

2. The guards will immediately open the gates. No further entry of visitors, contractors, or trucks will be permitted. All nonessential traffic within the facility will cease to allow safe exit of personnel and movement of emergency equipment.

3. All employees will be accounted for by their immediate supervisor. Supervisors will designate certain gates as the safety sites for his or her employees and will also choose an alternate exit if the first choice is inaccessible. To assist in this endeavor, the Emergency Coordinator will use the internal telephone system to call the area supervisor, to inform him or her of the nature of the emergency.

4. All personnel, visitors, and contractors will immediately leave through the North End or South End Main Gate (as shown in **Figure B-4**).

5. During exit, each supervisor is responsible for keeping his or her group together. Immediately after existing through a gate, the highest ranking supervisor will prepare a list of all personnel.

6. No personnel shall remain on or re-enter the facility unless specifically authorized by the Emergency Coordinator. This individual assumes responsibility for those personnel within the perimeter. Those within the fenced area will normally only include emergency response personnel/groups.

7. Upon completion of the employee list by each supervisor, the Emergency Coordinator will be notified.

8. A security guard at each gate will also maintain an updated list of all personnel to aid in their accountability procedure.

9. To re-enter the fenced area will be made only after clearance is given by the Emergency Coordinator. At his or her direction, a signal (2 blasts) or other notification will be given to personnel to re-enter into the facility.

10. In all questions of accountability, immediate supervisors will be held responsible for those persons reporting to them. Visitors are the responsibility of the employee they are visiting. Contractors are the responsibility of those persons administering the individual contract. Truck drivers are the responsibility of the area supervisor where the truck is loading/unloading. Security personnel will aid in accounting for visitors, contractors, and truckers by reference to the sign-in procedures at the Visitors' Reception Center.

Drills are held to practice the implementation of all of the above procedures as part of the facilities general training effort. Evacuation of individual buildings is rehearsed in annual fire drills. Partial facility evacuation procedures are administered by the Security Police, and follow the same general procedures as the complete evacuation.

After the completion of an event that required the use of emergency equipment, the Emergency Coordinator will ensure that all the equipment used is properly and thoroughly cleaned and decontaminated, and that any residue from the cleaning is properly disposed. He is also responsible for ensuring that potentially incompatible wastes are not stored in the areas of the spill until cleanup is complete. The Regional Administrator and appropriate state and local officials shall be notified that these tasks have been accomplished.

G-8 REQUIRED REPORTS [*40 CFR 264.56(d), (j)*]

The Emergency Coordinator must submit a report of the details surrounding any incident that resulted in implementation of the contingency plan to the Regional Administrator of the USEPA within 15 days of the occurrence of the incident. A sample report form for emergency events which identifies the time, date, and details of the emergency incident is shown in **Figure G-2.**

Any emergency event requiring implementation of this contingency plan will be reported immediately to the U.S. Coast Guard District Office, National Response Center, and through command channels to HQDA (DAEN-ZCE). The emergency Coordinator will additionally notify headquarters, DESCOM, and NYSDEC. Contact numbers for these organizations are contained in **Tables G-2** and **G-4.**

FIGURE G-2

REPORTING FORM FOR EMERGENCY EVENTS

Name, address, and phone number of owner or operator

Name, address, and phone number of facility

Date, time, and type of incident (i.e. fire, explosion, etc.)

Name and quantity of material(s) involved

Extent of injuries (if any)

Assessment of actual or potential hazards to human health or the environment (if applicable)

Estimated quantity and disposition of material recovered from the incident

Any emergency arising from an imminent or actual incident that, in the opinion of the Emergency Coordinator, could threaten human health or the environment, and, therefore, requires the implementation of the contingency plan, will be reported in writing within 15 days to the U.S. Environmental Protection Agency (USEPA) Regional Administrator (according to 40 CFR 265.56(i)). A sample reporting form for emergency events is shown in **Figure G-2.**

Additionally, any emergency event requiring implementation of this contingency plan will be reported immediately to the U.S. Coast Guard District Office, National Response Center, and through command channels to HQDA (CAEN-ZCE). The Emergency Coordinator will additionally notify headquarters, DESCOM, and NYSDEC. Contact numbers for these organizations are contained in Tables G-2 and G-4. The Emergency Coordinator will be prepared to transmit the following information:

a. Name of person reporting the incident

b. Name, address and location of facility (include ID number, if appropriate)

c. Phone number where Emergency Coordinator or installation commander may be reached

d. Date, time and location of the incident

e. A brief description of the incident including type and nature of hazardous waste, cause and source of the incident, and possible hazards to human health or the environment

f. Affected bodies of water (if applicable)

g. Quantity or duration of the discharge

h. Extent of injuries or property damage

i. Remedial actions taken

j. Other agencies notified

In addition, the report is reviewed by a Professional Engineer to determine if revisions or changes to the HWCP are necessary, based upon an analysis of the emergency incident and the response activities. If any changes in procedures and/or equipment are required, the Manager of Facilities Engineering Division will amend the plan and assure that all copies of the plan are updated and distributed according to the list in **Table G-1**. All amendments and updates will also be distributed as listed in **Table G-1.**

G-9 AMENDMENTS TO THE CONTINGENCY PLAN *[40 CFR 264.54 and 270.42][6NYCRR Part 373-2.4(e)]*

The contingency plan will be reviewed and immediately amended, as necessary, whenever:

a. The facility permit is received.

b. The plan fails in an emergency.

c. The facility changes in its design, construction, operation, maintenance, or other circumstances in a way that materially increases the potential for fires, explosions, or releases of hazardous waste or hazardous waste constituents, or changes the response necessary in any emergency.

d. The list of emergency coordinators changes.

e. The list of emergency equipment changes.

All amendments and updates will be distributed according to the list in **Table G-1.**

G-10 PROCEDURES FOR EVALUATING WASTES FROM EMERGENCY RESPONSE

Waste analysis is not necessary in the situation where a single waste type has been released and identification is certain.

Procedures for evaluating recovered wastes from fires, explosions and spills will follow the procedures in this section.

Fallen drums, in the event of an explosion, will be treated as individual spill sites. Identification will be determined to be "certain" only if the hazardous waste label is readily identifiable or DOT labels, in combination with the inventory log can confirm the contents of the drum. If there is reasonable doubt, the procedures below will be implemented.

If responsible doubt as to the contents of a given residue, or in the event that all wastes were mixed due to fires, explosions, or other catastrophic events, the residues will be tested for all the parameters of **Table 2-2.**

For limited responses, i.e., emergencies in a given section or adjacent sections (referring to **Figure C-1**), the Waste Analysis Plan will be used for guidance for testing the waste residues in the given waste stream's section (or adjacent storage areas). The Waste Analysis Plan implementation will include the sampling and analytical procedures discussed in Section C.

SECTION H

PERSONNEL TRAINING

The following section details the training programs required for personnel at SEAD that handle explosive hazardous wastes as required by 40 CFR 270.14(b)(12), 40 CFR 264.16 and 6NYCRR Part 373-2.2(h).

H-1 OUTLINE OF TRAINING PROGRAM *[40 CFR 264.16]*

Personnel handling hazardous waste at SEAD must successfully complete a training program that ensures compliance with the hazardous waste management plan. Personnel must be trained within six months after assignment to a position that includes duties involving hazardous waste and may not work unsupervised until they have completed the training. In addition, personnel will undergo annual retraining in appropriate areas.

The training includes two phases of instruction. The first phase of instruction follows the Program of Instruction for Defense Hazardous Materials Handling Course (U.S. Army, 1982). This program ensures proper training in: (1) the purpose of RCRA and importance of maintaining compliance with those regulations, (2) the hazardous nature of chemical wastes stored or treated within the facility, (3) proper handling and storage procedures for these wastes, and (4) emergency procedures and contingency plans. The course is used as a framework for training SEAD personnel in the proper procedures, equipment and systems to be used in managing hazardous wastes. In addition, key hazardous waste management facility personnel will periodically attend off-post training courses or seminars. **Table H-1** outlines the Hazardous Waste Training Manual and **Table H-2** outlines the Hazardous Materials Handling Course.

The second phase of instruction pertains to the proper handling and treatment of waste explosive materials. The course instruction ensures that personnel are knowledgeable in munitions safety awareness, have the necessary technical knowledge for safe treatment operations, and increases operational proficiency of affected employees. The mandatory training programs are outlined below.

TABLE H-1

OUTLINE OF HAZARDOUS WASTE TRAINING MANUAL

A. COURSE: Defense Hazardous Materials Handling Course

B. PURPOSE: To provide a basic understanding of the hazards and techniques associated with the handling of hazardous materials so that students will be better able to protect their personal health, prevent damage to the environment and comply with applicable laws, regulations and policies.

C. OBJECTIVES: At the completion of the course, the student should be able to:

1. Recognize, identify and classify hazardous materials.
2. Take actions necessary to prevent hazardous chemical incidents, protect personal health, and prevent damage to the environment.
3. Within the requirements of his job, properly package, label, store, handle, and transport hazardous materials and waste.
4. Take immediate and effective action in response to hazardous material spills or other emergencies.
5. Properly manage the resources under his control to prevent violations of applicable laws, regulations and policies.

D. PREREQUISITES: Nominees should be military or civilian personnel who identify, package, store, handle, transport or manage hazardous materials or waste.

E. METHODS OF INSPECTION: Instructional methods include lecture-conferences, seminars, films, guest speakers, and practical exercises.

F. SCOPE: The curriculum includes identification and classification of hazardous materials; health hazards and personal safety; packaging, labeling, storing, handling, and transportation procedures; release response; and hazardous materials and waste laws, regulations, and policies.

Source: U.S. Army, 1982

TABLE H-2

OUTLINE OF HAZARDOUS MATERIALS HANDLING COURSE

A. Course: HAZARDOUS MATERIALS HANDLING JMPTC-5
Location: Onsite at Place of Employment
Length: 4 hours

B. PURPOSE: To train military and civilian personnel who handle, load, unload, and store hazardous materials in the recognition of hazard class labels and placards, compatibility for loading and/or storage and safety. This training is for other than certifying official and meets the requirements of AFR 71-4/TM38-250/NAVSUP PUB 505/MCO P4030.19D/DLAM 4145.3, paragraph 1-22.

C. SCOPE: Recognition of material handling markings, hazard class labels, and the effects of each hazard if accidently released; segregation of classes of hazards according to published compatibility charts for loading in trucks, railcars and aircraft and for warehouse storage; neutralization and cleanup of minor spills; emergency measures in case of major incidents; recognition of damaged containers and proper disposition of same.

D. PREREQUISITES: Nominees should be military and civilian personnel who are assigned jobs involving the handling and storage of hazardous materials, such as forklift operators, freight terminal ramp personnel and warehousemen, or other jobs in which a knowledge of hazardous materials handling is required.

E. SECURITY CLEARANCE: None.

NOTE: The course is presented and monitored by personnel at the local installation. Personnel assigned to present the course should be selected on the basis of their knowledge of hazardous materials. Training materials are provided by JMPTC.

Training for personnel involved in the handling and treatment of explosive materials will be trained and fully capable of performing the following operations:

1. Identify, assemble, disassemble, prepare and successfully use all tool sets in each of their inherent modes;
2. Identify, render safe, recover and dispose of all conventional ordnance;
3. Know all the procedures to follow in fragmentation, identification and ordnance exploitation;
4. Identify, render safe and package components of all weapons utilized by the U.S. Army.
5. Perform all administrative and logistical tasks inherent to the SEAD mission.

H-1a <u>JOB TITLE AND DUTIES</u> *[40 CFR 264.16(d)(2)]*

The duties, responsibilities, and qualifications of employees involved in hazardous waste activities are shown below.

<u>POSITION TITLE: Facility Environmental Engineer</u>

RESPONSIBILITIES:

- Emergency Coordinator for all hazardous waste activities;
- Serves as the Hazardous Waste Training Coordinator by overseeing the training of employees and providing training;
- Responsible for all air, water, and waste control systems of the facility;
- Obtains all of the required permits and licenses or modifications of same from local, state, and Federal regulatory bodies;
- Resolves problems involving permits and licenses from local, state, and Federal regulatory agencies;
- Notifies proper authorities in emergency situations.

QUALIFICATIONS:

B.S. degree in Chemical, Civil, or Environmental Engineering. He must have three to five years of experience in industrial or municipal pollution control management. Also, training in hazardous waste management is required.

POSITION TITLE: Foreman of Demo Grounds

RESPONSIBILITIES:

- Plans and schedules work assignments on a daily or project-by-project basis within the instructions and time limits provided.
- Makes additional assignments as work nears completion.
- Reviews instructions received and ensures that arrangements are made for adequate personnel, materials, and equipment at the work site.
- Where work progress indicates the need for major changes in procedures or sequence, consults with supervisor to obtain approval.
- Plans and prescribes deadlines and work sequence for individual workers based on guidance received.
- Selects workers and assigns tasks to be performed.
- Explains work requirements, methods, and procedures; instructs subordinates in new procedures and provides assistance when problems arise. Reviews work in progress and on completion. Assures that equipment and supplies are maintained and properly used.
- Recommends performance requirements, promotions, reassignments, or other status changes of assigned personnel prior to initiation, and makes informal performance appraisals.

QUALIFICATIONS:

Incumbent must be able to obtain and maintain certification to meet environmental requirements for demilitarization operations.

POSITION TITLE: Leader, Explosives Operations

RESPONSIBILITIES:

- Serves as the field supervisor for demolition operations.
- Ensures that operations are conducted according to SOPs.
- Ensures that ordnances are properly stored and transported to the demolition site.
- Ensures that inspections are conducted after each burning operation.

QUALIFICATIONS:

Incumbent must posses or be able to obtain and maintain certification to meet environmental requirements for demilitarization operations.

POSITION TITLE: Engineering Equipment Operator

RESPONSIBILITIES:

- Operates an 18-ton bulldozer and a 12,000-lb.mobile crane in connection with ammunition burning and demolition operations. Time is about equally divided between the use of these two pieces of equipment. When not engaged in this heavy equipment operation, he is assigned to other miscellaneous work commensurate with incumbent's capabilities, approximately 20% of the time.
- Operates a bulldozer to make excavations, build fire breaks, build temporary roads, cover up munitions after they have been placed in pits and wired for detonation, and to grade and level off surrounding terrain to keep it in a serviceable condition. Must exercise special care when working around loaded pits to prevent sliding in on highly explosive material arranged for detonation.
- Operates a mobile crane equipped with a magnet, hook, sling, or other such attachment to load, unload, store and handle inert metal items and explosive items in the burning, demolition or other outside areas. Must use particular caution when handling high explosives and working in the immediate vicinity of explosive and demolition activities.

QUALIFICATIONS:

Incumbent must possess or able to obtain and maintain certification to meet environmental requirements for demilitarization operations.

POSITION TITLE: Explosives Operators

RESPONSIBILITIES:

- Serves as an Explosives Operator and performs a variety of intermediate level explosive operations involved in the complete renovation, demilitarization, modification, and normal maintenance of a wide variety of high explosives and ammunition items such as shells, ranging from small arms calibers to 280 mm artillery, mortars, bombs, mines, grenades, rockets, chemical or gas filled ammunition, incendiaries, pyrotechnics, items and components of guided missiles and other related items, most of which have been condition classified as unstable.
- Operates electrical, mechanical and/or pneumatic machines, equipment, tools, jigs and fixtures, e.g., defusing, deboosting, pull-apart or similar machines; remote control breakdown machines; priming and depriming machines; decoring machines; automatic linking and delinking machines; liner saws and other related equipment not requiring the skill of a top-level explosives operator.
- Works in the powder collection room with the responsibility for packaging and weighing loose powder.
- Debags powder by pulling bags over a stationary knife placed over a chute and dumping powder into the chute.
- Defuses and refuses projectiles, grenades, etc., by using mechanical or manual processes where special equipment is not required.
- Torque tests various types of fuses by placing the projectiles in a holding device, securing it in place.
- Feeds a furnace type destruction chamber with explosive components, keeping constant watch of temperature and operation of equipment.

QUALIFICATIONS:

Incumbent must be able to exercise extreme care in working with unstable and unusually hazardous items to prevent accident or explosions which could result in serious injury or loss of life to self or co-workers. Must have sufficient knowledge to operate electrical, mechanical, and/or pneumatic machines, equipment, tools, jigs, and fixtures properly. Must possess or be able to obtain and maintain certification to meet environmental requirements for demilitarization operations.

H-1b TRAINING CONTENT, FREQUENCY, AND TECHNIQUES *[40 CFR 264.16(a)(1)]*

All personnel who handle explosive hazardous waste at SEAD will undergo the classroom instruction course entitled Program of Instruction for Defense Hazardous Materials Handling Course mentioned in this section. This course is supplemented with three quizzes and a final examination which ensures that students have a thorough knowledge in the respective training materials. This course is presented by the Environmental Management Committee of the School of Material Readiness, U.S. Army Logistics Management Center. In addition, these employees are provided with copies of the following:

1. Hazardous Waste Compatibility Chart
2. List of Chemical Substances
3. Method for Determining Compatibility of Hazardous Waste
4. Indicators of Hazardous Materials Shipment Violation
5. Hazardous Waste Management Problems and Considerations

During the training program, employees are instructed on (1) the purpose of RCRA and importance of maintaining compliance with those regulations, (2) the hazardous nature of chemical wastes stored or treated within the facility, (3) proper handling and storage procedures for these wastes, and (4) emergency procedures and contingency plans.

In addition to the aforementioned training, personnel must undergo formal training in the effective and proper handling of explosive hazardous waste.

H-1c TRAINING FOR EMERGENCY RESPONSES *[40 CFR 264.16(16)(A)(3)]*

This training program is designed to ensure that personnel not only handle hazardous wastes in a safe manner but also properly respond to emergency situations. The program trains hazardous waste handling personnel to maintain compliance under both normal operating conditions and emergency situation. The installation response team has dry exercises at unannounced times twice each year.

Training elements addressing unusual or emergency situations include:

1. Procedures for locating, using, inspecting, repairing, and replacing facility emergency and monitoring equipment
2. Emergency communication procedures and alarm systems
3. Response to fires or explosions
4. Response to contamination incidents
5. Shutdown of operations and power failure procedures
6. Procedures for evacuation

In addition to hazardous waste management personnel, the Post Fire Department is on standby for response to all fires and spill emergencies.

H-1d TRAINING DIRECTOR *[40 CFR 264.16(a)(2)]*

The current training director for SEAD is Randal Battaglia. Mr. Battaglia selection was based on his knowledge of the wastes stated at SEAD, his educational background, training, and professional experience. Mr. Battaglia received a Bachelor of Science degree from Clarkson University, where he studied chemical engineering. Since he began employment at SEAD, he has received training in hazardous waste management through attendance in numerous government and private training sessions. **Table H-3** describes the training coordinator's seminar. He frequently contributes trainig sessions conducted on post by either private or government agencies. He is also intimately familiar with the waste management procedures at SEAD, as he is the individual responsible for managing all aspects of the program.

Assisting Mr. Battaglia in implementing the hazardous waste training program are the various Directorate Coordinators and Shop Supervisor. These individuals have received training, and

TABLE H-3

TRAINING COORDINATOR'S SEMINAR

Environmental Coordinator's Course (1985)

*DA Environmental Conference (1985)

Reference Hazardous Materials Handling Workshop (1986)

Installation Environmental Officer's Seminar (1986)

*World-Wide DEH/Environmental Conference (1986)

U.S. AMC Environmental Auditing Course (1985)

U.S. Army Corps of Engineers Training Course (Through University of Alabama/Huntsville).
Environmental Laws and Regulations (1986)

*Conference involve workshops on environmental areas, problems and concern.

are responsible for overseeing the on-the-job training in their shops/locations. Additionally, they may also contribute to training courses conducted by outside personnel.

H-1e <u>RELEVANCE OF TRAINING TO JOB POSITION</u> *[40 CFR 264.16(c) and (d)(3)]*

All personnel involved in hazardous waste management will meet at least annually for review and update of this training program. This session will discuss the following subjects:

1. All hazardous wastes currently being handled at the facility, noting any changes in waste type, volume, source, characteristics, or location that have occurred during the past year.

2. The status of storage and operating conditions and procedures, noting any areas where there are problems. Employees participate in developing effective solutions.

3. The requirements contained in the facility's RCRA Permit, noting any changes that have occurred during the past year. Areas where maintenance of compliance is a problem are identified and discussed, and effective solutions are sought.

4. Incidents that have occurred in the past year that warranted use of contingency plans and/or emergency action. This review focuses on the cause of the incident and identification of steps to prevent or to ensure better handling of such events in the future.

Hazardous waste is always managed, including handling, under the supervision of personnel who attend annual updated training as described above. Although the regulations (6NYCRR Part 373-2.2(h)) do not explicitly state that employees who actually handle hazardous wastes receive training, SEAD trains these personnel in the above course. These personnel do not always receive annual update training in a formal classroom situation. Furthermore, personnel receive informal "on-the-job" training.

H-1f PERSONNEL TRAINING RECORDS

Records documenting the job title for each position, job descriptions, names of employees, and completed training programs (both introductory and review) are maintained in the personnel office of SEAD. These reports are kept for at least three years from the date of an individual employee's last working day unless these records accompany the individual when he is transferred within the Army. Records for current employees will be maintained until facility closure.

H-2 IMPLEMENTATIONOFTRAININGPROGRAMS *[40 CFR 264.16(b),(d)(4), and (e)]*

All new personnel will complete this training program within six months of assignment to the OB/OD facility or within six months after their date of employment, whichever is later. No employee hired or assigned to work at this facility will work unsupervised prior to completion of the training program.

To implement training requirements specified in 40 CFR Part 264, a person trained in hazardous waste management procedures has been identified (see **Section H-1d**). The Environmental Engineering section of SEAD is responsible for development of all training material and recordkeeping. The following records will be maintained at the office:

1. Job title and employee name for all hazardous waste management positions.

2. A written job description for each position.

3. A written description of the introductory and continuing training given to each person employed for hazardous waste management activities.

4. All training records for employees are kept onsite during the course of employment and for a minimum of three years following termination of employment.

All emergency response personnel requiring protective equipment are formally trained. All personnel on Seneca Army Depot who handle hazardous materials are trained for hazard recognition under the OSHA Hazard Communications Rule.

Hazardous waste is always managed, including handling, under the supervision of personnel who attend annual update training, as described above. In addition, all personnel will receive an 8 hour Hazardous Waste Refresher course pursuant to 40 CFR 264.

H-3 PERSONNEL PROTECTIVE EQUIPMENT

Guest speakers at the Defense Hazardous Materials Handling Course include representatives from the Safety Office and Industrial Hygiene, who speak about their respective areas regarding hazardous materials and personnel protective equipment.

Personnel requiring respiratory protection are fitted in accordance with 29 CFR 1910.1001, Appendix C, Quantitative Fit Testing. Briefly, this procedure involves the following: allow the employee to select the most comfortable respirator (from 3 brands, 3 sizes). Visually inspect for obvious leaks, if none, the employee is to enter a test chamber which contains corn oil mist. The employee is then instructed to go through a series of exercises to determine if the seal keeps its integrity. During the exercise, the corn oil concentration inside the respirator is measured and recorded, and compared to the measured concentration in the chamber. A fit factor is then determined to establish proper fitting. If it is not acceptable, the entire process is repeated.

H-4 FIRE TRAINING

All personnel at Seneca Army Depot are required to attend an annual fire training briefing, which describes and demonstrated techniques and methods for fighting minor fires. This includes uses of, how to use, (and on what types of fires) various extinguishers (A, B, C) are used. Seneca's firemen are attending the following formal training:

1. Course Name: Fire Protection Specialist (Army 51M10)
   Sponsor: USAF Training Command, Chanute AFB, IL

   Description: 31-day course designed to teach Firefighting and Fire Protection Operations in connection with aircraft, structural and material fires and in other emergencies. Fire Protection Fundaments; Base and Mission Fire Protection; Operator Prevention Maintenance of Firefighting Vehicles and Equipment; Duties of Crew Members on Pumper Trucks; and Firefighting Vehicles in Practical Exercises.

2. Course Name: Fire, Radiation and Explosive Hazards Course
Sponsor: Savanna Army Depot, Savanna, IL

Description: 4-day course designed to provide training to firefighting personnel. Information is specific in terms of procedures in the use of radiation protection equipment, decontamination, and explosive safety procedures.

3. Course Name: Emergency Control of Hazardous Materials Incidents I
Source: New York State Fire Academy, Montour Falls, NY

Description: This 8-hour course, given in the field, provides information and awareness information to students which permit them to make reasonable judgements of hazardous materials situations. Topics include: Kinds of Hazards, Classification of Hazardous Materials, Kinds and Types of Vehicles and Developing a Local Master Plan for Implementation in case of a Hazardous Materials Incident.

4. Course Name: Emergency Control of Hazardous Materials Incidents II
Source: New York State Fire Academy, Montour Falls, NY

Description: This 24-hour course provides training in emergency response recovery following accidents involving hazardous materials. Designed to met the criteria established in Section 156-1 of the executive law. Course includes: Hands-on training in Leak and Spill Control Methods, Protective Clothing and Breathing Apparatus, Detection Equipment, Decontamination Procedures, Neutralization, Application of Foams, and Pickup and Disposal Methods. Classroom sessions focus on chemical and biological properties of various classes of chemicals, hazard assessment and decision making with emphasis on public safety. Students participate in workshop and practical exercises designed to improve their ability to make sound decisions based on the results of chemical tests and other observations.

5. Course Name: Pesticide and Spill Control
Sponsor: New York State Fire Academy, Montour Falls, NY

Description: This 12-hour course is designed to provide basic information on the safe handling of pesticide fire or spill incidents from product release to cleanup operations. Topics include: Recognition and identification of pesticides; exposure hazards to people, property and the environment; information resources; pre-planning; first aid; spill control and firefighting strategies and tactics.

SECTION I

CLOSURE, POST-CLOSURE, FINANCIAL REQUIREMENTS

The information in this section is submitted in accordance with the regulatory requirements of 40 CFR 270.14(b)(13)-(16) which apply to general closure requirements of a Part B permit. Additional regulatory requirements addressed in this section include 40 CFR 264.10, Subpart G, and 40 CFR 264.140, Subpart H. Subpart G describes requirements pertaining to closure and post closure and Subpart H refers to requirements pertaining to financial requirements.

I-1 CLOSURE PLAN

Closure plans for a Part B permit for miscellaneous units are not specifically described in 40 CFR 264.600 through 264.603. However, under 264.601, Environmental Performance Standards for Subpart X, the regulations state that other provisions of 40 CFR 264 should be applied as appropriate. Specifically, the regulations state:

"Permit terms and provisions shall include those requirements of Subparts I through O of this part, part 270, and part 146 that are appropriate for the miscellaneous unit being permitted".

The Subpart X regulations are intended to apply to a wide diversity of operable units and all aspects, such as closure, cannot be adequately addressed for each unique case. Consequently, the first step in developing a closure plan is to determine what type of unit is analogous to the miscellaneous unit in question. After this determination, a closure plan can be prepared for the miscellaneous unit following the requirements of the unit considered to be most appropriate.

Closure plans will be prepared separately for both the OB and OD treatment units. Currently, open burning of munitions is performed in aboveground steel trays which has been secured to a 64' x 42' x 0.5' reinforced concrete slab. Since the OB grounds is an NPL site, previous activities associated with open burning of munitions on the ground surface will be addressed under CERCLA including closure and post-closure monitoring. Accordingly, the closure plan for current activities associated with the open burning of munitions in the trays will only involve the steel trays, not the surrounding area. Further, since this engineered structure is exempt from groundwater monitoring under Subpart F, 40 CFR 264.90(b), no groundwater monitoring will be performed during closure and post-closure. Closure of the steel trays will be in accordance with the closure regulations for containers described in Subpart I, 40 CFR 264.178. Providing the trays can be decontaminated, the closure plan for the burning trays will aim for clean closure.

Closure of the open detonation mound and surrounding area will be in accordance with the closure requirements for waste piles described in Subpart L, 40 CFR 264.258. Providing that all waste residues can be removed or decontaminated from the facility, the closure plan will achieve clean closure. However, in the event that this is not feasible, the closure plan will perform closure in accordance with the requirements that apply to a landfill. In this case, the regulations that will apply will be 40 CFR 264.310, which describes requirements for closure and post closure care for landfills.

The approach discussed in the following sections allows for clean closure of both the Open Burning Tray and the Open Detonation Area. In the event that the Open Detonation Area, which is considered by EPA to be a Solid Waste Management Unit (SWMU), cannot be clean closed it will be closed as a landfill.

I-1a CLOSURE PERFORMANCE STANDARDS *[40 CFR 270.14(b)(13)]*

In order to clean close, a facility must remove hazardous waste and constituents to certain required levels. There are two steps in determining this performance standard 1) Determination of the Closure Performance Standard Parameters (CPSP), i.e., the hazardous constituents of concern at the site and 2) Determination of the appropriate levels for each CPSP. The procedure for each of these is described below:

1. Closure Performance Standard Parameters (CPSP)

Because the Waste Pile and Burning Tray has received characteristic reactive wastes, i.e., explosives, the residues which remain will be tested for this characteristic. In addition, the process of open burning and open detonation may produce a residue which may be characteristic by toxicity. This requires testing of the residues for toxicity using the Toxicity Characteristic Leaching Procedure (TCLP). This will be performed to assure the wastes will be handled properly. If the waste residues are still considered hazardous by characteristic then these wastes will be disposed of as hazardous wastes. However, if the wastes are found to be non-hazardous then testing will also include additional hazardous constituents which may be of concern. This will be similar to the constituents which are tested as part of the groundwater monitoring program.

2. Closure Performance Standard Levels (CPSL)

Since the waste pile and the burning trays may contain residues which may be a hazardous constituent of concern, the appropriate performance standard levels for these parameters will be background or the Agency approved health based standards, whichever is less stringent. Background and detonation area concentrations will be compared using an appropriate statistical procedure contained in applicable regulations or approved by NYSDEC/EPA.

Once performance standards have been established, the underlying soils and adjacent background soils will be sampled and analyzed according to accepted protocols. The underlying soils will be tested for the CPSP. Background soils will be tested for all CPSP except TCLP parameters and pH, since standards are already set for these parameters and will affect the method of disposal.

If the open burning tray and the open detonation area soils meet the performance standard, no further action will be taken. If the soils or tray is determined to be hazardous, the soils or tray will be removed and properly disposed of as a hazardous waste.

If the soils of the open detonation area are not hazardous wastes but do not meet the performance standard, a more extensive soil sampling program will be implemented. Based on the results of that program SEAD will evaluate whether soil remediation will be performed to attain a "clean" closure, or whether the open detonation area will be closed as a landfill or whether another option will be pursued. Examples of soil remediation technologies which may be appropriate are: capping, in situ containment and solidification, removal/extraction/treatment and complete removal/off-site disposal. The burning tray will be "clean closed", and the area will not be subject to additional soil testing since the area surrounding the tray will be decontaminated under CERCLA.

Groundwater adjacent to the open detonation area is currently sampled and analyzed according to the 40 CFR 265 Subpart F regulations. If the Subpart F groundwater program determines that the open detonation process is not impacting the groundwater, then the clean closure option is available subject to the soil performance standards.

If groundwater does not meet the performance standard, SEAD will evaluate whether groundwater remediation will be performed to attain a "clean" closure, or whether the area will be closed as a landfill, or whether another appropriate option will be pursued. Examples of groundwater remediation technologies which may be appropriate are: in situ treatment, or extraction and treatment. For purposes of the removal or treatment of contaminated groundwater, background or Agency approved health-based standards for SEAD, whichever is less stringent, will constitute the closure performance standard.

If groundwater and soil meet the performance standard, the open detonation area will be certified for "clean" closure and will no longer be subject to the post-closure requirements of 40 CFR 265.

If the basin is closed as a landfill, the Post-Closure Plan presented in Section I-2 will be implemented.

SEAD understands that the direction of the closure project, the remedial action evaluations, and the ultimate closure type implemented are subject to review and approval by EPA/NYSDEC.

This closure plan will meet all regulatory criteria by calling for removal of all sources of potential contamination which will eliminate the possibility of future contamination of groundwater, surface water or the atmosphere. This will fully protect human health and the environment from the effects of the hazardous constituents. All work performed during the closure will be in accordance with all relevant OSHA guidelines to protect the health of workers at the facility.

Until final closure is completed and certified in accordance with 40 CFR 264.115, a written copy of the approved plan and all approved revisions will be furnished to either the Director of the USEPA or a properly designated representative of the NYSDEC.

I-1b PARTIAL CLOSURE AND FINAL CLOSURE ACTIVITIES

Closure will consist of removal of contaminated soils surrounding the open detonation areas, removal and disposal of the waste inventory and cleaning of the burning trays. The open burning and open detonation areas will be closed simultaneously. Therefore, there will be no partial closure.

The waste inventory will be removed from each tray. Then the tray(s) will be washed and rinsed until the metal is decontaminated. Testing will be performed to assure that the metal is decontaminated. The first volume of sludge/rinse water generated during decontamination of the burning tray(s) will be expected to have a high organic content. This material will be assumed to be a hazardous waste. The material will be removed by a vacuum truck and sent to a properly permitted hazardous waste treatment facility.

The subsequent rinse water generated during the decontamination of the burning tray(s) is expected to contain only trace contaminants of organic material. This material will be sampled and analyzed to determine if decontamination is complete. These analysis can also be used to determine if the rinse water is a hazardous waste. If it is not a hazardous waste, the rinse water will be removed and sent to the base water treatment plant. If it is a hazardous waste, the water will be treated/handled in an appropriate manner. That decision must be deferred until that time. If the plant cannot be used, the water will be sent to a properly permitted hazardous waste treatment plant.

After the tray(s) are decontaminated, the closure equipment used to remove hazardous waste and to decontaminate the facility will be decontaminated. All hazardous waste will be disposed of at properly permitted disposal facilities.

I-1c MAXIMUM WASTE INVENTORY

The maximum hazardous waste inventory is assumed to be the maximum planned single day treatment since that is the maximum amount of waste ever on site. For this facility, that amount is 1,000 pounds Net Explosive Weight (NEW) for the open burning of PEPs, a maximum of three times a day for a total of 13,000 pounds. For the open detonation of high explosives, the maximum NEW is 100 pounds per detonation at ten detonation pits, two times a day for a total of 2,000 pounds NEW. Therefore a total maximum waste inventory would be 15,000 pounds NEW per day at this facility.

If clean closure is appropriate, the soils at the open detonation ground will be removed and disposed of off-site. All soils which need to be excavated at the open detonation area will be handled as hazardous waste. The excavated, contaminated soil will be sampled and analyzed to determine if the material meets the treatment standards for land disposal established per 40 CFR 268, Subpart D. If off-site land disposal is acceptable the material will be trucked to a properly permitted hazardous waste disposal facility. If this cannot be done the soils may need to be treated to achieve the acceptable treatment standards prior to off-site disposal.

I-1d SCHEDULE FOR CLOSURE

The regulations under 40 CFR Subpart G require closure to commence within ninety (90) days of approval of the plan and to be completed within one hundred eighty (180) days of approval unless an extension is approved. Because military appropriations are lengthy and deliberate, an extension is being requested for the closure initiation to begin within one hundred fifty (150) days of approval and for closure to be completed within two hundred forty (240) days after approvals (Section I-1).

I-1f INVENTORY DISPOSAL, REMOVAL OR DECONTAMINATION OF EQUIPMENT

1. Procedure for Cleaning Equipment and Removing Contaminated Soils

The final inventory of containerized ash will be handled in accordance with appropriate SEAD SOP's. Each tray will be inspected for any remaining ash. If ash remains, trained employees wearing rubber gloves, rubber boots, protective coveralls and appropriate breathing apparatus will remove such material with shovels and brushes. This material will be containerized and disposed of using normal ash handling procedures. The tray(s) will then be inspected to verify that they are ready for decontamination.

The tray(s) will be washed with water by trained employees wearing rubber boots and gloves and protective apron. The rinse water will be collected in appropriate drums. When the rinse is completed, the rinse water will be sampled and analyzed to determine if decontamination is complete. The drums of rinse water will be transferred to a truck and properly disposed of. If the analyses show that decontamination is not complete, the procedure will be repeated until the tray(s) are decontaminated. The analytical procedure which will be utilized to determine the effectiveness of the decontamination procedures will incorporate both field techniques and laboratory techniques. This will allow a field determination for decontamination. Providing the field screening techniques does not indicate the presence of gross contamination, a confirmatory sample will be submitted to the laboratory which will be analyzed using more rigorous techniques.

The field methods will include:

1. Special Report 90-38; Development of a Simplified Field Method for the determination of TNT in soil; November 1990.
2. Special Report 91-7; Development of a Field Screening Method for RDX in soil; June 1991.
3. Method 9050, Specific Conductivity.

The laboratory methods will include:

1. Method 8330; Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC).
2. Method 6010; Inductively Coupled Plasma-Atomic Emission Specticoscopy for As, Ba, Cd, Cr, Pb, Hg and Sb.

2. Methods for Sampling and Testing Soils Surrounding the OD Grounds

All sampling and analysis will be done in accordance with the procedures in the USEPA publication SW-846, Test Methods for Evaluating Solid Waste, Third Edition and Method 8330 for explosives. Soil sampling will be conducted using remote sampling techniques. The presence of reactive material will be determined by the use of the Detonation, Deflagration and Transition Test or the Gap test, both established by the U.S. Bureau of Mines. Soil samples will be analyzed for metals using Method 6010, and for explosives using Method 8330.

Concurrent to the tray cleaning activities, the soil at the open detonation areas will be sampled and analyzed to determine the existence of contaminated soil. Four soil samples, twenty feet apart, will be taken. At each sample location, a six-inch sample will be cored from the first foot of soil.

3. Criteria for Determining the Extent of Contamination

The process of determining the extent of metals (arsenic, antimony, barium, cadmium, chromium, lead, and mercury) contamination in soil will consist of comparing each analysis result with respect to a quantified reference. The set of samples which will be used for comparison will consist of three soil samples representing known uncontaminated background conditions and a fourth sample being evaluated for contamination. The arithmetic mean of the test analysis for the background samples will be compared to the test analysis for the sample in question. If the analysis for the sample in question is less than five times the mean of the background analyses, the materials in questions will be considered clean.

At each sample location which is a source of contamination an area extending a minimum of ten feet beyond the sampling point will be excavated a minimum depth of one foot. The excavated soil will be transported off site for disposal as a hazardous waste. Following excavation of the contaminated soil, the excavated area will be randomly sampled at three locations to a depth of six inches. These samples will be analyzed for the contaminants found in the analyses of the composite sample.

If the remaining soil in the excavation area is shown to be clean, no further excavation will be required. If not, the excavation and analytical procedure will be repeated until clean soil is reached or until the owner determines that clean closure cannot be achieved. After all contaminated soil has been excavated, the excavated areas will be backfilled with clean soil.

4. Other Activities

No need for ground water monitoring or leachate collection is anticipated at this location during closure. The existing run-on control and run-off control is sufficient.

I-2 POST-CLOSURE PLAN (40 CFR 270.14(b)(13)

If a unit(s) cannot be fully decontaminated as a result of closure activities, any such unit(s) will be closed as a landfill. Such a disposal unit will be fully covered with soil material having a permeability less than or equal to the permeability of the natural subsoils present beneath the unit to minimize the migration of liquids through the closed unit. The cover will be vegetated and contoured to promote drainage and to prevent erosion. The cover material will be of sufficient thickness and elasticity to accommodate settling and subsidence.

Any OB/OD unit closed as a landfill, will also have a run-on control system (i.e., a dike) installed to prevent flow onto the closed unit during peak discharge from at least a 25-year 24-hour duration storm.

A run-off management system will be installed to collect and control at least the water volume resulting from a 25-year 24-hour duration storm.

If it is determined that all hazardous waste or hazardous waste constituents cannot be removed from a given unit during closure, monitoring wells will be installed around the applicable OB/OD unit according to EPA's RCRA Groundwater Monitoring Technical Enforcement Guidance Document (OSWER - 9950.1; September 1986). The wells will be screened to intercept the upper 10 feet of the uppermost saturated zone, accounting for seasonal fluctuations in groundwater elevations. These wells will be sampled for hazardous constituents quarterly for a least one year to determine the extent of contamination and to determine if further monitoring is warranted.

During the facility post-closure care period the facility contact will be;

Mr. Randall W. Battaglia
Environmental Coordinator
Directorate of Engineering and Housing
Seneca Army Depot
Romulus, NY 14541
(607) 869-1450

I-3 NOTICES REQUIRED FOR DISPOSAL FACILITIES*[40 CFR 270.13(b)(13)]*

Open burning and open detonation is considered to be treatment and not disposal. Therefore, the requirements do not apply.

I-4 CLOSURE COST ESTIMATES *[40 CFR 270.14(b)(15)]*

The Federal Government is exempt from Financial Requirements.

I-5 FINANCIAL ASSURANCE MECHANISM FOR CLOSURE *[40 CRF 270.14(b)(17)]*

The Federal Government is exempt from Financial Requirements.

I-6 POST-CLOSURE COST ESTIMATE *[40 CFR 270.14(b)(16)]*

The Federal Government is exempt from Financial Requirements.

I-7 FINANCIAL ASSURANCE MECHANISM FOR POST-CLOSURE *[40 CFR 270.14(b)(18)]*

The Federal Government is exempt from Financial Requirements.

I-8 LIABILITY REQUIREMENTS *[40 CFR 270.14(b)(17)]*

The Federal Government is exempt from Financial Requirements.

I-9 STATE FINANCIAL MECHANISM *[40 CFR 270.14(b)(18)]*

The Federal Government is exempt from Financial Requirements.

SECTION J

CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS *[40 CFR 264.100 and 264.101]*

In a draft agreement between EPA Region II and NYSDEC the Army is required to identify and classify all solid waste management units (SWMU's) at SEAD, in accordance with the EPA guidance document for performing a RCRA Facility Assessment (RFA: EPA 1986). The SWMU Classification Study has been completed and submitted to NYSDEC (ERCE, 1991). Sixty-nine SWMU's have been identified in it and are listed on **Table J-1**. A brief description of each SWMU is presented in **Appendix 7**, and includes the following elements:

1. Unit Name
2. Unit Characteristics
    - unit type
    - dimensions
    - dates of usage
    - operating practices
    - present condition & status
3. Waste Characteristics
    - wastes disposed
    - physical and chemical characteristics
    - migration and dispersal characteristics
    - toxicological characteristics
4. Migration Pathways
5. Evidence of Release
6. Exposure Potential
7. Recommendations for Sampling
8. References
9. Comments

Of the 69 SWMU's initially identified, 11 have been selected by the U.S. Army Corps of Engineers (Huntsville) and SEAD for further investigation (SEAD-4, 8, 11, 13, 16, 17, 24, 25, 45 and 57). The OD area (SEAD-45) is part of the continuing RCRA Corrective Action Program involving SWMU's at SEAD. The OB area is currently being investigated under the CERCLA Remedial Investigation/Feasibility Study (RI/FS) process.

Most of EPA's August 7, 1991 comments on the previous Part B permit submitted are addressed in this section. However, the following information remains outstanding and will be obtained during the on-going RCRA Corrective Action Program.

- Quantity of waste managed at the SWMU
- Volume of release
- Nature of release
- Further media sampling data

Table J-1 has been modified to reflect the expected completion dates for the Site Investigation Reports and for the negotiation of the final ROD for the appropriate SWMU's. The status of the investigation program to implement for many of these SWMU's is still under negotiations so these have been listed as TBD, To Be Determined.

A SWMU location map is presented in **Appendix 1**. More extensive information is available in the RFA report (ERCE, 1991), such as engineering drawings (if available), photos of each SWMU and some groundwater and soil sampling data.

No state, local, or federal enforcement actions have occurred at SEAD in relation to environmental matters. SEAD has initiated a RCRA Corrective Action Program at the site pursuant to an interagency agreement between EPA and NYSCEC.

Citizen complaints have been made at SEAD in relation to open detonation of ordnance. The frequency of such complaints is 1 to 2 annually. No other complaints have been made.

TABLE J-1

SOLID WASTE MANAGEMENT UNITS
SENECA ARMY DEPOT
ROMULUS, NEW YORK

Unit Number	Unit Name	FINAL SI REPORT APPROVED
SEAD- 1	Building 307 - Hazardous Waste Container Storage Facility	TBD
SEAD- 2	Building 301 - PCB Transformer Storage Facility	TDB
SEAD- 3	Incinerator Cooling Water Pond	8 June 94 (a)
SEAD- 4	Munitions Washout Facility Leach Field	23 June 94
SEAD- 5	Sewage Sludge Waste Piles	23 June 95
SEAD- 6	Abandoned Ash Landfill	8 June 94 (a)
SEAD- 7	Shale Pit	TBD
SEAD- 8	Non-Combustible Fill Area	8 June 94 (a)
SEAD- 9	Old Scrap Wood Site	TBD
SEAD-10	Present Scrap Wood Site	TBD
SEAD-11	Old Construction Debris Landfill	23 June 94
SEAD-12	Radioactive Waste Burial Sites Location A: Northeast of Building 813 Location B: North of Building 804	23 June 95
SEAD-13	IRFNA Disposal Site	23 June 94
SEAD-14	Refuse Burning Pits (2 units)	8 June 94 (a)
SEAD-15	Building 2207 - Abandoned Solid Waste Incinerator	8 June 94 (a)
SEAD-16	Building S-311 - Abandoned Deactivation Furnace	23 June 94
SEAD-17	Building 367 - Existing Deactivation Furnace	23 June 94
SEAD-18	Building 709 - Classified Document Incinerator	TBD
SEAD-19	Building 801 - Classified Document Incinerator	TBD
SEAD-20	Sewage Treatment Plant No. 4	TBD
SEAD-21	Sewage Treatment Plant No. 715	TBD
SEAD-22	Sewage Treatment Plant No. 314	TBD

(a) Final ROD
TBD - To be determined

TABLE J-1
(Continued)

UNIT NUMBER	UNIT NAME	FINAL SI REPORT APPROVED
SEAD-23	**OPEN BURNING AREA**	8 June 94 (a)
SEAD-24	Abandoned Powder Burning Pit	23 June 94
SEAD-25	Fire Training and Demonstration Pad	23 June 94
SEAD-26	Fire Training Pit	23 June 94
SEAD-27	Building 360 Steam Cleaning Waste Tank	TBD
SEAD-28	Building 360 - Underground Waste Oil Tanks (2 units)	TBD
SEAD-29	Building 732 - Underground Waste Oil Tank	TBD
SEAD-30	Building 118 - Underground Waste Oil Tank	TBD
SEAD-31	Building 117 - Underground Waste Oil Tank	TBD
SEAD-32	Building 718 - Underground Waste Oil Tanks (2 units)	TBD
SEAD-33	Building 121 - Underground Waste Oil Tank	TBD
SEAD-34	Building 319 - Underground Waste Oil Tanks (2 units)	TBD
SEAD-35	Building 718 - Waste Oil-Burning Boilers (3 units)	TBD
SEAD-36	Building 121 - Waste Oil-Burning Boilers (2 units)	TBD
SEAD-37	Building 319 - Waste Oil-Burning Boilers (2 units)	TBD
SEAD-38	Building 2079 - Boiler Plant Blowdown Leach Pit	TBD
SEAD-39	Building 121 - Boiler Plant Blowdown Leach Pit	TBD
SEAD-40	Building 319 - Boiler Plant Blowdown Leach Pit	TBD
SEAD-41	Building 718 - Boiler Plant Blowdown Leach Pit	TBD
SEAD-42	Building 106 - Preventive Medicine Laboratory	TBD
SEAD-43	Building 606 - Old Missile Propellant Test Laboratory (Refer to SEAD-56)	23 June 95
SEAD-44	Quality Assurance Test Laboratory Location A: West of Building 616 Location B: Brady Road	23 June 95

(a) Final ROD
TBD - To be determined

TABLE J-1
(Continued)

Unit Number	Unit Name	Final SI Report Approved
SEAD-45	**OPEN DETONATION AREA**	23 June 94
SEAD-46	Small Arms Range	23 June 95
SEAD-47	Buildings 321 and 806 - Radiation Calibration Source Storage	TBD
SEAD-48	Pitchblend Storage Igloos	TBD
SEAD-49	Building 356 - Columbite Ore Storage	TBD
SEAD-50	Tank Farm (refer to SEAD-54)	23 June 95
SEAD-51	Herbicide Usage - Perimeter of High Security Area	TBD
SEAD-52	Buildings 608 and 612 - Ammunition Breakdown Area	TBD
SEAD-53	Munitions Storage Igloos	TBD
SEAD-54	Asbestos Storage (refer to SEAD-50)	TBD
SEAD-55	Building 357 - Tannin Storage	TBD
SEAD-56	Building 606 - Herbicide and Pesticide Storage (refer to SEAD-43)	TBD
SEAD-57	Explosive Ordnance Disposal Area	23 June 94
SEAD-58	Debris Area near Booster Station 2131	23 June 95
SEAD-59	Fill Area west of Building 135	23 June 95
SEAD-60	Oil Discharge adjacent to Building 609	23 June 95
SEAD-61	Building 718 - Underground Waste Oil Tank	TBD
SEAD-62	Nicotine Sulfate Disposal Area near Buildings 606 or 612	23 June 95
SEAD-63	Miscellaneous Components Burial Site	23 June 95
SEAD-64	Garbage Disposal Areas Location A: Debris Landfill south of Storage Pad Location B: Disposal Area south of Classification Yards Location C: Proposed Landfill Site Location D: Disposal Area west of Building 2203	23 June 95

(a) Final ROD
TBD - To be determined

TABLE J-1
(Continued)

Unit Number	Unit Name	Final SI Report Approved
SEAD-65	Acid Storage Areas	TBD
SEAD-66	Pesticide Storage near Buildings 5 and 6	TBD
SEAD-67	Dump Site east of Sewage Treatment Plant No. 4	23 June 95
SEAD-68	Building S-335 - Old Pest Control Shop	23 June 95
SEAD-69	Building 606 - Disposal Area	23 June 95

(a) Final ROD
TBD - To be determined

SECTION L

PART B CERTIFICATION[*40 CFR 270.11*]

Part B applications must be accompanied by certification as specified in 40 CFR 270.11(d). The certification must be signed as specified in 40 CFR 270.11(a). For a federal facility, the certification must be signed by either a principal executive officer or ranking elected official.

CERTIFICATIONFOR RCRA PART B PERMIT APPLICATION
FOR
SENECA ARMY DEPOT
ROMULUS, NEW YORK

Owner Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: James B. Cross

Rank or Office/Position: Colonel, U.S. Army

Company or Agency: Seneca Army Depot

____
Signature

____
Date Signed

CERTIFICATION FOR RCRA PART B PERMIT APPLICATION
FOR
SENECA ARMY DEPOT
ROMULUS, NEW YORK

Owner Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Name: James B. Cross

Rank or Office/Position: U.S. Army, Commanding Officer

Company or Agency: Seneca Army Depot

James B Cross
Signature

11 Sep 92
Date Signed

SECTION K

OTHER FEDERAL LAWS

THE ENDANGERED SPECIES ACT

U.S. Fish and Wildlife Service and the New York State Department of Environmental Conservation Natural Heritage Program have indicated that there are no Federal-listed endangered or threatened species, designated endangered species, or critical habitats known to occur in the SEAD area, although some species may occur as transients. Bald eagles (Haliaeetus Leucocephalus) nest at the Montezuma National Wildlife Refuge which is 20 miles northeast of the Seneca Army Depot (Paul Nickerson and Mark Clough, U.S. Fish and Wildlife Service, Newton, MA, personal communication, February 4, 1991). This endangered species may possibly use Seneca Lake as a feeding area, but would not be found at the SEAD or OB/OD facility. Due to the lack of probability of occurrence of Federal-listed endangered and threatened species, the Endangered Species Act is not applicable to the issuance of this Part B Permit.

THE WILD AND SCENIC ACT

Information has been reviewed concerning the applicability of the Wild and Scenic Rivers Act to SEAD. Those rivers which have been designated as wild and scenic in accordance with the Act are listed in 16 U.S.C. 1271. According to that list and the administering agency, the National Park Services, there are no designated wild and scenic rivers located within Seneca County (Phil Huffman, National Park Service, Newton, MA, personal communication, April 2, 1991). Since no Federal wild and scenic rivers occur on or near the SEAD, the Wild and Scenic Act is not applicable to the issuance of this Part B Permit.

THE NATIONAL HISTORIC PRESERVATION ACT

In order to determine if SEAD is in compliance with the National Historic Preservation Act, An Archeological Overview and Management Plan for Seneca Army Depot (Envirosphere 1986) was reviewed. According to this document, four known archeological sites are known to exist at SEAD, but none of these occur near the OB/OD grounds. None of the potential historic/archeological sites are located within the OB/OD grounds. The closest potential sites include former farmsteads, circa 1850, and are located near existing roads approximately 1,000 feet to the east, 3,000 feet to the south and 1,500 feet to the west of the OB/OD grounds. The nearest known archeological sites are located approximately 2.3 miles to the south of the OB/OD grounds. There are 231 potential historic archeological sites identified on the SEAD based on documentary sources. According to the report, no known historic sites were recorded at SEAD. None of these known archeological sites are considered worthy of inclusion onto the National Register of Archeological Sites. Since the OB/OD facility has no known or potential historic or archeological sites listed in the National Register or other listing, the National Historic Preservation Act is not applicable to the issuance of this Part B Permit.

THE WILDERNESS ACT AND NATIONAL WILDLIFE REFUGES

The U.S. Fish and Wildlife Service, which administers the Wilderness Act and the National Wildlife Refuge System, indicated that there are no areas protected by the Wilderness Act in the State of New York and that the nearest national wildlife refuge, Montezuma National Wildlife Refuge, is located approximately 20 miles to the northeast of the SEAD (Don Frickie, U.S. Fish and Wildlife Service, Newton, MA, personal communication, April 5, 1991). Since there are no Federal-designated wilderness areas on or near SEAD, the Wilderness Act is not applicable to the issuance of this Part B Permit.

COASTAL ZONE MANAGEMENT ACT

SEAD does not occur in a designated coastal zone area, so the Coastal Zone Management Act is not applicable to the issuance of the Part B Permit.

CLEAN WATER ACT

The U.S. Fish and Wildlife Service National Wetlands Inventory map (Geneva South Quad) was reviewed and none of the mapped wetlands are within the 90-acre OB/OD area. A detailed wetland field survey of the OB/OD facility will be performed during the on-going Superfund Remedial Investigation and Feasibility Study (RI/FS) process.

There are no permanent streams on the OB/OD grounds, although small intermittent drainages occur and connect into Reeder Creek which is located to the northeast and east of the OB/OD grounds.

Section 404 of the Clean Water Act (33 U.S.C.) regulates the discharge of dredged or fill materials into U.S. waters including wetlands. Section 401 of the Clean Water Act (33 U.S.C.) requires a water quality certification or waiver from a state water pollution control agency to discharge dredged or fill materials. Since no dredge or fill material would be discharged as part of OB/OD operations, Sections 401 and 404 of the Clean Water Act are not applicable to the issuance of this Part B Permit.

THE FISH AND WILDLIFE COORDINATION ACT

Since the proposed RI/FS work at the OB/OD facility does not involve the impoundment, diversion, control or modification of any body of water, the Fish and Wildlife Coordination Act is not applicable to the issuance of this Part B Permit.

SAFE DRINKING WATER ACT

Since none of the surface waters nor groundwater at the OB/OD facility or SEAD are used as a drinking water supply, the Safe Drinking Water Act is not applicable to the issuance of this Part B Permit.

APPENDIX 1
MAP POCKETS

FIGURE B-3	Area Map
FIGURE B-4	Detailed Site Map
FIGURE B-5	Water Supply Well Locations
PLATE 1	Surface Water and Wetland Location
FIGURE J-1	Solid Waste Management Units

APPENDIX 2

COMPOSITION OF PROPELLANTS, EXPLOSIVES AND PYROTECHNICS

TABLE 2-1

COMPOSITION OF PROPELLANT TREATED BY OPEN BURNING (OB)

Composition (% by wt.)

Propellant Designation	M1	M2	M5	M6	M7	M8
Chemical						
Nitrocellulose	85.0	77.45	81.95	87.0	54.6	52.15
Nitroglycerin	-	19.50	15.00	-	35.5	43.00
Nitroguanidine	-	-	-	-	-	-
Dinitrotoluene	10.0	-	-	10.0	-	-
Dibutylphthalate	5.0	-	-	3.0	-	-
Diethylphthalate	-	-	-	-	-	3.0
Diphenylamine	1.0*	-	-	1.0	-	-
Ethyl Centralite	-	0.60	0.60	-	0.9	0.60
Barium Nitrate	-	1.40	1.[illegible]0	-	-	-
Potassium Nitrate	-	-	-	-	7.8	-
Lead Carbonate	1.0**	-	-	-	-	-
Potassium Sulfate	1.0**	-	-	1.0*	-	-
Tin	-	-	-		-	-
Carbon Black	-	-	-		1.2	-
Graphite	-	0.30	0.30	-	-	-
Cryolite	-	-	-	-	-	-
2-Dinitro-diphenyldiamine	-	-	-	-	-	-
Lead Stearate	-	-	-	-	-	-
Triacetin	-	-	-	-	-	-
Charcoal	-	-	-	-	-	-
Sulfur	-	-	-	-	-	-

Notes: *Added basis
**Added basis when specified

TABLE 2-1
(Cont.)

Composition (% by wt.)

Propellant Designation	M9	M10	M12	M13	M14	M15
Chemical						
Nitrocellulose	57.75	98.00	97.70	57.30	90.00	20.0
Nitroglycerin	40.00	-	-	40.00	-	19.0
Nitroguanidine	-	-	-	-	-	54.7
Dinitrotoluene	-	-	Coating	-	8.00	-
Dibutylphthalate	-	-	-	-	2.00	-
Diethylphthalate	-	-	-	-	-	-
Diphenylamine	-	1.0	0.80	0.20	1.00*	-
Ethyl Centralite	0.75	-	-	1.00	-	6.0
Barium Nitrate	-	-	-	-	-	-
Potassium Nitrate	-	-	-	-	-	-
Lead Carbonate	-	-	-	-	-	-
Potassium Sulfate	-	1.0	0.75	1.50	-	-
Tin	-	-	0.75	-	-	-
Carbon Black	-	-	-	0.05*	-	-
Graphite	-	Glaze 0.1	-	-	-	-
Cryolite	-	-	-	-	-	0.3
2-Dinitro-diphenyldiamine	-	-	-	-	-	-
Lead Stearate	-	-	-	-	-	-
Triacetin	-	-	-	-	-	-
Charcoal	-	-	-	-	-	-
Sulfur	-	-	-	-	-	-

Notes: *Added basis
**Added basis when specified

TABLE 2-1
(Cont.)

Composition (% by wt.)

Propellant Designation	**M16**	**M17**	**M18**	**M26**	**M26 E1**	**M30**	**M30 A1**
Chemical							
Nitrocellulose	55.50	22.0	80.00	67.25	68.70	28.00	28.00
Nitroglycerin	27.50	21.5	10.00	25.00	25.00	22.50	22.50
Nitroguanidine	-	54.7	-	-	-	47.70	47.00
Dinitrotoluene	10.50	-	-	-	-	-	-
Dibutylphthalate	-	-	-	-	-	-	-
Diethylphthalate	-	-	-	-	-	-	-
Diphenylamine	-	-	.70	-	-	-	-
Ethyl Centralite	4.00	1.5	-	6.00	6.00	1.50	1.50
Barium Nitrate	-	-	-	0.75	-	-	-
Potassium Nitrate	-	-	-	0.70	-	-	-
Lead Carbonate	-	-	-	-	-	-	-
Potassium Sulfate	1.50	-	-	-	-	-	1.00
Tin	-	-	-	-	-	-	-
Carbon Black	0.50	-	-	-	-	-	-
Graphite	-	Glaze 0.1	-	0.30	0.30	Glaze 0.10	-
Cryolite	-	0.3	-	-	-	0.30	-
2-Dinitro-diphenyldiamine	-	-	-	-	-	-	-
Lead Stearate	.505	-	-	-	-	-	-
Triacetin	-	-	-	-	-	-	-
Charcoal	-	-	-	-	-	-	-
Sulfur	-	-	-	-	-	-	-

Notes: *Added basis
**Added basis when specified

TABLE 2-1
(Cont.)

Composition (% by wt.)

Propellant Designation	M31	M31 A1	IMR	T2	T8	T23	Black Powder
Chemical							
Nitrocellulose	20.00	20.00	90.00	57.50	58.00	67.25	-
Nitroglycerin	19.00	19.00	-	30.00	22.50	0.25	-
Nitroguanidine	54.70	54.00	-	-	-	-	-
Dinitrotoluene	-	4.50	9.00	4.50	2.50	-	-
Dibutylphthalate	-	-	-	-	-	-	-
Diethylphthalate	-	-	-	-	-	-	-
Diphenylamine	-	-	-	-	-	-	-
Ethyl Centralite	-	-	-	8.00	8.00	6.00	-
Barium Nitrate	-	-	-	-	-	0.75	-
Potassium Nitrate	-	-	-	-	-	0.70	74.00
Lead Carbonate	-	-	-	-	-	-	-
Potassium Sulfate	-	1.50	1.00*	1.50	-	-	-
Tin	-	-	-	-	-	-	-
Carbon Black	-	-	-	0.02*	-	-	-
Graphite	-	-	-	-	-	0.30	-
Cryolite	0.30	-	-	-	-	-	-
2-Dinitro-diphenyldiamine	1.50	-	-	-	-	-	-
Lead Stearate	-	-	-	0.50	0.50	-	-
Triacetin	-	-	-	-	8.50	-	-
Charcoal	-	-	-	-	-	-	15.60
Sulfur	-	-	-	-	-	-	10.40

Notes: *Added basis
**Added basis when specified

TABLE 2-2

CHEMICAL FORMULA OF EXPLOSIVES TREATED BY OPEN DETONATION (OD)

Primary Explosives - Chemical Name	Chemical Formula	Hazardous Waste ID Number
Lead Azide	N_6Pb (71% PB)	D003, D008
Mercury Fulminate	$C_2HgN_20_2$ (7.05% Hg)	D003, D009
Diazodinitrophenol (DDNP)	$C_6H_2N_4O_5$	D003
Lead Styphnate	$C_6HN_3O_8Pb$ (44.2% Pb)	D003, D008
Tetracene	$C_{18}H_{12}$	D003
Potassium Dinitrobenaofuroxane (KDNBF)	$C_6H_2N_4O_6K$	D003
Lead Monomitroresorcinate (LMNR)	$C_6H_3NO_2Pb$ (57.5% Pb)	D003, D008
Lead Thiocyanate (fuel)	$Pb(SCN)_2$ (64% Pb)	D008
Antimony Sulfide (fuel)	Sb_2S_5	D003
Calcium Silicate (fuel)	$CaSi0_3$	D003, D001
Potassium Chlorate (oxidizer)	$KClO_3$	D003
Ammonium Perchlorate (oxidizer)	NH_4Cl0_4	D003
Barium Nitrate	$Ba(N0_3)_2$	D003, D005

TABLE 2-2
(Cont.)

High Explosives - Chemical Name	Chemical Formula	Hazardous Waste ID Number
(Aliphatic Nitrate Esters)		
1,2,4-Butanetriol Trinitrate (BTN)	$C_4H_7N_3O_9$	D003
Diethyleneglycol Dinitrate (DEGN)	$C_4H_8N_2O_7$	D003
Nitroglycerine (NG)	$C_3H_5N_3O_9$	D003
Nitrostarch (NS)	$C_6H_{10}O_5NO_2$	D003
Pentaerythritol Tetranitrate (PETN)	$C_5H_8N_4O_{12}$	D003
Trimethylene Glycoldinitrate (TEGN)	$C_6H_{12}O_4N_2O4$	D003
1,1,1-Trimethylolethane Trinitrate (TMETN)	$C_5H_9O_{9N}3$	D003
Nitrocellulose (NC)	$C_{12}H_{16}(ONO_2)_4O_6$	D003
(Nitramines)		
Cyclotetramethylenete-Tranitramine (HMX)	$C_4H_8N_8O_2$	D003
Cyclotrimethylene-Trinitramine (RDX)	$C_3H_6N_6O_6$	D003
Ethylenediamine Dinitrate (EDDN: Haleite)	$C_2H_6N_4O_4$	D003
Nitroguanidine (NQ)	$CH_4N_4O_2$	D003
2,4,6-Trinitrophenyl-Methylnitramine	$C_7H_5N_5O_8$	D003

TABLE 2-2
(Cont.)

High Explosives - Chemical Name	Chemical Formula	Hazardous Waste ID Number
(Nitroaromatics)		
Ammonium Pictrate (Explosive D)	$C_6H_3N_3O_7H_3N$	D003
1,3-Diamino-2,4,6-Trinitrobenzene (DATB)	$C_6H_4N_6O_6$	D003
2,2'4,4'6,6'-Hexanitroazobenzene (HNAB)	$C_{12}N_8O_{12}$	D003
Hexnitrostilbene (HNS)	$C_{14}H_2N_6O_{12}$	D003
1,3,5-Triamino-2,4,6-Trinitrobenzene (TATB)	$C_6H_6N_6O_6$	D003
2,4,6-Trinitroluene (TNT)	$C_7H_5N_3O_6$	D003
Ammonium Nitrate	HN_4NO_3	D003
Plastic Bonded Explosive (PBX)		
Explosives (see above) and polymer binder, plasticizer, and fuel (aluminum or iron)		
(Pyrotechnics)		
Combination of: Oxidizer - oxygen or fluorine Fuel - powdered aluminum or magnesium Binding Agents - resins, waxes, plastics, oils, retardants, waterproofing, color intensifier		

TABLE 2-2
(Cont.)

Explosives - Chemical Name	Chemical Formula	Percent
Black Powder	Potassium Nitrate	74.0
	Charcoal	15.6
	Sulfur	10.4
Composition B	60/40 Cyclotol	
	RDX	60
	TNT	39
	WAX	17
Photoflash	Laminac	96.8
	Lupersol, DDM	3.0
	Iron Oxide	.2
Composition C4	RDX	91.0
	Polyisobutylene	2.1
	Motor Oil	1.6
	Di-(2-Ethylhexyl) Sebacate	5.3
TPA Incendiary	Triethylaluminum	?
Amatol	Ammonium Nitrate	?
	TNT	?
Composition A3	RDX	91
	WAX	9
Explosive A4	RDX	97
	WAX	3
HBX-1.3 & 6	RDX	39.6
	TNT	37.8
	Aluminum	17.1
	Densitizer Comp D2	5.0
	CACL	.5
Octol	HMX	75
	TNT	25

TABLE 2-2
(Cont.)

Explosives - Chemical Name	Chemical Formula	Percent
PBX	RDX	?
	Polystyrene	?
	Dioclylphthalate	?
Pentolite	PETN	50
	TNT	50
Picratol	Explosive D	52
	TNT	48
Tetrytol	Tetryl	?
	TNT	?
Torpex	RDX	42
	TNT	40
	Aluminum	18
Tritonal	Aluminum	?
	TNT	?
Military Dynamite - Medium Velocity	RDX	75
	TNT	15
	Starch	5
	SAE No. 10 Oil	4
	Polysobutylene	1
Military Dynamite - Low Velocity	RDX/dye*	17.5
	TNT	67.8
	Tripentaery-Thritol	8.6
	Binder**	4.1
	Celluloseacetate	2.0

Notes: * The dye is 1 - methylamino-anthraquinone (1-MA) used in the amount of .5% of the RDX mixture

** The binder is vistac No. 1 consisting of polybutene and diotyseabacate

APPENDIX 3

U.S. BUREAU OF MINES GAP TEST

U.S. BUREAU OF MINES DEFLAGRATION, DETONATION AND TRANSITION TEST

DESCRIPTION OF TEST METHODS

1) U.S. GAP TEST

The apparatus for the US Gap Test, Bureau of Mines reactivity test, is illustrated in Figure 1. The test is contained in a cylinder consisting of a 16-inch (40.6-cm) length of 1 1/2-inch schedule 80 black seamless steel pipe. A mild steel witness plate 6-inches (15.24 cm) square and 0.125-inch (0.32 cm) thick is mounted at the upper end of the sample tubing and separated from it by spacers 0.062-inch (0.16 cm) thick. The bottom of the cylinder is closed with two layers of 0.003-inch (0.008 cm) thick polyethylene sheet held in place with gum rubber bands and polyvinyl chloride electrical insulation tape. There is no other gap between the pentolite booster and the test sample as used in this test. A continuous velocity of detonation probe make of thin aluminum tube with an axial resistance of 7.62 ohms/inches (3.0 ohms/cm) is mounted on the wall of the sample tubing. The outer tubing of the probe is crimped against the inner wire at the lower end forming a resistor. When this assembly is inserted in a medium which transmits a shock wave, the outer wall crushes against the inner wire, as the wave moves up the tubing shortening the effective length and changing the resistance. If a constant current (usually 0.06 amperes) is make to flow between the outer and inner conductors, the voltage between them is proportional to the effective length and con be recorded as a function of the time using an oscilloscope. The slope of the oscilloscope trace is thus proportional to the velocity of the shock wave.

The sample is loaded to the top of the steel tube. Solid samples are loaded to the density attained by tapping the cylinder until further settling becomes imperceptible. The sample at 20° C ± 3 o C is subjected to the shock wave generated by the detonation of a pentolite (50/50 PETN/TNT) pellet, 2 inches (5.08 cm) in diameter and 2-inches (5.08 cm) thick having a density of 1.6 ± 0.05 g/cc. The pentolite pellet is butted against the bottom of the test sample and initiated with a No. 8 strength detonator. The detonator is held in place by a cork detonator holder.

The criteria for propagation are:

1. A stable propagation velocity greater than 4,900 ft/sec (1.5 km/sec) is observed.
2. A hole is punched through the witness plate.
3. The sample tube is fragmented along its entire length.

The overall test results are considered positive is any two of the three criteria are met.

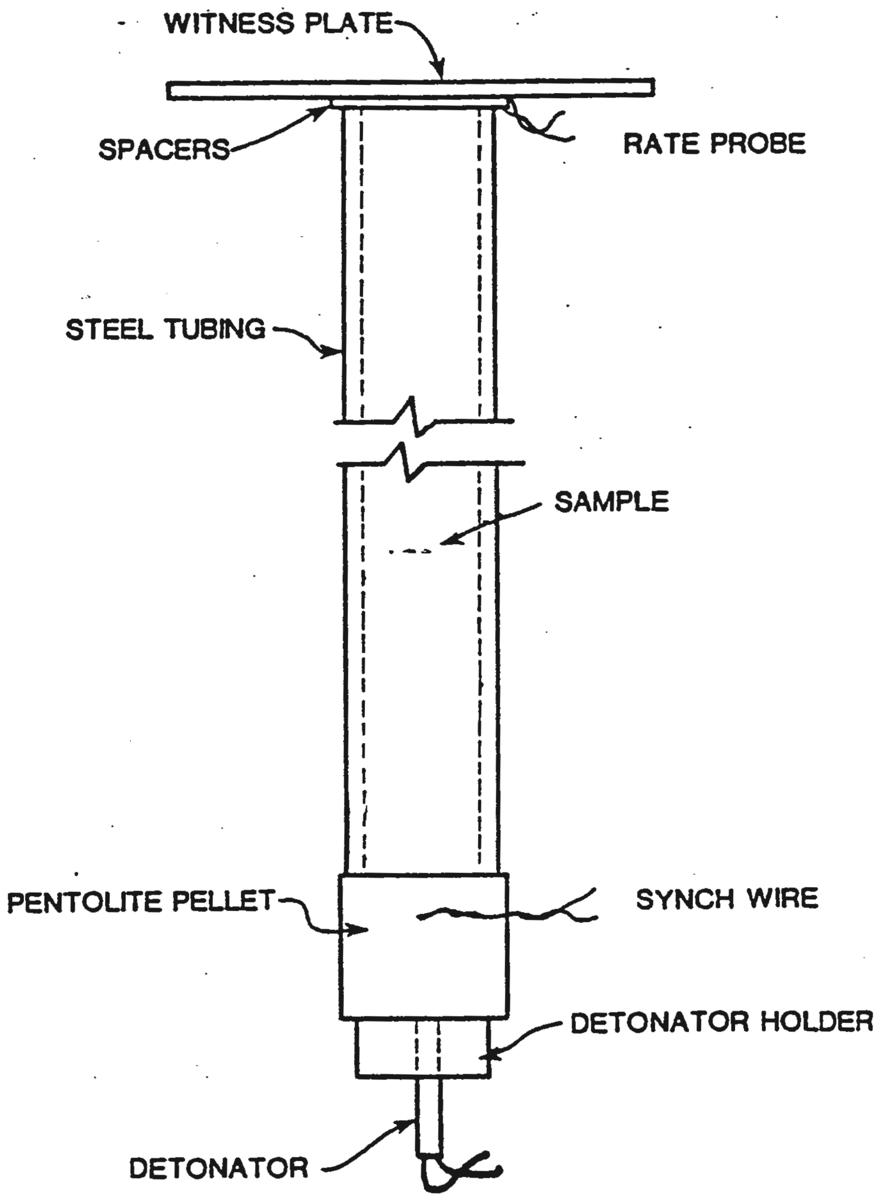


FIGURE 1

U.S. GAP TEST FOR SOLIDS

2) DEFLAGRATION, DETONATION AND TRANSITION (DDT) TEST

The experimental arrangement for this Bureau of Mines is shown in Figure 2. The sample of material to be tested is contained in an 18-inch (45.7 cm) length of 3-inch in a schedule 80 carbon steel pipe with inside diameter 2.9-inch (7.37 cm) wall thickness 0.30 inch (0.76 cm), capped at both ends with "3,000 lbs." forged steel pipe caps.

The sample is subjected to the thermal and pressure stimulus generated by an ignitor consisting of 0.7 oz. (20 g) of grade FFF black powder located at the center of the sample vessel. The ignitor assembly consists of a cylindrical container 0.81-inch (2.06 cm) in diameter and 2.5-inch (6.4 cm) long, which is held together by two layers of nylon filament cellulose acetate tape. The ignitor capsule contains a small loop formed from a 1-inch (2.54 cm) length of nickel-chromium alloy resistance wire 0.012 inch (0.030 cm) in diameter, having a resistance of 0.343 ohms. This loop is attached to two insulated copper-tinned lead wires 0.026 inch (0.066 cm) in diameter. The overall wire diameter including insulation is 0.05 inch (0.127 cm). These lead wires are fed through small holes in a brass disc approximately 0.4 inch (1 cm) in diameter and 0.03 inch (.08 cm) thick, which is soldered to the end of a 9-inch (23 cm) length of 1/8 inch steel pipe having a diameter of 0.405 inch (1.03 cm), which is threaded at the other end and screwed into a threaded hole on the inside of one of the pipe caps. This pipe supports the ignitor capsule and serves as a channel for the ignitor wires. The ignitor is fired by a current of 15 amperes obtained from a 20-voltx transformer.

The criterion currently used in the interpretation of this test is that for a positive result, either the pipe or at least one of the end caps be fragmented into at least two distinct pieces, i.e. results in which the pipe is merely split or laid open or in which the pipe or caps are distorted to the point at which the cops are blown off are considered to be negative results. Although it may be argued that a small number of fragments does not indicate the development of a detonation, it at least indicates a very rapidly rising pressure which in a larger sample could lead to development of detonation.

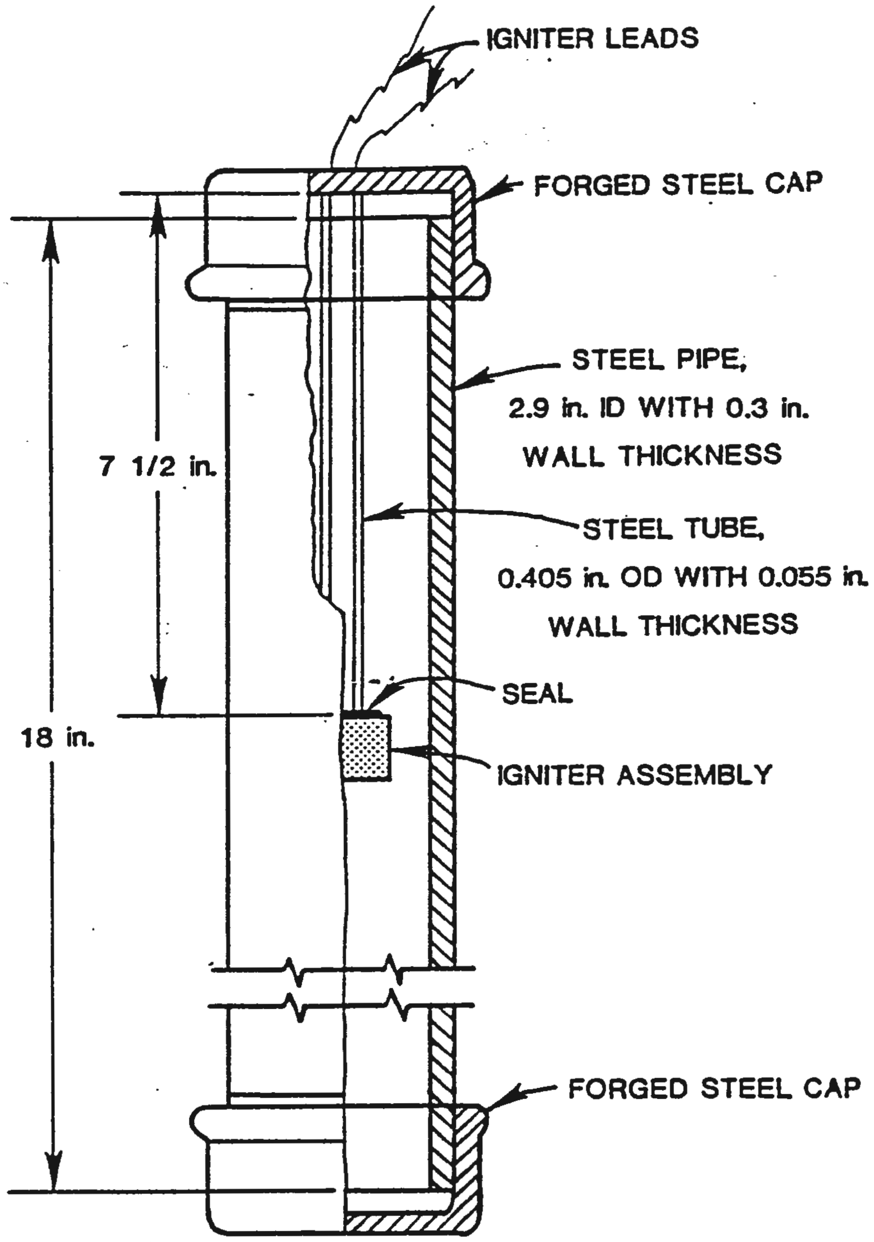


FIGURE 2

PIPE BOMB USED IN THE DEFLAGRATION DETONATION TRANSITION TEST

APPENDIX 4

STANDING OPERATING PROCEDURES

1. SENECA ARMY DEPOT

STANDING OPERATING PROCEDURE FOR:

2. ITEM: a. Ammunition Explosive and Explosive Contaminated Material

b. DODIC Various Classes

Various Fire Symbols

3. OPERATION: Demilitarization (By Burning)

4. EST DAILY PRODUCTION RATE: N/A

5. ORGANIZATION SYMBOL: SDSSE-CP

6. SOP NO. SE 000-H-005 Date 14Oct86

1 Date 7 OCT 1991

Date

-R 755-8 30Oct86

8. PREPAR rial Specialist

T. 41-262/441

9. REVIEWED Mis Div

10. SUBMITTED Specialist

ACTUAL SOP (ENTIRE) WAS SUBMITTED

). CONCURRENCES

OFFICE	GNATURE/DATE	TITLE
D/Ammo Operations	6 Sep91 CARSON W. LANKFORD	Director
D/Product Assurance	12 Sep91 KAREN F. MIKKELBORG	Director
Facility Engineer	27 SEP 1991 RANDALL BATTAGLIA	Environ Prot Officer
Safety Officer	20S91 THOMAS STINCIC	Safety Manager

12. APPROVAL James B. Cross DATE 7 Oct 91

JAMES B. CROSS
Colonel, Ordnance Corps
Commanding

AJ
CEA

1. SENECA ARMY DEPOT

STANDING OPERATING PROCEDURE FOR:

2. ITEM: a. Ammunition Explosive and Explosive Contaminated Material

b. DODIC Various Classes Various Fire Symbols

3. OPERATION: Demilitarization (By Burning)

4. EST DAILY PRODUCTION RATE: N/A

5. ORGANIZATION SYMBOL: SDSSE-CP

6. SOP NO. SE-0000-H-005 Date 14 Oct 86

a. Rev No. ______ Date ______

b. Change No. 1 Date 30 OCT 1989

7. AUTHORITY: AMC-R 385-100 DATE 01 Aug 85
AMC-R 700-107 DATE 29 Oct 86

8. PREPARED BY Michael D. Warner DATE 22 Jun 89 TITLE Prod Controller
MICHAEL WARNER TELE EXT. 7-262/441

9. REVIEWED BY DATE 7-10-89 TITLE C, Ammo Mis Div
PHILLIP S. WILKIE

10. SUBMITTED BY DATE 30 June 79 TITLE C, PP&C DIV
DON K. JONES

11. CONCURRENCES:

OFFICE	SIGNATURE/DATE	TITLE
D/Ammo Operations	for CARSON W. LANKFORD	Director
D/PRODUCT ASSURANCE	KF Mikkelborg KAREN F. MIKKELBORG	Director
Facility Engineer	18 Aug 89 RANDALL BATTAGLIA	Environ Prot Officer
Safety Officer	25 Oct 89 THOMAS STINCIC	Safety Manager

12. APPROVAL Franklin H. Cochran DATE 30 Oct 89
FRANKLIN H. COCHRAN
Colonel, OD
Commanding

SDSSE-HE (200-1a)

MEMORANDUM FOR C, Ammo Div., DMO

SUBJECT: Hazardous Waste Management, OB/OD

1. Effective immediately, the following requirements must be accomplished during open burning operations:

a. The concrete pad will be inspected after each burn for any ash residues.

b. The Environmental Protection Officer, ext. 41-450, will be notified if any ash residues are observed on the concrete pad.

c. Any ash residues on the concrete pad will be HEPA vacuumed as soon as it can be safely accomplished after each burn.

d. Ash residues must be HEPA vacuumed prior to any rain occurring and prior to the end of each day.

e. Ash residues which are too hot to HEPA vacuum may be placed in the tray at the end of the day in accordance with paragraph 12 (of the SOP's General Environmental Requirements, Appendix C).

2. Include these requirements in the October 1992 revision of the SOP.

3. POC is Randall Battaglia at ext. 41-450.

Stephen M Absolom

STEPHEN M. ABSOLOM
Chief, Engineering/Environmental
Management Division

APPENDIX 5

GROUNDWATER MONITORING PROGRAM SUPPLEMENTAL INFORMATION

Table of Contents

APPENDIX 5A

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

TABLE 1
MONITORING WELL DATA (1)

Well No.	Depth Drilled	Depth to Rock	Soil Type	Ground Elevation	Casing Height	Screen Setting (2)	Elevation of Water		
							9/7	9/13	10/5
1	13	12	Till	100.0	4.3	7-12	95.9	94.8	95.0
2	7	6.5	Till	85.1	3.7	1-6	82.2	81.4	81.4
3	11	9.5	Till	95.1	5.5	4.5-9.5	93.0	91.3	90.8
4	10	9.5	Till	98.7	3.0	4.5-9.5	92.1	92.4	92.6
5	15	13.5	Till	97.0	-	-	-	-	-

(1) All values reported in feet.

(2) Feet below the ground surface.

parratt wolff inc

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

TEST BORING LOG

PROJECT Seneca Army Depot
LOCATION Munitions Destruction Area
DATE STARTED 7/7/71 DATE COMPLETED 7/7/71

HOLE NO. B-5
SURF. EL. 118.5'
JOB NO. 8173
GROUND WATER DEPTH
WHILE DRILLING Dry
BEFORE CASING REMOVED Dry
AFTER CASING REMOVED Dry

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
						Brown moist SILT, trace fine to medium gravel, trace clay	3.0'
5.0'						Gray dry SILT, trace weathered shale	9.0'
10.0'						Gray dry weathered SHALE, trace silt	
						Bottom of Boring	10.0'
						Note: Installed observation well to 10.0'.	

parratt wolff inc

TEST BORING LOG

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

PROJECT	Seneca Army Depot	HOLE NO.	B-6
LOCATION	Munitions Destruction Area	SURF. EL.	111.0'
DATE STARTED	7/6/81 DATE COMPLETED 7/6/81	JOB NO.	8173

GROUND WATER DEPTH
WHILE DRILLING 8.0'
BEFORE CASING REMOVED 8.0'
AFTER CASING REMOVED 3.0'

N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
						Brown moist SILT, trace fine to coarse gravel, trace fine sand	3.0'
5.0'						Gray moist SILT, some fine to medium gravel, little fine sand	8.5'
▼ WL						Weathered SHALE	
10.0'						Bottom of Boring	9.0'
						Note: Installed observation well to 8.8'.	

parratt wolff inc

FISHER ROAD
EAST SYRACUSE, N.Y. 13057

TEST BORING LOG

PROJECT Seneca Army Depot

LOCATION Munitions Destruction Area

DATE STARTED 7/6/81 DATE COMPLETED 7/6/81

HOLE NO. B-7

SURF. EL. 104.0'

JOB NO. 8173

GROUND WATER DEPTH WHILE DRILLING

BEFORE CASING REMOVED

AFTER CASING REMOVED 4.2'

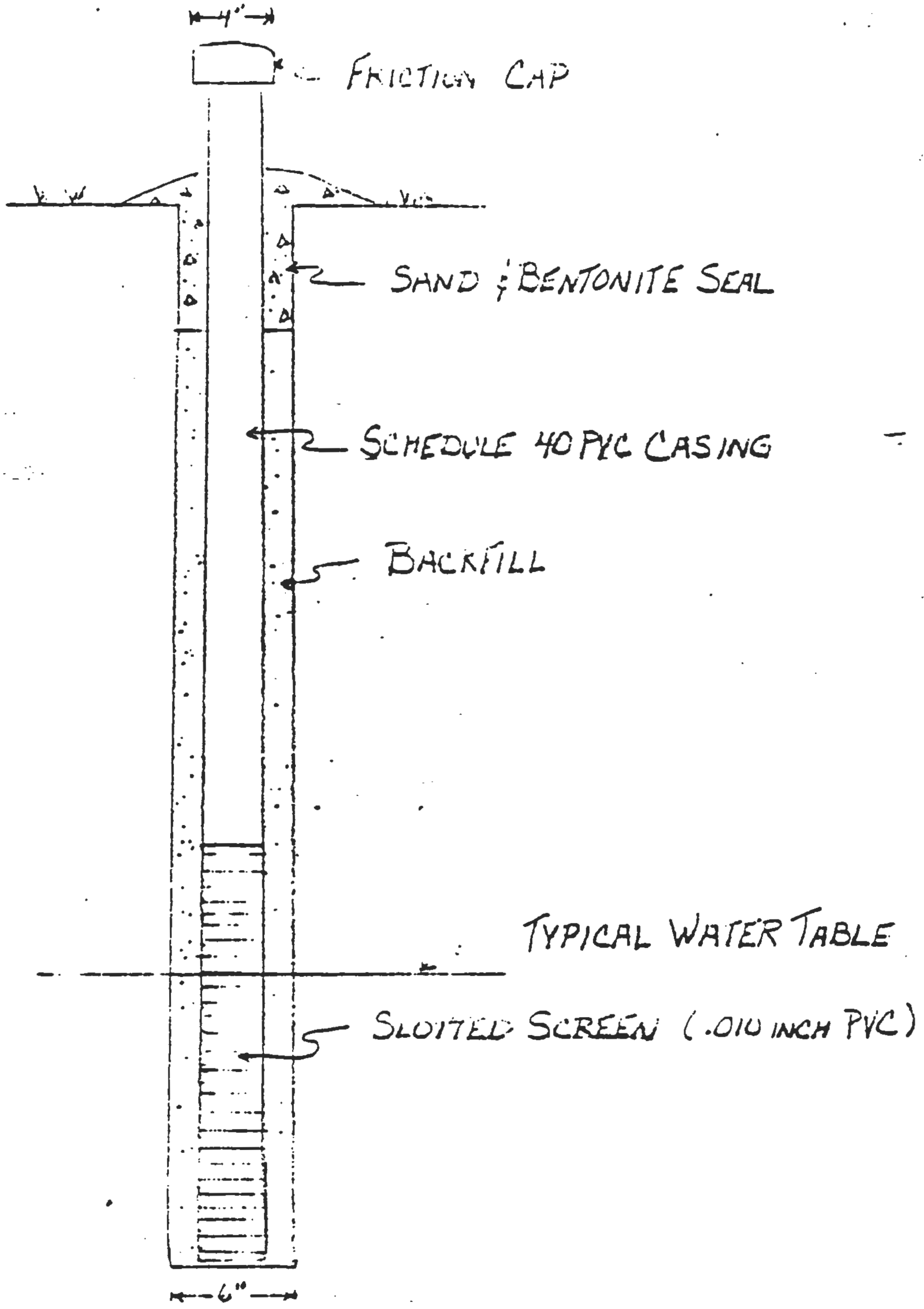
N — NO. OF BLOWS TO DRIVE SAMPLER 12" W/140# HAMMER FALLING 30" — ASTM D-1586, STANDARD PENETRATION TEST

C — NO. OF BLOWS TO DRIVE CASING 12" W/ # HAMMER FALLING "/OR — % CORE RECOVERY

CASING TYPE - HOLLOW STEM AUGER

SHEET 1 OF 1

DEPTH	SAMPLE DEPTH	SAMPLE NUMBER	C	SAMPLE DRIVE RECORD PER 6"	N	DESCRIPTION OF MATERIAL	STRATA CHANGE DEPTH
						Brown moist SILT, trace fine to coarse gravel, trace fine to coarse sand	3.0'
5.0'						Gray moist SILT, some weathered shale pieces, little fine to coarse sand	5.0'
						Gray moist SILT, some fine to coarse gravel, little fine to coarse sand, trace clay	5.8'
10.0'						Gray wet SILT and fine to coarse SAND, some fine to coarse gravel	6.0'
						SHALE	
						Bottom of Boring	6.5'
						Note: Installed observation well to 6.5'.	



MONITORING WELL

Parratt-Wolff Inc.	
MUNITIONS DESTRUCTION AREA SENECA ARMY DEPOT SCHEMATIC WELL DIAGRAM	
7/6/81	JOB # 8173

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT : Seneca Army Depot COE		SHEET 1 OF 1	BORING NO. MW8
SITE LOCATION: Romulus NY Burning Pads	JOB NO. 3161		
	LOCATION: 003266	GROUND ELEV. 119.74	TOTAL DEPTH 18.5'

	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
HNU=0	0		0'				f. SAND and SHALE			~~[illegible]~~
	2'		2'				dk. brown w/ SAND some silt trace clay few ~~gravel~~ 1/4"-1/2" shale gravels			
HNU=0	4'		4'				dk brown w/ SAND some silt little clay few gravel			
			~~5~~							
			6'				v.f. gray brown dry SAND and SILT trace gravel <1"			Till
HNU=0	40		8'				v.f. gray dry SAND and SILT some gravel (weathered shale) angular flat pieces <1"			
HNU 20			10-12	4"	50/4"	✗	spoon - gray black fine material surrounding flat thin layers of shale			Weathered Bedrock
	45									
HNU=0			12	5"	55/3"		1st 3" cave in wet clay last 3" dry weathered bedrock - very fractured flat pieces 1/4 - 1/2" diam			Competent Bedrock
	50									
			13.5'	5'			gray black shale few fractures Competent - not weathered			
			↓		7 min					
					6 min					
	55				6 min					
					6 min					
					5 min					
			18.5'							
	60									

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.: MW8

GROUNDWATER INSTALLATION

PROJECT: Seneca Army Depot JOB NO. 0032883161

WELL NO. MW8

DRILLING CONTRACTOR: Parratt-Wolff

COORDINATES: N 4864 E 8323

BEGUN: 10-5-88

FINISHED: 10-6-88

SUPERVISOR: S. Giesler

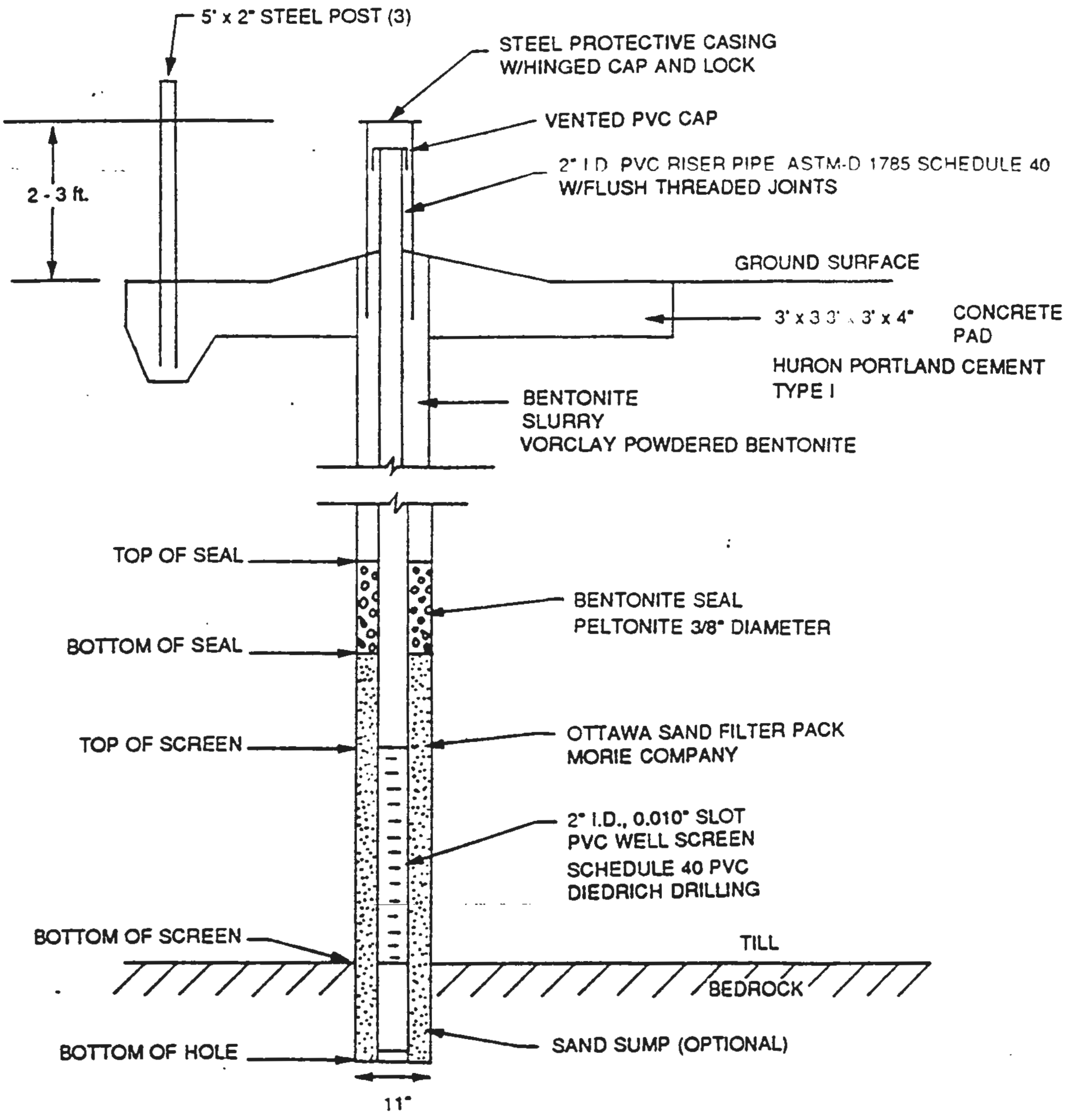
DRILLER: G. Lansing

WELL SITE: NW of pad H

WATER LEVEL 6.3'

DEPTH ELEV. 115.78

DEPTH IN.	ELEV. IN.
	122.08
0 ft	120.06
1.5 ft	118.56
3 ft	117.06
4.5 ft	115.56
9.5 ft	110.56
10 ft	110.06



TIME DEVELOPED: 5 hrs

GALLONS EXTRACTED: 9.5 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT: Seneca Army Depot COE		SHEET 1 OF	BORING NO. MW9
SITE LOCATION: Romulus NY Demo Grounds	JOB NO.:		
	LOCATION: E. of Pad H	GROUND ELEV. 115.48	TOTAL DEPTH 15'
DRILL CONTRACTOR: Parratt-Wolff	ENG/GEO: S. Giesler	BEGUN: 10-6-88	
DRILL RIG: 850 CME	DRILLER: G. Lansing	FINISHED: 10-7-88	
HOLE SIZE: 6"	WEATHER:	GROUND WATER (DEPTH/ELEV.): 113.59 14.3'	
DRILLING METHOD: HSA - CORE	DRILLING FLUID/SOURCE: Water	TOP OF ROCK (DEPTH/ELEV.): 7.5	

	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
HNU=.6	0		0'		grab		brown vf SAND and SILT trace clay			till
HNU=0			2'		grab		brown v.f. SAND and SILT some clay 5% ½" gravel			
HNU=0	5		4'		grab		brown v.f. SAND and SILT some clay 10% gravel ½-¾" d.			
			6'		grab		90% gravel angular to subangular ½"-1½" some sand silt + clay			
HNU=0	10		8'				½-1½" subangular gravel + fine material			weathered bedrock
HNU=0		SS	10'		50/.05"		fractured bedrock			
			10' ↓ 15'		8-8-8-10-8	minutes	thinly bedded sandy shale-cleaved along bedding planes 2"-4" beds			bedrock
	20									
	25									

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES:

BORING NO.:

GROUNDWATER INSTALLATION

PROJECT: Seneca Army Depot JOB NO. 0032883161

WELL NO. MW9

DRILLING CONTRACTOR: Parratt-Wolff

COORDINATES: N 4990 E 8547

BEGUN: 10-6-88

FINISHED: 10-7-88

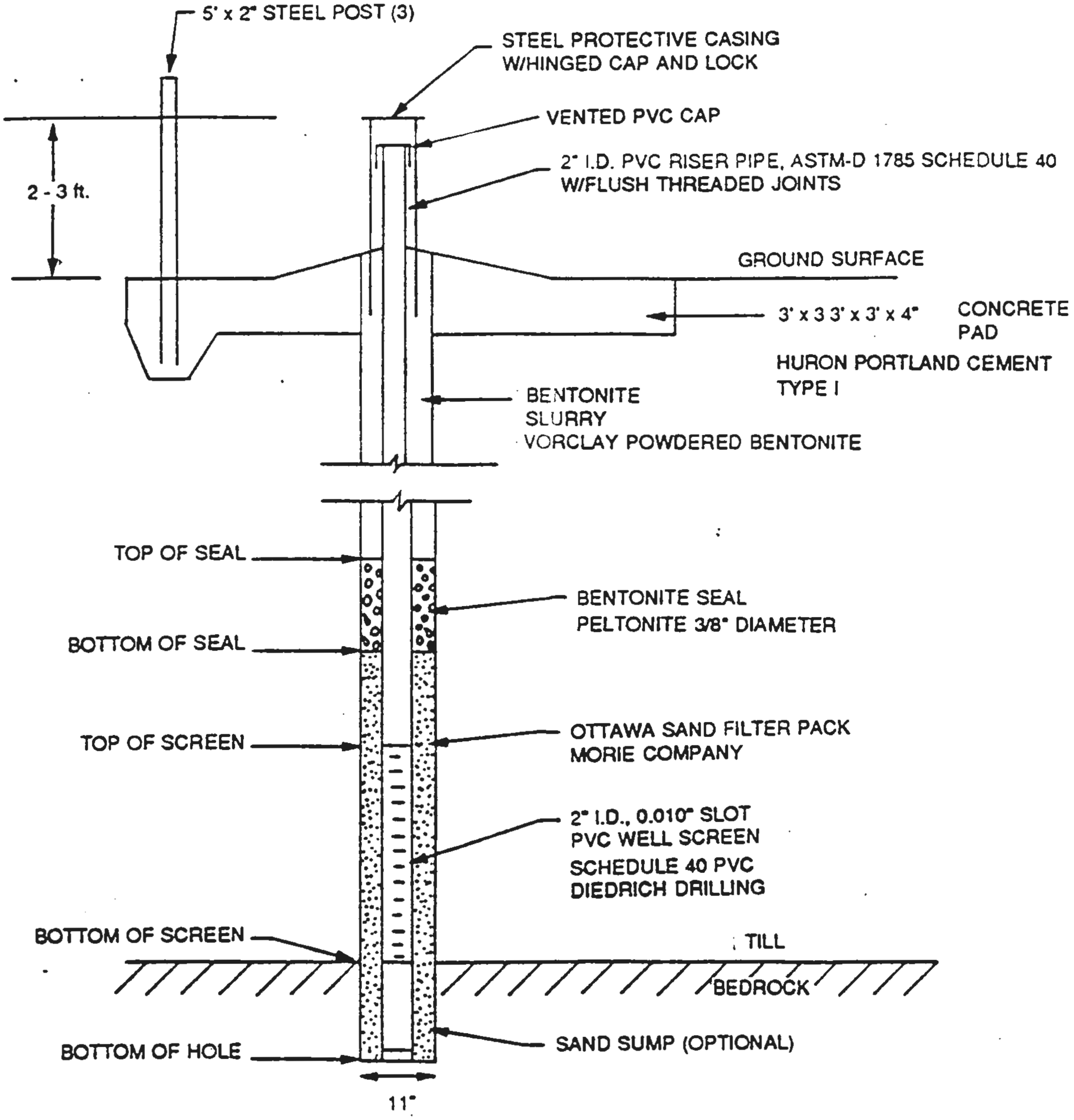
SUPERVISOR: S. Giesler

DRILLER: G. Lansing

WELL SITE: E. of pad H

WATER LEVEL	DEPTH ELEV.
4.3'	113.59

DEPTH IN.	ELEV. IN.
	117.89
0	115.74
1.0 ft	114.74
2.0 ft	113.74
3.0 ft	112.74
7.0 ft	108.74
7.5 ft	108.24



TIME DEVELOPED: 4 hours

GALLONS EXTRACTED: 16 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

M&E

PROJECT : Seneca Army Depot			SHEET 1 OF 1	BORING NO. MW 10
SITE LOCATION: Demo grounds Romulus NY	JOB NO. 0032883101	LOCATION: SW of Pad G	GROUND ELEV. 119.1	TOTAL DEPTH 18.5
DRILL CONTRACTOR: Parratt-Wolff	ENG/GEO: S. Giesler/H. Vick		BEGUN : 10-4-88	
DRILL RIG: CME 850	DRILLER: G Lansing		FINISHED: 10-4-88	
HOLE SIZE: 7"	WEATHER: Rainy		GROUND WATER (DEPTH/ELEV.): 5.7 ft. 1 116.54	
DRILLING METHOD: 6¼" HSA level C	DRILLING FLUID/SOURCE: DRY		TOP OF ROCK (DEPTH/ELEV.): 13.5 ft	

DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
		0'		grab		brown/gray vf SAND little SILT, trace clay			
		2'		grab		brown f. SAND and Clay little silt 5% gravel ¼-¾" d. dry loose			
5									
		4'		grab		brown f. SAND and Clay little Silt 10% ⅛-1" d. gravel			TILL
10		6'				brown f. SAND and CLAY some silt 10% ⅛-1" d. gravel			
		8'				brown Silty SAND and clay 80% gravel			
15							9.0		Weathered
	SS	10'-12		50/4"		fresh shale gray weathered			
20	SS	12-14		50/1"		SHALE			
							13.5		
	R	13.5 ↓			100%	Sandy Shale			SHALE
25		16.5							

Hnu=0

Hnu=0

Hnu=0

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

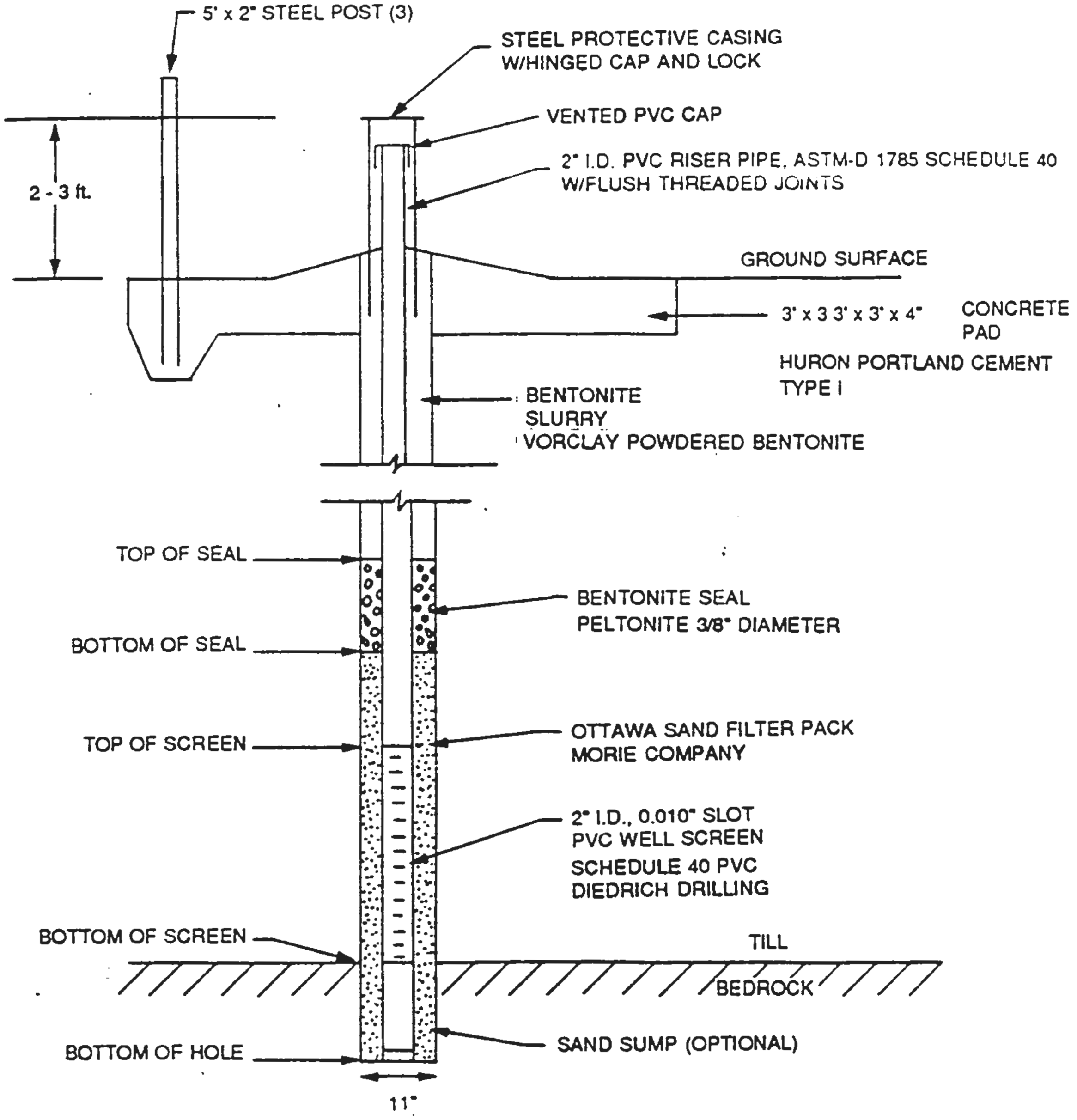
NOTES:

BORING NO.: MW10

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot	JOB NO. 0032883161	WELL NO. MW10
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 4347 E 8397		

BEGUN: 10-4-88 FINISHED: 10-4-88	SUPERVISOR: S. Giesler DRILLER: G. Lansing	WELL SITE: SW of pad G	WATER LEVEL 5.7'	DEPTH ELEV. 116.54

DEPTH IN.	ELEV. IN.
	122.24
0 ft	120.09
1.0 ft	119.09
2.5 ft	117.59
4.0 ft	116.09
9.0 ft	111.09
9.5 ft	110.59



TIME DEVELOPED: 7.5 hours

GALLONS EXTRACTED: 14.5 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

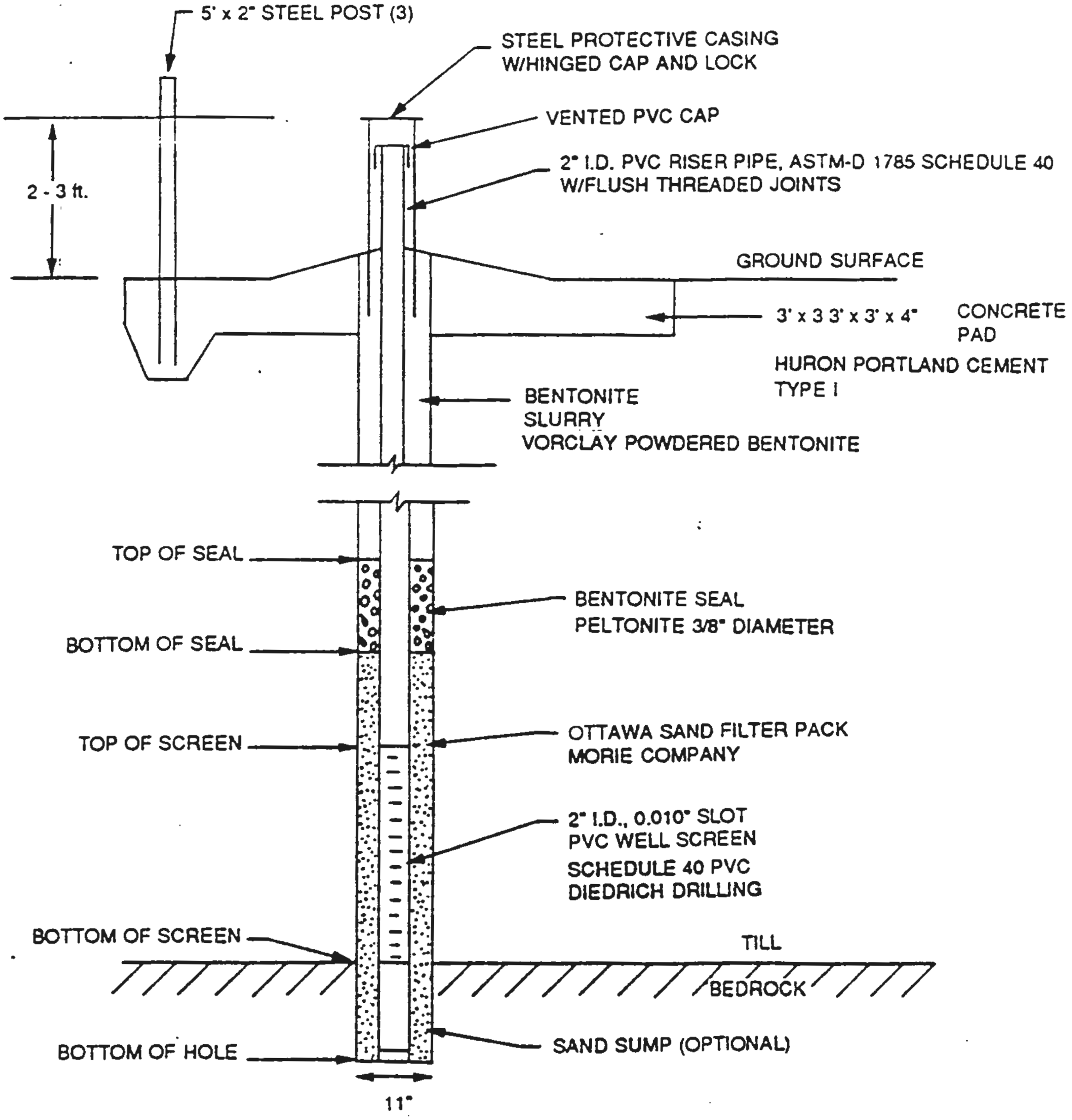
PROJECT : Seneca Army Depot COE		SHEET 1 OF 1	BORING NO. MW11
SITE LOCATION: Demo Grounds Romulus NY	JOB NO. 003288 3161		
	LOCATION: N. of burning pad G	GROUND ELEV. 111.46	TOTAL DEPTH 17.5'
DRILL CONTRACTOR: Parratt-Wolff	ENG/GEO: Sandra Giesler	BEGUN : 10-11-88	
DRILL RIG: 550 on track	DRILLER: Glen Lansing	FINISHED: 10-11-88	
HOLE SIZE: 10"	WEATHER: Cold 40° Windy Rainy Dark	GROUND WATER (DEPTH/ELEV.): approx 6.65 / 107.85	
DRILLING METHOD: 6" HSA Level C	DRILLING FLUID/SOURCE: DRY	TOP OF ROCK (DEPTH/ELEV.): weathered - 9' competent - 10'	

	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
			0'				brown v.f. SAND and SILT little clay - wet			Till
Hnu=0			2'				brown v.f. SAND and SILT little Clay 5% ½"d. gravel.			
			4				br. v.f. SAND and SILT some clay 2% ¼"-½"d. gravel			
			6'				br. v.f. SAND SILT and CLAY 5% ½"d. rounded gravel	6½'		▽
Hnu=0			8'				brown-gray v.f. SAND SILT and CLAY 15% angular gravel ½-1"d.		9	weathered bedrock (SHALE)
			10'	4"	50/4"		gray black fractured SHALE and CLAY rock thin laminar weathered pieces 1/10" thick			
			12.5'		5 min		2"-4" beds cleaving along bedding planes 5-10% off horizontal @ 3' some cleavage oriented 10°-20° off vertical after 3' beds 6" thick			SHALE
					4 min					
Core					4 min					
Hnu=0					5 min					
					6 min					
			17.5				17.5' EOB			

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.: MW11

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot JOB NO. 0032883161		WELL NO. MW11
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 4728 E 8864		
BEGUN: 10-11-88 FINISHED: 10-11-88	SUPERVISOR: S. Giesler DRILLER: G. Lansing	WELL SITE: NE of pad G	WATER LEVEL 6.1 ft DEPTH ELEV. 107.85

DEPTH IN.	ELEV. IN.
	113.95
0 ft	111.40
1.0 ft	110.40
2.5 ft	108.90
4 ft	107.40
9.0 ft	102.40
9.5 ft	101.90



TIME DEVELOPED: 4 hours

GALLONS EXTRACTED: 52 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

M&E

PROJECT : Seneca Army Depot COE		SHEET 1 OF 1	BORING NO. MW12
SITE LOCATION: Demo Grounds Romulus NY	JOB NO. 003288 3161		
	LOCATION: NE of Burning pad E	GROUND ELEV. 105.46	TOTAL DEPTH 15'
DRILL CONTRACTOR: Parrott Wolff	ENG/GEO: Sandra Giesler	BEGUN : 10-11-88	
DRILL RIG: 850 cme Track	DRILLER: Glen Lansing	FINISHED: 10-12-86	
HOLE SIZE: 6"	WEATHER: cold 35-40° rainy - windy	GROUND WATER (DEPTH/ELEV.): 4.5 ft / 103.24	
DRILLING METHOD: 4" HSA & core Level C	DRILLING FLUID/SOURCE: DRY	TOP OF ROCK (DEPTH/ELEV.): weathered 7' competent 9'	

DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
		0'				Brn v/f SAND ~~and~~ SILT trace Clay			TILL
		2'				Brn v/f SAND and SILT Some Clay 5% ¼"-½" gravel rounded			
		4'				brn v/f SAND and SILT Some Clay 10% angular gravel ½"-1"			
		6'				90% gravel ½"-1½" d. Little-trace clay + silt			
						7.5' drilling gets harder		7.5'	weathered SHALE
		9'				weathered bedrock drilling slow		9'	SHALE
		10	CORE			cleaved along bedding planes beds 1"-2"			
				5 min					
				4 min					
				5 min		@ 11' very fractured			
20				4 min		12' fractures @ 45°			
		15'		4 min		12.5' vertical fractures 13' beds thick ~1" 15' weathered silty ground up lense where water has run through. silt + clay			
25									

Hnu=0

|

HNU=0

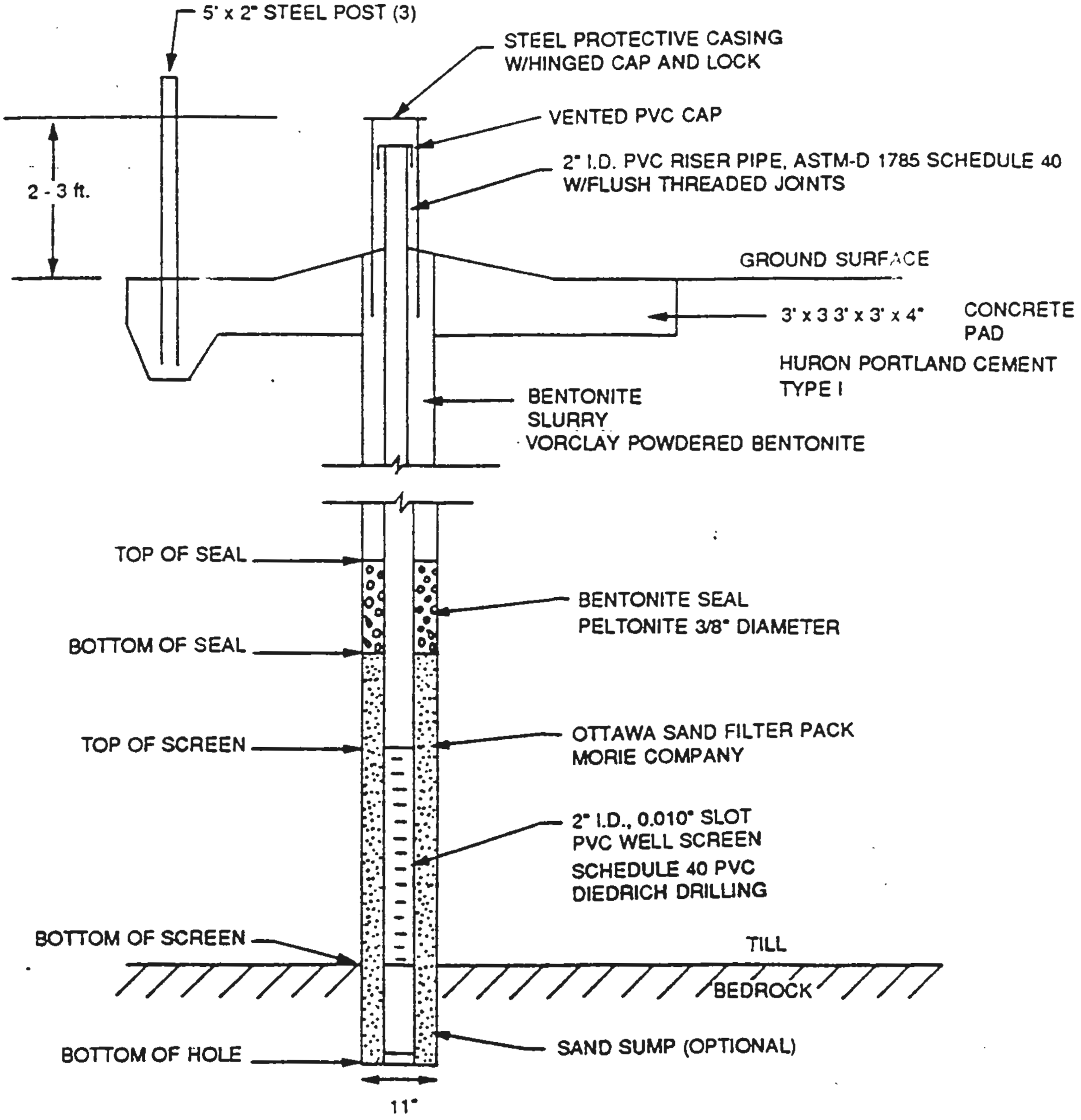
HNU=6

HNU=8

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.: MW12

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot JOB NO. 0032883161			WELL NO. MW12
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 4910 E 9322			
BEGUN: 10-11-88 FINISHED: 10-12-88	SUPERVISOR: S. Giesler DRILLER: G. Lansing	WELL SITE: NE of pad E	WATER LEVEL 4.5 ft	DEPTH ELEV. 103.24

DEPTH IN.	ELEV. IN.
	107.74
0 ft	105.57
1.0 ft	104.57
2.0 ft	103.57
3.0 ft	102.57
7.0 ft	98.57
7.5 ft	98.07



TIME DEVELOPED: 4.5 hrs

GALLONS EXTRACTED: 18 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

M&E

PROJECT: Seneca Army Depot COE		SHEET 1 OF	BORING NO. MW-13
SITE LOCATION: Demo Grounds	JOB NO.		
	LOCATION: W. of Burning Pad F,	GROUND ELEV. 111.57	TOTAL DEPTH 17'
DRILL CONTRACTOR: Parrott-Wolfe	ENG/GEO: Sandra Gresker	BEGUN: 10-7-88	
DRILL RIG: 850 CME track	DRILLER:	FINISHED: 10-8-88	
HOLE SIZE: ~~8"~~ 6"	WEATHER:	GROUND WATER (DEPTH/ELEV.): 5.1 ft / 108.9	
DRILLING METHOD: ~~10 1/4" HSA~~ 4" HSA + Corebarrel	DRILLING FLUID/SOURCE: Water	TOP OF ROCK (DEPTH/ELEV.): 8'	

	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
Hnu=0			0'				m. brown v.f. SAND and SILT trace clay 5% rounded 1/4-1/2" d gravel			
			2'				brown v.f. SAND and SILT some clay 5% rounded gravel 1/4-1/2" d			Till
	5									
Hnu=0			4'				brown v.f. SAND and SILT some clay 10% subangular 1/2"-1" d. gravel			
	10		6'				GRAVEL 1/4"-2" d. subangular 10% silt sand and clay		6.5'	▽ Till
Hnu=0			8'				Wet brown v.f. SAND silt and clay 40-50% gravel			Weathered Bedrock
	15									
Hnu=0		SS	10'	1"	50/1"		fractured shale			SHALE
	20		12'		6-6-5-5-6	minutes	Competent gray-black shale			
			17'							
	25									

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

NOTES:

BORING NO.: MW 13

GROUNDWATER INSTALLATION

PROJECT: Seneca Army Depot JOB NO. 0032883161

WELL NO. MW13

DRILLING CONTRACTOR: Parratt-Wolff

COORDINATES: N 5018 E 8913

BEGUN: 10-7-88

FINISHED: 10-7-88

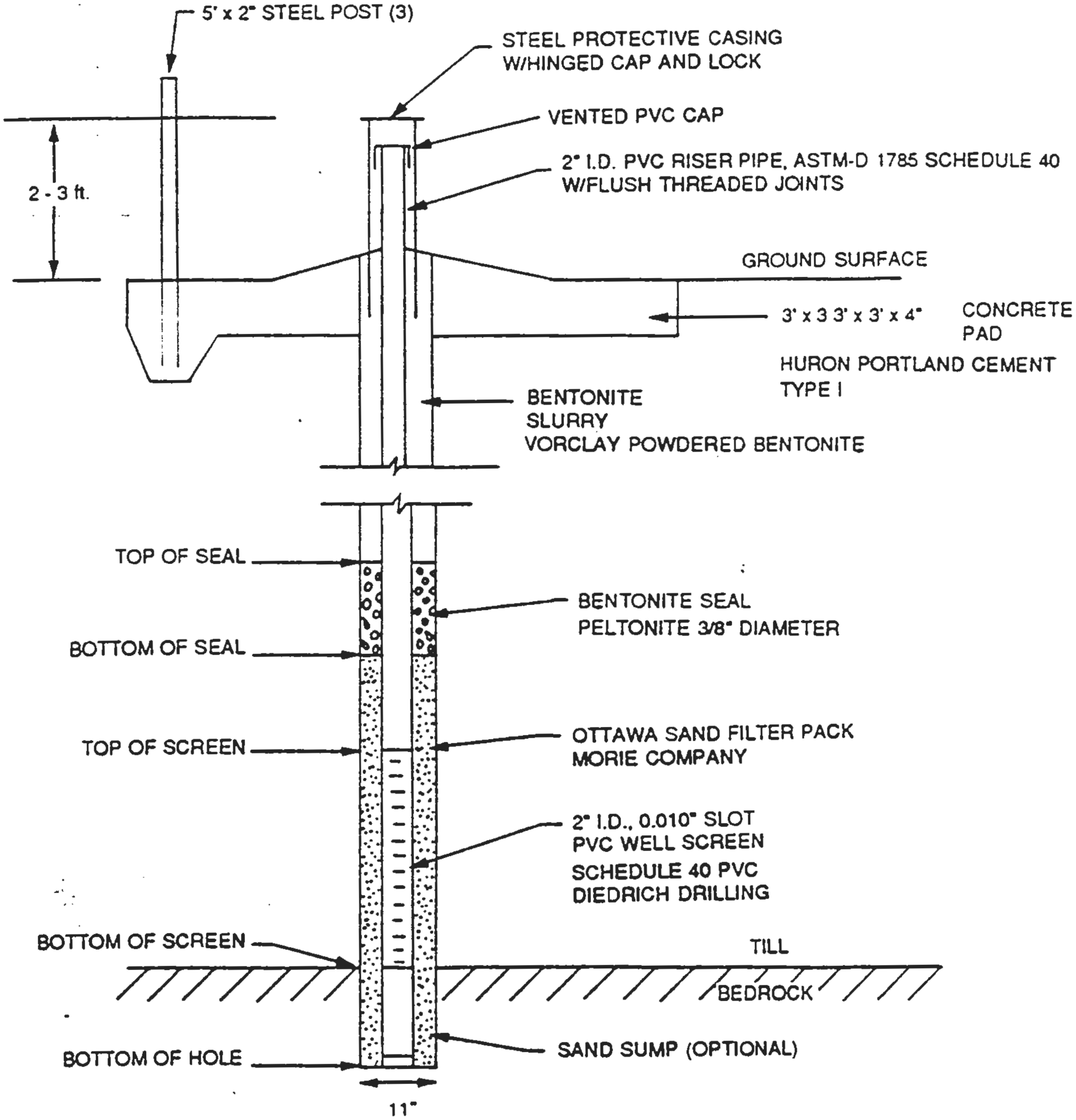
SUPERVISOR: S. Giesler

DRILLER: G. Lansing

WELL SITE: E. of pad F

WATER LEVEL	DEPTH ELEV.
5.1'	108.9

DEPTH IN.	ELEV. IN.
	114.0
0 ft	111.83
1 ft	110.83
2 ft	109.83
3 ft	108.83
8.0 ft	103.83
8.5 ft	103.33



TIME DEVELOPED: 4 hours

GALLONS EXTRACTED: 20 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT: Seneca Army Depot COE		SHEET 1 OF	BORING NO. MW14
SITE LOCATION: Demolition Grounds Romulus NY	JOB NO. 003288 32161		
	LOCATION: NE. of Burning pad #14	GROUND ELEV. 105.25	TOTAL DEPTH 16.5'
DRILL CONTRACTOR: Parrott-wolff	ENG/GEO: S. Gresler	BEGUN: 10-13-88	
DRILL RIG: 850cme	DRILLER: G. Lansing	FINISHED: 10-13-88	
HOLE SIZE: 7"	WEATHER: Cold - snowing 35°	GROUND WATER (DEPTH/ELEV.): 5.5ft / 101.93	
DRILLING METHOD: HSA Level C. Rock-CORE	DRILLING FLUID/SOURCE: Dry - Core Water	TOP OF ROCK (DEPTH/ELEV.): 9' weathered 11' competent	

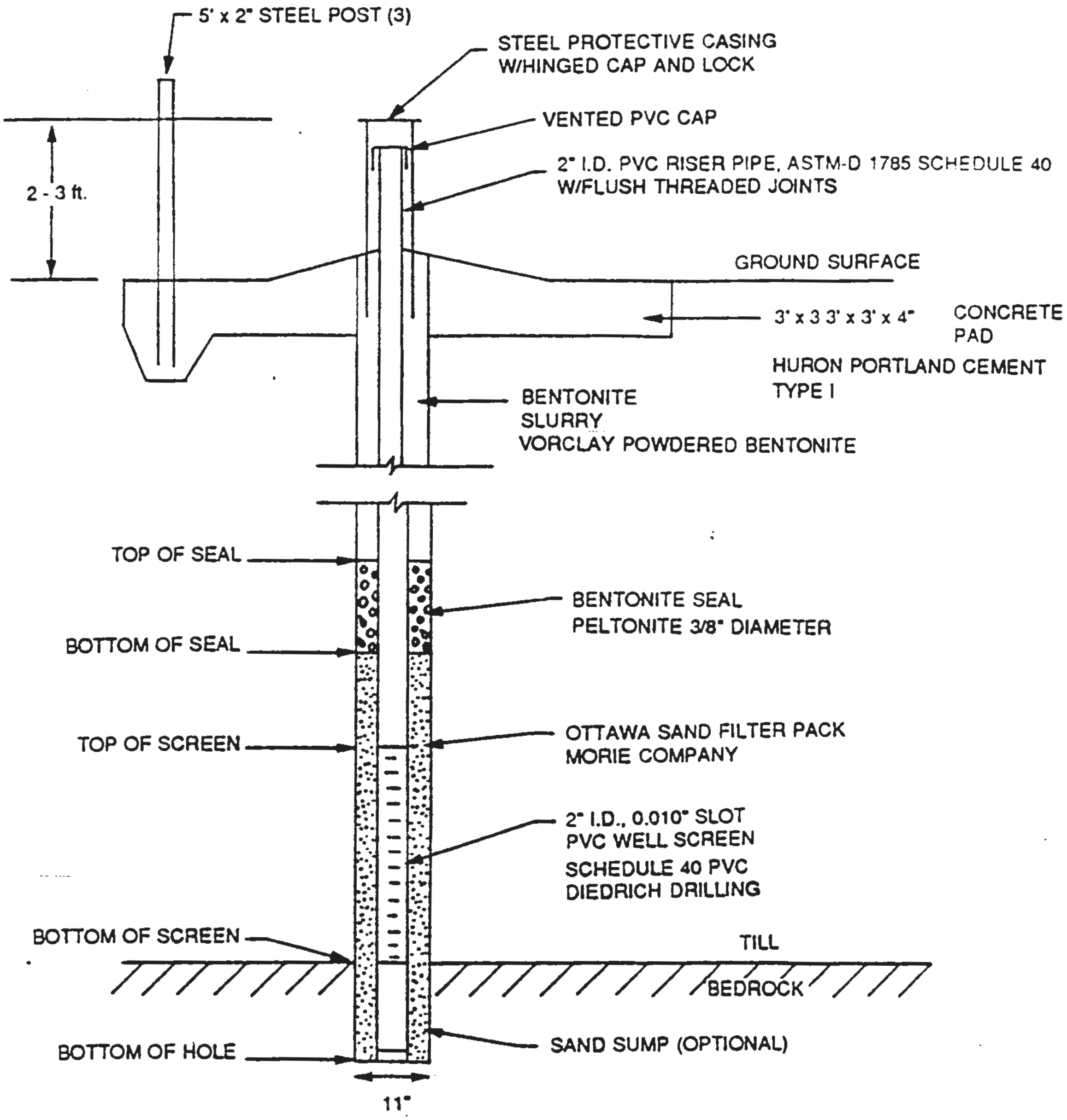
	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
			0		grab		brown v.f. SAND and SILT trace clay 2% 1" gravel			TILL
HNU=0			2'		"		brn. v.f SAND and SILT little clay 5-7% gravel ½"-1"d			
HNU=0			4'		"		brn. v.f SANDY SILT some clay 7% gravel ¼-½"d.			
HNU=0			6'				75% gravel ¼-1"d. angular to subang. Some Silty Clay			
HNU=0			8'				80% gravel ¼"-1"d angular some black silty clay			
							9' drilling harder weathered rock		9'	weathered SHALE
HNU=0		SS	10'		50 blows/2"		flat ⅛" thin ~~[illegible]~~ fractured SHALE some clay dust		11'	SHALE
		R	11.5	5'			gray-black SHALE first few inches fractured cleaved along bedding about 1-2" thick 2½' vertical fracture filled with silt layer 1mm. thick			
			↓	100%	4min					
					5min					
ANU=0					4min					
					4min					
			16.5		4 mm					

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.: MW14

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot JOB NO. 0032883161	WELL NO. MW14
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 5076 E 9212	

BEGUN: 10-13-88 FINISHED: 10-13-88	SUPERVISOR: S. Giesler DRILLER: G. Lansing	WELL SITE: NE of pad D	WATER LEVEL 5.5 ft	DEPTH ELEV. 101.93

DEPTH IN.	ELEV. IN.
	107.43
0 ft	105. 47
1 ft	105.47 01.47 104. 47
2.5 ft	[illegible] 102. 97
3.5 ft	[illegible] 101. 97
8.5 ft	[illegible] 96. 97
9.0 ft	[illegible] 96. 47



TIME DEVELOPED: 4 hrs

GALLONS EXTRACTED: 14 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT : Seneca Army Depot COE		SHEET 1 OF 1	BORING NO. MW15
SITE LOCATION: Demolition Grounds Romulus, NY	JOB NO. 003288 [illegible]		
	LOCATION: NE of Burning Pad B	GROUND ELEV. 99.67	TOTAL DEPTH 13.5'
DRILL CONTRACTOR: Parrott-wolff	ENG/GEO: S. Giesler	BEGUN : 10-14-88	
DRILL RIG: 850CME	DRILLER: G. Lansing	FINISHED: 10-14-88	
HOLE SIZE: 7"	WEATHER: Sunny 55° windy	GROUND WATER (DEPTH/ELEV.): 4 ft 1101.0	
DRILLING METHOD: HSA - core (water)	DRILLING FLUID/SOURCE: Dry	TOP OF ROCK (DEPTH/ELEV.): 6.5' weathered	

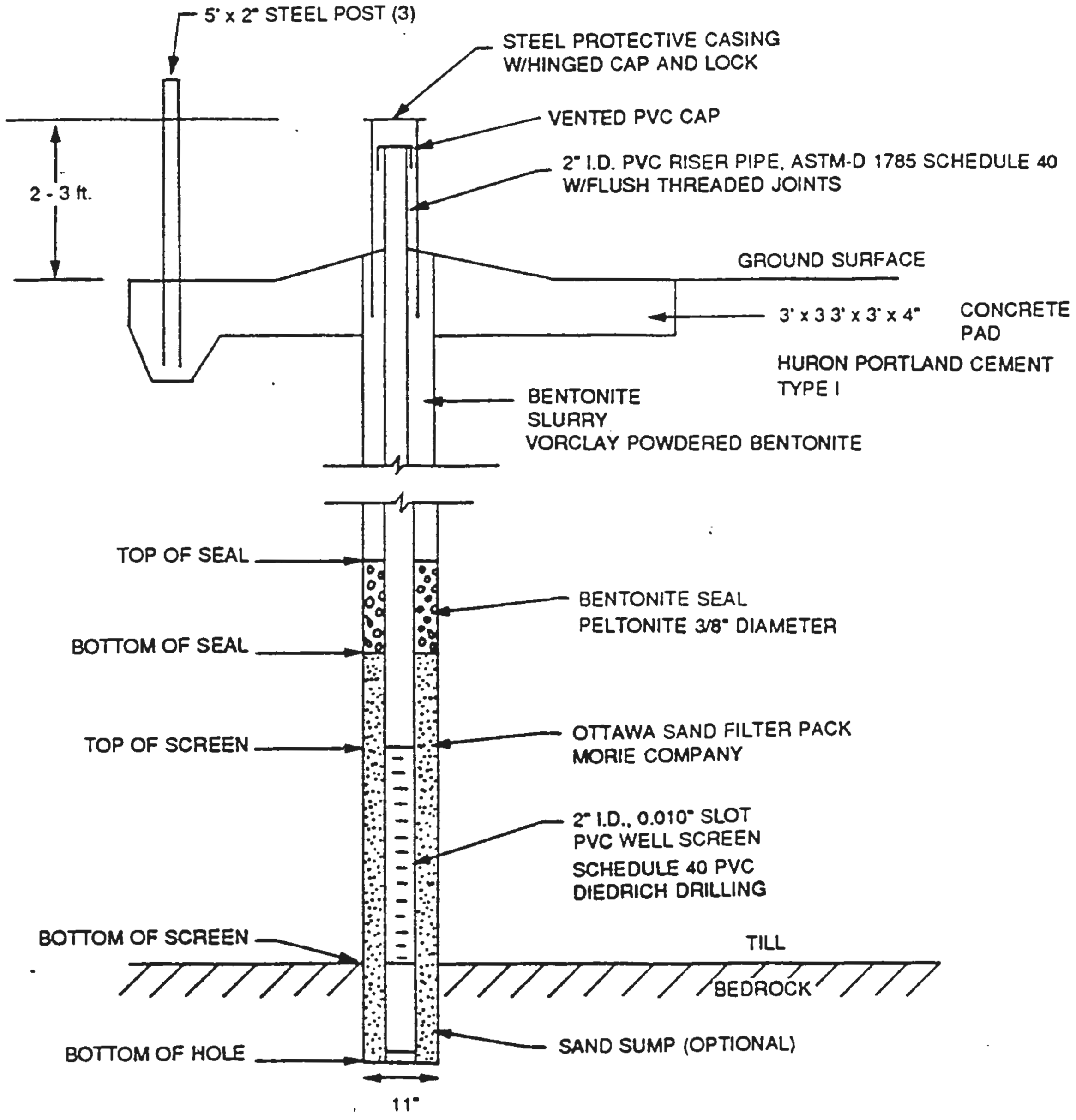
DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
		0'		grab		brown vf SAND and SILT trace ~~[illegible]~~" gravel			
		2'		grab		brown vf SAND and silty CLAY trace 2% 1/4"-1/2" gravel			
5		4'				90% 1/2-1 3/4" gravel 10% brown silty clay			TILL
		6'				98% 1/2"-3" gravel angular 2% SILTY CLAY			
10						6½' drilling harder weathered bedrock		6.5'	WEATHERED SHALE
	R	8.5				broken up gray-black SHALE - no orientation + of fractures in first		8.5'	SHALE
		9.5		5 min					
		10.5		4 min					
15		11.5		4 min		horizontal fractures begins @ 11.5' filled with silt layer			
		12.5		5 min					
		13.5		5 min					
20									
25									

HNU=0
HNU=0
HNU=0
HNU=0
HNU=0

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.: MW15

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot JOB NO. 0032883161			WELL NO. MW15
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 5073 E 9548			
BEGUN: 10-14-88 FINISHED: 10-14-88	SUPERVISOR: S. Giesler DRILLER: G. Lansing	WELL SITE: NE of pad B	WATER LEVEL 4 ft	DEPTH ELEV. 101.01

DEPTH IN.	ELEV. IN.
	105.01
0 ft	102.95
1.0 ft	101.95
2.0 ft	100.95
3.0 ft	99.95
6.5 ft	96.45
7.0 ft	95.95



TIME DEVELOPED: 6.5 hrs

GALLONS EXTRACTED: 9.6 gals

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

M&E

PROJECT : Seneca Army Depot COE	SHEET 1 OF	BORING NO. MW16
SITE LOCATION: Demo grounds Romulus NY	JOB NO. 0032883101	
LOCATION: NE of burning pad A	GROUND ELEV. 103.5	TOTAL DEPTH 13.5'
DRILL CONTRACTOR: Parratt-Wolff	ENG/GEO: S Giesler	BEGUN : 10-14-88
DRILL RIG: 850 CME	DRILLER: G. Lansing	FINISHED: 10-15-88
HOLE SIZE: 11"	WEATHER: Sunny 65-70°	GROUND WATER (DEPTH/ELEV.): 6.4 ft TOC 99.33 ft ~~TO~~
DRILLING METHOD: Level C HSA - core w/Water	DRILLING FLUID/SOURCE: Water	TOP OF ROCK (DEPTH/ELEV.): 6.5'

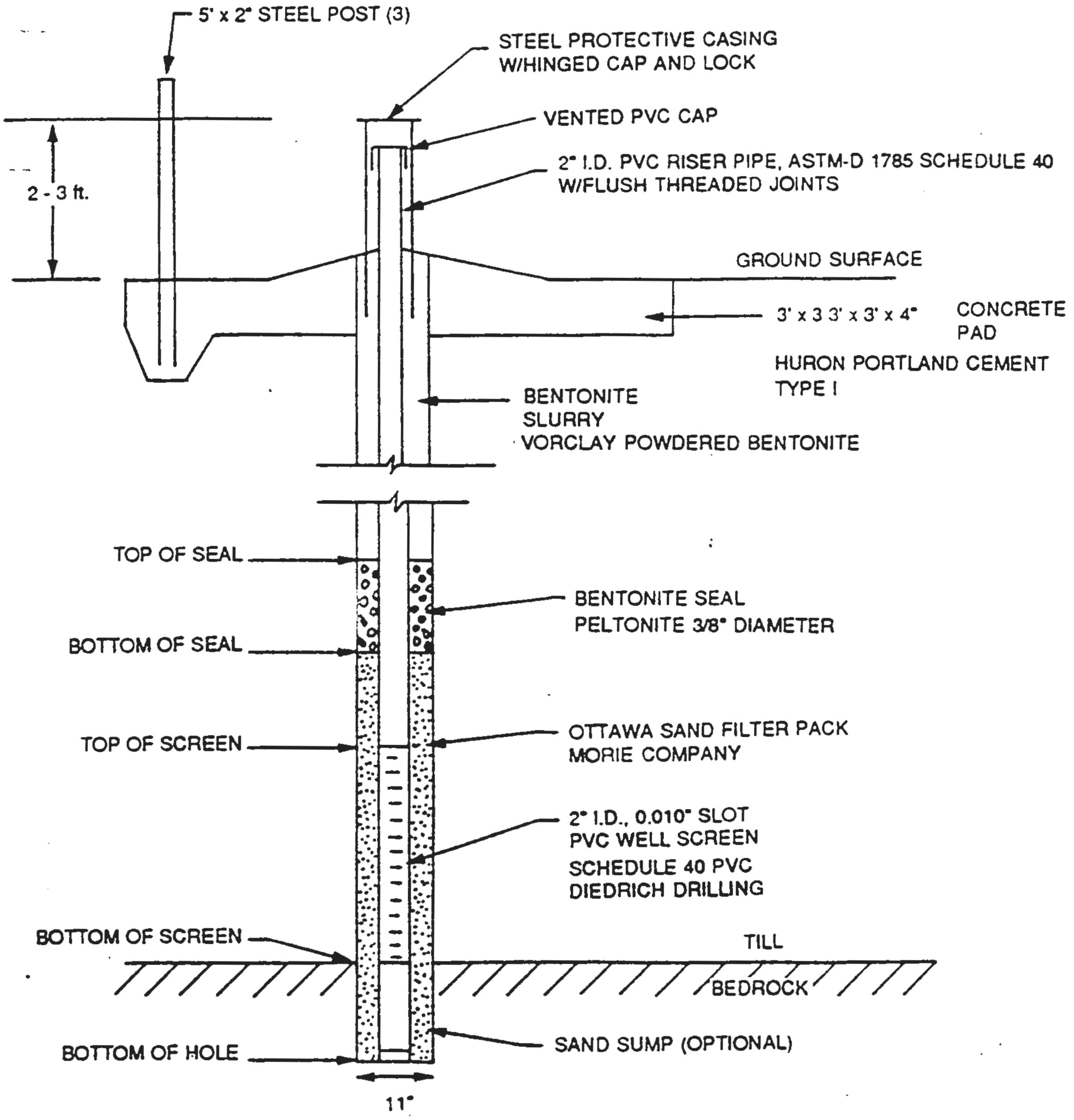
	DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
			0'		grab		brown v/f SAND and Silty CLAY			
HNU=0			2'		"		brown v/f SAND and Silty CLAY			
HNU=0	5		4		"		brown/gray v/f. SAND and SILTY CLAY 5% 1/4"-2" angular gravel			TILL
HNU=0			6'		"					
	10						graybrown - v/f SAND and SILTY CLAY 10% angular gravel <1" d			
HNU=0	15						6.5 drilling slows weathered bedrock		6.5	WEATHERED SHALE
			8.5		4min		SHALE-SANDY		8.5	SHALE
			↓		5min					
					5min					
	20		13.5		4min					
					6min					
	25									

SAMPLE TYPES SS=SPLIT SPOON, ST=SHELBY TUBE R=ROCK CORE, O=OTHER	NOTES:	BORING NO.:

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot	JOB NO. 0032883161	WELL NO. MW16
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 5036 E 9847		

BEGUN: 10-15-88	SUPERVISOR: S. Giesler	WELL SITE: NE. of pad A	WATER LEVEL 6.4 ft
FINISHED: 10-15-88	DRILLER: G. Lansing		DEPTH ELEV. 99.33

DEPTH IN.	ELEV. IN.
	105.73
0 ft	103.7
1.0 ft	102.7
2.0 ft	101.7
3.0 ft	100.7
6.5 ft	97.3
7.0 ft	96.8



TIME DEVELOPED: 4.5 hrs

GALLONS EXTRACTED: 0.1 gal

Metcalf & Eddy, Inc.
ENGINEERS

GEOLOGIC LOG

PROJECT : Seneca Army Depot CUE			SHEET 1 OF 1	BORING NO. MW-17
SITE LOCATION: Hemo Grounds Romulus, NY	JOB NO. 005288			
	LOCATION: SE of PAD C	GROUND ELEV. 105.52	TOTAL DEPTH 19'	
DRILL CONTRACTOR: Parrott-Wolff	ENG/GEO: S. Giesler	BEGUN : 10-12-88		
DRILL RIG: 850CME TRACK	DRILLER: G. Lansing	FINISHED: 10-12-88		
HOLE SIZE: 8"	WEATHER: COLD - SNOW - WINDY 35°	GROUND WATER (DEPTH/ELEV.): 4.55ft / 103.34		
DRILLING METHOD: HSA - NX CORE - LEVEL C	DRILLING FLUID/SOURCE: DRY - WATER	TOP OF ROCK (DEPTH/ELEV.): 8'		

Hnu=0

HNu=0

HNu=0

HNu=0

DEPTH	SAMPLE TYPE/NO.	SAMPLE DEPTH	SAMPLE RECOVERY	BLOW COUNT (per 6 inches) OR DRILLING TIME (min/ft)	% RECOVERY OR RQD	SAMPLE DESCRIPTION	ELEVATION	GRAPHIC LOG	STRATIGRAPHIC DESCRIPTION
		0'				✓ SAND and SILT little clay, 5% ½" angular gravel			
		2'				✓ SAND and SILT little clay 2% ½" angular gravel			
5		4'				✓ SAND and SILT some clay 5% ½-1" angular gravel			
		6'				✓ SAND and SILT and CLAY 20% gravel ½-¼" 40% gravel ½-1½"			
10									TILL
		8'				70% gravel ¼"-2"		8'	weathered shale
	SS	10		39-40-50/4"		weathered SHALE flat pieces -⅛·¼" thick with silt and clay		10	SHALE
15									
	R	14'		5min		Gray-black SHALE cleaved along bedding planes also cleaved often along one line perpendicular to bedding - Silty deposit inside held together along some sections to the end of core			
				6min					
				5min					
20				5min					
		19		6min					
25									

SAMPLE TYPES
SS=SPLIT SPOON, ST=SHELBY TUBE
R=ROCK CORE, O=OTHER

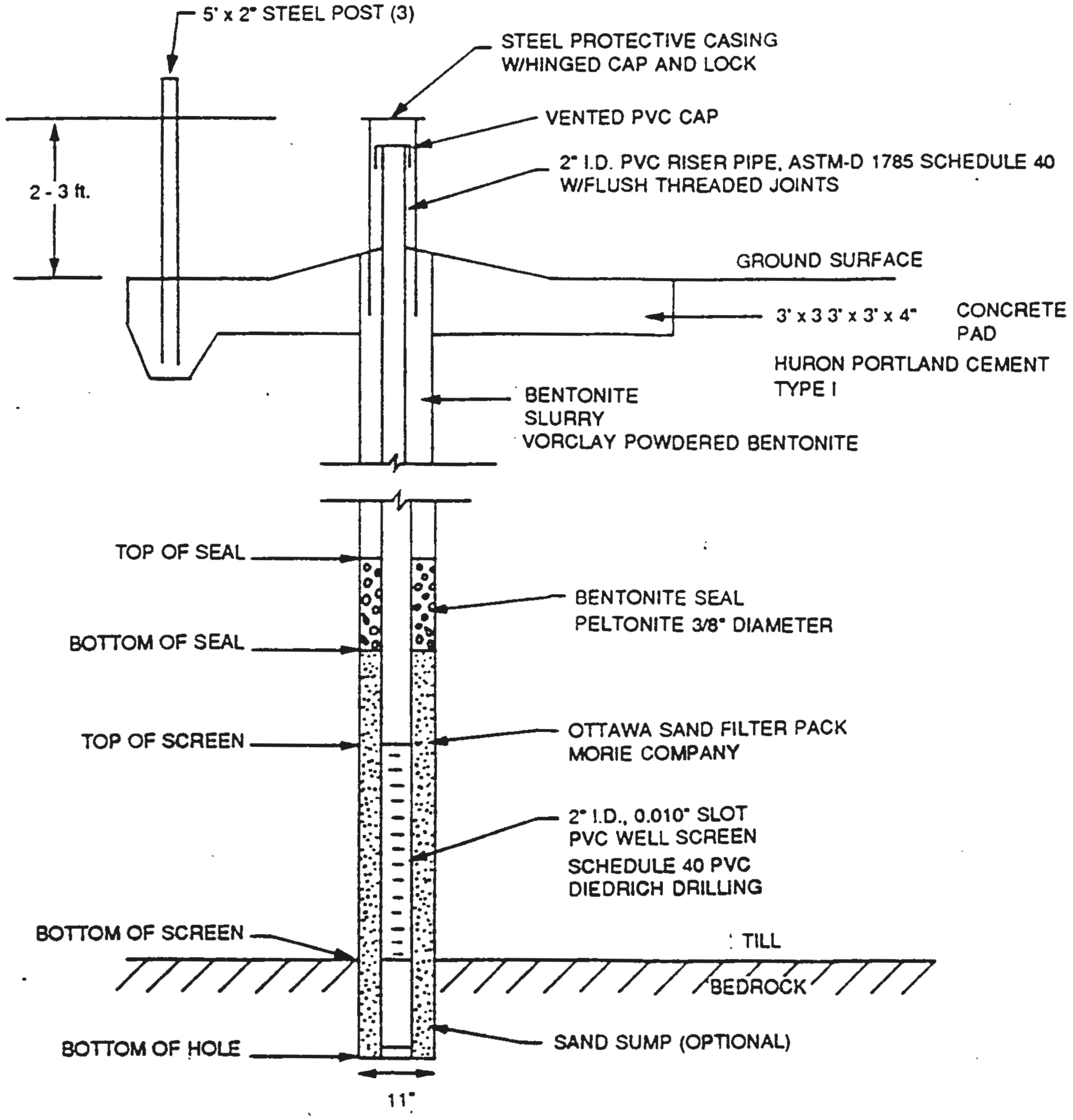
NOTES:

BORING NO.: MW17

GROUNDWATER INSTALLATION	PROJECT: Seneca Army Depot	JOB NO. 0032883161	WELL NO. MW17
DRILLING CONTRACTOR: Parratt-Wolff	COORDINATES: N 4707 E 9472		

BEGUN: 10-12-88	SUPERVISOR: S. Giesler	WELL SITE:	WATER LEVEL	DEPTH ELEV.
FINISHED: 10-12-88	DRILLER: G. Lansing	SE of pad C	4.55 ft	103.34

DEPTH IN.	ELEV. IN.
	107.89
0 ft	105.81
1.5 ft	104.31
3.0 ft	102.81
4.5 ft	101.31
9.5 ft	96.31
10.0 ft	95.81



TIME DEVELOPED: 2 hrs

GALLONS EXTRACTED: 35 gals

APPENDIX 5B

INTERIM STATUS GROUNDWATER MONITORING AND STATISTICAL ANALYSIS DATA

GROUNDWATER MONITORING DATA

STATISTICAL ANALYSIS DATA

GROUNDWATER MONITORING DATA

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS						
				B W5	W4	W6	W1	W3	W2	W7
WATER										
LEVELS (A)	04 JAN 82		FT	118.5	109.7	110.8	111.3	105.3	95.4	98.4
LEVELS (A)	13 APR 82		FT	118.2	109.4	110.9	111.6	105.4	94.7	103.3
LEVELS (A)	28 JUN 82		FT	116.3	108.2	108.7	108.2	102.6	93.4	99.9
LEVELS (A)	27 SEP 82		FT	112.9	107.2	105.2	108.6	99.7	92.6	
LEVELS (A)	07 FEB 83		FT	118.2	109.8	110.5	110.9	105.2	94.6	103.0
LEVELS (A)	08 AUG 83		FT	112.9	106.1	105.0		99.9	92.3	
LEVELS (A)	14 FEB 84		FT	118.3	108.9	109.7	109.3	105.5	94.9	103.1
LEVELS (A)	26 JUN 84		FT	109.4		109.6	109.3	104.6	94.8	99.3
LEVELS (A)	27 JUN 84		FT		109.0					
LEVELS (A)	17 SEP 84		FT	115.8	107.9	108.6	109.3	103.6	93.7	100.7
LEVELS (A)	19 MAR 85		FT	D	110.2	110.3	110.5	105.3	93.7	103.6
LEVELS (A)	12 SEP 85		FT	113.1		104.3	106.3	99.4	92.3	
LEVELS (A)	17 MAR 86		FT	118.5	110.8	110.0	112.9	105.5	95.7	104.0
LEVELS (A)	16 SEP 86		FT	115.7	108.3	107.7	107.5	102.5	93.1	99.8
LEVELS (A)	16 MAR 87		FT	118.5	109.8	111.0	110.5	104.9	94.1	102.8

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
ARSENIC	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
BARIUM	05 JAN 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	13 APR 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	29 JUN 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	28 SEP 82	.10	MGL	ND		ND	ND	ND	ND	
CADMIUM	05 JAN 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	13 APR 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	29 JUN 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	28 SEP 82	5.000	UGL	ND		ND	ND	ND	ND	
CHROMIUM	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
FLUORIDE	05 JAN 82	.1	MGL	.3	2	.3	.1	.2	.1	.3
FLUORIDE	13 APR 82	.1	MGL	.3	.2	.2	.2	.2	.1	.2
FLUORIDE	29 JUN 82	.1	MGL	.4	.2	.2	.2	.2	.2	.3
FLUORIDE	28 SEP 82	.1	MGL	.3	.2	.2	.2	.2	.2	
LEAD	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
MERCURY	05 JAN 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	13 APR 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	29 JUN 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	28 SEP 82	.2	UGL	ND	ND	ND	ND	ND	ND	
NO2+NO3 AS N	05 JAN 82	.05	MGL	6.70	.71	1.20	1.60	.08	ND	.22
NO2+NO3 AS N	13 APR 82	.05	MGL	5.00	.49	1.00	1.00	.13	ND	.38
NO2+NO3 AS N	29 JUN 82	.05	MGL	6.00	.52	2.00	2.00	.06	ND	.30
NO2+NO3 AS N	28 SEP 82	.05	MGL	10.00	.12	3.00	2.00	.08	ND	
SELENIUM	05 JAN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	13 APR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	29 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	28 SEP 82	.005	MGL	ND		ND	ND	ND	ND	
SILVER	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
ENDRIN	05 JAN 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
ARSENIC	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
ARSENIC	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
BARIUM	05 JAN 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	13 APR 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	29 JUN 82	.10	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	28 SEP 82	.10	MGL	ND		ND	ND	ND	ND	
CADMIUM	05 JAN 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	13 APR 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	29 JUN 82	5.000	UGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	28 SEP 82	5.000	UGL	ND		ND	ND	ND	ND	
CHROMIUM	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
FLUORIDE	05 JAN 82	.1	MGL	.3	.2	.3	.1	.2	.1	.3
FLUORIDE	13 APR 82	.1	MGL	.3	.2	.2	.2	.2	.1	.2
FLUORIDE	29 JUN 82	.1	MGL	.4	.2	.2	.2	.2	.2	.3
FLUORIDE	28 SEP 82	.1	MGL	.3	.2	.2	.2	.2	.2	
LEAD	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
LEAD	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
MERCURY	05 JAN 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	13 APR 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	29 JUN 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	28 SEP 82	.2	UGL	ND	ND	ND	ND	ND	ND	
NO2+NO3 AS N	05 JAN 82	.05	MGL	6.70	.71	1.20	1.60	.08	ND	.22
NO2+NO3 AS N	13 APR 82	.05	MGL	5.00	.49	1.00	1.00	.13	ND	.38
NO2+NO3 AS N	29 JUN 82	.05	MGL	6.00	.52	2.00	2.00	.06	ND	.30
NO2+NO3 AS N	28 SEP 82	.05	MGL	10.00	.12	3.00	2.00	.08	ND	
SELENIUM	05 JAN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	13 APR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	29 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SELENIUM	28 SEP 82	.005	MGL	ND		ND	ND	ND	ND	
SILVER	05 JAN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	29 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	28 SEP 82	.010	MGL	ND		ND	ND	ND	ND	
ENDRIN	05 JAN 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
ENDRIN	13 APR 82	40.00	UGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	29 JUN 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	28 SEP 82	.04	UGL	ND		ND	ND	ND	ND	
LINDANE	05 JAN 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	13 APR 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	29 JUN 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	28 SEP 82	.08	UGL	ND		ND	ND	ND	ND	
TOXAPHENE	05 JAN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	13 APR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	29 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	28 SEP 82	1.6	UGL	ND		ND	ND	ND	ND	
METHOXYCHLOR	05 JAN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	13 APR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	29 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	28 SEP 82	1.6	UGL	ND		ND	ND	ND	ND	
2,4-D	05 JAN 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	13 APR 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	29 JUN 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	28 SEP 82	3.8	UGL	ND		ND	ND	ND	ND	
SILVEX	05 JAN 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	13 APR 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	29 JUN 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	28 SEP 82	.5	UGL	ND		ND	ND	ND	ND	
GROSS ALPHA	05 JAN 82	4.61	PCL	ND	ND	ND	ND	ND	4.14	ND
GROSS ALPHA	13 APR 82	3.37	PCL	3.33	ND	2.63	2.30	3.64	3.39	ND
GROSS ALPHA	29 JUN 82	6.49	PCL	4.81	4.26	5.99	ND	12.60	9.04	3.87
GROSS ALPHA	28 SEP 82	5.20	PCL	ND		ND	ND	ND		
RADIUM-226	28 JUN 82	.24	PCL			ND	.27	ND	ND	
RADIUM-226	28 SEP 82	.18	PCL	ND						
GROSS BETA	05 JAN 82	1.52	PCL	2.02	3.01	2.06	2.31	2.91	2.12	ND
GROSS BETA	13 APR 82	1.64	PCL	ND	1.60	ND	2.05	2.08	ND	ND
GROSS BETA	29 JUN 82	1.86	PCL	1.59	3.34	ND	1.62	1.96	1.99	ND
GROSS BETA	28 SEP 82	1.76	PCL	ND		1.22	1.85	3.14		
CHLORIDE	05 JAN 82	1.0	MGL	4.6	10.0	17.6	7.9	28.5	5.8	3.5
CHLORIDE	13 APR 82	1.0	MGL	4.0	9.0	3.0	7.0	46.0	4.9	2.0
CHLORIDE	29 JUN 82	1.0	MGL	9.0	9.0	11.0	12.0	51.0	10.0	7.0
CHLORIDE	28 SEP 82	1.0	MGL	1.0	ND	ND	3.0	11.2	6.0	
CHLORIDE	08 FEB 83	1.0	MGL	2.0	6.0	7.0	6.0	9.0	3.0	2.0
CHLORIDE	09 AUG 83	1.0	MGL	3.0	5.0	3.0		15.0	4.0	
CHLORIDE	14 FEB 84	2.0	MGL	ND	8.7	20.0	2.3	4.0	ND	ND
CHLORIDE	20 MAR 85	1.0	MGL		6.0	12.0	7.0	15.0	4.0	3.0

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RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
CHLORIDE	18 MAR 86	1.0	MGL	3.0	5.0	4.0	5.0	6.0	3.0	2.0
CHLORIDE	17 MAR 87	1.0	MGL	2.0	4.0	4.0	6.0	5.0	3.0	1.0
IRON	05 JAN 82	.02	MGL	.13	.15	.27	.15	.19	.10	.14
IRON	13 APR 82	.03	MGL	ND	.08	.09	.10	.10	.02	.10
IRON	29 JUN 82	.03	MGL	ND	.24	.26	.44#	.06	.09	.70#
IRON	28 SEP 82	.02	MGL	.12		.24	.19	.23	.09	
IRON	08 FEB 83	.02	MGL	.13	.10	.15	.09	.07	.06	.08
IRON	09 AUG 83	.02	MGL	.09	.16	.25		.07	.12	
IRON	14 FEB 84	.10	MGL	.15	.11	ND	ND	ND	ND	1.02#
IRON	20 MAR 85	.10	MGL		ND	ND	ND	ND	ND	ND
IRON	18 MAR 86	.03	MGL	ND	ND	.03	ND	ND	ND	ND
IRON	17 MAR 87	.10	MGL	ND	ND	ND	ND	ND	ND	ND
MANGANESE	05 JAN 82	.010	MGL	.270#	.040	.300#	ND	ND	.070#	.090#
MANGANESE	13 APR 82	.010	MGL	.100#	.060#	.040	.020	ND	.050	.030
MANGANESE	29 JUN 82	.001	MGL	.210#	.050	.020	.020	.030	.130#	.010
MANGANESE	28 SEP 82	.010	MGL	ND		ND	ND	.040	.160#	
MANGANESE	08 FEB 83	.010	MGL	.020	.120#	.020	ND	ND	.010	.010
MANGANESE	09 AUG 83	.001	MGL	.120#	.320#	.010		.020	.210#	
MANGANESE	14 FEB 84	.030	MGL	ND	ND	.035	ND	ND	ND	ND
MANGANESE	20 MAR 85	.030	MGL		.085#	.045	ND	ND	.038	ND
MANGANESE	18 MAR 86	.010	MGL	ND	.120#	ND	ND	ND	ND	ND
MANGANESE	17 MAR 87	.030	MGL	.078#	.275#	ND	ND	ND	ND	ND
PHENOL	05 JAN 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
PHENOL	13 APR 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
PHENOL	29 JUN 82	.01	MGL	ND	ND	ND	.01&	ND	ND	ND
PHENOL	28 SEP 82	.01	MGL	.01&	.01&	ND	.02&	ND	ND	ND
PHENOL	08 FEB 83	.01	MGL	ND	ND	ND	ND	ND	.01&	
PHENOL	09 AUG 83	.01	MGL	ND	ND	ND		ND	ND	ND
PHENOL	14 FEB 84	.01	MGL	ND	ND	ND	ND	ND	ND	
PHENOL	20 MAR 85	.01	MGL		ND	ND	ND	ND	ND	ND
PHENOL	18 MAR 86	.01	MGL	ND	ND	ND	ND	ND	ND	ND
PHENOL	17 MAR 87	.01	MGL	ND	ND	ND	ND	ND	ND	ND
SODIUM	05 JAN 82	1.	MGL	15.	28.	20.	15.	14.	22.	12.
SODIUM	13 APR 82	1.	MGL	10.	37.	8.	11.	15.	21.	10.
SODIUM	29 JUN 82	1.	MGL	12.	11.	9.	15.	20.	24.	8.
SODIUM	28 SEP 82	1.	MGL	12.		9.	8.	10.	16.	
SODIUM	08 FEB 83	1.	MGL	21.	37.	11.	12.	8.	15.	7.
SODIUM	09 AUG 83	1.	MGL	16.	36.	11.		9.	15.	
SODIUM	14 FEB 84	1.	MGL	7.	7.	16.	5.	4.	14.	3.
SODIUM	20 MAR 85	1.	MGL		23.	24.	9.	7.	9.	2.
SODIUM	18 MAR 86	1.	MGL	8.	20.	30.	7.	5.	6.	4.

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
SODIUM	17 MAR 87	1.	MGL	8.	30.	14.	11.	6.	9.	4.
SULFATE	05 JAN 82	2.0	MGL	57.5	327.0&	38.8	233.0	147.0	225.0	77.0
SULFATE	13 APR 82	2.0	MGL	110.0	330.0&	100.0	220.0	210.0	263.0&	84.0
SULFATE	29 JUN 82	2.0	MGL	110.0	150.0	100.0	260.0&	220.0	293.0&	70.0
SULFATE	28 SEP 82	2.0	MGL	130.0	81.0	88.0	180.0	194.0	280.0&	
SULFATE	08 FEB 83	2.0	MGL	93.0	600.0&	110.0	210.0	180.0	200.0	74.0
SULFATE	09 AUG 83	2.0	MGL	129.0	333.0&	106.0		215.0	203.0	
SULFATE	14 FEB 84	2.0	MGL	51.0	117.0	130.0	119.0	148.0	108.0	7.3
SULFATE	20 MAR 85	2.0	MGL		306.0&	231.0	231.0	194.0	180.0	47.0
SULFATE	18 MAR 86	2.0	MGL	77.0	283.0&	63.0	248.0	148.0	117.0	57.0
SULFATE	17 MAR 87	2.0	MGL	24.0	255.0&	67.0	160.0	56.0	6.0	27.0
COND(FIELD)	20 MAR 85	1.	UMC		680.	440.	540.	550.	490.	270.
COND(FIELD)	18 MAR 86	1.	UMC	415.	650.	315.	460.	440.	340.	240.
COND(FIELD)	18 MAR 86	1.	UMC	415.	645.	320.	460.	440.	335.	240.
COND(FIELD)	18 MAR 86	1.	UMC	415.	650.	315.	460.	450.	335.	240.
COND(FIELD)	18 MAR 86	1.	UMC	415.	645.	310.	460.	445.	335.	235.
COND(FIELD)	17 MAR 87	1.	UMC	380.	700.	400.	500.	445.	450.	310.
COND(FIELD)	17 MAR 87	1.	UMC	375.	705.	400.	495.	440.	445.	315.
COND(FIELD)	17 MAR 87	1.	UMC	370.	700.	405.	500.	445.	450.	315.
COND(FIELD)	17 MAR 87	1.	UMC	375.	695.	405.	500.	440.	440.	315.
PH(FIELD)	05 JAN 82		PH	7.3	7.2	7.5	7.2	7.4	7.3	7.1
PH(FIELD)	05 JAN 82		PH	7.3	7.2	7.5	7.2	7.4	7.3	7.1
PH(FIELD)	05 JAN 82		PH	7.3	7.2	7.5	7.2	7.4	7.3	7.1
PH(FIELD)	05 JAN 82		PH	7.3	7.2	7.5	7.2	7.4	7.3	7.1
PH(FIELD)	13 APR 82		PH	7.6	7.2	7.6	7.6	7.4	7.4	7.4
PH(FIELD)	13 APR 82		PH	7.6	7.2	7.6	7.6	7.4	7.4	7.4
PH(FIELD)	13 APR 82		PH	7.6	7.2	7.6	7.6	7.4	7.4	7.4
PH(FIELD)	13 APR 82		PH	7.6	7.2	7.6	7.6	7.4	7.4	7.4
PH(FIELD)	29 JUN 82		PH	7.8	7.8	7.8	8.1	7.7	7.8	7.8
PH(FIELD)	29 JUN 82		PH	7.8	7.8	7.8	8.1	7.7	7.8	7.8
PH(FIELD)	29 JUN 82		PH	7.8	7.8	7.8	8.1	7.7	7.8	7.8
PH(FIELD)	29 JUN 82		PH	7.8	7.8	7.8	8.1	7.7	7.8	7.8
PH(FIELD)	27 SEP 82		PH	7.6	7.9	7.7	7.5	7.5	7.6	
PH(FIELD)	27 SEP 82		PH	7.6	7.9	7.7	7.5	7.5	7.6	
PH(FIELD)	27 SEP 82		PH	7.6	7.9	7.7	7.5	7.5	7.6	
PH(FIELD)	27 SEP 82		PH	7.6	7.9	7.7	7.5	7.5	7.6	
PH(FIELD)	08 FEB 83		PH	7.8	7.3	7.8	7.5	7.5	7.7	7.6
PH(FIELD)	08 FEB 83		PH	7.8	7.3	7.8	7.5	7.5	7.7	7.6
PH(FIELD)	08 FEB 83		PH	7.8	7.3	7.8	7.5	7.5	7.7	7.6
PH(FIELD)	08 FEB 83		PH	7.8	7.3	7.8	7.5	7.5	7.7	7.6
PH(FIELD)	09 AUG 83		PH	7.1	6.9	6.9		7.0	7.1	

SAMPLING SITES RESULTS

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B						
				W5	W4	W6	W1	W3	W2	W7
PH(FIELD)	09 AUG 83		PH	7.1	6.9	6.9		7.0	7.1	
PH(FIELD)	09 AUG 83		PH	7.1	6.9	6.9		7.0	7.1	
PH(FIELD)	09 AUG 83		PH	7.1	6.9	6.9		7.0	7.1	
PH(FIELD)	14 FEB 84		PH	7.3	6.8	7.2	7.3	7.4	7.4	7.5
PH(FIELD)	14 FEB 84		PH	7.3	6.9	7.2	7.3	7.4	7.5	7.5
PH(FIELD)	14 FEB 84		PH	7.4	6.8	7.3	7.3	7.4	7.4	7.6
PH(FIELD)	14 FEB 84		PH	7.3	6.9	7.3	7.3	7.5	7.4	7.6
PH(FIELD)	27 JUN 84		PH	7.0	6.8	7.1	7.1	7.0	7.1	7.1
PH(FIELD)	18 SEP 84		PH	8.4	7.5	7.6	7.6	7.5	7.1	7.6
PH(FIELD)	18 SEP 84		PH	8.3	7.6	7.5	7.7	7.4	7.1	7.5
PH(FIELD)	18 SEP 84		PH	8.4	7.6	7.5	7.7	7.4	7.1	7.5
PH(FIELD)	18 SEP 84		PH	8.3	7.5	7.6	7.6	7.4	7.2	7.5
PH(FIELD)	20 MAR 85		PH		6.8	6.9	6.7	6.8	7.0	7.0
PH(FIELD)	13 SEP 85		PH	7.1		7.1	7.1	7.1	7.0	
PH(FIELD)	18 MAR 86		PH	7.1	6.8	7.4	7.2	7.0	7.2	7.3
PH(FIELD)	18 MAR 86		PH	7.1	6.9	7.4	7.3	7.1	7.3	7.3
PH(FIELD)	18 MAR 86		PH	7.1	6.8	7.4	7.2	7.0	7.3	7.3
PH(FIELD)	18 MAR 86		PH	7.1	6.8	7.4	7.1	7.0	7.2	7.3
PH(FIELD)	16 SEP 86		PH	7.1	7.0	7.4	6.9	7.0	7.0	7.2
PH(FIELD)	17 MAR 87		PH	6.9	7.3	7.4	6.9	7.2	7.1	6.9
PH(FIELD)	17 MAR 87		PH	7.0	7.2	7.4	6.8	7.1	7.0	7.0
PH(FIELD)	17 MAR 87		PH	6.8	7.1	7.5	6.9	7.1	6.9	6.8
PH(FIELD)	17 MAR 87		PH	6.9	7.2	7.4	6.9	7.1	6.9	6.9
PH(LAB)	14 FEB 84		PH	7.9	7.7	7.8	7.7	7.8	7.9	7.5
SPEC COND	05 JAN 82	1.	UMC	730.	1130.	720.	850.	860.	930.	640.
SPEC COND	05 JAN 82	1.	UMC	730.	1120.	722.	850.	860.	930.	640.
SPEC COND	05 JAN 82	1.	UMC	730.	1130.	720.	850.	850.	930.	640.
SPEC COND	05 JAN 82	1.	UMC	730.	1130.	720.	850.	850.	920.	640.
SPEC COND	13 APR 82	1.	UMC	719.	1300.	699.	810.	1000.	975.	639.
SPEC COND	13 APR 82	1.	UMC	718.	1302.	699.	810.	1000.	972.	639.
SPEC COND	13 APR 82	1.	UMC	719.	1301.	699.	810.	1000.	974.	640.
SPEC COND	13 APR 82	1.	UMC	720.	1300.	699.	810.	1000.	973.	638.
SPEC COND	29 JUN 82	1.	UMC	620.	590.	580.	750.	1040.	890.	490.
SPEC COND	29 JUN 82	1.	UMC	620.	590.	580.	760.	1030.	890.	490.
SPEC COND	29 JUN 82	1.	UMC	620.	600.	585.	760.	1030.	890.	490.
SPEC COND	29 JUN 82	1.	UMC	620.	600.	580.	750.	1030.	890.	490.
SPEC COND	28 SEP 82	1.	UMC	795.		665.	700.	925.	980.	
SPEC COND	28 SEP 82	1.	UMC	790.		665.	700.	920.	980.	
SPEC COND	28 SEP 82	1.	UMC	795.		665.	700.	920.	980.	
SPEC COND	28 SEP 82	1.	UMC	795.		665.	700.	920.	980.	
SPEC COND	08 FEB 83	1.	UMC	580.	1160.	685.	760.	680.	755.	605.

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B						
				W5	W4	W6	W1	W3	W2	W7
SPEC COND	08 FEB 83	1.	UMC	580.	1160.	690.	755.	680.	755.	605.
SPEC COND	08 FEB 83	1.	UMC	585.	1160.	680.	755.	680.	760.	600.
SPEC COND	08 FEB 83	1.	UMC	580.	1160.	685.	760.	685.	760.	600.
SPEC COND	09 AUG 83	1.	UMC	900.	1190.	1020.		1050.	930.	
SPEC COND	09 AUG 83	1.	UMC	890.	1200.	1020.		1050.	940.	
SPEC COND	09 AUG 83	1.	UMC	890.	1190.	1020.		1040.	940.	
SPEC COND	09 AUG 83	1.	UMC	900.	1200.	1020.		1040.	940.	
SPEC COND	14 FEB 84	1.	UMC	360.	430.	620.	400.	500.	570.	88.
SPEC COND	14 FEB 84	1.	UMC	360.	420.	620.	410.	510.	580.	87.
SPEC COND	14 FEB 84	1.	UMC	360.	430.	620.	400.	510.	580.	88.
SPEC COND	14 FEB 84	1.	UMC	360.	430.	630.	400.	510.	570.	88.
SPEC COND	18 SEP 84	1.	UMC	710.	1000.	620.	670.	760.	860.	500.
SPEC COND	18 SEP 84	1.	UMC	720.	990.	620.	680.	760.	860.	500.
SPEC COND	18 SEP 84	1.	UMC	720.	1000.	620.	680.	760.	860.	490.
SPEC COND	18 SEP 84	1.	UMC	720.	1000.	620.	680.	760.	860.	510.
SPEC COND	20 MAR 85	1.	UMC		990.	700.	750.	760.	750.	390.
SPEC COND	20 MAR 85	1.	UMC		1000.	700.	750.	760.	740.	400.
SPEC COND	20 MAR 85	1.	UMC		1000.	700.	750.	760.	740.	390.
SPEC COND	20 MAR 85	1.	UMC		990.	700.	760.	760.	740.	390.
SPEC COND	13 SEP 85	1.	UMC	720.		610.	880.	830.	840.	
SPEC COND	13 SEP 85	1.	UMC	720.		600.	880.	840.	840.	
SPEC COND	13 SEP 85	1.	UMC	730.		600.	870.	840.	840.	
SPEC COND	13 SEP 85	1.	UMC	730.		600.	880.	830.	830.	
SPEC COND	18 MAR 86	1.	UMC	590.	960.	490.	670.	620.	520.	3600.
SPEC COND	18 MAR 86	1.	UMC	590.	960.	500.	660.	620.	520.	3600.
SPEC COND	18 MAR 86	1.	UMC	590.	950.	500.	670.	620.	520.	3600.
SPEC COND	18 MAR 86	1.	UMC	590.	950.	490.	660.	610.	520.	3600.
SPEC COND	16 SEP 86	1.	UMC	710.	1160.	690.	870.	950.	820.	600.
SPEC COND	16 SEP 86	1.	UMC	720.	1150.	690.	880.	950.	810.	600.
SPEC COND	16 SEP 86	1.	UMC	710.	1150.	690.	880.	950.	820.	600.
SPEC COND	16 SEP 86	1.	UMC	720.	1160.	690.	880.	960.	820.	610.
SPEC COND	17 MAR 87	1.	UMC	640.	990.	670.	820.	710.	730.	530.
SPEC COND	17 MAR 87	1.	UMC	630.	1000.	680.	810.	710.	730.	530.
SPEC COND	17 MAR 87	1.	UMC	630.	1000.	680.	820.	720.	730.	530.
SPEC COND	17 MAR 87	1.	UMC	640.	1000.	690.	820.	710.	740.	530.
TOC	05 JAN 82	.1	MGL	1.0	1.0	1.0	1.0	4.0	1.0	1.0
TOC	05 JAN 82	.1	MGL	1.0	1.0	1.0	1.0	4.0	1.0	1.0
TOC	05 JAN 82	.1	MGL	1.0	1.0	1.0	1.0	4.0	1.0	1.0
TOC	05 JAN 82	.1	MGL	1.0	1.0	1.0	1.0	4.0	1.0	1.0
TOC	13 APR 82	.1	MGL	39.0	54.0	40.0	37.0	48.0	44.0	40.0
TOC	13 APR 82	.1	MGL	39.0	54.0	40.0	37.0	47.0	44.0	40.0

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
TOC	13 APR 82	.1	MGL	40.0	54.0	42.0	37.0	47.0	44.0	40.0
TOC	13 APR 82	.1	MGL	39.0	55.0	43.0	37.0	48.0	44.0	40.0
TOC	29 JUN 82	.1	MGL	43.0	30.0	43.0	42.0	53.0	42.0	38.0
TOC	29 JUN 82	.1	MGL	42.0	30.0	41.0	40.0	53.0	42.0	39.0
TOC	29 JUN 82	.1	MGL	42.0	30.0	43.0	40.0	54.0	41.0	40.0
TOC	29 JUN 82	.1	MGL	42.0	30.0	43.0	42.0	54.0	43.0	38.0
TOC	28 SEP 82	.1	MGL	37.0	28.0	39.0	21.0	44.0	4.0	
TOC	28 SEP 82	.1	MGL	38.0	29.0	39.0	23.0	43.0	4.0	
TOC	28 SEP 82	.1	MGL	37.0	27.0	39.0	22.0	43.0	4.0	
TOC	28 SEP 82	.1	MGL	38.0	28.0	39.0	22.0	43.0	4.0	
TOC	08 FEB 83	.1	MGL	23.0	32.0	26.0	22.0	27.0	25.0	26.0
TOC	08 FEB 83	.1	MGL	23.0	33.0	27.0	22.0	26.0	25.0	26.0
TOC	08 FEB 83	.1	MGL	24.0	32.0	27.0	22.0	27.0	25.0	26.0
TOC	08 FEB 83	.1	MGL	23.0	33.0	27.0	22.0	27.0	25.0	26.0
TOC	09 AUG 83	.1	MGL	53.0	47.0	46.0		74.0	23.0	
TOC	09 AUG 83	.1	MGL	53.0	47.0	47.0		74.0	22.0	
TOC	09 AUG 83	.1	MGL	54.0	46.0	45.0		74.0	21.0	
TOC	09 AUG 83	.1	MGL	53.0	46.0	46.0		74.0	22.0	
TOC	14 FEB 84	.1	MGL	24.0	35.0	32.0	24.0	29.0	29.0	12.0
TOC	14 FEB 84	.1	MGL	23.0	36.0	33.0	24.0	29.0	29.0	11.0
TOC	14 FEB 84	.1	MGL	23.0	36.0	33.0	24.0	29.0	30.0	11.0
TOC	14 FEB 84	.1	MGL	24.0	35.0	32.0	24.0	29.0	29.0	11.0
TOC	18 SEP 84	.1	MGL	3.0	3.0	3.0	3.0	4.0	3.0	3.0
TOC	18 SEP 84	.1	MGL	3.0	4.0	3.0	3.0	4.0	3.0	4.0
TOC	18 SEP 84	.1	MGL	3.0	4.0	3.0	3.0	4.0	3.0	2.0
TOC	18 SEP 84	.1	MGL	3.0	4.0	3.0	3.0	5.0	4.0	3.0
TOC	20 MAR 85	.1	MGL		5.9	8.8	5.9	6.0	4.1	9.5
TOC	20 MAR 85	.1	MGL		5.7	8.8	6.1	6.0	4.0	9.6
TOC	20 MAR 85	.1	MGL		5.8	8.7	5.8	6.0	4.1	9.4
TOC	20 MAR 85	.1	MGL		5.7	8.8	5.9	6.0	4.1	9.5
TOC	13 SEP 85	.1	MGL	3.4		3.0	2.7	3.3	3.1	
TOC	13 SEP 85	.1	MGL	3.4		2.7	2.5	3.2	3.3	
TOC	13 SEP 85	.1	MGL	3.4		2.8	2.6	3.3	3.1	
TOC	13 SEP 85	.1	MGL	3.4		2.9	2.5	3.3	3.5	
TOC	18 MAR 86	.1	MGL	3.4	3.6	6.3	5.0	5.4	3.5	4.2
TOC	18 MAR 86	.1	MGL	3.4	3.5	6.3	5.0	5.1	3.5	4.2
TOC	18 MAR 86	.1	MGL	3.4	3.5	6.4	5.0	5.1	3.4	4.2
TOC	18 MAR 86	.1	MGL	3.4	3.5	6.2	5.2	5.2	3.6	4.2
TOC	16 SEP 86	.1	MGL	5.1	4.7	5.3	5.2	6.2	4.7	5.2
TOC	16 SEP 86	.1	MGL	5.0	4.7	5.4	5.4	6.2	4.9	5.1
TOC	16 SEP 86	.1	MGL	5.0	4.8	5.4	5.4	6.3	4.7	5.1

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
TOC	16 SEP 86	.1	MGL	4.9	4.8	5.5	5.4	6.2	4.8	5.2
TOC	17 MAR 87	.1	MGL	5.0	3.8	3.7	2.3	5.6	4.0	3.6
TOC	17 MAR 87	.1	MGL	5.0	3.7	3.8	2.2	5.5	4.0	3.6
TOC	17 MAR 87	.1	MGL	4.9	3.6	3.7	2.2	5.5	3.9	3.5
TOC	17 MAR 87	.1	MGL	5.0	3.7	3.8	2.1	5.6	4.0	3.5
TOX	05 JAN 82	.010	MGL	ND	.060	.033	.016	.063	.048	.021
TOX	05 JAN 82	.010	MGL	ND	.050	.025	ND	.038	.059	.039
TOX	05 JAN 82	.010	MGL	ND	.050	.014	.019	.048	.016	.034
TOX	05 JAN 82	.010	MGL	.016	.052	.013	.016	.046	.056	.020
TOX	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	.014
TOX	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	13 APR 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	13 APR 82	.010	MGL	ND	ND	.012	ND	.011	ND	.010
TOX	29 JUN 82	.010	MGL	ND	ND	ND	.017	.063	.068	.026
TOX	29 JUN 82	.010	MGL	.064	ND	ND	.076	ND	.039	.028
TOX	29 JUN 82	.010	MGL	.098	ND	.015	.070	.051	.026	.031
TOX	29 JUN 82	.010	MGL	.045	ND	ND	.066	ND	.082	.020
TOX	28 SEP 82	.010	MGL	.041		.130	.067	.096		
TOX	28 SEP 82	.010	MGL	ND		.080	ND	.069		
TOX	28 SEP 82	.010	MGL	ND		.095	.077	ND		
TOX	28 SEP 82	.010	MGL	ND		.095	.040	.062		
TOX	08 FEB 83	.010	MGL	.043	.030	.040	.039	.046	.017	.030
TOX	08 FEB 83	.010	MGL	.042	.047	.047	.028	.046	.033	.038
TOX	08 FEB 83	.010	MGL	.042	.041	.040	.044	.031	.039	.047
TOX	08 FEB 83	.010	MGL	.036	.041	.043	.041	.056	.038	.036
TOX	09 AUG 83	.010	MGL	.041	.040	.041		ND	ND	
TOX	09 AUG 83	.010	MGL	.036	.041	.036		ND	ND	
TOX	09 AUG 83	.010	MGL	.042	.038	.039		ND	ND	
TOX	09 AUG 83	.010	MGL	.040	.040	.036		ND	ND	
TOX	14 FEB 84	.010	MGL	.070	.064	ND	.037	.055	.064	ND
TOX	14 FEB 84	.010	MGL	.060	.074	ND	.035	.055	.030	.014
TOX	14 FEB 84	.010	MGL	.077	.041	ND	.036	.049	.044	.014
TOX	14 FEB 84	.010	MGL	.032	.062	ND	.039	.064	.041	.012
TOX	18 SEP 84	.010	MGL	.022	.016	ND	.015	.013	ND	.027
TOX	18 SEP 84	.010	MGL	.022	.018	.011	.025	.012	ND	.034
TOX	18 SEP 84	.010	MGL	.020	.016	ND	.013	ND	ND	.045
TOX	18 SEP 84	.010	MGL	.021	.026	.012	.013		ND	.045
TOX	20 MAR 85	.010	MGL		ND	ND	ND	ND	ND	.012
TOX	20 MAR 85	.010	MGL		ND	ND	ND	ND	ND	.013
TOX	20 MAR 85	.010	MGL		ND	ND	ND	ND	ND	.014
TOX	20 MAR 85	.010	MGL		ND	ND	ND	ND	ND	.014

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B W5	W4	W6	W1	W3	W2	W7
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TOX	18 MAR 86	.010	MGL	ND	ND	.010	ND	ND	ND	ND
TOX	18 MAR 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	18 MAR 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	18 MAR 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	16 SEP 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	16 SEP 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	16 SEP 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	16 SEP 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	17 MAR 87	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	17 MAR 87	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	17 MAR 87	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TOX	17 MAR 87	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TDS	29 JUN 82	1.	MGL	465.	431.	406.	672.#	704.#	698.#	382.
2,4,6-TNT	27 JUN 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	18 SEP 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	20 MAR 85	.001	MGL		ND	ND	ND	ND	ND	ND
2,4,6-TNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
2,4,6-TNT	18 MAR 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	16 SEP 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4,6-TNT	17 MAR 87	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	27 JUN 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	18 SEP 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	20 MAR 85	.001	MGL		ND	ND	ND	ND	ND	ND
2,4-DNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
2,4-DNT	18 MAR 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	16 SEP 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	17 MAR 87	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	27 JUN 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	18 SEP 84	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	20 MAR 85	.001	MGL		ND	ND	ND	ND	ND	ND
2,6-DNT	13 SEP 85	.001	MGL	ND		ND	ND	ND	ND	
2,6-DNT	18 MAR 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	16 SEP 86	.001	MGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	17 MAR 87	.001	MGL	ND	ND	ND	ND	ND	ND	ND
RDX	27 JUN 84	.030	MGL	ND	ND	ND	ND	ND	ND	ND
RDX	18 SEP 84	.030	MGL	ND	ND	ND	ND	ND	ND	ND
RDX	20 MAR 85	.030	MGL		ND	ND	ND	ND	ND	ND

RUN DATE: 19 AUG 87

INSTALLATION: SENECA AD, NY

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS						
				B W5	W4	W6	W1	W3	W2	W7
RDX	13 SEP 85	.030	MGL	ND		ND	ND	ND	ND	
RDX	18 MAR 86	.030	MGL	ND	ND	ND	ND	ND	ND	ND
RDX	16 SEP 86	.030	MGL	ND	ND	ND	ND	ND	ND	ND
RDX	17 MAR 87	.030	MGL	ND	ND	ND	ND	ND	ND	ND
HMX	27 JUN 84	.100	MGL	ND	ND	ND	ND	ND	ND	ND
HMX	18 SEP 84	.100	MGL	ND	ND	ND	ND	ND	ND	ND
HMX	20 MAR 85	.100	MGL		ND	ND	ND	ND	ND	ND
HMX	13 SEP 85	.100	MGL	ND		ND	ND	ND	ND	
HMX	18 MAR 86	.100	MGL	ND	ND	ND	ND	ND	ND	ND
HMX	16 SEP 86	.100	MGL	ND	ND	ND	ND	ND	ND	ND
HMX	17 MAR 87	.100	MGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	27 JUN 84	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	18 SEP 84	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	20 MAR 85	.010	MGL		ND	ND	ND	ND	ND	ND
TETRYL	13 SEP 85	.010	MGL	ND		ND	ND	ND	ND	
TETRYL	18 MAR 86	.005	MGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	16 SEP 86	.010	MGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	17 MAR 87	.010	MGL	ND	ND	ND	ND	ND	ND	ND

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

B	UPGRADIENT SITE
#	VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
&	VALUE EXCEEDS A STATE WATER QUALITY STANDARD OR CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

MONITORING WELL MW–1

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.090	–	–	–	–	0.090
CADMIUM	mg/l	0.002	–	–	–	–	0.002
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	0.002	–	–	–	–	0.002
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	8.6	3.4	–	4.3	–	5.4
CONDUCTANCE	umhos/cm	–	860	1400	845	–	1035
IRON	mg/l	0.022	1.500	–	ND	–	0.507
MANGANESE	mg/l	–	0.015	–	ND	–	0.008
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			6.60	–	6.60
POTASSIUM	mg/l	2.70	–	–	–	–	2.70
SODIUM	mg/l	6.70	8.60	–	12.50	–	9.27
SULFATE	mg/l	220	280	–	292	–	264
TOC	mg/l	6.10	5.00	4.70	8.90	–	6.18
TOX	mg/l	ND	0.04	ND	0.007	–	0.012
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	–	0.000
RDX	mg/l	ND	ND	ND	ND	–	0.000
HMX	mg/l	ND	ND	ND	ND	–	0.000
TETRYL	mg/l	ND	ND	ND	ND	–	0.000

MONITORING WELL MW–2

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.078	–	–	–	–	0.078
CADMIUM	mg/l	ND	–	–	–	–	0.000
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	0.002	–	–	–	–	0.002
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	6.2	2.6	–	2.6	–	3.8
CONDUCTANCE	umhos/cm	–	520	1700	585	–	935
IRON	mg/l	0.032	1.400	–	ND	–	0.477
MANGANESE	mg/l	–	0.011	–	ND	–	0.006
PHENOL	mg/l	ND	ND	–	0.003	–	0.001
pH	Standard	–			6.80	–	6.80
POTASSIUM	mg/l	0.80	–	–	–	–	0.80
SODIUM	mg/l	6.80	3.50	–	14.40	–	8.23
SULFATE	mg/l	140	73	–	103	–	105
TOC	mg/l	4.50	6.40	7.10	250.00	–	67.00
TOX	mg/l	ND	0.05	ND	0.012	–	0.016
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	–	0.000
RDX	mg/l	ND	ND	ND	ND	–	0.00
HMX	mg/l	ND	ND	ND	ND	–	0.00
TETRYL	mg/l	ND	ND	ND	ND	–	0.00

MONITORING WELL MW–3

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.058	–	–	–	–	0.058
CADMIUM	mg/l	ND	–	–	–	–	0.000
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	ND	–	–	–	–	0.000
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	13.0	4.0	–	4.3	–	7.1
CONDUCTANCE	umhos/cm	–	650	1400	575	838	866
IRON	mg/l	0.043	0.670	–	ND	–	0.238
MANGANESE	mg/l	–	ND	–	ND	–	0.000
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			6.80	7.10	6.95
POTASSIUM	mg/l	0.90	–	–	–	–	0.90
SODIUM	mg/l	3.70	3.40	–	3.50	–	3.53
SULFATE	mg/l	210	100	–	60	–	123
TOC	mg/l	5.60	6.20	5.90	7.30	15.60	8.12
TOX	mg/l	ND	0.06	ND	9.20	ND	1.85
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	ND	0.000
RDX	mg/l	ND	ND	ND	ND	ND	0.00
HMX	mg/l	ND	ND	ND	ND	ND	0.00
TETRYL	mg/l	ND	ND	ND	ND	ND	0.00

MONITORING WELL MW–4

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.072	–	–	–	–	0.072
CADMIUM	mg/l	0.001	–	–	–	–	0.001
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	ND	–	–	–	–	0.000
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	6.4	3.5	–	4.3	–	4.7
CONDUCTANCE	umhos/cm	–	890	1400	900	–	1063
IRON	mg/l	0.042	4.100	–	ND	–	1.381
MANGANESE	mg/l	–	0.064	–	0.030	–	0.047
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			6.60	–	6.60
POTASSIUM	mg/l	4.10	–	–	–	–	4.10
SODIUM	mg/l	9.00	16.00	–	22.30	–	15.77
SULFATE	mg/l	130	220	–	232	–	194
TOC	mg/l	11.30	5.00	9.00	3.60	–	7.23
TOX	mg/l	0.02	0.02	ND	0.005	–	0.011
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	ND	0.000
RDX	mg/l	ND	ND	ND	ND	ND	0.00
HMX	mg/l	ND	ND	ND	ND	ND	0.00
TETRYL	mg/l	ND	ND	ND	ND	ND	0.00

MONITORING WELL MW–5

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.060	–	–	–	–	0.060
CADMIUM	mg/l	ND	–	–	–	–	0.000
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	ND	–	–	–	–	0.000
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	6.2	2.8	–	3.5	–	4.2
CONDUCTANCE	umhos/cm	–	3500	1700	730	–	1977
IRON	mg/l	0.024	0.790	–	ND	–	0.271
MANGANESE	mg/l	–	0.028	–	0.020	–	0.024
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			6.90	–	6.90
POTASSIUM	mg/l	0.80	–	–	–	–	0.80
SODIUM	mg/l	6.90	5.30	–	15.90	–	9.37
SULFATE	mg/l	100	70	–	94	–	88
TOC	mg/l	3.50	6.20	4.30	6.00	–	5.00
TOX	mg/l	ND	0.03	0.02	ND	–	0.01
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	–	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	–	0.000
RDX	mg/l	ND	ND	ND	ND	–	0.00
HMX	mg/l	ND	ND	ND	ND	–	0.00
TETRYL	mg/l	ND	ND	ND	ND	–	0.00

MONITORING WELL MW–6

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.018	–	–	–	–	0.018
CADMIUM	mg/l	ND	–	–	–	–	0.000
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	ND	–	–	–	–	0.000
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	6.0	4.0	–	3.5	–	4.5
CONDUCTANCE	umhos/cm	–	680	1700	688	718	947
IRON	mg/l	0.120	0.970	–	ND	–	0.363
MANGANESE	mg/l	–	0.019	–	ND	–	0.010
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			6.70	7.20	6.95
POTASSIUM	mg/l	0.80	–	–	–	–	0.80
SODIUM	mg/l	9.40	8.00	–	13.10	–	10.17
SULFATE	mg/l	69	93	–	88	–	83
TOC	mg/l	7.20	8.70	1.50	5.40	389.00	82.36
TOX	mg/l	0.04	0.05	ND	ND	0.052	0.028
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	ND	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	ND	ND	ND	ND	ND	0.000
RDX	mg/l	ND	ND	ND	ND	ND	0.00
HMX	mg/l	ND	ND	ND	ND	ND	0.00
TETRYL	mg/l	ND	ND	ND	ND	ND	0.00

MONITORING WELL MW–7

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	ND	–	–	–	–	0.000
BARIUM	mg/l	0.036	–	–	–	–	0.036
CADMIUM	mg/l	ND	–	–	–	–	0.000
CHROMIUM	mg/l	ND	–	–	–	–	0.000
LEAD	mg/l	ND	–	–	–	–	0.000
MERCURY	mg/l	ND	–	–	–	–	0.000
SELENIUM	mg/l	ND	–	–	–	–	0.000
SILVER	mg/l	ND	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	1.8	1.2	–	1.7	–	1.6
CONDUCTANCE	umhos/cm	–	400	–	524	–	462
IRON	mg/l	2.000	1.600	–	ND	–	1.200
MANGANESE	mg/l	–	0.019	–	0.010	–	0.015
PHENOL	mg/l	ND	ND	–	ND	–	0.000
pH	Standard	–			7.00	–	7.00
POTASSIUM	mg/l	4.20	–	–	–	–	4.20
SODIUM	mg/l	1.40	1.60	–	8.85	–	3.95
SULFATE	mg/l	29	24	–	40	–	31
TOC	mg/l	18.30	6.00	–	9.00	–	11.10
TOX	mg/l	0.02	0.08	–	ND	–	0.03
EXPLOSIVES							
TNT 2,4,6	mg/l	ND	ND	–	ND	–	0.000
DNT 2,4	mg/l	ND	ND	–	ND	–	0.000
DNT 2,6	mg/l	ND	ND	–	ND	–	0.000
RDX	mg/l	ND	ND	–	ND	–	0.00
HMX	mg/l	ND	ND	–	ND	–	0.00
TETRYL	mg/l	ND	ND	–	ND	–	0.00

MONITORING WELL MW–8

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	26.0	–	19.9	–	23.0
CONDUCTANCE	umhos/cm	–	1500	1100	1753	1402	1439
IRON	mg/l	–	0.680	–	ND	–	0.340
MANGANESE	mg/l	–	0.029	–	0.020	–	0.025
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.50	7.10	6.80
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	32.00	–	17.70	–	24.85
SULFATE	mg/l	–	640	–	807	–	724
TOC	mg/l	–	10.00	1.60	ND	ND	2.90
TOX	mg/l	–	0.07	ND	ND	ND	0.02
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW-9

CONSTITUENT	DATE/ UNITS	Mar-89	Mar-90	Sept-90	Mar-91	Sept-91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	6.8	–	3.5	–	5.1
CONDUCTANCE	umhos/cm	–	860	1500	901	1102	1091
IRON	mg/l	–	0.800	–	ND	–	0.400
MANGANESE	mg/l	–	0.035	–	0.030	–	0.033
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.60	7.10	6.85
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	10.00	–	10.10	–	10.05
SULFATE	mg/l	–	210	–	228	–	219
TOC	mg/l	–	4.60	1.50	ND	7.90	3.50
TOX	mg/l	–	0.03	ND	0.008	0.012	0.013
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW–10

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	13.0	–	10.4	–	11.7
CONDUCTANCE	umhos/cm	–	940	1400	972	605	979
IRON	mg/l	–	0.140	–	ND	–	0.070
MANGANESE	mg/l	–	0.020	–	0.020	–	0.020
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.60	7.40	7.00
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	10.00	–	11.10	–	10.55
SULFATE	mg/l	–	270	–	252	–	261
TOC	mg/l	–	5.20	ND	ND	6.50	2.93
TOX	mg/l	–	0.03	ND	ND	25.00	6.26
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW-11

CONSTITUENT	DATE/ UNITS	Mar-89	Mar-90	Sept-90	Mar-91	Sept-91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	41.0	–	15.6	–	28.3
CONDUCTANCE	umhos/cm	–	1000	1200	789	1257	1062
IRON	mg/l	–	0.500	–	ND	–	0.250
MANGANESE	mg/l	–	0.022	–	ND	–	0.011
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.60	6.80	6.70
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	17.00	–	15.60	–	16.30
SULFATE	mg/l	–	250	–	189	–	220
TOC	mg/l	–	5.50	ND	12.40	ND	4.48
TOX	mg/l	–	0.02	ND	ND	ND	0.01
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW–12

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	11.0	–	6.9	–	9.0
CONDUCTANCE	umhos/cm	–	9900	1400	926	910	3284
IRON	mg/l	–	0.890	–	ND	–	0.445
MANGANESE	mg/l	–	0.019	–	0.010	–	0.015
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.70	7.30	7.00
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	20.00	–	19.20	–	19.60
SULFATE	mg/l	–	110	–	106	–	108
TOC	mg/l	–	5.00	1.90	25.80	6.60	9.83
TOX	mg/l	–	0.05	ND	ND	0.010	0.015
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW–13

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	11.0	–	7.8	–	9.4
CONDUCTANCE	umhos/cm	–	820	1400	865	892	994
IRON	mg/l	–	0.140	–	ND	–	0.070
MANGANESE	mg/l	–	ND	–	ND	–	0.000
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.50	7.00	6.75
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	14.00	–	13.10	–	13.55
SULFATE	mg/l	–	250	–	181	–	216
TOC	mg/l	–	7.10	2.30	12.60	7.80	7.45
TOX	mg/l	–	0.06	ND	ND	ND	0.02
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW–14

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	16.0	–	23.3	–	19.7
CONDUCTANCE	umhos/cm	–	1100	1200	1174	1176	1163
IRON	mg/l	–	0.290	–	ND	–	0.145
MANGANESE	mg/l	–	ND	–	ND	–	0.000
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.60	6.90	6.75
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	34.00	–	34.90	–	34.45
SULFATE	mg/l	–	140	–	282	–	211
TOC	mg/l	–	3.00	3.60	14.60	6.90	7.03
TOX	mg/l	–	0.04	ND	0.005	ND	0.011
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

MONITORING WELL MW−15

CONSTITUENT	DATE/ UNITS	Mar−89	Mar−90	Sept−90	Mar−91	Sept−91	Average
METALS							
ARSENIC	mg/l	−	−	−	−	−	0.000
BARIUM	mg/l	−	−	−	−	−	0.000
CADMIUM	mg/l	−	−	−	−	−	0.000
CHROMIUM	mg/l	−	−	−	−	−	0.000
LEAD	mg/l	−	−	−	−	−	0.000
MERCURY	mg/l	−	−	−	−	−	0.000
SELENIUM	mg/l	−	−	−	−	−	0.000
SILVER	mg/l	−	−	−	−	−	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	−	11.0	−	7.8	−	9.4
CONDUCTANCE	umhos/cm	−	1400	940	1506	1175	1255
IRON	mg/l	−	1.100	−	ND	−	0.550
MANGANESE	mg/l	−	0.044	−	0.020	−	0.032
PHENOL	mg/l	−	ND	−	ND	−	0.000
pH	Standard				6.60	6.70	6.65
POTASSIUM	mg/l	−	−	−	−	−	0.00
SODIUM	mg/l	−	22.00	−	35.60	−	28.80
SULFATE	mg/l	−	420	−	389	−	405
TOC	mg/l	−	9.80	5.90	20.50	ND	9.05
TOX	mg/l	−	0.05	ND	0.015	0.019	0.021
EXPLOSIVES							
TNT 2,4,6	mg/l	−	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	−	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	−	ND	ND	ND	ND	0.000
RDX	mg/l	−	ND	ND	ND	ND	0.00
HMX	mg/l	−	ND	ND	ND	ND	0.00
TETRYL	mg/l	−	ND	ND	ND	ND	0.00

MONITORING WELL MW-16

CONSTITUENT	DATE/ UNITS	Mar-89	Mar-90	Sept-90	Mar-91	Sept-91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	1.9	–	1.7	–	1.8
CONDUCTANCE	umhos/cm	–	730	840	764	–	778
IRON	mg/l	–	1.500	–	ND	–	0.750
MANGANESE	mg/l	–	0.020	–	ND	–	0.010
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.70	–	6.70
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	4.90	–	8.20	–	6.55
SULFATE	mg/l	–	190	–	187	–	189
TOC	mg/l	–	4.00	1.00	19.90	–	8.30
TOX	mg/l	–	0.03	ND	ND	–	0.01
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	–	0.000
DNT 2,4	mg/l	–	ND	ND	ND	–	0.000
DNT 2,6	mg/l	–	ND	ND	ND	–	0.000
RDX	mg/l	–	ND	ND	ND	–	0.00
HMX	mg/l	–	ND	ND	ND	–	0.00
TETRYL	mg/l	–	ND	ND	ND	–	0.00

MONITORING WELL MW–17

CONSTITUENT	DATE/ UNITS	Mar–89	Mar–90	Sept–90	Mar–91	Sept–91	Average
METALS							
ARSENIC	mg/l	–	–	–	–	–	0.000
BARIUM	mg/l	–	–	–	–	–	0.000
CADMIUM	mg/l	–	–	–	–	–	0.000
CHROMIUM	mg/l	–	–	–	–	–	0.000
LEAD	mg/l	–	–	–	–	–	0.000
MERCURY	mg/l	–	–	–	–	–	0.000
SELENIUM	mg/l	–	–	–	–	–	0.000
SILVER	mg/l	–	–	–	–	–	0.000
MISCELLANEOUS							
CHLORIDE	mg/l	–	2.5	–	3.5	–	3.0
CONDUCTANCE	umhos/cm	–	560	580	497	616	563
IRON	mg/l	–	4.000	–	ND	–	2.000
MANGANESE	mg/l	–	0.200	–	ND	–	0.100
PHENOL	mg/l	–	ND	–	ND	–	0.000
pH	Standard				6.70	7.20	6.95
POTASSIUM	mg/l	–	–	–	–	–	0.00
SODIUM	mg/l	–	4.80	–	5.40	–	5.10
SULFATE	mg/l	–	59	–	44	–	52
TOC	mg/l	–	2.10	2.00	8.50	5.30	4.48
TOX	mg/l	–	0.03	ND	ND	0.010	0.010
EXPLOSIVES							
TNT 2,4,6	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,4	mg/l	–	ND	ND	ND	ND	0.000
DNT 2,6	mg/l	–	ND	ND	ND	ND	0.000
RDX	mg/l	–	ND	ND	ND	ND	0.00
HMX	mg/l	–	ND	ND	ND	ND	0.00
TETRYL	mg/l	–	ND	ND	ND	ND	0.00

STATISTICAL ANALYSIS DATA

Well in the OD area
Background Upgradient Concentrations

Backgroundwell MW-4								
pH	jan-82	apr-82	jun-82	sep-82	diff			
	7.2	7.2	7.8	7.9	-0.325	-0.325	0.275	0.375
	7.2	7.2	7.8	7.9	-0.325	-0.325	0.275	0.375
	7.2	7.2	7.8	7.9	-0.325	-0.325	0.275	0.375
	7.2	7.2	7.8	7.9	-0.325	-0.325	0.275	0.375
				sqd. diff.	0.4225	0.4225	0.3025	0.5625
Average	7.525	Varience	0.114					
Spec Cond	jan-82	apr-82	jun-82	sep-82	diff			
	1130	1300	590	-	122.25	292.25	-417.75	
	1120	1302	590	-	112.25	294.25	-417.75	
	1130	1301	600	-	122.25	293.25	-407.75	
	1130	1300	600	-	122.25	292.25	-407.75	
				sqd. diff.	57435.25	343398.8	681550.3	
Average	1007.75	Varience	98398.57					
TOC	jan-82	apr-82	jun-82	sep-82	diff			
	1	54	30	28	-27.3125	25.6875	1.6875	-0.3125
	1	54	30	29	-27.3125	25.6875	1.6875	0.6875
	1	54	30	27	-27.3125	25.6875	1.6875	-1.3125
	1	55	30	28	-27.3125	26.6875	1.6875	-0.3125
					2983.891	2691.766	11.39063	2.390625
Average	28.3125	Varience	379.2958					
TOX	jan-82	apr-82	jun-82	sep-82	diff			
	0.06	0.005	0.005		0.039	-0.016	-0.016	
	0.05	0.005	0.005		0.029	-0.016	-0.016	
	0.05	0.005	0.005		0.029	-0.016	-0.016	
	0.052	0.005	0.005		0.031	-0.016	-0.016	
					0.004164	0.001024	0.001024	
Average	0.021	Varience	0.000565					

Students t–Test for wells in the OD area
TOC – Year 1983

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–2

	semiannual data			'diff	
	feb–83	aug–83		feb–83	aug–83
TOC	25	23		0	1
	25	22		0	0
	25	21		0	–1
	25	22		0	0
average	25	22	varience	0	0.67
			Tstar	–0.68	–1.29
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.17
			Wb	23.71	23.71
			Tc	2.60	2.62
			If Tstar < Tc no release	no rel	no rel

Students t−Test for wells in the OD area
TOC − Year 1984

Background Well MW−4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW−2

			semiannual data		diff	
	feb−84	sep−84			feb−84	sep−84
TOC	29	3			−0.25	−0.25
	29	3			−0.25	−0.25
	30	3			0.75	−0.25
	29	4			−0.25	0.75
average	29.25	3.25		varience	0.25	0.25
				Tstar	0.19	−5.14
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.06	0.06
				Wb	23.71	23.71
				Tc	2.61	2.61
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1985

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–2

			semiannual data		'diff	
	mar–85	sep–85			mar–85	sep–85
TOC	4.1	3.1			0.025	–0.15
	4	3.3			–0.075	0.05
	4.1	3.1			0.025	–0.15
	4.1	3.5			0.025	0.25
average	4.075	3.25		varience	0.0025	0.0367
				Tstar	–4.98	–5.15
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.00	0.01
				Wb	23.71	23.71
				Tc	2.60	2.60
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1986

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–2

	semiannual data			'diff	
	mar–86	sep–86		mar–86	sep–86
TOC	3.5	4.7		0	–0.075
	3.5	4.9		0	0.125
	3.4	4.7		–0.1	–0.075
	3.6	4.8		0.1	0.025
average	3.5	4.775	varience	0.0067	0.0092
			Tstar	–5.10	–4.83
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	23.71	23.71
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1987

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–2

		annual data		'diff
	mar–87			mar–87
TOC	4.0			0.025
	4.0			0.025
	3.9			–0.075
	4.0			0.025
average	3.975		varience	0.0025
			Tstar	–5.00
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	23.71
			Tc	2.60
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
TOC – Year 1983

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–3

		semiannual data		'diff	
	feb–83	aug–83		feb–83	aug–83
TOC	27	74		0.25	0
	26	74		–0.75	0
	27	74		0.25	0
	27	74		0.25	0
average	26.75	74	varience	0.25	0.00
			Tstar	–0.32	9.38
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.06	0.00
			Wb	23.71	23.71
			Tc	2.61	2.60
			If Tstar < Tc no release	no rel	rel

Students t–Test for wells in the OD area
TOC – Year 1984

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–3

			semiannual data		'diff	
	feb–84	sep–84			feb–84	sep–84
TOC	29	4			0	–0.25
	29	4			0	–0.25
	29	4			0	–0.25
	29	5			0	0.75
average	29	4.25		varience	0	0.25
				Tstar	0.14	–4.94
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.00	0.06
				Wb	23.71	23.71
				Tc	2.60	2.61
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1985

Background Well MW–4

Initial Mean = 28.31
Initial Varience = 379.30
Sample Size = 16

Compliance Well MW–3

	semiannual data			'diff	
	mar–85	sep–85		mar–85	sep–85
TOC	6.0	3.3		0	0.025
	6.0	3.2		0	–0.075
	6.0	3.3		0	0.025
	6.0	3.3		0	0.025
average	6	3.275	varience	0	0.0025
			Tstar	–4.58	–5.14
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	23.71	23.71
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1986

Background Well MW–4

Initial Mean = 28.31
Initial Varience = 379.30
Sample Size = 16

Compliance Well MW–3

		semiannual data		'diff	
	mar–86	sep–86		mar–86	sep–86
TOC	5.4	6.2		0.2	–0.025
	5.1	6.2		–0.1	–0.025
	5.1	6.3		–0.1	0.075
	5.2	6.2		0	–0.025
average	5.2	6.225	varience	0.0200	0.0025
			Tstar	–4.75	–4.54
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.01	0.00
			Wb	23.71	23.71
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1987

Background Well MW–4

Initial Mean = 28.31
Initial Varience = 379.30
Sample Size = 16

Compliance Well MW–3

		annual data	'diff
	mar–87		mar–87
TOC	5.6		0.05
	5.5		–0.05
	5.5		–0.05
	5.6		0.05
average	5.55	varience	0.0033
		Tstar	–4.67
		Tb	2.60
		Tm	4.54
		Wm	0.00
		Wb	23.71
		Tc	2.60
		If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1983

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–2

			semiannual data		'diff	
	feb–83	aug–83			feb–83	aug–83
Spec. Cond.	755	930			–2.5	–7.5
	755	940			–2.5	2.5
	760	940			2.5	2.5
	760	940			2.5	2.5
average	757.5	937.5		varience	8.3333	25
				Tstar	–2.76	–0.78
				Tb	2.72	2.72
				Tm	4.54	4.54
				Wm	2.08	6.25
				Wb	8199.88	8199.88
				Tc	2.72	2.72
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1984

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–2

	semiannual data			'diff	
	feb–84	sep–84		feb–84	sep–84
Spec. Cond.	570	860		–5	0
	580	860		5	0
	580	860		5	0
	570	860		–5	0
average	575	860	varience	33.3333	0
			Tstar	–4.78	–1.63
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	8.33	0.00
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1985

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–2

			semiannual data		'diff	
	mar–85	sep–85			mar–85	sep–85
Spec. Cond.	750	840			7.5	2.5
	740	840			–2.5	2.5
	740	840			–2.5	2.5
	740	830			–2.5	–7.5
average	742.5	837.5		varience	25	25
				Tstar	–2.93	–1.88
				Tb	2.72	2.72
				Tm	4.54	4.54
				Wm	6.25	6.25
				Wb	8199.88	8199.88
				Tc	2.72	2.72
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1986

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–2

	semiannual data			'diff	
	mar–86	sep–86		mar–86	apr–82
Spec. Cond.	520	820		0	2.5
	520	810		0	–7.5
	520	820		0	2.5
	520	820		0	2.5
average	520	817.5	varience	0	25
			Tstar	–5.39	–2.10
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	6.25
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1987

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–2

		annual data				'diff
	mar–87					mar–87
Spec. Cond.	730					–2.5
	730					–2.5
	730					–2.5
	740					7.5
average	732.5	0	0	0	varience	25
					Tstar	–3.04
					Tb	2.72
					Tm	4.54
					Wm	6.25
					Wb	8199.88
					Tc	2.72
			If Tstar < Tc no release			no rel

Students t−Test for wells in the OD area
Specific Conductance − Year 1983

Background Well MW−4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW−3

	semiannual data			’diff	
	feb−83	aug−83		feb−83	aug−83
Spec. Cond.	680	1050		−1.25	5
	680	1050		−1.25	5
	680	1040		−1.25	−5
	685	1040		3.75	−5
average	681.25	1045	varience	6.2500	33.3333
			Tstar	−3.61	0.41
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	1.56	8.33
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1984

Background Well MW–4

Initial Mean = 1007.75
Initial Varience = 98398.57
Sample Size = 12

Compliance Well MW–3

			semiannual data	'diff	
	feb–84	sep–84		feb–84	sep–84
Spec. Cond.	500	760		–7.5	0
	510	760		2.5	0
	510	760		2.5	0
	510	760		2.5	0
average	507.5	760	varience	25	0
			Tstar	–5.52	–2.74
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	6.25	0.00
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1985

Background Well MW–4

Initial Mean = 1007.75
Initial Varience = 98398.57
Sample Size = 12

Compliance Well MW–3

	semiannual data			'diff	
	mar–85	sep–85		mar–85	sep–85
Spec. Cond.	760	830		0	–5
	760	840		0	5
	760	840		0	5
	760	830		0	–5
average	760	835	varience	0	33.3333
			Tstar	–2.74	–1.91
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	8.33
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t-Test for wells in the OD area
Specific Conductance - Year 1986

Background Well MW-4

Initial Mean = 1007.75
Initial Varience = 98398.57
Sample Size = 12

Compliance Well MW-3

			semiannual data	'diff	
	mar-86	sep-86		mar-86	apr-82
Spec. Cond.	620	950		2.5	-2.5
	620	950		2.5	-2.5
	620	950		2.5	-2.5
	610	960		-7.5	7.5
average	617.5	952.5	varience	25	25
			Tstar	-4.31	-0.61
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	6.25	6.25
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t-Test for wells in the OD area
Specific Conductance - Year 1987

Background Well MW-4

Initial Mean = 1007.75
Initial Varience = 98398.57
Sample Size = 12

Compliance Well MW-3

		annual data				'diff
	mar-87					mar-87
Spec. Cond.	710					-2.5
	710					-2.5
	720					7.5
	710					-2.5
average	712.5	0	0	0	varience	25
					Tstar	-3.26
					Tb	2.72
					Tm	4.54
					Wm	6.25
					Wb	8199.88
					Tc	2.72
					If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
TOX – Year 1983

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–2

	✓	✓	semiannual data		'diff	
	feb–83	aug–83			feb–83	aug–83
TOX	0.017	0.005			–0.01475	0
	0.033	0.005			0.00125	0
	0.039	0.005			0.00725	0
	0.038	0.005			0.00625	0
average	0.03175	0.005		varience	0.00010358	0
				Tstar	1.26	–2.33
				Tb	2.72	2.72
				Tm	4.54	4.54
				Wm	0.00	0.00
				Wb	0.00	0.00
				Tc	3.36	2.72
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1984

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–2

	✓	✓	semiannual data	'diff	
	feb–84	sep–84		feb–84	sep–84
TOX	0.064	0.005		0.01925	0
	0.030	0.005		–0.01475	0
	0.044	0.005		–0.00075	0
	0.041	0.005		–0.00375	0
average	0.04475	0.005	varience	0.00020092	0
			Tstar	2.41	–2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	3.66	2.72
			If Tstar < Tc no release	no rel ✓	no rel

Students t–Test for wells in the OD area
TOX – Year 1985

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–2

			semiannual data		'diff	
	mar–85	sep–85			mar–85	sep–85
TOX	0.005	0.005			0	0
	0.005	0.005			0	0
	0.005	0.005			0	0
	0.005	0.005			0	0
average	0.005	0.005		varience	0	0
				Tstar	–2.33	–2.33
				Tb	2.72	2.72
				Tm	4.54	4.54
				Wm	0.00	0.00
				Wb	0.00	0.00
				Tc	2.72	2.72
			If Tstar < Tc no release		no rel	no rel

Students t Test for wells in the OD area
TOX – Year 1986

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–2

		semiannual data		'diff	
	mar–86	sep–86		mar–86	sep–86
TOX	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
average	0.005	0.005	varience	0	0
			Tstar	-2.33	-2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1987

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–2

		annual data	'diff
	mar–86		mar–86
TOX	0.005		0
	0.005		0
	0.005		0
	0.005		0
average	0.005		

varience	0
Tstar	–2.33
Tb	2.72
Tm	4.54
Wm	0.00
Wb	0.00
Tc	2.72
If Tstar < Tc no release	no rel

Students t-Test for wells in the OD area
TOX - Year 1983

Background Well MW-4

Initial Mean = 0.021
Initial Varience = 0.000565
Sample Size = 12

Compliance Well MW-3

		semiannual data		diff	
	feb-83	aug-83		feb-83	aug-83
TOX	0.046	0.005		0.00125	0
	0.046	0.005		0.00125	0
	0.031	0.005		-0.01375	0
	0.056	0.005		0.01125	0
average	0.04475	0.005	varience	0.00010625	0
			Tstar	2.77	-2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	3.38	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1984

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–3

	annual data			'diff
	feb–84			feb–84
TOX	0.055			–0.00075
	0.055			–0.00075
	0.049			–0.00675
	0.064			0.00825
average	0.05575		varience	0.000038
			Tstar	4.62
			Tb	2.72
			Tm	4.54
			Wm	0.00
			Wb	0.00
			Tc	3.03
		If Tstar < Tc no release		rel

Students t–Test for wells in the OD area
TOX – Year 1985

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–3

	semiannual data			diff	
	mar–85	sep–85		mar–85	sep–85
TOX	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
average	0.005	0.005	varience	0	0
			Tstar	–2.33	–2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t−Test for wells in the OD area
TOX − Year 1986

Background Well MW−4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW−3

	semiannual data			'diff	
	mar−86	sep−86		mar−86	sep−86
TOX	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
average	0.005	0.005	varience	0	0
			Tstar	−2.33	−2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1987

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–3

		annual data		'diff
	mar–86			mar–86
TOX	0.005			0
	0.005			0
	0.005			0
	0.005			0
average	0.005		varience	0
			Tstar	–2.33
			Tb	2.72
			Tm	4.54
			Wm	0.00
			Wb	0.00
			Tc	2.72
		If Tstar < Tc no release		no rel

Students t-Test for wells in the OD area
pH - Year 1983

Background Well MW-4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW-2

	✓	✓ semiannual data		'diff	
	feb-83	aug-83		feb-83	aug-83
pH	7.7	7.1		0	0
	7.7	7.1		0	0
	7.7	7.1		0	0
	7.7	7.1		0	0
average	7.7	7.1	varience	0	0
			Tstar	2.07	-5.03
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.01	0.01
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
pH – Year 1984

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–2

			semiannual data		'diff	
	feb–84	sep–84			feb–84	sep–84
pH	7.4	7.1			–0.025	–0.025
	7.5	7.1			0.075	–0.025
	7.4	7.1			–0.025	–0.025
	7.4	7.2			–0.025	0.075
average	7.425	7.125		varience	0.0025	0.0025
				Tstar	–1.14	–4.54
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.00	0.00
				Wb	0.01	0.01
				Tc	2.76	2.76
				If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
pH – Year 1986

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–2

		annual data		diff
	mar–86			mar–86
pH	7.2			–0.05
	7.3			0.05
	7.3			0.05
	7.2			–0.05
average	7.25		varience	0.0033
			Tstar	–3.08
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	2.81
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
pH – Year 1987

Background Well MW–4

Initial Mean = 7.525
Initial Varience = 0.114
Sample Size = 16

Compliance Well MW–2

	✓	annual data		’diff
	mar–87			mar–87
pH	7.1			0.125
	7.0			0.025
	6.9			–0.075
	6.9			–0.075
average	6.975		varience	0.0092
			Tstar	–5.67
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	3.07
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
pH – Year 1983

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–3

	semiannual data			'diff	
	feb–83	aug–83		feb–83	aug–83
pH	7.5	7.0		0	0
	7.5	7.0		0	0
	7.5	7.0		0	0
	7.5	7.0		0	0
average	7.5	7.0	varience	0	0
			Tstar	–0.30	–6.22
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.01	0.01
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
pH – Year 1984

Background Well MW–4

Initial Mean =	**7.525**
Initial Varience =	**0.114**
Sample Size =	**16**

Compliance Well MW–3

			semiannual data		'diff	
	feb–84	sep–84			feb–84	sep–84
pH	7.4	7.5			–0.025	0.075
	7.4	7.4			–0.025	–0.025
	7.4	7.4			–0.025	–0.025
	7.5	7.4			0.075	–0.025
average	7.425	7.425		varience	0.0025	0.0025
				Tstar	–1.14	–1.14
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.00	0.00
				Wb	0.01	0.01
				Tc	2.76	2.76
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
pH – Year 1986

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–3

		annual data		'diff
	mar–86			mar–86
pH	7.0			–0.025
	7.1			0.075
	7.0			–0.025
	7.0			–0.025
average	7.025		varience	0.0025
			Tstar	–5.68
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	2.76
		If Tstar < Tc no release		no rel

Students t−Test for wells in the OD area
pH − Year 1987

Background Well MW−4

Initial Mean = 7.525
Initial Varience = 0.114
Sample Size = 16

Compliance Well MW−3

		annual data		'diff
	mar−87			mar−87
pH	7.2			0.075
	7.1			−0.025
	7.1			−0.025
	7.1			−0.025
average	7.125		varience	0.0025
			Tstar	−4.54
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	2.76
			If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
pH – Year 1983

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–4

	semiannual data			'diff	
	feb–83	aug–83		feb–83	aug–83
pH	7.3	6.9		0	0
	7.3	6.9		0	0
	7.3	6.9		0	0
	7.3	6.9		0	0
average	7.3	6.9	varience	0	0
			Tstar	–2.67	–7.40
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.01	0.01
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t-Test for wells in the OD area
pH - Year 1984

Background Well MW-4

Initial Mean = 7.525
Initial Varience = 0.114
Sample Size = 16

Compliance Well MW-4

		semiannual data		'diff	
	feb-84	sep-84		feb-84	sep-84
pH	6.8	7.5		-0.05	-0.05
	6.9	7.6		0.05	0.05
	6.8	7.6		-0.05	0.05
	6.9	7.5		0.05	-0.05
average	6.85	7.55	varience	0.0033	0.0033
			Tstar	-7.57	0.28
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.01	0.01
			Tc	2.81	2.81
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
pH – Year 1986

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–4

		annual data		'diff
	mar–86			mar–86
pH	6.8			–0.025
	6.9			0.075
	6.8			–0.025
	6.8			–0.025
average	6.825		varience	0.0025
			Tstar	–7.95
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	2.76
			If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
pH – Year 1987

Background Well MW–4

Initial Mean =	7.525
Initial Varience =	0.114
Sample Size =	16

Compliance Well MW–4

		annual data		'diff
	mar–87			mar–87
pH	7.3			0.1
	7.2			0
	7.1			–0.1
	7.2			0
average	7.2		varience	0.0067
			Tstar	–3.47
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	0.01
			Tc	2.97
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1983

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–4

	semiannual data			'diff	
	feb–83	aug–83		feb–83	aug–83
Spec. Cond.	1160	1190		0	–5
	1160	1200		0	5
	1160	1190		0	–5
	1160	1200		0	5
average	1160	1195	varience	0.0000	33.3333
			Tstar	1.68	2.07
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	8.33
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1984

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–4

	semiannual data			'diff	
	feb–84	sep–84		feb–84	sep–84
Spec. Cond.	430	1000		2.5	2.5
	420	990		−7.5	−7.5
	430	1000		2.5	2.5
	430	1000		2.5	2.5
average	427.5	997.5	varience	25.0000	25
			Tstar	−6.41	−0.11
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	6.25	6.25
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1985

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–4

		annual data		'diff
	mar–85			mar–85
Spec. Cond.	990			–5
	1000			5
	1000			5
	990			–5
average	995		varience	33.3333
			Tstar	–0.14
			Tb	2.72
			Tm	4.54
			Wm	8.33
			Wb	8199.88
			Tc	2.72
			If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1986

Background Well MW–4

Initial Mean =	1007.75
Initial Varience =	98398.57
Sample Size =	12

Compliance Well MW–4

	semiannual data			'diff	
	mar–86	sep–86		mar–86	apr–82
Spec. Cond.	960	1160		5	5
	960	1150		5	–5
	950	1150		–5	–5
	950	1160		–5	5
average	955	1155	varience	33.3333	33.3333
			Tstar	–0.58	1.63
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	8.33	8.33
			Wb	8199.88	8199.88
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
Specific Conductance – Year 1987

Background Well MW–4

Initial Mean = 1007.75
Initial Varience = 98398.57
Sample Size = 12

Compliance Well MW–4

		annual data				'diff
	mar–87					mar–87
Spec. Cond.	990					–7.5
	1000					2.5
	1000					2.5
	1000					2.5
average	997.5	0	0	0	varience	25
					Tstar	–0.11
					Tb	2.72
					Tm	4.54
					Wm	6.25
					Wb	8199.88
					Tc	2.72
				If Tstar < Tc no release		no rel

Students t-Test for wells in the OD area
TOC - Year 1983

Background Well MW-4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW-4

	semiannual data			'diff	
	feb-83	aug-83		feb-83	aug-83
TOC	32	47		-0.5	0.5
	33	47		0.5	0.5
	32	46		-0.5	-0.5
	33	46		0.5	-0.5
average	32.5	46.5	varience	0.3333	0.3333
			Tstar	0.86	3.73
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.08	0.08
			Wb	23.71	23.71
			Tc	2.61	2.61
			If Tstar < Tc no release	no rel	rel

Students t–Test for wells in the OD area
TOC – Year 1984

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–4

		semiannual data			'diff	
	feb–84	sep–84			feb–84	sep–84
TOC	35	3			–0.5	–0.75
	36	4			0.5	0.25
	36	4			0.5	0.25
	35	4			–0.5	0.25
average	35.5	3.75		varience	0.3333	0.2500
				Tstar	1.47	–5.04
				Tb	2.60	2.60
				Tm	4.54	4.54
				Wm	0.08	0.06
				Wb	23.71	23.71
				Tc	2.61	2.61
			If Tstar < Tc no release		no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1985

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–4

		annual data		'diff
	mar–85			mar–85
TOC	5.9			0.125
	5.7			–0.075
	5.8			0.025
	5.7			–0.075
average	5.775		varience	0.0092
			Tstar	–4.63
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	23.71
			Tc	2.60
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
TOC – Year 1986

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–4

		semiannual data		'diff	
	mar–86	sep–86		mar–86	sep–86
TOC	3.6	4.7		0.075	–0.05
	3.5	4.7		–0.025	–0.05
	3.5	4.8		–0.025	0.05
	3.5	4.8		–0.025	0.05
average	3.525	4.75	varience	0.0025	0.0033
			Tstar	–5.09	–4.84
			Tb	2.60	2.60
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	23.71	23.71
			Tc	2.60	2.60
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOC – Year 1987

Background Well MW–4

Initial Mean =	28.31
Initial Varience =	379.30
Sample Size =	16

Compliance Well MW–4

	annual data			'diff
	mar–87			mar–87
TOC	3.8			0.1
	3.7			0
	3.6			–0.1
	3.7			0
average	3.7		varience	0.0067
			Tstar	–5.05
			Tb	2.60
			Tm	4.54
			Wm	0.00
			Wb	23.71
			Tc	2.60
		If Tstar < Tc no release		no rel

Students t–Test for wells in the OD area
TOX – Year 1983

Background Well MW–4

Initial Mean = 0.021
Initial Varience = 0.000565
Sample Size = 12

Compliance Well MW–4

	semiannual data			'diff	
	feb–83	aug–83		feb–83	aug–83
TOX	0.03	0.04		–0.00975	0.00025
	0.047	0.041		0.00725	0.00125
	0.041	0.038		0.00125	–0.00175
	0.041	0.04		0.00125	0.00025
average	0.03975	0.03975	varience	0.0001	0.00000
			Tstar	2.43	2.72
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	3.10	2.73
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1984

Background Well MW–4

Initial Mean = 0.021
Initial Varience = 0.000565
Sample Size = 12

Compliance Well MW–4

	semiannual data			'diff	
	feb–84	sep–84		feb–84	sep–84
TOX	0.064	0.016		0.00375	–0.003
	0.074	0.018		0.01375	–0.001
	0.041	0.016		–0.01925	–0.003
	0.062	0.026		0.00175	0.007
average	0.06025	0.019	varience	0.0002	0.00002
			Tstar	4.02	–0.28
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	3.64	2.91
			If Tstar < Tc no release	rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1985

Background Well MW–4

Initial Mean =	0.021
Initial Varience =	0.000565
Sample Size =	12

Compliance Well MW–4

	annual data		'diff
	mar–85		mar–85
TOX	0.005		0
	0.005		0
	0.005		0
	0.005		0
average	0.005	varience	0
		Tstar	–2.33
		Tb	2.72
		Tm	4.54
		Wm	0.00
		Wb	0.00
		Tc	2.72
		If Tstar < Tc no release	no rel

Students t–Test for wells in the OD area
TOX – Year 1986

Background Well MW–4

Initial Mean = 0.021
Initial Varience = 0.000565
Sample Size = 12

Compliance Well MW–4

	semiannual data			'diff	
	mar–86	sep–86		mar–86	sep–86
TOX	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
	0.005	0.005		0	0
average	0.005	0.005	varience	0	0
			Tstar	−2.33	−2.33
			Tb	2.72	2.72
			Tm	4.54	4.54
			Wm	0.00	0.00
			Wb	0.00	0.00
			Tc	2.72	2.72
			If Tstar < Tc no release	no rel	no rel

Students t–Test for wells in the OD area
TOX – Year 1987

Background Well MW–4

Initial Mean = 0.021
Initial Varience = 0.000565
Sample Size = 12

Compliance Well MW–4

		annual data		'diff
	mar–86			mar–86
TOX	0.005			0
	0.005			0
	0.005			0
	0.005			0
average	0.005		varience	0
			Tstar	–2.33
			Tb	2.72
			Tm	4.54
			Wm	0.00
			Wb	0.00
			Tc	2.72
		If Tstar < Tc no release		no rel

APPENDIX 5C

GROUNDWATER FLOW CALCULATIONS

MAIN
1893

Client Groundwater Flow Calculations Job No. 720229-8009 Sheet 1 of 3
Subject SEAD, Subpart X By MS Date 4/15/92
Ckd. Rev.

Monitoring Well	K cm/sec	K ft/day	Source
MW-7	10^{-4}	0.28	O'Brien & Gere, 8
MW-8		0.15	M&E, 1989
MW-9		0.75	
MW-10		0.02	
MW-11		0.72	
MW-12		1.10	
MW-13		0.04	
MW-14		0.13	
MW-15		0.24	
MW-16		0.38	
MW-17		1.47	

Average 0.48 ft/day

Client SEAD, Subpart X Job No. 720229-8000 Sheet 2 of 3
Subject Groundwater Flow Calculations By MS Date 4/15/92
Ckd. Rev.

Flow Velocity

Darcy's Law $v = \frac{k\,i}{n}$

where
k = hydraulic conductivity (ft/day)
i = hydraulic flow gradient (ft/ft)
n = porosity

Average Hydraulic conductivity = 0.48 ft/day

& Hydraulic Gradient (Figure E-1 & E-2) = 0.011 ft/ft

Porosity (Typical Values for Glacial Till, Driscoll, 1986) = 10-25%

(Source: Groundwater and Wells, F.G. Driscoll, 1986)

Assuming a porosity of 10%; $v = 0.48 \frac{ft}{day} \times \frac{0.011}{0.10} \frac{ft}{ft}$

$= 0.053$ ft/day

Assuming a porosity of 25% $v = 0.48 \frac{ft}{day} \times \frac{0.011}{0.25} \frac{ft}{ft}$

$= 0.021$ ft/day

Thus, the groundwater flow velocity is expected to range between 0.021 ft/day to 0.053 ft/day.

MAIN
1893

Client SEAD , Subpart X
Job No. 720229-8000 Sheet 3 of 3
Subject Groundwater Flow Calculations
By MS Date 4/15/92
Ckd. Rev.

For the purposes of estimating a suitable sampling frequency ~~the~~ for independent sample collection the worst case is the slowest flow velocity. Hence, for these purposes ~~a velocity~~ the lower velocity number of 0.021 ft/day should be used.

Sampling Frequency

Groundwater Flow Velocity = 0.021 ft/day

= 0.252 in/day

Time required for groundwater to flow one well diameter

$$\text{(2 inches)} = \frac{2\text{in}}{0.252\left(\frac{\text{in}}{\text{day}}\right)} = 7.93 \text{ days}$$

The above calculations present the worst case scenario. ~~To~~ However to account for variable recharge rates which can affect flow velocity a sampling interval of 10 days is suggested.

APPENDIX 5D

STANDARD OPERATING PROCEDURES FOR DRILLING AND MONITORING WELL INSTALLATION

CONTENTS

SOIL BORINGS

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

SOIL BORINGS

1.0 OBJECTIVE

The objective of these guidelines is to provide procedures for Soil Borings.

2.0 EQUIPMENT

1. Drill rig capable of remote drilling using the following techniques: hollow-stem augers, drive-and-wash and rock coring.
2. Hollow stem augers up to ten-inch outer diameter.
3. Steel casing.

3.0 SUPPORTING SOPs

SOP No.	Title
430	Volatile Organic Compound Screening with a Photoionizing Detector (PID)
565	Field Equipment Decontamination
522	Subsurface soil sampling

4.0 PROCEDURES

Soil Boring techniques will involve a remote drilling operation. The remote drilling operations are necessary due to the unexploded ordinance conditions. Drilling procedures may involve the manual set-up of the augers and split spoons, remote augering, remote driving of the split spoon and manual retrieval of the sample.

The drilling equipment, including the rig, water tank (inside and outside), casing, augers, rods, tubs, etc., will be steam cleaned at the job site prior to starting the work. The equipment will be kept clean until it is used. All the downhole equipment will be steam cleaned between borings, then inspected to make sure oil, asphalt, grease, grout, soil, etc. has been removed from the drilling equipment. The subcontractor will provide the steam cleaning equipment. The decontamination area will be agreed on by the contractor, MAIN, and Client.

Between samples, the split spoons will be rinsed with alconox, then washed with soapy potable water, and rinsed with potable water after each use.

Whenever possible, hollow-stem augers will be used to advance a boring. This technique introduces no water during drilling. When conditions prevent the use of augers, such as fine sand running up into the augers, the drillers will use the drive-and-wash technique with steel casing or another appropriate technique. At first, potable water will be used as the drilling fluid. An additive will not be used unless absolutely needed, and, if required, bentonite with no organic additives will be used.

Soil samples will be collected during the borings using a split spoon sampler. Shelby tubes may also be used to collect undisturbed soil samples. The split spoon samples will be obtained continuously or at five foot intervals in the overburden of all borings. The soils would be sampled continuously to define lithology or in contaminated zones. Each sample will be screened for volatile organic compounds using a field-portable instrument such as an OVA, HNu, or gas chromatograph immediately after the split spoon is opened or in the headspace of the soil sample jar. Representative soil samples will be placed in half-pint or one-pint glass jars with air-tight, screw-type lids. These jars will be stored in cardboard boxes with cardboard separators. The soils will be described by the site engineer/geologist using the Unified Soil classification system in the field and reported on Test Boring Report forms filled out by MAIN personnel (Figure 121-1).

PREPARED BY: ______________________

APPROVED BY: ______________________
Chief Hydrogeologist

APPROVED BY: ______________________
Project Manager

Figure 121–1

CHAS. T. MAIN, INC.	TEST BORING REPORT	BORING NO. :

ROJECT :
ENT :
ACTOR :

JOB NO. :
SHEET NO. :
ELEV. DATUM :
ELEV. (GS) :
ELEV. (TOC) :
DATE START :
DATE FINISH :
DRILLER / HELPER :
INSPECTOR:

	METH	SMPR	COR. BAR.	GROUNDWATER READINGS			
YPE :				DATE	TIME	DEPTH TO WATER	STABILIZATION TIME
IZE /OD :							
AMMER EIGHT:							
AMMER ALL :							

DEPTH (FEET)	SAMPLE					SAMPLE DESCRIPTION	USCS CLASS
	CASING BLOWS PER FOOT	SAMPLE BLOWS PER 6 INCHES	SAMPLE NUMBER	PENETRATION RECOVERY	VOC SCREEN (ppm)		
5							
10							
15							

ER USED (gal) :
ER LOST (gal) :
OR :

DATE OF DEV. :
METHOD:
WATER REMOVED :

REMARKS:

IPE :	TYPE	DIAM.	SLOT SIZE
ASING :	TYPE	DIAM.	KEY : YES NO

Figure 121–1

CHAS. T. MAIN, INC.	TEST BORING REPORT	BORING NO. : PAGE: ____ OF ____

DEPTH (FEET)	SAMPLE CASING BLOWS PER FOOT	 SAMPLE BLOWS PER 6 INCHES	 SAMPLE NUMBER	 PENETRATION RECOVERY	 VOC SCREEN (ppm)	SAMPLE DESCRIPTION	USCS CLASS
20							
25							
30							
35							

Figure 121–1

CHAS. T. MAIN, INC.	TEST BORING REPORT	BORING NO. :
		PAGE: _____ OF _____

	SAMPLE						
DEPTH (FEET)	CASING BLOWS PER FOOT	SAMPLE BLOWS PER 6 INCHES	SAMPLE NUMBER	PENETRATION RECOVERY	VOC SCREEN (ppm)	SAMPLE DESCRIPTION	USCS/ CLASS
40							
45							
50							
55							

Figure 121–1

CHAS. T. MAIN, INC.	**TEST BORING REPORT**	**BORING NO. :**
		PAGE: _____ OF _____

DEPTH (FEET)	SAMPLE					SAMPLE DESCRIPTION	USCS CLASS
	CASING BLOWS PER FOOT	SAMPLE BLOWS PER 6 INCHES	SAMPLE NUMBER	PENETRATION RECOVERY	VOC SCREEN (ppm)		

WELL INSTALLATION

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

MONITORING WELL INSTALLATION

1.0 OBJECTIVE

The objective of these guidelines is to provide procedures for the installation of groundwater monitoring wells.

2.0 EQUIPMENT

1) Truck-mounted drill rig capable of the following techniques: hollow-stem augers and drive-and-wash.
2) Hollow stem augers up to ten-inch outer diameter.
3) Steel casing.
4) Additional water tanks if necessary.

Wells are specified by diameter, type of material and thickness of pipe. Well screen requires an additional specification of slot size. Thickness of pipe is referred to as "schedule" for polyvinyl chloride (PVC) casing and is usually schedule 40 or 80. Steel casing thickness if often referred to as "Strength" and Standard Strength is usually adequate for monitoring well purposes. Obviously, the larger the diameter of the casing, the thicker the casing may need to be to maintain adequate strength.

Other materials include: medium silica sand, Bentonite chips and powder, cement powder and protective casings (either a metal standpipe or a roadway box) with a locking cap.

3.0 SUPPORTING SOPs

SOP No.	Title
635	Decontamination Procedures

4.0 PROCEDURES

The installation of each monitoring well will begin after the boring has been completed. Installation will begin within 48 hours for fully cased boreholes. Once installation has begun, no breaks in the installation process will be made until the well has been grouted and the drill casing removed.

40.1 INSTALLATION

If water was used while drilling the well, the casing will be flushed with potable water until the water runs clear.

The well screen and casing will be constructed of standard strength stainless steel. The screen slot size will be selected based on the grain size distribution of the unit to be screened. The minimum casing diameter will be 2 inches. All the pipe will be new and have threaded, flush joints. No glued connections will be used.

Clean, medium silica sand will be placed into the annulus 0.5 feet below, around, and 2 to 3 feet above the screened interval. Above the sand pack, 2 to 3 feet of bentonite slurry will be installed. For wells installed in rock, the thickness of sand and bentonite above the screened interval will be adjusted so that the bentonite seal will be in sound rock. Sound rock is below the depth at which the boring encountered refusal. This should be below the weathered and highly fractured zone.

The remaining annular space will be backfilled with lean grout containing at least 5% bentonite powder by volume to a depth of about 2.5 feet below ground surface. All grout seals placed below the water table will be tremie piped into place. Care will be taken to seal across potentially confining stratigraphic layers to eliminate/reduce the possibility of cross-contaminating different aquifer units.

A protective casing or roadway box will be installed over the riser pipe. The protective casing will consist of a 5-foot-long steel pipe 4 or 6 inches in diameter with a locking protective cap. The roadway box will consist of a 4 or 6 inch diameter cast iron pipe with a keyed cover and mechanism under the cover that will be secured with a pad lock.

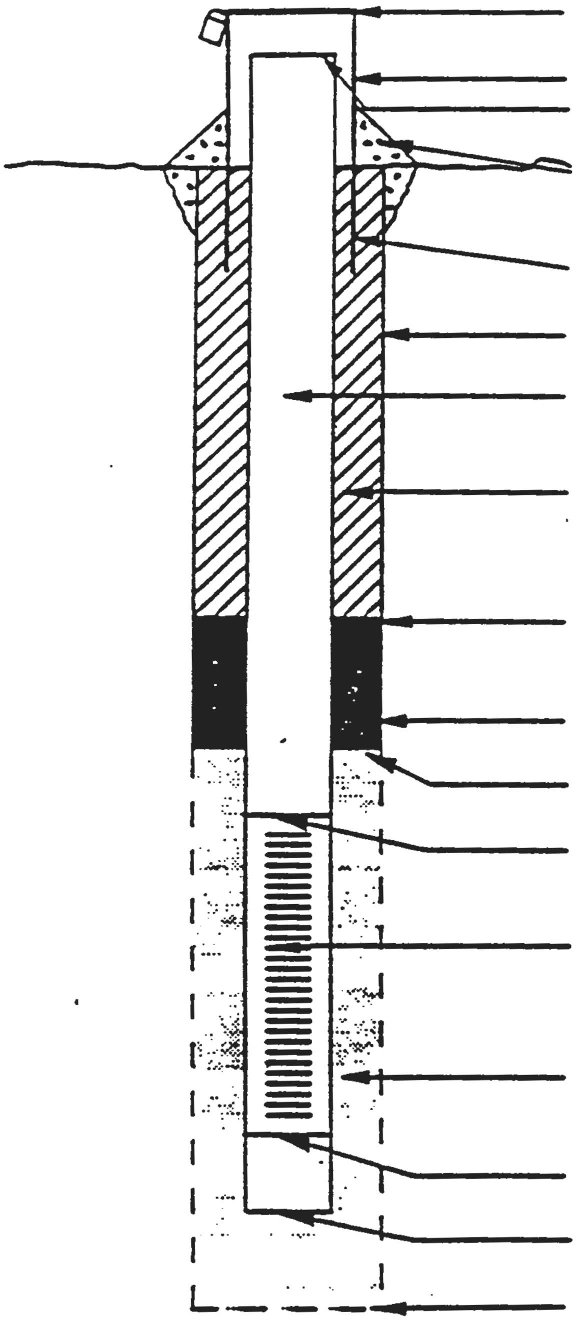
The protective casing will be installed so that the top of the riser pipe is 0.1 to 0.5 feet below the top of the steel casing and about 2.5 feet of the steel casing is above ground surface. The space between the casing and the borehole and inside the steel casing is filled with grout. The lock used to secure the cap to the protective casing and roadway box will be keyed to the same combination as the other well locks on site.

Figure 130-1

MAIN
1893

OVERBURDEN MONITORING WELL

Project ______ Location ______ Driller ______
Project No. ______ Boring ______ Drilling Method ______
Elevation ______ Date ______ Development Method ______



Elevation of Top of Surface Casing: ______
Slick up of Casing Above Ground Surface: ______
Elevation Top of Riser: ______
Type of Surface Seal: ______
______
I.D. of Surface Casing: ______
Diameter of Hole: ______
Riser Pipe I.D.: ______
Type of Riser Pipe: ______
Type of Backfill: ______
______
______
Elevation/Depth Top of Seal: ______
______
Type of Seal: ______
Elevation/Depth Top of Sand: ______
Elevation/Depth Top of Screen: ______
Type of Screen: ______
Slot Size x Length: ______
I.D. Screen: ______
Type of Sand Pack: ______
______
Elevation/Depth Bottom of Screen: ______
Sediment Sump with Plug: ______
Elevation/Depth Bottom of Hole: ______

WELL DEVELOPMENT

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

MONITORING WELL DEVELOPMENT

1.0 OBJECTIVE

The objective of these guidelines is to provide procedures for the development of monitoring wells.

2.0 EQUIPMENT

1. Submersible pump or air sparger
2. Bottom filling bailor
3. Stopwatch or watch
4. pH meter
5. Specific Conductivity meter.
6. Nephelometer (field portable)
7. Battery operated water level indicator

3.0 SUPPORTING SOPs

SOP No.	Title
565	Field Equipment Decontamination
640	pH Measurements
645	Specific Conductivity Measurements
600	Groundwater Elevation Measurements
660	Turbidity Measurements

4.0 PROCEDURES

All data and calculations should be recorded on the Well Development Report (Figure 140-1).

1. Measure the groundwater elevation and well depth.

2. Calculate the standing water volume taking into account the water standing in the riser pipe and screen, and in the gravel pack around the screen, assuming 30% porosity in the sand.
3. Remove 3 times the standing water volume and measure pH, turbidity, and specific conductivity.
4. Remove at least two more standing water volumes and measure the pH, turbidity, and specific conductivity after each. If the pH and specific conductivity measurements are within 10 percent of each other and the turbidity is less than 5 NTUs, development is complete.
5. If the pH and specific conductivity measurements are not within 10 percent and the turbidity is not less than 5 NTUs, additional standing water volumes should be removed until this criteria is met.

PREPARED BY: ____________________

APPROVED BY: ____________________
Chief Hydrogelogist

APPROVED BY: ____________________
Project Manager

CHAS. T. MAIN, INC.

WELL DEVELOPMENT REPORT

WELL NO.: ____________ DATE OF WELL INSTALLATION: ________

DEVELOPMENT DATE: ____________ TIME: ____________

WELL DEVELOPER: ____________ MAIN PERSONNEL: ____________

CALCULATIONS

WATER DEPTH (TOC): ________ FT. WELL DEPTH (TOC): ________ FT.

WELL DIAMETER: ________ IN. BORING OD: ________ IN.

A = Standing Water Depth _____ Ft. x Well Diam. Factor _____ Gal/Ft. = ________ Gals.

B = [Standing Water Depth _____ Ft. x Boring OD Factor ___ Gal/Ft. - A ___Gals]. 3 = _____ Gals

FACTORS

Diameter (In.)	1	2	3	4	5	6	7	8	9	10	11	12
Gal./Ft.	.041	.163	.367	.654	1.02	1.47	2.00	2.61	3.30	4.08	4.93	5.87

Standing Water Volume = A + B = _____ Gal.
Water Volume Loss During Drilling = _____ Gal.

DEVELOPMENT

	PUMP	SURGE BLOCK	OTHER: _____
Type	_____	_____	_____
Pumping Rate	_____	_____	_____
Volume Removed	_____	_____	_____
Total Purging Time	_____	_____	_____

Water Characteristics

	COLOR	CLARITY	OTHER	SEDIMENT THICKNESS
Start	_____	_____	_____	_____
End	_____	_____	_____	_____

REMARKS

SOIL AND ROCK DESCRIPTION

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

SOIL AND ROCK DESCRIPTIONS

1.0 OBJECTIVE

To visually classify soil and rock samples in the field.

2.0 SOIL DESCRIPTIONS

Soils will be classified according to the Unified Soils Classification System (USCS). This system is presented in Attachment A in summary form and by inclusion of ASTM Methods D2487-90 and D 2488-90.

Each soil sample will be described on the Test Boring Report in the following order:

1. Density
2. Color
3. Materials present in descending order of occurance
4. Other descriptions, such as stratifications, plasticity, other materials present, and odor.

An example description of a soil sample follows:

> Medium dense, tan fine gravelly medium to coarse SAND, little fine sand, trace silt with 1/8 to 1/4 inch layers of fine sandy SILT.

For judging the size of the material without a measuring device, 1/4 inch is considered equivalent to the No. 4 sieve, and No. 200 sieve is about the smallest particle size that can be distinguished by the unaided eye.

Two materials are smaller than the No. 200 sieve: silt (M) and clay (C). Some classification systems define size ranges for these soil particles, but for field classification purposes, they are identified by their respective behaviors. Organic material (O) is a common component of soil but has no size range; it is recognized by its composition.

These terms identify the major characteristics of soil.

1. Color

The color of the soil is described using the Munsell Soil Color Chart, which should be taken into the field.

2. Density and Consistency

The density of noncohesive granular soils is classified according to standard penetration resistances, as follows:

Designation	Standard Penetration Resistance (blows per foot)
Very loose	0 to 4
Loose	5 to 10
Medium dense	11 to 30
Dense	31 to 50
Very dense	Over 50

Standard penetration resistance is the number of blows required to drive a split barrel sampler with a 2-inch OD 12 inches into the material, using a 140-lb hammer falling freely through 30 inches. The sampler is driven through an 18 inch sample interval, and the number of blows is recorded for each 6 inch increment. The density designation of granular soils is obtained by adding the number of blows required to penetrate the last 12 inches of each sample interval.

The consistency of cohesive soils is determined either by blow counts, with a pocket penetrometer (values listed in the table as Unconfined Compressive Strength), or by hand by determining the resistance to penetration by the thumb. The pocket penetrometer and thumb determination methods are conducted on a selected sample of the soil, preferably the lowest 0.5 ft of the sample in the split barrel sampler. The sample should be broken in half and the thumb or penetrometer pushed into the end of the sample to determine the consistency. Do not determine consistency by attempting to penetrate a rock fragment. If the sample is decomposed rock, it is classified as a soft decomposed rock rather than a hard soil.

3. Plasticity

The most commonly used test performed in the field to categorize the plasticity of soil is the thread test. If a moist soil can be rolled into such a thread at some moisture content, it is said to have some plasticity. Materials that cannot be rolled in this manner are nonplastic, or have very low plasticity. The number of times that the thread may be lumped together and the rolling process repeated without crumbling and breaking is a measure of the degree of plasticity in the soil.

When the soil sample finally crumbles at about 1/8 inch diameter, which is the plastic limit, the degree of plasticity of the soil may be further measured by the ease with which this material may again be remolded. After reaching the plastic limit, the degree of plasticity may be described as follows:

1. High plasticity (CH) - The soil may be remolded into a ball and the ball deformed under extreme pressure by the fingers without cracking or crumbling.
2. Medium plasticity (CL) - The soil may be remodeled into a ball but the ball will crack and easily crumble under pressure of the fingers.
3. Low plasticity (CL, ML, or MH) - The soil cannot be lumped together into a ball without completely breaking up.

4. Stratification

Only by examining samples after the sample barrel has been split and before they are placed in jars is it possible to detect the stratification of granular material. The presence of this feature as well as its angle with respect to the horizontal are important to the proper interpretation of geologic conditions and should be noted at the end of the description on the field logs.

5. Moisture

Moisture content is estimated in the field according to four categories: dry, moist, wet, and saturated. In dry soil, there appears to be little or no water. Saturated samples obviously have all the water they can hold. Moist and wet classifications are somewhat subjective and often are determined by the individual's judgement. Laboratory tests for water content should be performed if the natural water content is important.

6. Texture/Fabric/Bedding

The texture/fabric/bedding of the soil should be described. Texture is described as the relative angularity of the particles: rounded, sub-rounded, subangular, and angular. Fabric should be noted as to whether the particles are flat or bulky and whether there is a particular relation between particles (i.e., all the flat particles are parallel or there is some cementation). The bedding or structure should also be noted (e.g., stratified, lensed, nonstratified, heterogeneous varved).

The following terms are used to further describe soils:

And -	Modifier which identifies a proportion of soil which ranges from 35 to 50 percent.
Some -	Modifier which identifies a proportion of soil which ranges from 20 to 35 percent.
Little -	Modifier which identifies a proportion of soil which ranges from 10 to 20 percent.
Trace -	Modifier which identifies a proportion of soil which ranges from 1 to 10 percent.

3.0 ROCK DESCRIPTIONS

Bedrock samples will be described using the following parameters and in the order presented:

		Example
1.	Field Hardness	Soft, very hard
2.	Weathering	Fresh, slight, severe
3.	Continuity	Sound, moderately fractured
4.	Color	Gray, green, yellow-brown
5.	Texture	Coarse grained, porphyritic, crystalline
6.	Lithology	Limestone, sandstone, granite
7.	Discontinuities	Close spaced 30° joints, open wide spaced cracks, well-cemented vertical fault.
8.	Bedding and Foliation	Thin bedded, cross-bedded, foliated
9.	Solution Cavities and Voids	Pitted, vuggy with partial clay infilling.
10.	Miscellaneous Features	Fossils, secondary mineralization.

The lithology of the rock will be classified according to the system described by Russell B. Travis in Volume 50, Number 1 of the "Quarterly of the Colorado School of Mines" (Attachment B).

An example description of a rock core sample follows:

> Hard, slightly weathered, moderately fractured, gray, coarse-grained CAMBRIDGE ARGILLITE; moderately close, tight, shallow, smooth joints; minor shear parallel to bedding at 40-foot depth; very thin, horizontal bedding; with siltstone and shale partings and occasional calcite fillings.

The rock quality will also be evaluated by calculating the recovery and the Rock Quality Designation (RQD). The recovery is calculated by summing the length of all the pieces recovered in the core barrel, then dividing it by the cored distance. The RQD is calculated by summing the length of all the pieces 4 inches or longer recovered in the core barrel, then dividing it by the cored distance (Attachment C).

PREPARED BY: ______________________

APPROVED BY: ______________________
Chief Hydrogeologist

APPROVED BY: ______________________
Project Manager

ATTACHMENT A
SOIL DESCRIPTIONS

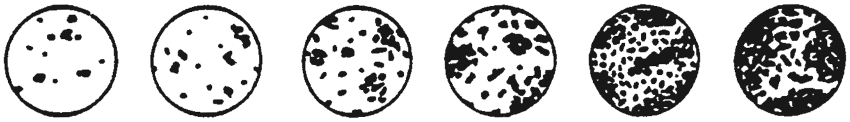
0 mm 10 20 30 40 50 60 70 80 90 100 110

Geotechnical Gauge

Manuf. by:
W.F. McCollough
3161 Elkridge Ct.
Beltsville, MD 2070

6 5 4 3 2 1 0 inches

Very Angular | Angular | Sub Angular | Sub Rounded | Rounded | Well Rounded



3 % 5 % 15 % 25 % 40 % 50 %

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	▨	GW	WELL - GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES.
			▨	GP	POORLY - GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES.
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES.
			▨	GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES.
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)	▨	SW	WELL - GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
			▨	SP	POORLY - GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES.
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)	▨	SM	SILTY - SANDS, SAND - SILT MIXTURES.
			▨	SC	CLAYEY SANDS, SAND - CLAY MIXTURES.
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	▨	ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY.
			▨	CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS.
			▨	OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY.
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	■	MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS.
			■	CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS.
			▨	OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS.
HIGHLY ORGANIC SOILS			▤	PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS.

■	Light Brown
■	Yellowish Orange
■	Greenish Gray
■	Olive Gray
■	Light Gray
■	Dark Gray

CLAY

CLAY CONSISTENCY	THUMB PENETRATION	SPT, N BLOWS/ FT.	Undrained Shear Strength c (PSF)	Unconfined Compressive Strength q_u
			TORVANE	Pocket Penetrometer
VERY SOFT	Easily penetrated several inches by thumb. Exudes between thumb and finger's when squeezed in hand.	< 2	250	500
SOFT	Easily penetrated one inch by thumb. Molded by light finger pressure.	2 - 4	250 - 500	500 - 1000
MEDIUM STIFF	Can be penetrated over 1/4 " by thumb with moderate effort. Molded by strong finger pressure.	4 - 8	500 - 1000	1000 - 2000
STIFF	Indented about 1/4" by thumb but penetrated only with great effort.	8 - 15	1000 - 2000	2000 - 4000
VERY STIFF	Readily indented by thumbnail.	15 - 30	2000 - 4000	4000 - 8000
HARD	Indented with difficulty by thumbnail.	> 30	> 4000	> 8000

SAND

SOILTYPE	SPT, N Blows/ft.	Relative Density,%	FIELD TEST
VERY LOOSE SAND	4	0 - 15	Easily penetrated with 1/2" reinforcing rod pushed by hand.
LOOSE SAND	4 - 10	15 - 35	Easily penetrated with 1/2" reinforcing rod pushed by hand.
MEDIUM DENSE SAND	10 - 30	35 - 65	Penetrated a foot with 1/2" reinforcing rod driven with 5-lb hammer.
DENSE SAND	30 - 50	65 - 85	Penetrated a foot with 1/2" reinforcing rod driven with 5-lb hammer.
VERY DENSE SAND	50	85 - 100	Penetrated only a few inches with 1/2" reinforcing rod driven with 5-lb hammer.

Unified Soil Classification System (USCS)

	MILLIMETERS	INCHES	SIEVE SIZES
BOULDERS	> 300	> 11.8	-
COBBLES	75 - 300	2.9 - 11.8	-
GRAVEL:			
COARSE	75 - 19	2.9 - .75	-
FINE	19 - 4.8	.75 - .19	3/4" - No. 4
SAND:			
COARSE	4.8 - 2.0	.19 - .08	No. 4 - No. 10 
MEDIUM	2.0 - .43	.08 - .02	No. 10 - No. 40 
FINE	.43 - .08	.02 - .003	No. 40 - No. 200 
FINES:			
SILTS	< .08	< .003	< No. 200 
CLAYS	< .08	< .003	< No. 200

Standard Test Method for Classification of Soils for Engineering Purposes[1]

This standard is issued under the fixed designation D 2487; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

This test method has been approved for use by agencies of the Department of Defense. Consult the DOD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This test method describes a system for classifying mineral and organo-mineral soils for engineering purposes based on laboratory determination of particle-size characteristics, liquid limit, and plasticity index and shall be used when precise classification is required.

NOTE 1—Use of this standard will result in a single classification group symbol and group name except when a soil contains 5 to 12 % fines or when the plot of the liquid limit and plasticity index values falls into the crosshatched area of the plasticity chart. In these two cases, a dual symbol is used, for example, GP-GM, CL-ML. When the laboratory test results indicate that the soil is close to another soil classification group, the borderline condition can be indicated with two symbols separated by a slash. The first symbol should be the one based on this standard, for example, CL/CH, GM/SM, SC/CL. Borderline symbols are particularly useful when the liquid limit value of clayey soils is close to 50. These soils can have expansive characteristics and the use of a borderline symbol (CL/CH, CH/CL) will alert the user of the assigned classifications of expansive potential.

1.2 The group symbol portion of this sytem is based on laboratory tests performed on the portion of a soil sample passing the 3-in. (75-mm) sieve (see Specification E 11).

1.3 As a classification system, this test method is limited to naturally occurring soils.

NOTE 2—The group names and symbols used in this test method may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. See Appendix X2.

1.4 This test method is for qualitative application only.

NOTE 3—When quantitative information is required for detailed designs of important structures, this test method must be supplemented by laboratory tests or other quantitative data to determine performance characteristics under expected field conditions.

1.5 The system is based on the widely recognized Unified Soil Classification System which was adopted by several U.S. Government agencies in 1952 as an outgrowth of the Airfield Classification System developed by A. Casagrande.[2]

1.6 *This standard does not purport to address the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

C 117 Test Method for Materials Finer Than 75-μm (No. 200) Sieve in Mineral Aggregates by Washing[3]

C 136 Method for Sieve Analysis of Fine and Coarse Aggregates[3]

C 702 Practice for Reducing Field Samples of Aggregate to Testing Size[3]

D 420 Guide for Investigating and Sampling Soil and Rock[4]

D 421 Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[4]

D 422 Method for Particle-Size Analysis of Soils[4]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[4]

D 1140 Test Method for Amount of Material in Soils Finer than the No. 200 (75-μm) Sieve[4]

D 2216 Method for Laboratory Determination of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures[4]

D 2217 Practice for Wet Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants[4]

D 2488 Practice for Description and Identification of Soils (Visual-Manual Procedure)[4]

D 4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)[4]

D 4318 Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils[4]

D 4427 Classification of Peat Samples by Laboratory Testing[4]

E 11 Specification for Wire-Cloth Sieves for Testing Purposes[3]

3. Terminology

3.1 *Definitions*—Except as listed below, all definitions are in accordance with Terms and Symbols D 653.

NOTE 4—For particles retained on a 3-in. (75-mm) U.S. standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) U.S. standard sieve, and

Boulders—particles of rock that will not pass a 12in. (300-mm) square opening

3.1.1 *gravel*—particles of rock that will pass a 3-in.

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[1] This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

Current edition approved June 29, 1990. Published August 1990. Originally published as D 2487 – 66 T. Last previous edition D 2487 – 85$^{\epsilon1}$.

[2] Casagrande, A., "Classification and Identification of Soils," *Transactions*, ASCE, 1948, p. 901.

[3] *Annual Book of ASTM Standards*, Vol 04.02.

[4] *Annual Book of ASTM Standards*, Vol 04.08.

(75-mm) sieve and be retained on a No. 4 (4.75-mm) U.S. standard sieve with the following subdivisions:

Coarse—passes 3-in. (75-mm) sieve and retained on ¾-in. (19-mm) sieve, and

Fine—passes ¾-in. (19-mm) sieve and retained on No. 4 (4.75-mm) sieve.

3.1.2 *sand*—particles of rock that will pass a No. 4 (4.75-mm) sieve and be retained on a No. 200 (75-μm) U.S. standard sieve with the following subdivisions:

Coarse—passes No. 4 (4.75-mm) sieve and retained on No. 10 (2.00-mm) sieve,

Medium—passes No. 10 (2.00-mm) sieve and retained on No. 40 (425-μm) sieve, and

Fine—passes No. 40 (425-μm) sieve and retained on No. 200 (75-μm) sieve.

3.1.3 *clay*—soil passing a No. 200 (75-μm) U.S. standard sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents and that exhibits considerable strength when air dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line.

3.1.4 *silt*—soil passing a No. 200 (75-μm) U.S. standard sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4 or if the plot of plasticity index versus liquid limit falls below the "A" line.

3.1.5 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.6 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.7 *peat*—a soil composed of vegetable tissue in various stages of decomposition usually with an organic odor, a dark-brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.2 *Descriptions of Terms Specific to This Standard:*

3.2.1 *coefficient of curvature*, Cc—the ratio $(D_{30})^2/(D_{10} \times D_{60})$, where D_{60}, D_{30}, and D_{10} are the particle diameters corresponding to 60, 30, and 10 % finer on the cumulative particle-size distribution curve, respectively.

3.2.2 *coefficient of uniformity*, Cu—the ratio D_{60}/D_{10}, where D_{60} and D_{10} are the particle diameters corresponding to 60 and 10 % finer on the cumulative particle-size distribution curve, respectively.

4. Summary of Test Method

4.1 As illustrated in Table 1, this classification system identifies three major soil divisions: coarse-grained soils, fine-grained soils, and highly organic soils. These three divisions are further subdivided into a total of 15 basic soil groups.

4.2 Based on the results of visual observations and prescribed laboratory tests, a soil is catalogued according to the basic soil groups, assigned a group symbol(s) and name, and thereby classified. The flow charts, Fig. 1 for fine-grained soils, and Fig. 2 for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name.

5. Significance and Use

5.1 This test method classifies soils from any geographic location into categories representing the results of prescribed laboratory tests to determine the particle-size characteristics, the liquid limit, and the plasticity index.

5.2 The assigning of a group name and symbol(s) along with the descriptive information required in Practice D 2488 can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.3 The various groupings of this classification system have been devised to correlate in a general way with the engineering behavior of soils. This test method provides a useful first step in any field or laboratory investigation for geotechnical engineering purposes.

5.4 This test method may also be used as an aid in training personnel in the use of Practice D 2488.

5.5 This test method may be used in combination with Practice D 4083 when working with frozen soils.

6. Apparatus

6.1 In addition to the apparatus that may be required for obtaining and preparing the samples and conducting the prescribed laboratory tests, a plasticity chart, similar to Fig. 3, and a cumulative particle-size distribution curve, similar to Fig. 4, are required.

NOTE 5—The "U" line shown on Fig. 3 has been empirically determined to be the approximate "upper limit" for natural soils. It is a good check against erroneous data, and any test results that plot above or to the left of it should be verified.

7. Sampling

7.1 Samples shall be obtained and identified in accordance with a method or methods, recommended in Recommended Guide D 420 or by other accepted procedures.

7.2 For accurate identification, the minimum amount of test sample required for this test method will depend on which of the laboratory tests need to be performed. Where only the particle-size analysis of the sample is required, specimens having the following minimum dry weights are required:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

Whenever possible, the field samples should have weights two to four times larger than shown.

7.3 When the liquid and plastic limit tests must also be performed, additional material will be required sufficient to provide 150 g to 200 g of soil finer than the No. 40 (425-μm) sieve.

7.4 If the field sample or test specimen is smaller than the minimum recommended amount, the report shall include an appropriate remark.

TABLE 1 Soil Classification Chart

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification	
				Group Symbol	Group Name[B]
Coarse-Grained Soils More than 50 % retained on No. 200 sieve	Gravels More than 50 % of coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5 % fines[C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$[E]	GW	Well-graded gravel[F]
			$Cu < 4$ and/or $1 > Cc > 3$[E]	GP	Poorly graded gravel[F]
		Gravels with Fines More than 12 % fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50 % or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5 % fines[D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$[E]	SW	Well-graded sand
			$Cu < 6$ and/or $1 > Cc > 3$[E]	SP	Poorly graded sand[I]
		Sands with Fines More than 12 % fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50 % or more passes the No. 200 sieve	Silts and Clays Liquid limit less than 50	inorganic	PI > 7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI < 4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OL	Organic clay[K,L,M,N] Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	$\frac{\text{Liquid limit} - \text{oven dried}}{\text{Liquid limit} - \text{not dried}} < 0.75$	OH	Organic clay[K,L,M,P] Organic silt[K,L,M,Q]
Highly organic soils		Primarily organic matter, dark in color, and organic odor		PT	Peat

[A] Based on the material passing the 3-in. (75-mm) sieve.

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12 % fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D] Sands with 5 to 12 % fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15 % sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15 % gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in hatched area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29 % plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30 % plus No. 200, predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30 % plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.

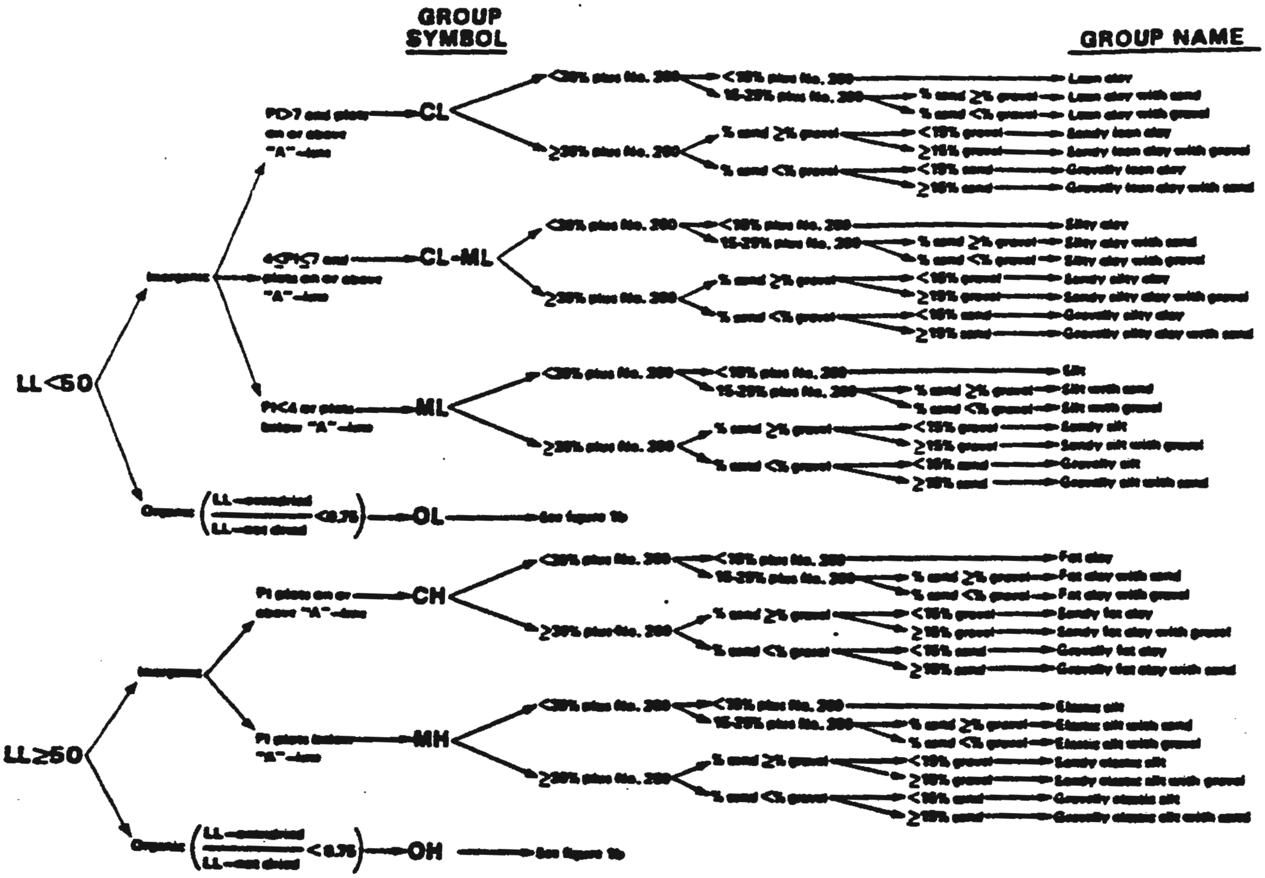


FIG. 1a Flow Chart for Classifying Fine-Grained Soil (50 % or More Passes No. 200 Sieve)

sification of Peat

8.1 A sample composed primarily of vegetable tissue in arious stages of decomposition and has a fibrous to amorhous texture, a dark-brown to black color, and an organic dor should be designated as a highly organic soil and shall e classified as peat, PT, and not subjected to the classificaon procedures described hereafter.

8.2 If desired, classification of type of peat can be perrmed in accordance with Classification D 4427.

Preparation for Classification

9.1 Before a soil can be classified according to this test ethod, generally the particle-size distribution of the minus in. (75-mm) material and the plasticity characteristics of e minus No. 40 (425-μm) sieve material must be deterined. See 9.8 for the specific required tests.

9.2 The preparation of the soil specimen(s) and the testing r particle-size distribution and liquid limit and plasticity dex shall be in accordance with accepted standard proceres. Two procedures for preparation of the soil specimens r testing for soil classification purposes are given in ppendixes X3 and X4. Appendix X3 describes the wet eparation method and is the preferred method for cohesive ils that have never dried out and for organic soils.

9.3 When reporting soil classifications determined by this t method, the preparation and test procedures used shall reported or referenced.

9.4 Although the test procedure used in determining the particle-size distribution or other considerations may require a hydrometer analysis of the material, a hydrometer analysis is not necessary for soil classification.

9.5 The percentage (by dry weight) of any plus 3-in. (75-mm) material must be determined and reported as auxiliary information.

9.6 The maximum particle size shall be determined (measured or estimated) and reported as auxiliary information.

9.7 When the cumulative particle-size distribution is required, a set of sieves shall be used which include the following sizes (with the largest size commensurate with the maximum particle size) with other sieve sizes as needed or required to define the particle-size distribution:

3-in. (75-mm)
¾-in.(19.0-mm)
No. 4 (4.75-mm)
No. 10 (2.00-mm)
No. 40 (425-μm)
No. 200 (75-μm)

9.8 The tests required to be performed in preparation for classification are as follows:

9.8.1 For soils estimated to contain less than 5 % fines, a plot of the cumulative particle-size distribution curve of the fraction coarser than the No. 200 (75-μm) sieve is required. The cumulative particle-size distribution curve may be plotted on a graph similar to that shown in Fig. 4.

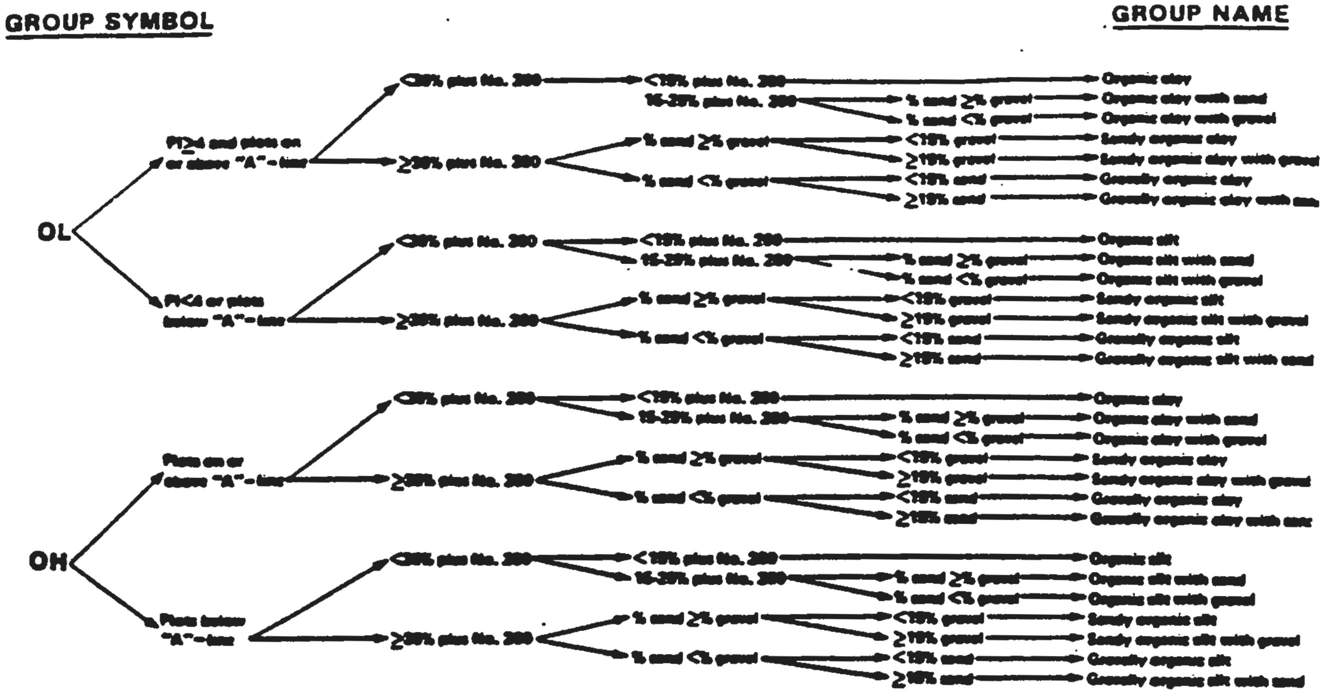


FIG. 1b Flow Chart for Classifying Organic Fine-Grained Soil (50 % or More Passes No. 200 Sieve)

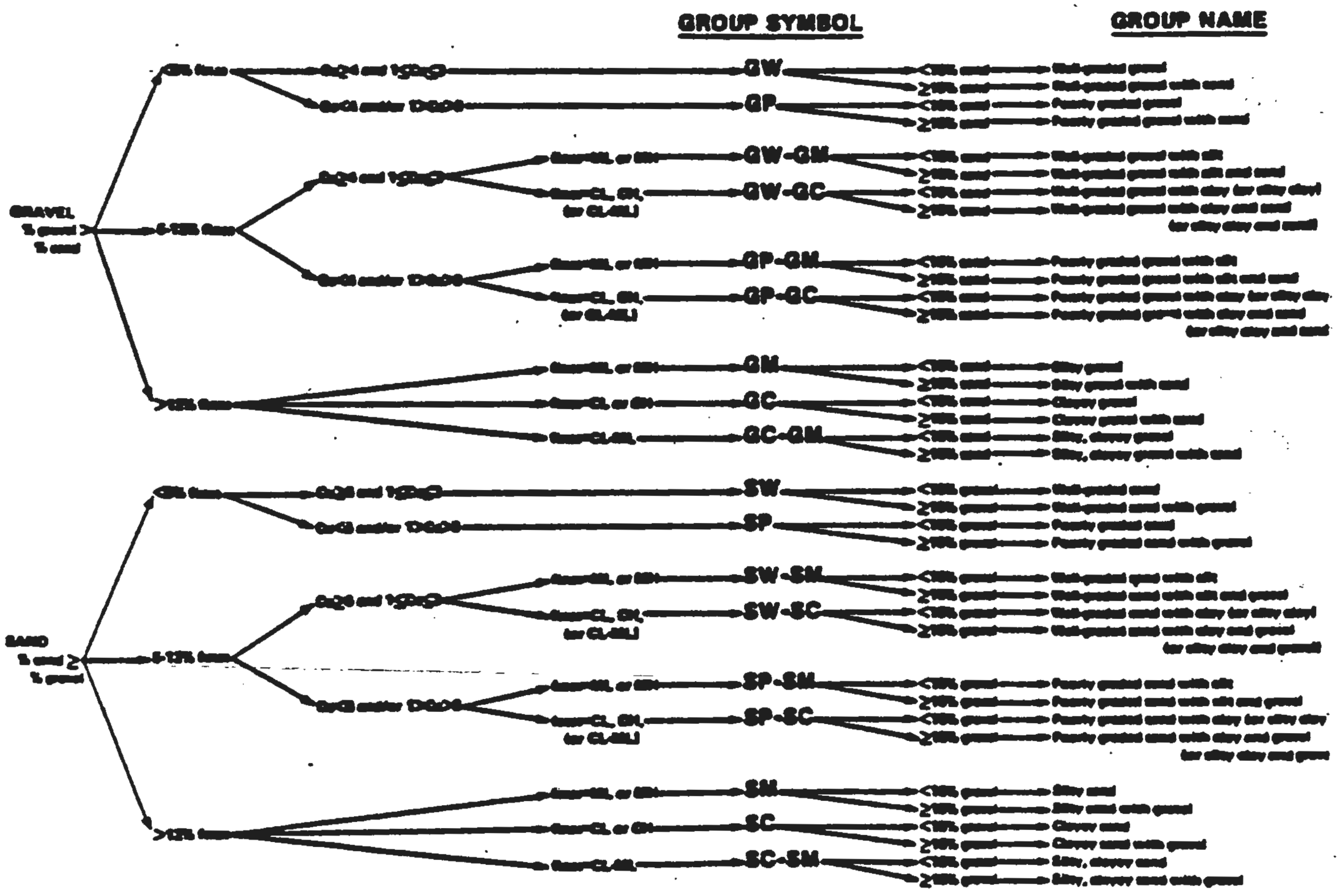


FIG. 2 Flow Chart for Classifying Coarse-Grained Soils (More Than 50 % Retained on No. 200 Sieve)

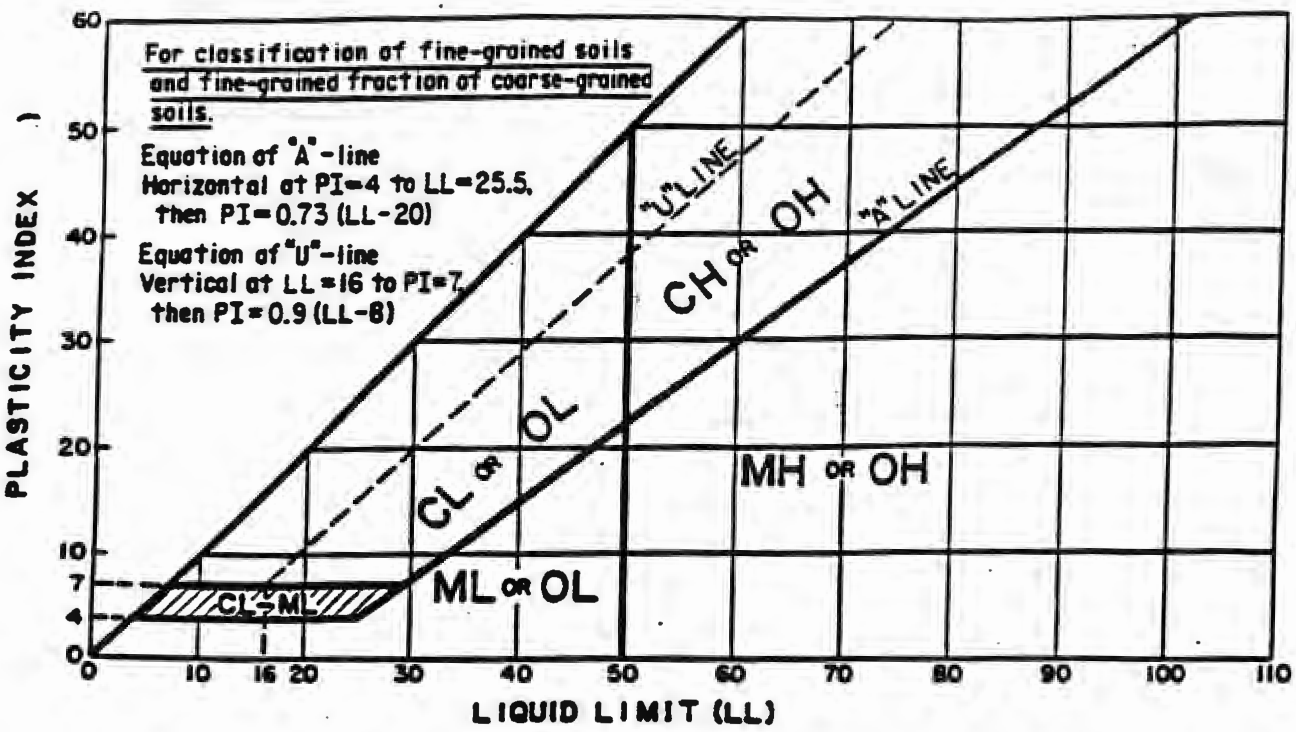


FIG. 3 Plasticity Chart

9.8.2 For soils estimated to contain 5 to 15 % fines, a cumulative particle-size distribution curve, as described in 9.8.1, is required, and the liquid limit and plasticity index are required.

9.8.2.1 If sufficient material is not available to determine the liquid limit and plasticity index, the fines should be estimated to be either silty or clayey using the procedures described in Practice D 2488 and so noted in the report.

9.8.3 For soils estimated to contain 15 % or more fines, a letermination of the percent fines, percent sand, and percent ravel is required, and the liquid limit and plasticity index re required. For soils estimated to contain 90 % fines or nore, the percent fines, percent sand, and percent gravel nay be estimated using the procedures described in Practice 2488 and so noted in the report.

0. Preliminary Classification Procedure

10.1 Class the soil as fine-grained if 50 % or more by dry eight of the test specimen passes the No. 200 (75-µm) sieve nd follow Section 11.

10.2 Class the soil as coarse-grained if more than 50 % by ry weight of the test specimen is retained on the No. 200 75-µm) sieve and follow Section 12.

1. Procedure for Classification of Fine-Grained Soils (50 % or more by dry weight passing the No. 200 (75-µm) sieve)

11.1 The soil is an inorganic clay if the position of the lasticity index versus liquid limit plot, Fig. 3, falls on or bove the "A" line, the plasticity index is greater than 4, and e presence of organic matter does not influence the liquid mit as determined in 11.3.2.

Note 6—The plasticity index and liquid limit are determined on the minus No. 40 (425 µm) sieve material.

11.1.1 Classify the soil as a *lean clay*, CL, if the liquid limit is less than 50. See area identified as CL on Fig. 3.

11.1.2 Classify the soil as a *fat clay*, CH, if the liquid limit is 50 or greater. See area identified as CH on Fig. 3.

Note 7—In cases where the liquid limit exceeds 110 or the plasticity index exceeds 60, the plasticity chart may be expanded by maintaining the same scale on both axes and extending the "A" line at the indicated slope.

11.1.3 Classify the soil as a *silty clay*, CL-ML, if the position of the plasticity index versus liquid limit plot falls on or above the "A" line and the plasticity index is in the range of 4 to 7. See area identified as CL-ML on Fig. 3.

11.2 The soil is an inorganic silt if the position of the plasticity index versus liquid limit plot, Fig. 3, falls below the "A" line or the plasticity index is less than 4, and presence of organic matter does not influence the liquid limit as determined in 11.3.2.

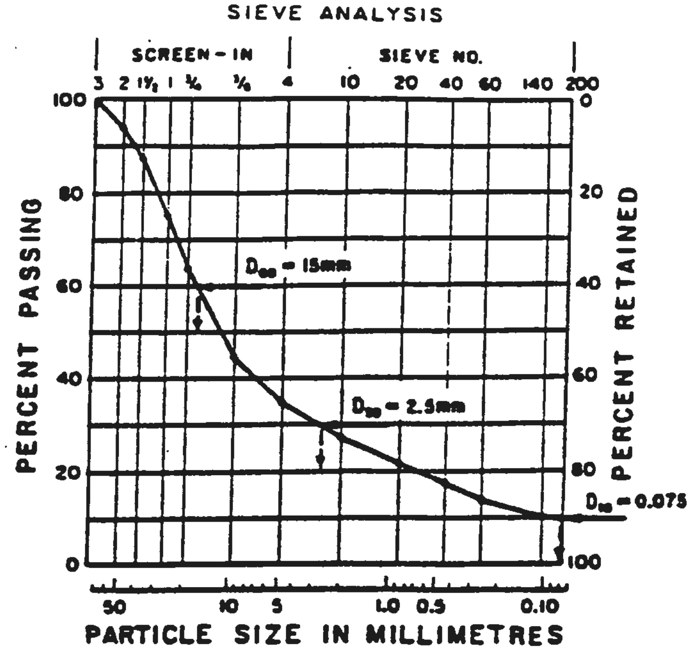
11.2.1 Classify the soil as a *silt*, ML, if the liquid limit is less than 50. See area identified as ML on Fig. 3.

11.2.2 Classify the soil as an *elastic silt*, MH, if the liquid limit is 50 or greater. See area identified as MH on Fig. 3.

11.3 The soil is an organic silt or clay if organic matter is present in sufficient amounts to influence the liquid limit as determined in 11.3.2.

11.3.1 If the soil has a dark color and an organic odor when moist and warm, a second liquid limit test shall be performed on a test specimen which has been oven dried at 110 ± 5°C to a constant weight, typically over night.

11.3.2 The soil is an organic silt or organic clay if the liquid limit after oven drying is less than 75 % of the liquid



$$C_u = \frac{D_{60}}{D_{10}} = \frac{15}{0.075} = 200 \qquad C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}} = \frac{(2.5)^2}{0.075 \times 15} = 5.6$$

FIG. 4 Cumulative Particle-Size Plot

limit of the original specimen determined before oven drying (see Procedure B of Practice D 2217).

11.3.3 Classify the soil as an *organic silt* or *organic clay*, OL, if the liquid limit (not oven dried) is less than 50 %. Classify the soil as an *organic silt*, OL, if the plasticity index is less than 4, or the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay*, OL, if the plasticity index is 4 or greater and the position of the plasticity index versus liquid limit plot falls on or above the "A" line. See area identified as OL (or CL-ML) on Fig. 3.

11.3.4 Classify the soil as an *organic clay* or *organic silt*, OH, if the liquid limit (not oven dried) is 50 or greater. Classify the soil as an *organic silt*, OH, if the position of the plasticity index versus liquid limit plot falls below the "A" line. Classify the soil as an *organic clay*, OH, if the position of the plasticity index versus liquid-limit plot falls on or above the "A" line. See area identified as OH on Fig. 3.

11.4 If less than 30 % but 15 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words "with sand" or "with gravel" (whichever is predominant) shall be added to the group name. For example, lean clay with sand, CL; silt with gravel, ML. If the percent of sand is equal to the percent of gravel, use "with sand."

11.5 If 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly sand. Add the word "gravelly" if 30 % or more of the test specimen is retained on the No. 200 (75-µm) sieve and the coarse-grained portion is predominantly gravel. For example, sandy lean clay, CL; gravelly fat clay, CH; sandy silt, ML. If the percent of sand is equal to the percent of gravel, use "sandy."

12. Procedure for Classification of Coarse-Grained Soils (more than 50 % retained on the No. 200 (75-µm) sieve)

12.1 Class the soil as gravel if more than 50 % of the coarse fraction [plus No. 200 (75-µm) sieve] is retained on the No. 4 (4.75-mm) sieve.

12.2 Class the soil as sand if 50 % or more of the coarse fraction [plus No. 200 (75-µm) sieve] passes the No. 4 (4.75-mm) sieve.

12.3 If 12 % or less of the test specimen passes the No. 200 (75-µm) sieve, plot the cumulative particle-size distribution, Fig. 4, and compute the coefficient of uniformity, Cu, and coefficient of curvature, Cc, as given in Eqs 1 and 2.

$$Cu = D_{60}/D_{10} \qquad (1)$$

$$Cc = (D_{30})^2/(D_{10} \times D_{60}) \qquad (2)$$

where:

D_{10}, D_{30}, and D_{60} = the particle-size diameters corresponding to 10, 30, and 60 %, respectively, passing on the cumulative particle-size distribution curve, Fig. 4.

NOTE 8—It may be necessary to extrapolate the curve to obtain the D_{10} diameter.

12.3.1 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as a *well-graded gravel*, GW, or *well-graded sand*, SW, if Cu is greater than 4.0 for gravel or greater than 6.0 for sand, and Cc is at least 1.0 but not more than 3.0.

12.3.2 If less than 5 % of the test specimen passes the No. 200 (75-µm) sieve, classify the soil as *poorly graded gravel*, *GP*, or *poorly graded sand*, SP, if either the Cu or the Cc criteria for well-graded soils are not satisfied.

12.4 If more than 12 % of the test specimen passes the No. 200 (75-μm) sieve, the soil shall be considered a coarse-grained soil with fines. The fines are determined to be either clayey or silty based on the plasticity index versus liquid limit plot on Fig. 3. (See 9.8.2.1 if insufficient material available for testing). (See Note 6)

12.4.1 Classify the soil as a *clayey gravel*, GC, or *clayey sand*, SC, if the fines are clayey, that is, the position of the plasticity index versus liquid limit plot, Fig. 3, falls on or above the "A" line and the plasticity index is greater than 7.

12.4.2 Classify the soil as a *silty gravel*, GM, or *silty sand*, SM, if the fines are silty, that is, the position of the plasticity index versus liquid limit plot, Fig. 3, falls below the "A" line or the plasticity index is less than 4.

12.4.3 If the fines plot as a silty clay, CL-ML, classify the soil as a *silty, clayey gravel*, GC-GM, if it is a gravel or a *silty, clayey sand*, SC-SM, if it is a sand.

12.5 If 5 to 12 % of the test specimen passes the No. 200 (75-μm) sieve, give the soil a dual classification using two group symbols.

12.5.1 The first group symbol shall correspond to that for a gravel or sand having less than 5 % fines (GW, GP, SW, SP), and the second symbol shall correspond to a gravel or sand having more than 12 % fines (GC, GM, SC, SM).

12.5.2 The group name shall correspond to the first group symbol plus "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example, well-graded gravel with clay, GW-GC; poorly graded sand with silt, SP-SM (See 9.8.2.1 if insufficient material available for testing).

Note 9—If the fines plot as a *silty clay*, CL-ML, the second group symbol should be either GC or SC. For example, a poorly graded sand with 10 % fines, a liquid limit of 20, and a plasticity index of 6 would be classified as a poorly graded sand with silty clay, SP-SC.

12.6 If the specimen is predominantly sand or gravel but contains 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example, poorly graded gravel with sand, clayey sand with gravel.

12.7 If the field sample contained any cobbles or boulders or both, the words "with cobbles," or "with cobbles and boulders" shall be added to the group name. For example, silty gravel with cobbles, GM.

13. Report

13.1 The report should include the group name, group symbol, and the results of the laboratory tests. The particle-size distribution shall be given in terms of percent of gravel, sand, and fines. The plot of the cumulative particle-size distribution curve shall be reported if used in classifying the soil. Report appropriate descriptive information according to the procedures in Practice D 2488. A local or commercial name or geologic interpretation for the material may be added at the end of the descriptive information if identified as such. The test procedures used shall be referenced.

Note 10—*Example: Clayey Gravel with Sand and Cobbles* (GC)—46 % fine to coarse, hard, subrounded gravel; 30 % fine to coarse, hard, subrounded sand; 24 % clayey fines, LL = 38, PI = 19; weak reaction with HCl; original field sample had 4 % hard, subrounded cobbles; maximum dimension 150 mm.

In-Place Conditions—firm, homogeneous, dry, brown.

Geologic Interpretation—alluvial fan.

Note 11—Other examples of soil descriptions are given in Appendix X1.

14. Precision and Bias

14.1 This test method provides qualitative data only; therefore, a precision and bias statement is nonapplicable.

15. Keywords

15.1 Atterberg limits; classification; clay; gradation; gravel; laboratory classification; organic soils; sand; silt; soil classification; soil tests

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF DESCRIPTIONS USING SOIL CLASSIFICATION

X1.1 The following examples show how the information required in 13.1 can be reported. The appropriate descriptive information from Practice D 2488 is included for illustrative purposes. The additional descriptive terms that would accompany the soil classification should be based on the intended use of the classification and the individual circumstances.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—73 % fine to coarse, hard, subangular gravel; 23 % fine to coarse, hard, subangular sand; 4 % fines; Cc = 2.7, Cu = 12.4.

X1.1.2 *Silty Sand with Gravel (SM)*—61 % predominantly fine sand; 23 % silty fines, LL = 33, PI = 6; 16 % fine, hard, subrounded gravel; no reaction with HCl; (field sample smaller than recommended). *In-Place Conditions*—Firm, stratified and contains lenses of silt 1 to 2 in. thick, moist, brown to gray; in-place density = 106 lb/ft^3 and in-place moisture = 9 %.

X1.1.3 *Organic Clay (OL)*—100 % fines, LL (not dried) = 32, LL (oven dried) = 21, PI (not dried) = 10; wet, dark brown, organic odor, weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—74 % fine to coarse, hard, subangular reddish sand; 26 % organic and silty dark-brown fines, LL (not dried) = 37, LL (oven dried) = 26, PI (not dried) = 6, wet, weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—78 % fine to coarse, hard, subrounded to subangular gravel; 16 % fine to coarse, hard, subrounded to subangular sand; 6 % silty (estimated) fines; moist, brown; no reaction with HCl; original field sample had 7 % hard, subrounded cobbles and 2 % hard, subrounded boulders with a maximum dimension of 18 in.

X2. USING SOIL CLASSIFICATION AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, ETC.

X2.1 The group names and symbols used in this test method may be used as a descriptive system applied to materials that exist in situ as shale, claystone, sandstone, siltstone, mudstone, etc., but convert to soils after field or laboratory processing (crushing, slaking, etc.).

X2.2 Materials such as shells, crushed rock, slag, etc., should be identified as such. However, the procedures used in this method for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, a classification in accordance with this test method may be assigned to aid in describing the material.

X2.3 If a classification is used, the group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how soil classifications could be incorporated into a description system for materials that are not naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. pieces of shale from power auger hole, dry, brown, no reaction with HCl. After laboratory processing by slaking in water for 24 h, material classified as "Sandy Lean Clay (CL)"—61 % clayey fines, LL = 37, PI = 16; 33 % fine to medium sand; 6 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"—91 % fine to medium sand; 9 % silty (estimated) fines; dry, reddish-brown, strong reaction with HCl.

X2.4.3 *Broken Shells*—62 % gravel-size broken shells; 31 % sand and sand-size shell pieces; 7 % fines; would be classified as "Poorly Graded Gravel with Sand (GP)".

X2.4.4 *Crushed Rock*—Processed gravel and cobbles from Pit No. 7; "Poorly Graded Gravel (GP)"—89 % fine, hard, angular gravel-size particles; 11 % coarse, hard, angular sand-size particles, dry, tan; no reaction with HCl; Cc = 2.4, Cu = 0.9.

X3. PREPARATION AND TESTING FOR CLASSIFICATION PURPOSES BY THE WET METHOD

X3.1 This appendix describes the steps in preparing a soil sample for testing for purposes of soil classification using a wet-preparation procedure.

X3.2 Samples prepared in accordance with this procedure should contain as much of their natural water content as possible and every effort should be made during obtaining, preparing, and transportating the samples to maintain the natural moisture.

X3.3 The procedures to be followed in this test method assume that the field sample contains fines, sand, gravel, and plus 3-in. (75-mm) particles and the cumulative particle-size distribution plus the liquid limit and plasticity index values are required (see 9.8). Some of the following steps may be omitted when they are not applicable to the soil being tested.

X3.4 If the soil contains plus No. 200 (75-μm) particles that would degrade during dry sieving, use a test procedure for determining the particle-size characteristics that prevents this degradation.

X3.5 Since this classification system is limited to the portion of a sample passing the 3-in. (75-mm) sieve, the plus 3-in. (75-mm) material shall be removed prior to the determination of the particle-size characteristics and the liquid limit and plasticity index.

X3.6 The portion of the field sample finer than the 3-in. (75-mm) sieve shall be obtained as follows:

X3.6.1 Separate the field sample into two fractions on a 3-in. (75-mm) sieve, being careful to maintain the natural water content in the minus 3-in. (75-mm) fraction. Any particles adhering to the plus 3-in. (75-mm) particles shall be brushed or wiped off and placed in the fraction passing the 3-in. (75-mm) sieve.

X3.6.2 Determine the air-dry or oven-dry weight of the fraction retained on the 3-in. (75-mm) sieve. Determine the total (wet) weight of the fraction passing the 3-in. (75-mm) sieve.

X3.6.3 Thoroughly mix the fraction passing the 3-in. (75-mm) sieve. Determine the water content, in accordance with Method D 2216, of a representative specimen with a minimum dry weight as required in 7.2. Save the water-content specimen for determination of the particle-size analysis in accordance with X3.8.

X3.6.4 Compute the dry weight of the fraction passing the 3-in. (75-mm) sieve based on the water content and total (wet) weight. Compute the total dry weight of the sample and calculate the percentage of material retained on the 3-in. (75-mm) sieve.

X3.7 Determine the liquid limit and plasticity index as follows:

X3.7.1 If the soil disaggregates readily, mix on a clean, hard surface and select a representative sample by quartering in accordance with Methods C 702.

X3.7.1.1 If the soil contains coarse-grained particles coated with and bound together by tough clayey material, take extreme care in obtaining a representative portion of the No. 40 (425-μm) fraction. Typically, a larger portion than normal has to be selected, such as the minimum weights required in 7.2.

X3.7.1.2 To obtain a representative specimen of a basically cohesive soil, it may be advantageous to pass the soil through a ¾-in. (19-mm) sieve or other convenient size so the material can be more easily mixed and then quartered or split to obtain the representative specimen.

X3.7.2 Process the representative specimen in accordance with Procedure B of Practice D 2217.

X3.7.3 Perform the liquid-limit test in accordance with Test Method D 4318, except the soil shall not be air dried prior to the test.

X3.7.4 Perform the plastic-limit test in accordance with Test Method D 4318, except the soil shall not be air dried or to the test, and calculate the plasticity index.

X3.8 Determine the particle-size distribution as follows:

X3.8.1 If the water content of the fraction passing the 3-in. (75-mm) sieve was required (X3.6.3), use the water-content specimen for determining the particle-size distribution. Otherwise, select a representative specimen in accordance with Practice C 702 with a minimum dry weight as required in 7.2.

X3.8.2 If the cumulative particle-size distribution including a hydrometer analysis is required, determine the particle-size distribution in accordance with Method D 422. See 9.7 for the set of required sieves.

X3.8.3 If the cumulative particle-size distribution without a hydrometer analysis is required, determine the particle-size distribution in accordance with Method C 136. See 9.7 for the set of required sieves. The specimen should be soaked until all clayey aggregations have softened and then washed in accordance with Test Method C 117 prior to performing the particle-size distribution.

X3.8.4 If the cumulative particle-size distribution is not required, determine the percent fines, percent sand, and percent gravel in the specimen in accordance with Test Method C 117, being sure to soak the specimen long enough to soften all clayey aggregations, followed by Method C 136 using a nest of sieves which shall include a No. 4 (4.75-mm) sieve and a No. 200 (75-μm) sieve.

X3.8.5 Calculate the percent fines, percent sand, and percent gravel in the minus 3-in. (75-mm) fraction for classification purposes.

X4. AIR-DRIED METHOD OF PREPARATION OF SOILS FOR TESTING FOR CLASSIFICATION PURPOSES

X4.1 This appendix describes the steps in preparing a soil sample for testing for purposes of soil classification when air-drying the soil before testing is specified or desired or when the natural moisture content is near that of an air-dried state.

X4.2 If the soil contains organic matter or mineral colloids that are irreversibly affected by air drying, the wet-preparation method as described in Appendix X3 should be used.

X4.3 Since this classification system is limited to the portion of a sample passing the 3-in. (75-mm) sieve, the plus 3-in. (75-mm) material shall be removed prior to the determination of the particle-size characteristics and the d limit and plasticity index.

X4.4 The portion of the field sample finer than the 3-in. (75-mm) sieve shall be obtained as follows:

X4.4.1 Air dry and weigh the field sample.

X4.4.2 Separate the field sample into two fractions on a 3-in. (75-mm) sieve.

X4.4.3 Weigh the two fractions and compute the percentage of the plus 3-in. (75-mm) material in the field sample.

X4.5 Determine the particle-size distribution and liquid limit and plasticity index as follows (see 9.8 for when these tests are required):

X4.5.1 Thoroughly mix the fraction passing the 3-in. (75-mm) sieve.

X4.5.2 If the cumulative particle-size distribution including a hydrometer analysis is required, determine the particle-size distribution in accordance with Method D 422. See 9.7 for the set of sieves that is required.

X4.5.3 If the cumulative particle-size distribution without a hydrometer analysis is required, determine the particle-size distribution in accordance with Test Method D 1140 followed by Method C 136. See 9.7 for the set of sieves that is required.

X4.5.4 If the cumulative particle-size distribution is not required, determine the percent fines, percent sand, and percent gravel in the specimen in accordance with Test Method D 1140 followed by Method C 136 using a nest of sieves which shall include a No. 4 (4.75-mm) sieve and a No. 200 (75-μm) sieve.

X4.5.5 If required, determine the liquid limit and the plasticity index of the test specimen in accordance with Test Method D 4318.

X5. RATIONALE

X5.1 Significant revisions were made to the standard which appeared as D 2487 – 83 from the previous version of D 2487 – 69 (1975). The changes are documented in the literature.

X5.2 Changes in this version from the last include the addition of 8.2 on classification of peat, the addition of 4.5 on classification of frozen soils, the addition of Note 6 for clarification of materials used to determine the plasticity index and liquid limit, and the addition of Appendix X5 on Rationale.

Designation: D 2488 – 90

Standard Practice for
Description and Identification of Soils (Visual-Manual Procedure)[1]

This standard is issued under the fixed designation D 2488; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the Department of Defense. Consult the DoD Index of Specifications and Standards for the specific year of issue which has been adopted by the Department of Defense.

1. Scope

1.1 This practice covers procedures for the description of soils for engineering purposes.

1.2 This practice also describes a procedure for identifying soils, at the option of the user, based on the classification system described in Test Method D 2487. The identification is based on visual examination and manual tests. It must be clearly stated in reporting an identification that it is based on visual-manual procedures.

1.2.1 When precise classification of soils for engineering purposes is required, the procedures prescribed in Test Method D 2487 shall be used.

1.2.2 In this practice, the identification portion assigning a group symbol and name is limited to soil particles smaller than 3 in. (75 mm).

1.2.3 The identification portion of this practice is limited to naturally occurring soils (disturbed and undisturbed).

NOTE 1—This practice may be used as a descriptive system applied to such materials as shale, claystone, shells, crushed rock, etc. (See Appendix X2).

1.3 The descriptive information in this practice may be used with other soil classification systems or for materials other than naturally occurring soils.

1.4 *This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements see Section 8.

1.5 The values stated in inch-pound units are to be regarded as the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[2]

D 1452 Practice for Soil Investigation and Sampling by Auger Borings[2]

D 1586 Method for Penetration Test and Split-Barrel Sampling of Soils[2]

D 1587 Practice for Thin-Walled Tube Sampling of Soils[2]

D 2113 Practice for Diamond Core Drilling for Site Investigation[2]

D 2487 Test Method for Classification of Soils for Engineering Purposes[2]

D 4083 Practice for Description of Frozen Soils (Visual-Manual Procedure)[2]

3. Terminology

3.1 *Definitions:*

3.1.1 Except as listed below, all definitions are in accordance with Terminology D 653.

NOTE 2—For particles retained on a 3-in. (75-mm) US standard sieve, the following definitions are suggested:

Cobbles—particles of rock that will pass a 12-in. (300-mm) square opening and be retained on a 3-in. (75-mm) sieve, and

Boulders—particles of rock that will not pass a 12-in. (300-mm) square opening.

3.1.1.2 *clay*—soil passing a No. 200 (75-μm) sieve that can be made to exhibit plasticity (putty-like properties) within a range of water contents, and that exhibits considerable strength when air-dry. For classification, a clay is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index equal to or greater than 4, and the plot of plasticity index versus liquid limit falls on or above the "A" line (see Fig. 3 of Test Method D 2487).

3.1.1.3 *gravel*—particles of rock that will pass a 3-in. (75-mm) sieve and be retained on a No. 4 (4.75-mm) sieve with the following subdivisions:

coarse—passes a 3-in. (75-mm) sieve and is retained on a ¾-in. (19-mm) sieve.

fine—passes a ¾-in. (19-mm) sieve and is retained on a No. 4 (4.75-mm) sieve.

3.1.1.4 *organic clay*—a clay with sufficient organic content to influence the soil properties. For classification, an organic clay is a soil that would be classified as a clay, except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.1.5 *organic silt*—a silt with sufficient organic content to influence the soil properties. For classification, an organic silt is a soil that would be classified as a silt except that its liquid limit value after oven drying is less than 75 % of its liquid limit value before oven drying.

3.1.1.6 *peat*—a soil composed primarily of vegetable tissue in various stages of decomposition usually with an organic odor, a dark brown to black color, a spongy consistency, and a texture ranging from fibrous to amorphous.

3.1.1.7 *sand*—particles of rock that will pass a No. 4

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[1] This practice is under the jurisdiction of ASTM Committee D-18 on Soil and Rock and is the direct responsibility of Subcommittee D18.07 on Identification and Classification of Soils.

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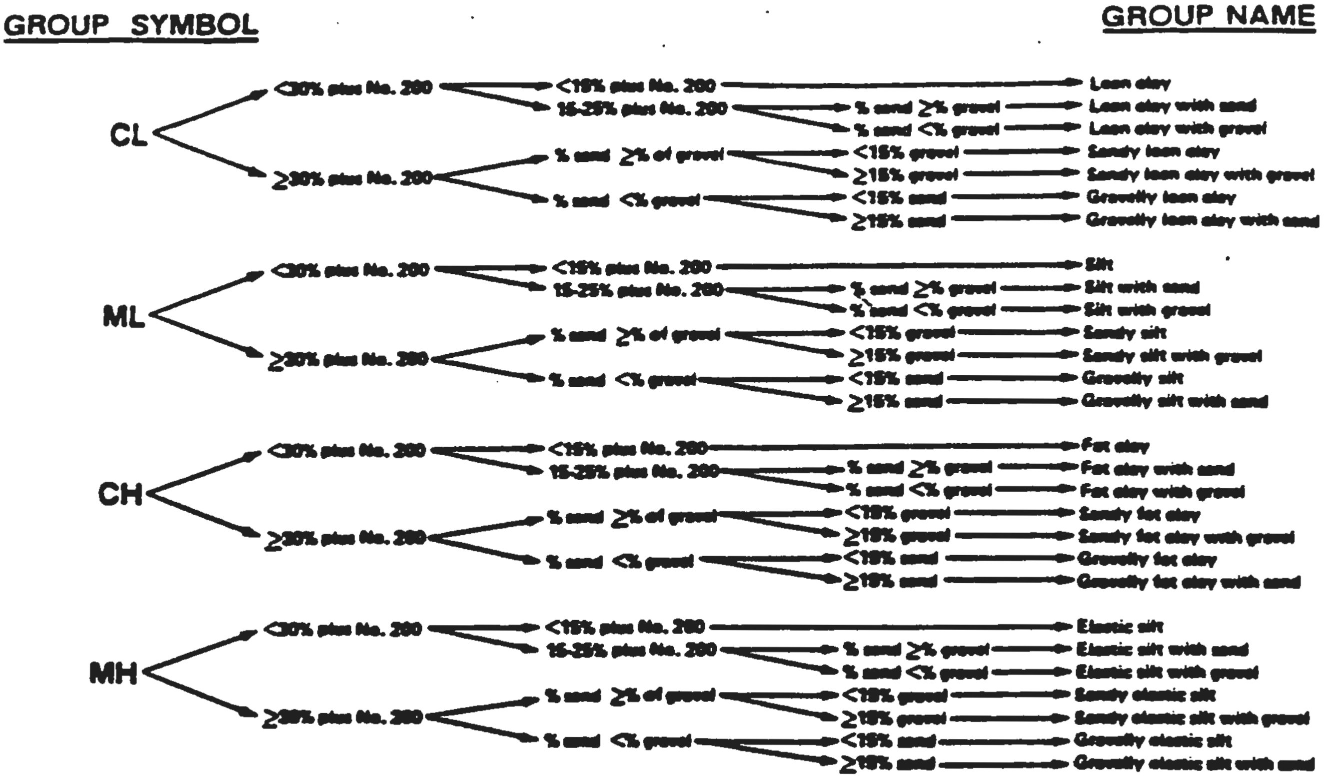
[2] *Annual Book of ASTM Standards*, Vol 04.08.



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1a Flow Chart for Identifying Inorganic Fine-Grained Soil (50 % or more fines)

(4.75-mm) sieve and be retained on a No. 200 (75-µm) sieve with the following subdivisions:

coarse—passes a No. 4 (4.75-mm) sieve and is retained on a No. 10 (2.00-mm) sieve.

medium—passes a No. 10 (2.00-mm) sieve and is retained on a No. 40 (425-µm) sieve.

fine—passes a No. 40 (425-µm) sieve and is retained on a No. 200 (75-µm) sieve.

3.1.1.8 *silt*—soil passing a No. 200 (75-µm) sieve that is nonplastic or very slightly plastic and that exhibits little or no strength when air dry. For classification, a silt is a fine-grained soil, or the fine-grained portion of a soil, with a plasticity index less than 4, or the plot of plasticity index versus liquid limit falls below the "A" line (see Fig. 3 of Test Method D 2487).

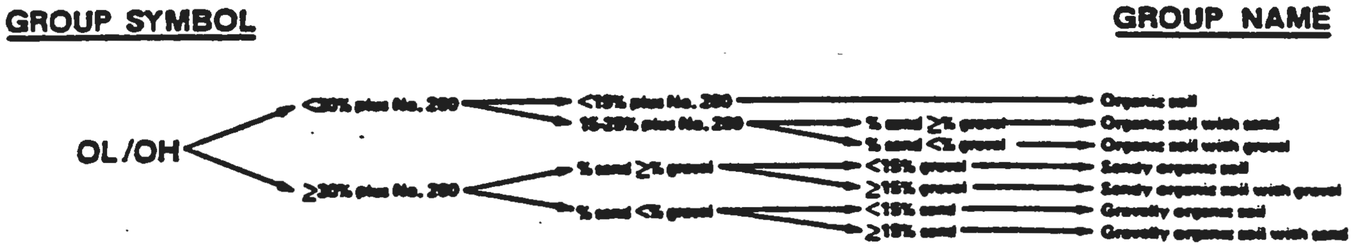
4. Summary of Practice

4.1 Using visual examination and simple manual tests, this practice gives standardized criteria and procedures for describing and identifying soils.

4.2 The soil can be given an identification by assigning a group symbol(s) and name. The flow charts, Figs. 1a and 1b for fine-grained soils, and Fig. 2, for coarse-grained soils, can be used to assign the appropriate group symbol(s) and name. If the soil has properties which do not distinctly place it into a specific group, borderline symbols may be used, see Appendix X3.

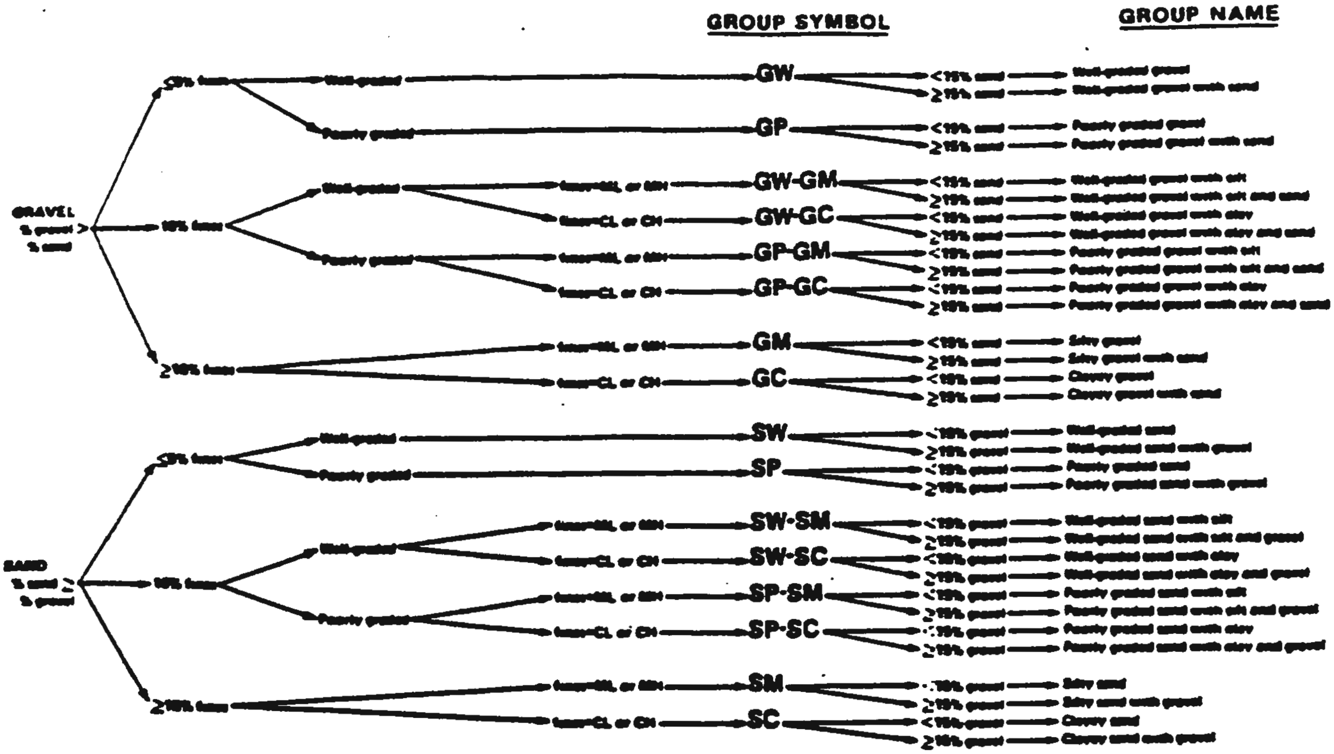
NOTE 3—It is suggested that a distinction be made between *dual symbols* and *borderline symbols*.

Dual Symbol—A dual symbol is two symbols separated by a hyphen, for example, GP-GM, SW-SC, CL-ML used to indicate that the soil has been identified as having the properties of a classification in accordance with Test Method D 2487 where two symbols are required. Two symbols are required when the soil has between 5 and 12 % fines or



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 1b Flow Chart for Identifying Organic Fine-Grained Soil (50 % or more fines)



NOTE—Percentages are based on estimating amounts of fines, sand, and gravel to the nearest 5 %.

FIG. 2 Flow Chart for Identifying Coarse-Grained Soils (less than 50 % fines)

when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart.

Borderline Symbol—A borderline symbol is two symbols separated by a slash, for example, CL/CH, GM/SM, CL/ML. A borderline symbol should be used to indicate that the soil has been identified as having properties that do not distinctly place the soil into a specific group (see Appendix X3).

5. Significance and Use

5.1 The descriptive information required in this practice can be used to describe a soil to aid in the evaluation of its significant properties for engineering use.

5.2 The descriptive information required in this practice should be used to supplement the classification of a soil as determined by Test Method D 2487.

5.3 This practice may be used in identifying soils using the classification group symbols and names as prescribed in Test Method D 2487. Since the names and symbols used in this practice to identify the soils are the same as those used in Test Method D 2487, it shall be clearly stated in reports and all other appropriate documents, that the classification symbol and name are based on visual-manual procedures.

5.4 This practice is to be used not only for identification of soils in the field, but also in the office, laboratory, or wherever soil samples are inspected and described.

5.5 This practice has particular value in grouping similar soil samples so that only a minimum number of laboratory tests need be run for positive soil classification.

NOTE 4—The ability to describe and identify soils correctly is learned more readily under the guidance of experienced personnel, but it may also be acquired systematically by comparing numerical laboratory test results for typical soils of each type with their visual and manual characteristics.

5.6 When describing and identifying soil samples from a given boring, test pit, or group of borings or pits, it is not necessary to follow all of the procedures in this practice for every sample. Soils which appear to be similar can be grouped together; one sample completely described and identified with the others referred to as similar based on performing only a few of the descriptive and identification procedures described in this practice.

5.7 This practice may be used in combination with Practice D 4083 when working with frozen soils.

6. Apparatus

6.1 *Required Apparatus:*

6.1.1 *Pocket Knife or Small Spatula.*

6.2 *Useful Auxiliary Apparatus:*

6.2.1 *Small Test Tube and Stopper* (or jar with a lid).

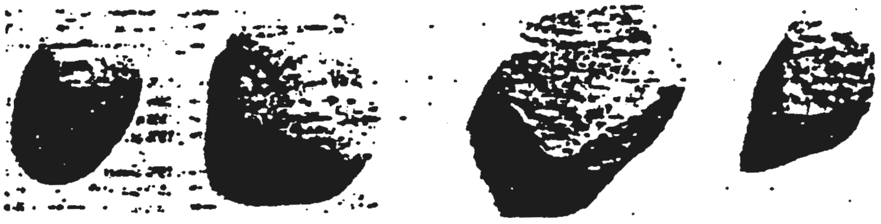
6.2.2 *Small Hand Lens.*

7. Reagents

7.1 *Purity of Water*—Unless otherwise indicated, references to water shall be understood to mean water from a city water supply or natural source, including non-potable water.

7.2 *Hydrochloric Acid*—A small bottle of dilute hydrochloric acid, HCl, one part HCl (10 *N*) to three parts water (This reagent is optional for use with this practice). See Section 8.

(a) Rounded (b) Angular



(c) Subrounded (d) Subangular

FIG. 3 Typical Angularity of Bulky Grains

8. Safety Precautions

8.1 When preparing the dilute HCl solution of one part concentrated hydrochloric acid (10 *N*) to three parts of distilled water, slowly add acid into water following necessary safety precautions. Handle with caution and store safely. If solution comes into contact with the skin, rinse thoroughly with water.

8.2 Caution—Do not add water to acid.

9. Sampling

9.1 The sample shall be considered to be representative of the stratum from which it was obtained by an appropriate, accepted, or standard procedure.

NOTE 5—Preferably, the sampling procedure should be identified as having been conducted in accordance with Practices D 1452, D 1587, or D 2113, or Method D 1586.

9.2 The sample shall be carefully identified as to origin.

NOTE 6—Remarks as to the origin may take the form of a boring number and sample number in conjunction with a job number, a geologic stratum, a pedologic horizon or a location description with respect to a permanent monument, a grid system or a station number and offset with respect to a stated centerline and a depth or elevation.

9.3 For accurate description and identification, the minimum amount of the specimen to be examined shall be in accordance with the following schedule:

Maximum Particle Size, Sieve Opening	Minimum Specimen Size, Dry Weight
4.75 mm (No. 4)	100 g (0.25 lb)
9.5 mm (⅜ in.)	200 g (0.5 lb)
19.0 mm (¾ in.)	1.0 kg (2.2 lb)
38.1 mm (1½ in.)	8.0 kg (18 lb)
75.0 mm (3 in.)	60.0 kg (132 lb)

NOTE 7—If random isolated particles are encountered that are significantly larger than the particles in the soil matrix, the soil matrix can be accurately described and identified in accordance with the preceding schedule.

9.4 If the field sample or specimen being examined is smaller than the minimum recommended amount, the report shall include an appropriate remark.

TABLE 1 Criteria for Describing Angularity of Coarse-Grained Particles (see Fig. 3)

Description	Criteria
Angular	Particles have sharp edges and relatively plane sides with unpolished surfaces
Subangular	Particles are similar to angular description but have rounded edges
Subrounded	Particles have nearly plane sides but have well-rounded corners and edges
Rounded	Particles have smoothly curved sides and no edges

10. Descriptive Information for Soils

10.1 *Angularity*—Describe the angularity of the sand (coarse sizes only), gravel, cobbles, and boulders, as angular, subangular, subrounded, or rounded in accordance with the criteria in Table 1 and Fig. 3. A range of angularity may be stated, such as: subrounded to rounded.

10.2 *Shape*—Describe the shape of the gravel, cobbles, and boulders as flat, elongated, or flat and elongated if they meet the criteria in Table 2 and Fig. 4. Otherwise, do not mention the shape. Indicate the fraction of the particles that have the shape, such as: one-third of the gravel particles are flat.

10.3 *Color*—Describe the color. Color is an important property in identifying organic soils, and within a given

TABLE 2 Criteria for Describing Particle Shape (see Fig. 4)

The particle shape shall be described as follows where length, width, and thickness refer to the greatest, intermediate, and least dimensions of a particle, respectively.

Flat	Particles with width/thickness > 3
Elongated	Particles with length/width > 3
Flat and elongated	Particles meet criteria for both flat and elongated

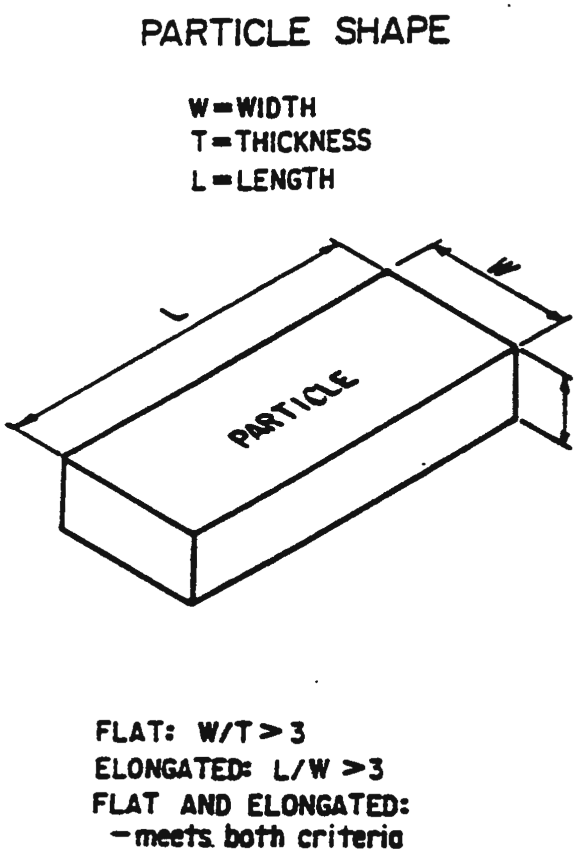


FIG. 4 Criteria for Particle Shape

TABLE 3 Criteria for Describing Moisture Condition

Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water, usually soil is below water table

locality it may also be useful in identifying materials of similar geologic origin. If the sample contains layers or patches of varying colors, this shall be noted and all representative colors shall be described. The color shall be described for moist samples. If the color represents a dry condition, this shall be stated in the report.

10.4 *Odor*—Describe the odor if organic or unusual. Soils containing a significant amount of organic material usually have a distinctive odor of decaying vegetation. This is especially apparent in fresh samples, but if the samples are dried, the odor may often be revived by heating a moistened sample. If the odor is unusual (petroleum product, chemical, and the like), it shall be described.

10.5 *Moisture Condition*—Describe the moisture condition as dry, moist, or wet, in accordance with the criteria in Table 3.

10.6 *HCl Reaction*—Describe the reaction with HCl as none, weak, or strong, in accordance with the critera in Table 4. Since calcium carbonate is a common cementing agent, a report of its presence on the basis of the reaction with dilute hydrochloric acid is important.

TABLE 4 Criteria for Describing the Reaction With HCl

Description	Criteria
None	No visible reaction
Weak	Some reaction, with bubbles forming slowly
Strong	Violent reaction, with bubbles forming immediately

TABLE 5 Criteria for Describing Consistency

Description	Criteria
Very soft	Thumb will penetrate soil more than 1 in. (25 mm)
Soft	Thumb will penetrate soil about 1 in. (25 mm)
Firm	Thumb will indent soil about ¼ in. (6 mm)
Hard	Thumb will not indent soil but readily indented with thumbnail
Very hard	Thumbnail will not indent soil

10.7 *Consistency*—For intact fine-grained soil, describe the consistency as very soft, soft, firm, hard, or very hard, in accordance with the criteria in Table 5. This observation is inappropriate for soils with significant amounts of gravel.

10.8 *Cementation*—Describe the cementation of intact coarse-grained soils as weak, moderate, or strong, in accordance with the criteria in Table 6.

10.9 *Structure*—Describe the structure of intact soils in accordance with the criteria in Table 7.

10.10 *Range of Particle Sizes*—For gravel and sand components, describe the range of particle sizes within each component as defined in 3.1.2 and 3.1.6. For example, about 20 % fine to coarse gravel, about 40 % fine to coarse sand.

10.11 *Maximum Particle Size*—Describe the maximum particle size found in the sample in accordance with the following information:

10.11.1 *Sand Size*—If the maximum particle size is a sand size, describe as fine, medium, or coarse as defined in 3.1.6. For example: maximum particle size, medium sand.

10.11.2 *Gravel Size*—If the maximum particle size is a gravel size, describe the maximum particle size as the smallest sieve opening that the particle will pass. For example, maximum particle size, 1½ in. (will pass a 1½-in. square opening but not a ¾-in. square opening).

10.11.3 *Cobble or Boulder Size*—If the maximum particle size is a cobble or boulder size, describe the maximum dimension of the largest particle. For example: maximum dimension, 18 in. (450 mm).

10.12 *Hardness*—Describe the hardness of coarse sand and larger particles as hard, or state what happens when the particles are hit by a hammer, for example, gravel-size particles fracture with considerable hammer blow, some gravel-size particles crumble with hammer blow. "Hard" means particles do not crack, fracture, or crumble under a hammer blow.

10.13 Additional comments shall be noted, such as the presence of roots or root holes, difficulty in drilling or augering hole, caving of trench or hole, or the presence of mica.

10.14 A local or commercial name or a geologic interpre-

TABLE 6 Criteria for Describing Cementation

Description	Criteria
Weak	Crumbles or breaks with handling or little finger pressure
Moderate	Crumbles or breaks with considerable finger pressure
Strong	Will not crumble or break with finger pressure

TABLE 7 Criteria for Describing Structure

Description	Criteria
Stratified	Alternating layers of varying material or color with layers at least 6 mm thick; note thickness
Laminated	Alternating layers of varying material or color with the layers less than 6 mm thick; note thickness
Fissured	Breaks along definite planes of fracture with little resistance to fracturing
Slickensided	Fracture planes appear polished or glossy, sometimes striated
Blocky	Cohesive soil that can be broken down into small angular lumps which resist further breakdown
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay; note thickness
Homogeneous	Same color and appearance throughout

tation of the soil, or both, may be added if identified as such.

10.15 A classification or identification of the soil in accordance with other classification systems may be added if identified as such.

11. Identification of Peat

11.1 A sample composed primarily of vegetable tissue in various stages of decomposition that has a fibrous to amorphous texture, usually a dark brown to black color, and an organic odor, shall be designated as a highly organic soil and shall be identified as peat, PT, and not subjected to the identification procedures described hereafter.

12. Preparation for Identification

12.1 The soil identification portion of this practice is based on the portion of the soil sample that will pass a 3-in. (75-mm) sieve. The larger than 3-in. (75-mm) particles must be removed, manually, for a loose sample, or mentally, for an intact sample before classifying the soil.

12.2 Estimate and note the percentage of cobbles and the percentage of boulders. Performed visually, these estimates will be on the basis of volume percentage.

NOTE 8—Since the percentages of the particle-size distribution in Test Method D 2487 are by dry weight, and the estimates of percentages for gravel, sand, and fines in this practice are by dry weight, it is recommended that the report state that the percentages of cobbles and boulders are by volume.

12.3 Of the fraction of the soil smaller than 3 in. (75 mm), estimate and note the percentage, by dry weight, of the gravel, sand, and fines (see Appendix X4 for suggested procedures).

NOTE 9—Since the particle-size components appear visually on the basis of volume, considerable experience is required to estimate the percentages on the basis of dry weight. Frequent comparisons with laboratory particle-size analyses should be made.

12.3.1 The percentages shall be estimated to the closest 5 %. The percentages of gravel, sand, and fines must add up to 100 %.

12.3.2 If one of the components is present but not in sufficient quantity to be considered 5 % of the smaller than 3-in. (75-mm) portion, indicate its presence by the term *trace*, for example, trace of fines. A trace is not to be considered in the total of 100 % for the components.

13. Preliminary Identification

13.1 The soil is *fine grained* if it contains 50 % or more fines. Follow the procedures for identifying fine-grained soils of Section 14.

13.2 The soil is *coarse-grained* if it contains less than 50 % fines. Follow the procedures for identifying coarse-grained soils of Section 15.

14. Procedure for Identifying Fine-Grained Soils

14.1 Select a representative sample of the material for examination. Remove particles larger than the No. 40 sieve (medium sand and larger) until a specimen equivalent to about a handful of material is available. Use this specimen for performing the dry strength, dilatancy, and toughness tests.

14.2 *Dry Strength:*

14.2.1 From the specimen, select enough material to mold into a ball about 1 in. (25 mm) in diameter. Mold the material until it has the consistency of putty, adding water if necessary.

14.2.2 From the molded material, make at least three test specimens. A test specimen shall be a ball of material about ½ in. (12 mm) in diameter. Allow the test specimens to dry in air, or sun, or by artificial means, as long as the temperature does not exceed 60°C.

14.2.3 If the test specimen contains natural dry lumps, those that are about ½ in. (12 mm) in diameter may be used in place of the molded balls.

NOTE 10—The process of molding and drying usually produces higher strengths than are found in natural dry lumps of soil.

14.2.4 Test the strength of the dry balls or lumps by crushing between the fingers. Note the strength as none, low, medium, high, or very high in accordance with the criteria in Table 8. If natural dry lumps are used, do not use the results of any of the lumps that are found to contain particles of coarse sand.

14.2.5 The presence of high-strength water-soluble cementing materials, such as calcium carbonate, may cause exceptionally high dry strengths. The presence of calcium carbonate can usually be detected from the intensity of the reaction with dilute hydrochloric acid (see 10.6).

14.3 *Dilatancy:*

14.3.1 From the specimen, select enough material to mold into a ball about ½ in. (12 mm) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.

14.3.2 Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on

TABLE 8 Criteria for Describing Dry Strength

Description	Criteria
None	The dry specimen crumbles into powder with mere pressure of handling
Low	The dry specimen crumbles into powder with some finger pressure
Medium	The dry specimen breaks into pieces or crumbles with considerable finger pressure
High	The dry specimen cannot be broken with finger pressure. Specimen will break into pieces between thumb and a hard surface
Very high	The dry specimen cannot be broken between the thumb and a hard surface

TABLE 9 Criteria for Describing Dilatancy

Description	Criteria
None	No visible change in the specimen
Slow	Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing
Rapid	Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing

TABLE 10 Criteria for Describing Toughness

Description	Criteria
Low	Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft
Medium	Medium pressure is required to roll the thread to near the plastic limit. The thread and the lump have medium stiffness
High	Considerable pressure is required to roll the thread to near the plastic limit. The thread and the lump have very high stiffness

the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 9. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

14.4 *Toughness:*

14.4.1 Following the completion of the dilatancy test, the test specimen is shaped into an elongated pat and rolled by hand on a smooth surface or between the palms into a thread about ⅛ in. (3 mm) in diameter. (If the sample is too wet to roll easily, it should be spread into a thin layer and allowed to lose some water by evaporation.) Fold the sample threads and reroll repeatedly until the thread crumbles at a diameter of about ⅛ in. The thread will crumble at a diameter of ⅛ in. when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, the pieces should be lumped together and kneaded until the lump crumbles. Note the toughness of the material during kneading.

14.4.2 Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 10.

14.5 *Plasticity*—On the basis of observations made during the toughness test, describe the plasticity of the material in accordance with the criteria given in Table 11.

14.6 Decide whether the soil is an *inorganic* or an *organic* fine-grained soil (see 14.8). If inorganic, follow the steps given in 14.7.

14.7 *Identification of Inorganic Fine-Grained Soils:*

TABLE 11 Criteria for Describing Plasticity

Description	Criteria
Nonplastic	A ⅛-in. (3-mm) thread cannot be rolled at any water content
Low	The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit
Medium	The thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit

14.7.1 Identify the soil as a *lean clay*, CL, if the soil has medium to high dry strength, no or slow dilatancy, and medium toughness and plasticity (see Table 12).

14.7.2 Identify the soil as a *fat clay*, CH, if the soil has high to very high dry strength, no dilatancy, and high toughness and plasticity (see Table 12).

14.7.3 Identify the soil as a *silt*, ML, if the soil has no to low dry strength, slow to rapid dilatancy, and low toughness and plasticity, or is nonplastic (see Table 12).

14.7.4 Identify the soil as an *elastic silt*, MH, if the soil has low to medium dry strength, no to slow dilatancy, and low to medium toughness and plasticity (see Table 12).

NOTE 11—These properties are similar to those for a lean clay. However, the silt will dry quickly on the hand and have a smooth, silky feel when dry. Some soils that would classify as MH in accordance with the criteria in Test Method D 2487 are visually difficult to distinguish from lean clays, CL. It may be necessary to perform laboratory testing for proper identification.

14.8 *Identification of Organic Fine-Grained Soils:*

14.8.1 Identify the soil as an *organic soil*, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soils usually have a dark brown to black color and may have an organic odor. Often, organic soils will change color, for example, black to brown, when exposed to the air. Some organic soils will lighten in color significantly when air dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

NOTE 12—In some cases, through practice and experience, it may be possible to further identify the organic soils as organic silts or organic clays, OL or OH. Correlations between the dilatancy, dry strength, toughness tests, and laboratory tests can be made to identify organic soils in certain deposits of similar materials of known geologic origin.

14.9 If the soil is estimated to have 15 to 25 % sand or gravel, or both, the words "with sand" or "with gravel" (whichever is more predominant) shall be added to the group name. For example: "lean clay with sand, CL" or "silt with gravel, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percentage of gravel, use "with sand."

14.10 If the soil is estimated to have 30 % or more sand or gravel, or both, the words "sandy" or "gravelly" shall be added to the group name. Add the word "sandy" if there appears to be more sand than gravel. Add the word "gravelly" if there appears to be more gravel than sand. For example: "sandy lean clay, CL", "gravelly fat clay, CH", or "sandy silt, ML" (see Figs. 1a and 1b). If the percentage of sand is equal to the percent of gravel, use "sandy."

15. Procedure for Identifying Coarse-Grained Soils (Contains less than 50 % fines)

15.1 The soil is a *gravel* if the percentage of gravel is estimated to be more than the percentage of sand.

TABLE 12 Identification of Inorganic Fine-Grained Soils from Manual Tests

Soil Symbol	Dry Strength	Dilatancy	Toughness
ML	None to low	Slow to rapid	Low or thread cannot be formed
CL	Medium to high	None to slow	Medium
MH	Low to medium	None to slow	Low to medium
CH	High to very high	None	High

15.2 The soil is a *sand* if the percentage of gravel is estimated to be equal to or less than the percentage of sand.

15.3 The soil is a *clean gravel* or *clean sand* if the percentage of fines is estimated to be 5 % or less.

15.3.1 Identify the soil as a *well-graded gravel*, GW, or as a *well-graded sand*, SW, if it has a wide range of particle sizes and substantial amounts of the intermediate particle sizes.

15.3.2 Identify the soil as a *poorly graded gravel*, GP, or as a *poorly graded sand*, SP, if it consists predominantly of one size (uniformly graded), or it has a wide range of sizes with some intermediate sizes obviously missing (gap or skip graded).

15.4 The soil is either a *gravel with fines* or a *sand with fines* if the percentage of fines is estimated to be 15 % or more.

15.4.1 Identify the soil as a *clayey gravel*, GC, or a *clayey sand*, SC, if the fines are clayey as determined by the procedures in Section 14.

15.4.2 Identify the soil as a *silty gravel*, GM, or a *silty sand*, SM, if the fines are silty as determined by the procedures in Section 14.

15.5 If the soil is estimated to contain 10 % fines, give the soil a dual identification using two group symbols.

15.5.1 The first group symbol shall correspond to a clean gravel or sand (GW, GP, SW, SP) and the second symbol shall correspond to a gravel or sand with fines (GC, GM, SC, SM).

15.5.2 The group name shall correspond to the first group symbol plus the words "with clay" or "with silt" to indicate the plasticity characteristics of the fines. For example: "well-graded gravel with clay, GW-GC" or "poorly graded sand with silt, SP-SM" (see Fig. 2).

15.6 If the specimen is predominantly sand or gravel but contains an estimated 15 % or more of the other coarse-grained constituent, the words "with gravel" or "with sand" shall be added to the group name. For example: "poorly graded gravel with sand, GP" or "clayey sand with gravel, SC" (see Fig. 2).

15.7 If the field sample contains any cobbles or boulders, or both, the words "with cobbles" or "with cobbles and boulders" shall be added to the group name. For example: "silty gravel with cobbles, GM."

16. Report

16.1 The report shall include the information as to origin, and the items indicated in Table 13.

TABLE 13 Checklist for Description of Soils

1. Group name
2. Group symbol
3. Percent of cobbles or boulders, or both (by volume)
4. Percent of gravel, sand, or fines, or all three (by dry weight)
5. Particle-size range:
   Gravel—fine, coarse
   Sand—fine, medium, coarse
6. Particle angularity: angular, subangular, subrounded, rounded
7. Particle shape: (if appropriate) flat, elongated, flat and elongated
8. Maximum particle size or dimension
9. Hardness of coarse sand and larger particles
10. Plasticity of fines: nonplastic, low, medium, high
11. Dry strength: none, low, medium, high, very high
12. Dilatancy: none, slow, rapid
13. Toughness: low, medium, high
14. Color (in moist condition)
15. Odor (mention only if organic or unusual)
16. Moisture: dry, moist, wet
17. Reaction with HCl: none, weak, strong

For intact samples:

18. Consistency (fine-grained soils only): very soft, soft, firm, hard, very hard
19. Structure: stratified, laminated, fissured, slickensided, lensed, homogeneous
20. Cementation: weak, moderate, strong
21. Local name
22. Geologic interpretation
23. Additional comments: presence of roots or root holes, presence of mica, gypsum, etc., surface coatings on coarse-grained particles, caving or sloughing of auger hole or trench sides, difficulty in augering or excavating, etc.

NOTE 13—*Example: Clayey Gravel with Sand and Cobbles, GC*—About 50 % fine to coarse, subrounded to subangular gravel; about 30 % fine to coarse, subrounded sand; about 20 % fines with medium plasticity, high dry strength, no dilatancy, medium toughness; weak reaction with HCl: original field sample had about 5 % (by volume) subrounded cobbles, maximum dimension, 150 mm.

In-Place Conditions—Firm, homogeneous, dry, brown

Geologic Interpretation—Alluvial fan

NOTE 14—Other examples of soil descriptions and identification are given in Appendixes X1 and X2.

NOTE 15—If desired, the percentages of gravel, sand, and fines may be stated in terms indicating a range of percentages, as follows:

Trace—Particles are present but estimated to be less than 5 %
Few—5 to 10 %
Little—15 to 25 %
Some—30 to 45 %
Mostly—50 to 100 %

16.2 If, in the soil description, the soil is identified using a classification group symbol and name as described in Test Method D 2487, it must be distinctly and clearly stated in log forms, summary tables, reports, and the like, that the symbol and name are based on visual-manual procedures.

17. Precision and Bias

17.1 This practice provides qualitative information only; therefore, a precision and bias statement is not applicable.

18. Keywords

18.1 classification; clay; gravel; organic soils; sand; silt; soil classification; soil description; visual classification

APPENDIXES

(Nonmandatory Information)

X1. EXAMPLES OF VISUAL SOIL DESCRIPTIONS

X1.1 The following examples show how the information required in 16.1 can be reported. The information that is included in descriptions should be based on individual circumstances and need.

X1.1.1 *Well-Graded Gravel with Sand (GW)*—About 75 % fine to coarse, hard, subangular gravel; about 25 % fine to coarse, hard, subangular sand; trace of fines; maximum size, 75 mm, brown, dry; no reaction with HCl.

X1.1.2 *Silty Sand with Gravel (SM)*—About 60 % predominantly fine sand; about 25 % silty fines with low plasticity, low dry strength, rapid dilatancy, and low toughness; about 15 % fine, hard, subrounded gravel, a few gravel-size particles fractured with hammer blow; maximum size, 25 mm; no reaction with HCl (Note—Field sample size smaller than recommended).

In-Place Conditions—Firm, stratified and contains lenses of silt 1 to 2 in. (25 to 50 mm) thick, moist, brown to gray; in-place density 106 lb/ft^3; in-place moisture 9 %.

X1.1.3 *Organic Soil (OL/OH)*—About 100 % fines with low plasticity, slow dilatancy, low dry strength, and low toughness; wet, dark brown, organic odor; weak reaction with HCl.

X1.1.4 *Silty Sand with Organic Fines (SM)*—About 75 % fine to coarse, hard, subangular reddish sand; about 25 % organic and silty dark brown nonplastic fines with no dry strength and slow dilatancy; wet; maximum size, coarse sand; weak reaction with HCl.

X1.1.5 *Poorly Graded Gravel with Silt, Sand, Cobbles and Boulders (GP-GM)*—About 75 % fine to coarse, hard, subrounded to subangular gravel; about 15 % fine, hard, subrounded to subangular sand; about 10 % silty nonplastic fines; moist, brown; no reaction with HCl; original field sample had about 5 % (by volume) hard, subrounded cobbles and a trace of hard, subrounded boulders, with a maximum dimension of 18 in. (450 mm).

X2. USING THE IDENTIFICATION PROCEDURE AS A DESCRIPTIVE SYSTEM FOR SHALE, CLAYSTONE, SHELLS, SLAG, CRUSHED ROCK, AND THE LIKE

X2.1 The identification procedure may be used as a descriptive system applied to materials that exist in-situ as [illegible] claystone, sandstone, siltstone, mudstone, etc., but [illegible] to soils after field or laboratory processing (crushing, slaking, and the like).

X2.2 Materials such as shells, crushed rock, slag, and the like, should be identified as such. However, the procedures used in this practice for describing the particle size and plasticity characteristics may be used in the description of the material. If desired, an identification using a group name and symbol according to this practice may be assigned to aid in describing the material.

X2.3 The group symbol(s) and group names should be placed in quotation marks or noted with some type of distinguishing symbol. See examples.

X2.4 Examples of how group names and symbols can be ncorporated into a descriptive system for materials that are ot naturally occurring soils are as follows:

X2.4.1 *Shale Chunks*—Retrieved as 2 to 4-in. (50 to 100-mm) pieces of shale from power auger hole, dry, brown, no reaction with HCl. After slaking in water for 24 h, material identified as "Sandy Lean Clay (CL)"; about 60 % fines with medium plasticity, high dry strength, no dilatancy, and medium toughness; about 35 % fine to medium, hard sand; about 5 % gravel-size pieces of shale.

X2.4.2 *Crushed Sandstone*—Product of commercial crushing operation; "Poorly Graded Sand with Silt (SP-SM)"; about 90 % fine to medium sand; about 10 % nonplastic fines; dry, reddish-brown, strong reaction with HCl.

X2.4.3 *Broken Shells*—About 60 % gravel-size broken shells; about 30 % sand and sand-size shell pieces; about 10 % fines; "Poorly Graded Gravel with Sand (GP)."

X2.4.4 *Crushed Rock*—Processed from gravel and cobbles in Pit No. 7; "Poorly Graded Gravel (GP)"; about 90 % fine, hard, angular gravel-size particles; about 10 % coarse, hard, angular sand-size particles; dry, tan; no reaction with HCl.

X3. SUGGESTED PROCEDURE FOR USING A BORDERLINE SYMBOL FOR SOILS WITH TWO POSSIBLE IDENTIFICATIONS.

X3.1 Since this practice is based on estimates of particle ize distribution and plasticity characteristics, it may be ifficult to clearly identify the soil as belonging to one tegory. To indicate that the soil may fall into one of two possible basic groups, a borderline symbol may be used with the two symbols separated by a slash. For example: SC/CL or CL/CH.

X3.1.1 A borderline symbol may be used when the percentage of fines is estimated to be between 45 and 55 %. One symbol should be for a coarse-grained soil with fines and the other for a fine-grained soil. For example: GM/ML or CL/SC.

X3.1.2 A borderline symbol may be used when the percentage of sand and the percentage of gravel are estimated o be about the same. For example: GP/SP, SC/GC, GM/SM. It is practically impossible to have a soil that would have a borderline symbol of GW/SW.

X3.1.3 A borderline symbol may be used when the soil could be either well graded or poorly graded. For example: GW/GP, SW/SP.

X3.1.4 A borderline symbol may be used when the soil could either be a silt or a clay. For example: CL/ML, CH/MH, SC/SM.

X3.1.5 A borderline symbol may be used when a fine-grained soil has properties that indicate that it is at the boundary between a soil of low compressibility and a soil of high compressibility. For example: CL/CH, MH/ML.

X3.2 The order of the borderline symbols should reflect similarity to surrounding or adjacent soils. For example: soils in a borrow area have been identified as CH. One sample is considered to have a borderline symbol of CL and CH. To show similarity, the borderline symbol should be CH/CL.

X3.3 The group name for a soil with a borderline symbol should be the group name for the first symbol, except for:

CL/CH lean to fat clay
ML/CL clayey silt
CL/ML silty clay

X3.4 The use of a borderline symbol should not be used indiscriminately. Every effort shall be made to first place the soil into a single group.

X4. SUGGESTED PROCEDURES FOR ESTIMATING THE PERCENTAGES OF GRAVEL, SAND, AND FINES IN A SOIL SAMPLE

X4.1 *Jar Method*—The relative percentage of coarse- and fine-grained material may be estimated by thoroughly shaking a mixture of soil and water in a test tube or jar, and then allowing the mixture to settle. The coarse particles will fall to the bottom and successively finer particles will be deposited with increasing time; the sand sizes will fall out of suspension in 20 to 30 s. The relative proportions can be estimated from the relative volume of each size separate. This method should be correlated to particle-size laboratory determinations.

X4.2 *Visual Method*—Mentally visualize the gravel size particles placed in a sack (or other container) or sacks. Then, do the same with the sand size particles and the fines. Then, [illegible]ally compare the number of sacks to estimate the [illegible]entage of plus No. 4 sieve size and minus No. 4 sieve size present. The percentages of sand and fines in the minus sieve size No. 4 material can then be estimated from the wash test (X4.3).

X4.3 *Wash Test (for relative percentages of sand and fines)*—Select and moisten enough minus No. 4 sieve size material to form a 1-in (25-mm) cube of soil. Cut the cube in half, set one-half to the side, and place the other half in a small dish. Wash and decant the fines out of the material in the dish until the wash water is clear and then compare the two samples and estimate the percentage of sand and fines. Remember that the percentage is based on weight, not volume. However, the volume comparison will provide a reasonable indication of grain size percentages.

X4.3.1 While washing, it may be necessary to break down lumps of fines with the finger to get the correct percentages.

X5. RATIONALE

X5.1 This practice was significantly revised in the D 2488 – 84 version from the previous version D 2488 – 69 (1975). The revisions are documented in the literature.[3]

X5.2 Changes in this version from the previous version include rewording of 1.2.3 to say (disturbed and undisturbed), the addition of 5.7 to refer to the practice for describing frozen soils, and the addition of Appendix X5 on Rationale.

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[3] Howard, A. K. "The Revised ASTM Standard on the Description and Identification of Soils (Visual-Manual Procedure)," *Geotechical Testing Journal*, GTJODJ Vol. 10, No. 4, December 1987.

ATTACHMENT B

ROCK CLASSIFICATION SYSTEM

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CLASSIFICATION OF SEDIMENTARY ROCK

By Russell B. Travis

	TEXTURE →	GRAIN SIZE <1/256 mm.		GRAIN SIZE 1/256-2 mm.								GRAIN SIZE >2 mm.	
		CRYSTALLINE, CLASTIC OR AMORPHOUS		CRYSTALLINE, CLASTIC, BIOCLASTIC, OOLITIC, ETC.		CLASTIC UNCONSOLIDATED - silt, sand CONSOLIDATED - siltstone, sandstone SIZE GRADES (mm.) 1/256 - 1/16, silt; 1/16 - 1/8 very fine sand; 1/8 - 1/4, fine sand; 1/4 - 1/2, medium sand; 1/2 - 1, coarse sand; 1-2, very coarse sand						CLASTIC UNCONSOLIDATED - gravel (rounded), rubble (angular) CONSOLIDATED - conglomerate (rounded), breccia (angular) SIZE GRADES (mm.) - 2-4, granules; 4-64, pebbles; 64-256 cobbles; >256 boulders	
						Chiefly Quartz							
	COMPOSITION OF MAJOR FRACTION →	Composition as Indicated in left column (prefix appropriate names for mixtures)	Clay Minerals or Clay-Size Material	Composition as Indicated in left column (prefix appropriate names for mixtures)	Chiefly Calcite or Dolomite	>90% Quartz	Feldspar 10-25%	Rock Chips >10%	Quartz and >25% Feldspar	Quartz, Feldspar, Rock Chips, Pelitic Matrix, Angular grains, Tough	Volcanic Ejecta	CHIEFLY ONE CONSTITUENT Especially quartz, chert, or quartzite. Also shale or limestone. Homogeneous conglomerates and breccias.	SEVERAL CONSTITUENTS Usually including unstable constituents. Mixed conglomerates and breccias.
COMPOSITION OF MINOR FRACTION	<10% Minor Fraction				LIMESTONE DOLOMITE ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	QUARTZ SANDSTONE [illegible]	[illegible] SANDSTONE	LITHIC SANDSTONE	[illegible]	GRAYWACKE [illegible] SUBGRAYWACKE [illegible]	TUFF [illegible] VOLCANIC BRECCIA [illegible] AGGLOMERATE—large proportion (>25%) of [illegible]	[illegible] of chief constituent and size grade, for example: QUARTZ PEBBLE CONGLOMERATE CHERT COBBLE CONGLOMERATE LIMESTONE PEBBLE BRECCIA ETC.	Name consists of "mixed" or "polycomponent" and size grade, for example, MIXED PEBBLE CONGLOMERATE or MIXED COBBLE CONGLOMERATE Name may include composition as GRAYWACKE-ANDESITE-CHERT PEBBLE CONGLOMERATE
	Clay Minerals or Clay-Size Materials	CLAYSTONE—[illegible] blocky structure. MUDSTONE—indurated mud. Includes claystone and siltstone, etc. SHALE—finely fissile. May include much silt. CLAY SHALE (Argillaceous shale)—chiefly clay minerals. ARGILLITE—highly indurated. Incipiently recrystallized. BENTONITE—swells and disaggregates in water.			ARGILLACEOUS LIMESTONE ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	[illegible]	ARGILLACEOUS FELDSPATHIC SANDSTONE LOESS—[illegible]	ARGILLACEOUS LITHIC SANDSTONE	ARGILLACEOUS ARKOSE	ARGILLACEOUS GRAYWACKE [illegible] SUBGRAYWACKE	[illegible]	ARGILLACEOUS (rock, grade) CONGLOMERATE—[illegible]	ARGILLACEOUS MIXED (grade) CONGLOMERATE GLACIAL TILL—chaotic mixture of clay, sand and gravel TILLITE—indurated till FANGLOMERATE—alluvial fan material
	SILICA Opal Chalcedony Quartz	CHERT—[illegible]. Bedded, nodular, massive. DIATOMITE (Diatomaceous earth)—diatom tests. RADIOLARITE (Tripoli, in part)—radiolarian tests. SILICEOUS SINTER (Geyserite)—porous geyser deposit. PORCELLANITE—argillaceous or silty chert.	SILICEOUS SHALE – CLAYSTONE – MUDSTONE ETC.	SILICEOUS OOLITE—>50% oolitic OOLITIC CHERT—<50% oolitic DIATOMITE—diatom tests RADIOLARITE—radiolarian tests	SILICEOUS LIMESTONE—disseminated silica CHERTY LIMESTONE—containing chert nodules ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	ORTHOQUARTZITE (Sedimentary quartzite) (Siliceous quartz sandstone)	FELDSPATHIC ORTHOQUARTZITE	LITHIC ORTHOQUARTZITE	SILICEOUS ARKOSE [illegible]	SILICEOUS SUBGRAYWACKE		SILICEOUS (rock, grade) CONGLOMERATE Orthoquartzitic (rock, grade) conglomerate)	SILICEOUS MIXED (grade) CONGLOMERATE
	CALCITE OR DOLOMITE	LIMESTONE—chiefly calcite, massive. DOLOMITE (Dolostone)—chiefly dolomite, massive. CHALK—chalky texture. TUFA—very porous, friable. TRAVERTINE—banded, coherent, denser than tufa. CALICHE—lime-rich deposit formed near surface.	CALCAREOUS SHALE (Limy shale) etc. MARLSTONE 25-75% carbonate	LIMESTONE — chiefly calcite, crystalline DOLOMITE (Dolostone) — chiefly dolomite, crystalline CLASTIC LIMESTONE (Calcarenite or calcite sandstone) — clastic CALCAREOUS OOLITE — > 50% oolitic OOLITIC LIMESTONE — < 50% oolitic COQUINA — shells, lime cement ORGANIC LIMESTONE — Richly fossiliferous		CALCAREOUS QUARTZ SANDSTONE	CALCAREOUS FELDSPATHIC SANDSTONE	CALCAREOUS LITHIC SANDSTONE	CALCAREOUS ARKOSE	CALCAREOUS SUBGRAYWACKE		CALCAREOUS (rock, grade) CONGLOMERATE	CALCAREOUS MIXED (grade) CONGLOMERATE
	IRON MINERALS Chiefly: Limonite Siderite Goethite Chamosite Hematite	HEMATITE ROCK—[illegible] LIMONITE ROCK—[illegible] BOG IRON ORE—[illegible] IRONSTONE—[illegible] SIDERITE (Iron carbonate)—[illegible]	LIMONITIC or HEMATITIC (Ferruginous) SHALE ETC.	HEMATITE OOLITE—>50% oolitic LIMONITE OOLITE—>50% oolitic OOLITIC IRON ORE—<50% oolitic SIDERITE (Iron carbonate)—chiefly siderite, crystalline	LIMONITIC or HEMATITIC (Ferruginous) LIMESTONE ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	LIMONITIC or HEMATITIC (Ferruginous) QUARTZ SANDSTONE	LIMONITIC or HEMATITIC (Ferruginous) FELDSPATHIC SANDSTONE	LIMONITIC or HEMATITIC (Ferruginous) LITHIC SANDSTONE	LIMONITIC or HEMATITIC (Ferruginous) ARKOSE	LIMONITIC or HEMATITIC (Ferruginous) GRAYWACKE LIMONITIC or HEMATITIC (Ferruginous) SUBGRAYWACKE		LIMONITIC or HEMATITIC (Ferruginous) (rock, grade) CONGLOMERATE	LIMONITIC or HEMATITIC (Ferruginous) MIXED (grade) CONGLOMERATE
	CARBON Humus-Yields carbonaceous derivatives Sapropel-Yields bituminous derivatives	COAL BITUMINOUS—blocky fracture. ANTHRACITE—conchoidal fracture. ASPHALT—asphaltic. GILSONITE—black, high luster, amorphous.	RBONACEOUS ALE, ETC.—carbonized material. UMINOUS ALE (Oil shale) TC.—sapropelic	PEAT—dark semi-carbonized plant remains LIGNITE—brown-black well-carbonized plant remains	CARBONACEOUS LIMESTONE BITUMINOUS LIMESTONE ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	CARBONACEOUS QUARTZ SANDSTONE BITUMINOUS QUARTZ SANDSTONE	CARBONACEOUS FELDSPATHIC SANDSTONE BITUMINOUS FELSPATHIC SANDSTONE	CARBONACEOUS LITHIC SANDSTONE BITUMINOUS LITHIC SANDSTONE	CARBONACEOUS ARKOSE BITUMINOUS ARKOSE	CARBONACEOUS GRAYWACKE ETC. CARBONACEOUS SUBGRAYWACKE ETC.		CARBONACEOUS (rock, grade) CONGLOMERATE BITUMINOUS (rock, grade) CONGLOMERATE	CARBONACEOUS MIXED (grade) CONGLOMERATE BITUMINOUS MIXED (grade) CONGLOMERATE
	MISCELLANEOUS Phosphate (Collophane) Evaporites Halite and Sylvite Anhydrite Gypsum	PHOSPHORITE—phosphate rock. ROCK SALT—massive halite or sylvite. ROCK ANHYDRITE—massive anhydrite ROCK GYPSUM—massive gypsum	PHOSPHATIC SHALE, ETC.	PHOSPHATIC OOLITE—>50% oolitic ROCK SALT—crystalline ROCK ANHYDRITE—crystalline ROCK GYPSUM—crystalline GYPSUM SAND—clastic	PHOSPHATIC LIMESTONE ETC. All varieties in the Calcite-Dolomite horizontal column are possible here.	PHOSPHATIC QUARTZ SANDSTONE ETC.	PHOSPHATIC FELDSPATHIC SANDSTONE ETC.	PHOSPHATIC LITHIC SANDSTONE ETC.	PHOSPHATIC ARKOSE ETC.	PHOSPHATIC SUBGRAYWACKE ETC.		PHOSPHATIC (rock, grade) CONGLOMERATE	PHOSPHATIC MIXED (grade) CONGLOMERATE

The names in the above chart are root names and should be preceded by appropriate terms for any significant feature of the rock. The proper order is color, structure, grain size (sandstones only), minor constituents, cement, and root name. Structure includes, for example, "thin-bedded," "massive," "cross-bedded," "thinly laminated," etc. The size grade for conglomerates should immediately precede "conglomerate." Some common nonmineral minor constituent terms are "tuffaceous," "cherty," "fossiliferous," "crinoidal," "coralline," "clayey (argillaceous)," "silty," "shaly," "sandy (arenaceous)," and "conglomeratic." Minor mineralogy should follow the nonmineral composition and should be restricted to one conspicuous mineral not implied in the root name. It should be applied in adjective form as "micaceous," "chloritic," "glauconitic," and "pyritic." The most common cement terms are given in the chart with the root names. Some typical rock names are "black thin-bedded micaceous shale," "gray massive, medium-grained glauconitic quartz sandstone," "tan siliceous quartz pebble conglomerate," and "white vuggy foraminiferal limestone."

Graywacke currently has two meanings. To some, it denotes a feldspar-quartz sandstone with more than 20 (or 15) percent pelitic matrix. To many others, it has retained its original meaning, that is a very hard, firm sandstone without porosity or chemical cement. In addition these "true" graywackes typically have extremely angular grains, a pelitic matrix, and a dark color.

FREQUENCY OF OCCURRENCE
This size type indicates COMMON ROCKS.
This size type indicates UNCOMMON ROCKS.
This size type indicates RARE ROCKS.

CLASSIFICATION OF METAMORPHIC ROCKS

By Russell B. Travis

COLOR	CHIEF MINERALS	CHARACTERIZING ACCESSORY MINERALS	NONDIRECTIONAL STRUCTURE Massive or Granulose		DIRECTIONAL STRUCTURE (Lineate or Foliate)					
			Contact Metamorphism*		Mechanical Metamorphism	Regional Metamorphism				Plutonic Metamorphism
			Fine Grained (Aphanitic)	Medium or Coarse Grained (Phaneritic)	Cataclastic	Slaty	Phyllitic	Schistose	Gneissose	Migmatitic
LIGHT	QUARTZ FELDSPAR CALCITE DOLOMITE TALC MUSCOVITE SERICITE	Muscovite Sericite Sillimanite Kyanite Cordierite Tremolite Wollastonite Albite Andalusite Garnet Phlogopite Diopside Enstatite Staurolite Glaucophane Anthophyllite Pyrophyllite Chloritoid Actinolite Tourmaline Epidote Chiastolite Olivine Serpentine Chlorite Biotite Graphite Chondrodite Scapolite	METAQUARTZITE MARBLE BRUCITE MARBLE SOAPSTONE—chiefly talc HORNFELS—any metamorphic rock with nondirectional structure	METAQUARTZITE MARBLE BRUCITE MARBLE TREMOLITE MARBLE WOLLASTONITE MARBLE TREMOLITE HORNFELS WOLLASTONITE HORNFELS CALC-SILICATE HORNFELS—[illegible]	These rocks are formed by crushing and shearing with only minor recrystallization. If there are no conspicuous directional features, the rock is called "crush breccia" if coarse grained, and "cataclasite" if fine grained. Most of them, however, are foliate. MYLONITE—finely ground, foliate FLASER GRANITE, FLASER DIORITE, FLASER CONGLOMERATE, ETC.—flaser structure AUGEN GNEISS—augen structure ULTRAMYLONITE—[illegible] [illegible]	[illegible]	PHYLLITE is intermediate between slate and schist. It differs from slate in that crystallization of micaceous minerals imparts a sheen to the rock; it differs from schist in that grains are too small for megascopic identification. [illegible]	QUARTZ-MICA SCHIST TALC SCHIST SILLIMANITE SCHIST CALCITE-MICA SCHIST QUARTZ-SERICITE SCHIST KYANITE SCHIST CALCITE SCHIST	[illegible] GNEISS QUARTZ PORPHYRY GNEISS QUARTZITE GNEISS SILLIMANITE GNEISS GRANULITE—banding due to elongated quartz or feldspar grains	These rocks have a gneissose, streaked, or irregular structure produced by intimate mixing of metamorphic and magmatic materials. When they can be recognized as "mixed rock," they are called migmatite or migmatite gneiss. They may originate by injection (injection migmatite, injection gneiss, or lit-par-lit gneiss), or by differential fusion. Many so-called migmatites probably originate by partial granitization or by metamorphic differentiation. But at great depth these processes apparently do not differ substantially from the igneous processes forming migmatite so the products are usually indistinguishable. Migmatites are named by prefixing the rock name of the granitic material to the appropriate root, as granite migmatite, monzonite injection migmatite, [illegible]
INTERMEDIATE (Includes Red or Brown)	ABOUT EQUAL PROPORTIONS OF LIGHT-COLORED AND DARK-COLORED MINERALS		METAQUARTZITE MARBLE SKARN—[illegible] SOAPSTONE—chiefly talc HORNFELS—any metamorphic rock with nondirectional structure SERPENTINE*	METAQUARTZITE MARBLE DIOPSIDE MARBLE CHONDRODITE MARBLE [illegible] SKARN [illegible] GARNET HORNFELS [illegible] HORNFELS ANTHOPHYLLITE HORNFELS CALC-SILICATE HORNFELS SERPENTINE* CORDIERITE-ANTHOPHYLLITE HORNFELS				MICA SCHIST CHIASTOLITE SCHIST ANDALUSITE SCHIST STAUROLITE SCHIST KYANITE SCHIST [illegible] GARNET-MICA SCHIST SERPENTINE* TOURMALINE-MICA SCHIST [illegible] STAUROLITE-KYANITE SCHIST SILLIMANITE-GARNET SCHIST GRAPHITE SCHIST CALCITE SCHIST SCHISTOSE QUARTZITE	GRANITE GNEISS SYENITE GNEISS MONZONITE GNEISS GRANODIORITE GNEISS ANORTHOSITE GNEISS [illegible] CONGLOMERATE GNEISS [illegible] GNEISS SANDSTONE GNEISS AUGEN GNEISS—augen structure BIOTITE GNEISS STAUROLITE GNEISS [illegible] GNEISS GARNET GNEISS MUSCOVITE-BIOTITE-QUARTZ GNEISS KYANITE GNEISS GRANULITE—banding due to elongated quartz or feldspar grains	
DARK (Includes Green)	QUARTZ CALCITE DOLOMITE FELDSPAR CHLORITE HORNBLENDE SERPENTINE BIOTITE PYROXENE ACTINOLITE EPIDOTE OLIVINE MAGNETITE		METAQUARTZITE MARBLE SKARN—[illegible] GRAPHITE MARBLE CHLORITE MARBLE SERPENTINE MARBLE (Ophicalcite) HORNFELS—any metamorphic rock with nondirectional structure SERPENTINE*	METAQUARTZITE MARBLE GRAPHITE MARBLE CHLORITE MARBLE OLIVINE MARBLE SKARN ACTINOLITE MARBLE ACTINOLITE-EPIDOTE HORNFELS ACTINOLITE HORNFELS PYROXENE HORNFELS EPIDOTE HORNFELS TOURMALINE HORNFELS ANDALUSITE-BIOTITE HORNFELS SERPENTINE* ECLOGITE—pyrope-omphacite hornfels MAGNETITE ROCK CORDIERITE HORNFELS AMPHIBOLITE—chiefly hornblende and/or plagioclase		[illegible] [illegible] BLACK SLATE SPOTTED SLATE ANDALUSITE SPOTTED SLATE CHIASTOLITE SPOTTED SLATE BIOTITE SPOTTED SLATE CARBONACEOUS SLATE CALCAREOUS SLATE		GREENSCHIST CHLORITE SCHIST CHLORITOID SCHIST [illegible] AMPHIBOLITE HORNBLENDE SCHIST ACTINOLITE SCHIST GRAPHITE SCHIST PYROXENE SCHIST EPIDOTE-CHLORITE SCHIST HORNBLENDE-BIOTITE SCHIST BIOTITE-CHLORITE SCHIST SERPENTINE* TOURMALINE SCHIST EPIDOTE AMPHIBOLITE GARNET-PYROXENE AMPHIBOLITE GARNET-CHLORITE SCHIST	QUARTZ DIORITE GNEISS DIORITE GNEISS GABBRO GNEISS PERIDOTITE GNEISS MARBLE GNEISS PYROXENE GNEISS GRAYWACKE GNEISS EPIDOTE GNEISS GARNET-BIOTITE GNEISS SKARN GNEISS AMPHIBOLITE GNEISS	

As can be noted from the chart, naming a metamorphic rock consists chiefly of prefixing the structural term with mineral names or an appropriate rock name. The rock name indicates either the original rock, if recognizable, or the new mineral composition. The prefix "meta," as "metagabbro," "metasandstone," "metatuff," etc., is applied to rocks that have undergone considerable recrystallization but have largely retained their original fabric. Most of the minerals listed as accessories are genetically important and if present should be included in the rock name regardless of their quantity.

* SERPENTINE is a product of hydrothermal alteration which some authors consider to be an igneous process and others a metamorphic process. For this reason, serpentine appears both on this chart and on the igneous rock chart.

FREQUENCY OF OCCURRENCE

This size type indicates COMMON ROCKS.
This size type indicates UNCOMMON ROCKS.
This size type indicates RARE ROCKS.

CLASSIFICATION OF IGNEOUS ROCKS
Russell B. Travis

	ESSENTIAL MINERALS	POTASH FELDSPAR > ⅔ TOTAL FELDSPAR			POTASH FELDSPAR ⅓–⅔ TOTAL FELDSPAR			PLAGIOCLASE FELDSPAR > ⅔ TOTAL FELDSPAR						LITTLE OR NO FELDSPAR		SPECIAL TYPES
		QUARTZ >10%	QUARTZ <10% FELDSPATHOID <10%	FELDSPATHOID >10%	QUARTZ >10%	QUARTZ <10% FELDSPATHOID <10%	FELDSPATHOID >10%	POTASH FELDSPAR >10% TOTAL FELDSPAR	POTASH FELDSPAR <10% TOTAL FELDSPAR					CHIEFLY PYROXENE AND/OR OLIVINE	CHIEFLY FERRO-MAGNESIAN MINERALS AND FELDSPATHOIDS	
									SODIC PLAGIOCLASE		CALCIC PLAGIOCLASE					
								QUARTZ >10%	QUARTZ >10%	QUARTZ <10% FELDSPATHOID <10%	QUARTZ <10% FELDSPATHOID <10%		FELDSPATHOID >10% PYROXENE >10%			
	CHARACTERIZING ACCESSORY MINERALS	CHIEFLY: HORNBLENDE, BIOTITE, PYROXENE, MUSCOVITE ALSO: SODIC AMPHIBOLES, AEGIRINE, CANCRINITE, SODALITE, TOURMALINE			CHIEFLY: HORNBLENDE, BIOTITE, PYROXENE ALSO: SODIC AMPHIBOLES, AEGIRINE			CHIEFLY: HORNBLENDE, BIOTITE, PYROXENE (IN ANDESITE) ALSO: PYROXENE, FELDSPATHOID, SODIC AMPHIBOLES			CHIEFLY: PYROXENE, URALITE, OLIVINE ALSO: HORNBLENDE, BIOTITE, QUARTZ, ANALCITE, AEGIRINE, SODIC AMPHIBOLES			CHIEFLY: SERPENTINE, IRON ORE ALSO: HORNBLENDE, BIOTITE	HORNBLENDE BIOTITE IRON ORE	
	COLOR INDEX	10	15	20	20	25	30	20	20	25	50		60	95	55	
AVERAGE CHEMICAL COMPOSITION (DALY)	SiO_2	71.5	60.4	56.0	66.8	57.0	54.1	65.3	61.6	58.2	48.6		47.4	41.1	42.0	
	Al_2O_3	14.0	17.0	19.2	15.8	17.1	21.0	16.1	16.2	17.0	16.8		15.4	4.8	17.9	
	Fe_2O_3	1.5	2.7	2.9	2.3	3.4	1.8	2.1	2.5	3.2	4.8		4.9	4.0	5.7	
	FeO	1.4	2.9	[illegible]	1.3	3.6	3.3	2.3	3.8	3.7	6.0		5.4	7.1	5.7	
	MgO	0.6	1.8	0.6	1.0	2.3	1.1	1.7	2.8	3.5	5.1		5.0	32.2	3.4	
	CaO	1.6	3.7	2.0	2.8	5.4	3.2	3.9	5.4	6.3	8.9		9.7	4.4	10.3	
	Na_2O	3.4	4.2	8.5	3.7	4.7	6.2	3.8	3.4	3.5	3.7		3.8	0.5	8.0	
	K_2O	4.3	5.1	5.3	4.2	3.7	5.9	2.7	2.1	2.1	1.9		3.5	1.0	2.4	
PHANERITIC	EQUIGRANULAR Batholiths, lopoliths, stocks, large laccoliths, thick dikes, and sills	GRANITE ALASKITE—few dark minerals GRAPHIC GRANITE—graphic texture ALKALI GRANITE—abundant albite and sodic amphibole or pyroxene CHARNOCKITE—with orthopyroxene LUXULLIANITE—tourmalinized	SYENITE QUARTZ SYENITE—a little quartz ALKALI SYENITE—no plagioclase except albite PULASKITE—a little nepheline NORDMARKITE—a little quartz LARVIKITE—with "blue" feldspar SHONKINITE—abundant mafic minerals	NEPHELINE SYENITE LEUCITE SYENITE—pseudoleucite only feldspathoid SODALITE SYENITE—sodalite only feldspathoid FOYAITE—abundant K feldspar MALIGNITE—abundant mafic minerals DITROITE—with nepheline and sodalite	QUARTZ MONZONITE (ADAMELLITE)	MONZONITE	NEPHELINE MONZONITE	GRANODIORITE	QUARTZ DIORITE (TONALITE)	DIORITE	GABBRO GABBRO—with clinopyroxene NORITE—with orthopyroxene OLIVINE GABBRO—with olivine TROCTOLITE—olivine and plagioclase only ANORTHOSITE—plagioclase only QUARTZ GABBRO—with quartz	DIABASE (Dolerite of British) Phaneritic diabasic texture, normally medium or fine-grained	THERALITE ESSEXITE—[illegible] NEPHELINE GABBRO TESCHENITE—[illegible] OLIVINE THERALITE—[illegible]	PERIDOTITE PERIDOTITE—clinopyroxene and olivine HARZBURGITE—orthopyroxene and olivine PICRITE—pyroxene and olivine with some plagioclase DUNITE—olivine only PYROXENITE—pyroxene only SERPENTINE (SERPENTINITE)—chiefly serpentine	MISSOURITE—pyroxene, olivine, and leucite IJOLITE—pyroxene and nepheline FERGUSITE—pyroxene and pseudoleucite UNCOMPAHGRITE (MELILITE PYROXENITE)—pyroxene and melilite	PEGMATITE—phanerocrystalline, normally silicic, dike rock (or small irregular mass) having a conspicuously coarser texture than parent. APLITE—phanerocrystalline rock having sugary (fine-grained allotriomorphic-granular) texture.
PORPHYRITIC	PHANERITIC GROUNDMASS Laccoliths, dikes, sills, plugs, small stocks, margins of larger masses	GRANITE PORPHYRY	SYENITE PORPHYRY	NEPHELINE SYENITE PORPHYRY	QUARTZ MONZONITE PORPHYRY	MONZONITE PORPHYRY	NEPHELINE MONZONITE PORPHYRY	GRANODIORITE PORPHYRY	QUARTZ DIORITE PORPHYRY	DIORITE PORPHYRY	GABBRO PORPHYRY		THERALITE PORPHYRY	PERIDOTITE PORPHYRY KIMBERLITE—peridotite porphyry or breccia		LAMPROPHYRE—dark dike rock with exclusively mafic phenocrysts and/or abundant mafic minerals in groundmass.
	APHANITIC GROUNDMASS Dikes, sills, laccoliths, surface flows, margins of larger masses, welded tuffs	RHYOLITE PORPHYRY	TRACHYTE PORPHYRY	PHONOLITE PORPHYRY	QUARTZ LATITE PORPHYRY	LATITE PORPHYRY	NEPHELINE LATITE PORPHYRY	DACITE PORPHYRY		ANDESITE PORPHYRY	BASALT PORPHYRY		TEPHRITE PORPHYRY	LIMBURGITE PORPHYRY		
APHANITIC	MICROCRYSTALLINE Dikes, sills, surface flows, margins of larger masses, welded tuffs.	RHYOLITE	TRACHYTE	PHONOLITE LEUCITE PHONOLITE (Leucite trachyte)—leucite only feldspathoid TINGUAITE—abundant aegirine WYOMINGITE—leucite and phlogopite	QUARTZ LATITE (DELLENITE)	LATITE (TRACHY-ANDESITE)	NEPHELINE LATITE	DACITE		ANDESITE	BASALT OLIVINE BASALT—with olivine ANALCITE BASALT—with analcite QUARTZ BASALT—with quartz OCEANITE—with abundant olivine		TEPHRITE LEUCITE TEPHRITE—leucite only feldspathoid BASANITE—with olivine LEUCITE BASANITE—with olivine and leucite	LIMBURGITE	NEPHELINITE—pyroxene and nepheline LEUCITITE—pyroxene and leucite MELILITITE—pyroxene and melilite OLIVINE NEPHELINITE (NEPHELINE BASALT)—pyroxene, nepheline, and olivine ETC.	TRAP—dark-colored aphanitic rock. FELSITE—light-colored aphanitic rock.
	GLASSY Surface flows, margins of dikes and sills, welded tuffs.	OBSIDIAN—black PITCHSTONE—resinous VITROPHYRE—porphyritic PERLITE—concentric fractures PUMICE—finely cellular, light colored SCORIA—coarsely cellular, dark colored			Normally it is not possible to determine the composition of these rocks. They are customarily designated by the names at the left of this column. Basic glass is rare so rocks named, except scoria, will normally be silicic. If the approximate composition (by close association) or silica content (by refractive index or analysis), can be determined, the name may be prefixed by the name of the appropriate aphanitic rock, for example, "trachyte obsidian," or "latite vitrophyre." In general, scoria is basic; basic obsidian is called "tachylite"; and spherulitic tachylite is "variolite."								FREQUENCY OF OCCURRENCE This size type indicates COMMON ROCKS. This size type indicates UNCOMMON ROCKS. This size type indicates RARE ROCKS.			

ATTACHMENT C

ROCK QUALITY DESIGNATION CALCULATIONS

Rock Quality Designation (RQD)

In 1967 a modified core recovery procedure was developed to provide a Rock Quality Designation (RQD) for a given cored interval of NX core (Deere et al., 1967). The RQD value is the percentage obtained by dividing the summed lengths of all core pieces equal to or greater than 10-cm (4-in.) long by the cored interval length (see Module 4.6). Smaller pieces and/or core loss, are assumed to result from closely spaced discontinuities, shearing, faulting, or weathering, all of which decrease rock mass quality. An RQD of 100% indicates 100% core recovery with all pieces equal to or greater than 10 cm in length. Thus, it does not imply an unjointed rock mass.

The RQD percentages are directly proportional to the various measures of rock mass quality such as fracture frequency and *in situ* modulus of deformation (Figures 4.48 and 4.49). They have been found to be of value in estimating rock loads on tunnel supports where RQD provides some measure of block loosening that may occur; this, in turn, affects the loads the support system must withstand (Cording et al., 1975). An estimation based on RQD is enhanced by knowledge of the orientations of the discontinuities that define the blocks. The RQD and uniaxial compressive strength have been used to determine the most appropriate method of tunneling in rock (Figure 4.50).

The RQD values may not be representative of rock mass properties for reasons other than the lack of orientation data. If smaller diameter core is obtained, more breakage will occur than with NX core. Excessive breakage and possible core loss may result from improper drilling and handling. Orientation of the drillhole parallel to discontinuities also may result in excessive breakage and loss (Cording and Mahar, 1978).

MODULE 4.6

RQD calculation from core measurements.

Data from 10-ft (drilled length) core in shale
Discontinuities-bedding surfaces and two high-angle joints
All measurements in inches (in.) and feet (ft.)

Recovered core measurements (in.)

3:4	1.3	1.3	5.7	1.3	0.5	1.1
2.8	2.9	4.3	1.2	2.3	0.3	2.0
2.6	3.0	3.2	3.2	1.2	1.2	110.2
3.5	1.2	6.8	1.0	0.5	1.1	
3.1	2.9	0.9	2.0	0.5	0.3	
4.2	6.4	0.9	2.3	1.1	0.9	
2.2	2.6	4.4	2.8	0.3	1.7	
0.5	2.1	1.5	3.6	2.0	2.1	

Core-loss calculation

Total length cored (10 ft.)	120.0 in.
Recovered core	−110.2
Core loss	9.8 in.

RQD calculation: sum of pieces = or >4 in. (underlined in recovered core measurements)

4.2
6.4
4.3
6.8
4.4
5.7
31.8 in.

RQD = 31.8/120 = 0.265 × 100 = 26.5%

Source: R.B. Johnson and J.V. DeGraff, Principals of Engineering Geology, John Wiley and Sons, Inc., 1988.

VOC SCREENING

SOP No.: 430
Revision No.: 0
Date: January 31, 1992

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

VOLATILE ORGANIC COMPOUND SCREENING WITH A PHOTOIONIZING DETECTOR (PID)

1.0 OBJECTIVE

The objective of these guidelines is to provide procedures for volatile organic compound screeing using an Photoionizing Detector (PID).

2.0 EQUIPMENT

1) Photoionizing Detector (PID) such as HNu Systems, Inc. PI 101 (HNu)
2) Calibration Gas.

3.0 PROCEDURES

3.1 AMBIENT AIR CHARACTERIZATION

1. Protect HNu from contamination by bagging the readout/control assembly in plastic, wrapping the power cord in plastic, and bagging the sensor/probe assembly. Do not cover air sample inlet.
2. Set function switch on the 0 to 20 ppm range.
3. Prior to entering into a potentially contaminated area take a background reading and record.
4. Monitor work area continuously.

3.2 HEADSPACE CHARACTERIZATION

1. Collect the soil or water sample in glass container (a volatile organics analysis septum vial is not required) leaving 25 percent headspace.
2. Shake water samples or allow soil samples to thermally equilibrate. (Samples may also be warmed in a water bath).
3. Remove sample container cover and insert HNu probe extender into headspace. Record reading on Test Boring Report form.

4.0 MAINTENANCE

The following subsections describe the minimum routine maintenance necessary. The instrument contains only one moving part and consumes no gases or reagents.

4.1 CLEANING UV LIGHT SOURCE WINDOW

The only routine maintenance procedure specified by the manufacturer is cleaning the light source window as necessary. This procedure is accomplished as follows:

1. Turn the function switch to the OFF position and disconnect the sensor/probe from the readout/control unit.
2. Remove the exhaust screw found near the base of the probe. Grasp the end cap in one hand and the probe shell in the other and gently pull to seperate the end cap and lamp housing from the shell.
3. Loosen the screws on the top of the end cap and separate the end cap and ion chamber from the lamp and lamp housing. Care must be taken so that the ion chamber does not fall out of the end cap and the lamp does not slide out of the lamp housing. Turn the end cap over in your hand and tap on the top of it; the ion chamber should fall out in your hand.
4. Place one hand over the top of the lamp housing and tilt slightly; the light source will slide out of the housing. The lamp window may now be cleaned with the manufacturer-supplied cleaning compound.
5. Following the completion of cleaning, reassemble the unit by first sliding the lamp back into the lamp housing. Then replace the ion chambe on top of the lamp housing, checking to make sure that the contacts are properly aligned.
6. Place the end cap on top of the ion chamber and replace the two screws. The screws should be tightened only enough to seal the "O" ring. Do not overtighten. Line up the pins on the base of the lamp housing with pins inside the probe shell. Gently slide the housing assembly into the shell; it only fits one way.
7. Replace the exhaust screw.

4.2 "FOGGING" OF UV LIGHT SOURCE WINDOW

During cold weather operations, condensation may form on the UV light source window, resulting in reduced levels of response. Field operators can follow the procedure outlined in 4.1 for removing the lamp to clear it of condensation. Consideration should also be given to more frequent cleaning when the instrument is used under very dusty conditions, such as on a landfill in dry weather.

4.3 BATTERY CHARGING

To charge the battery, plug the charger into the jack on the side of the instrument case. The battery is fully charged after 14 hours of charging. Disconnect the 120 V AC power before disconnecting the charger plug. A full charge provides about 10 continuous hours of operation. The instrument will be recharged after every use. If the instrument has not been used for a substantial period of time, the battery should be checked prior to use and recharged if necessary.

The instrument is equipped with an automatic cutoff circuit which turns off the power if the battery voltage drops below 11 V DC. This prevents accidental damage to the electronics if it is inadvertently left on. Note that the unit can be operated with the charger on, unless it is in a hazardous (explosive) environment; however, it must be charged in a non-hazardous (non-explosive) area.

5.0 CALIBRATION

Primary calibration of the HNu is accomplished at the factory. For MAIN applications, the calibration standard used in benzene equivalent and the SPAN potentiometer reading is 9.8. Primary calibration is normally stable for a long time. Routine calibration is most easily accomplished by using a manufacturer-supplied cylinder of calibration gas. A sample of the calibration gas is drawn into the instrument and the SPAN potentiometer is adjusted until the instrument is reading the concentration of the calibration gas. Small deviations from the span setting over time are normal. Deviations of greater than +5 percent indicate that the lamp window may need cleaning or, if that does not eliminate the deviation, the unit needs servicing. It is MAIN policy that routine calibration is performed prior to each field use. This will also serve as an operational check to ensure that the instrument is responding properly. Records of routine calibration should be recorded in the HNu log, which always accompanies the instrument and also the site health and safety officer keeps this record.

PREPARED BY: ____________________

APPROVED BY: ____________________
Chief Hydrogeologist

APPROVED BY: ____________________
Project Manager

APPENDIX 5E

STANDARD OPERATING PROCEDURES FOR GROUNDWATER SAMPLE COLLECTION

CONTENTS

GROUNDWATER SAMPLING

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE FOR GROUNDWATER SAMPLING

1.0 OBJECTIVE

To collect representative samples of groundwater from monitoring wells or piezometers.

2.0 EQUIPMENT

A general checklist of equipment needed to sample monitoring wells follows:

1) Sample collection equipment (bailers, pumps, sample lines, tripods, etc.).
2) Reagents for sample preservation.
3) Appropriate sample containers.
4) pH and conductivity meters for desired on site measurements.
5) Appropriate trip blanks and high quality blank water.
6) Appropriate field duplicate samples.
7) Sample Records, Chain-of-Custody forms, and sample bottle labels.
8) Security lock, keys or codes. Many monitoring wells have locking caps and key locks with combination or key entry. Furthermore, some sites are secured using fences and/or by having guards, in which case keys and/or permission to enter are necessary.
9) Tools to assist in well access. These may include screw drivers, hammers, chisels, pipe wrenches with chain, or a propane torch. These may be necessary for removing security caps on wells which have not been recently opened.
10) Tape measure. A tape measure is useful for measuring the diameter of the well casing and the well casing elevation above ground level.
11) Electronic water level indicator/graduated depth sounder. These are necessary for determining the static water level and the total depth of the well.
12) Pocket calculator. This is used for determining the number of well volumes to be evacuated from a well prior to sampling.
13) Log book and indelible ink marker. This is for recording field information.
14) Clean plastic sheeting (e.g., polyethylene) or other clean, unused tarp to place on the ground and use to minimize possible sampling equipment contamination.
15) Decontamination supplies and reagents.
16) Meter to measure volatile organic compounds.
17) Health and safety equipment.

3.0 SUPPORTING SOPs

SOP No.	Title
430	Volatile Organic Compound Screening with a Photoionizing Detector (PID)
535	Non-Aqueous Phase Layer Sampling
540	Quality Assurance/Quality Control Sampling
555	Sample Field Filtration
560	Sample Field Preservation
565	Field Equipment Decontamination
570	Sample Packaging and Shipping Procedures
600	Groundwater Level Measurements
640	pH Measurements
645	Specific Conductance Measurements
650	Temperature Measurements
710	Record Keeping
720	Chain-of-Custody Procedures

4.0 PROCEDURES

4.1 INTRODUCTION

Prior to going to the site, obtain well construction background information to improve the efficiency and cost effectiveness of the sampling program. The specifics of the well location and well construction, including the diameter of the well, the depth of the casing, the depth to the screened portion of the well, the total length of the screen, and the material used in the construction of the well and screen should be known. The well diameter is important as it partially defines sampling equipment and procedures. Generally, a majority of wells used only for monitoring have two-inch outside diameter casings; however, in cases where groundwater recovery is used to remediate a contamination problem, wells with either four-, six-,or eight-inch outside diameter well casings may be used. It is also important to establish the accessibility to wells before arrival on-site, as this may effect the selection of the sampling equipment and transport of equipment to the well. Information identifying the documented point of reference (top of well casing, top of protective casing, etc.) is essential to ensure that all field elevation measurements are referenced to the proper location. Details of historic depth to groundwater surface and depth to well casing bottom are also useful, as these may impact on the sampling equipment and approach selected for completion of the sampling. Periodically, the well depth should be measured to monitor siltation of the well screen. Information describing well location, using topographic maps or descriptions tied directly to prominent field markers is helpful, as these allow personnel unfamiliar with the site to find wells. Good quality well siting descriptions or maps are also valuable under severe weather conditions. In practice, it is also a good idea to establish a listing identifying the order in which wells are to be sampled (i.e. cleanest to most contaminated) and the equipment that is necessary for completion of the assigned task.

4.2 WATER LEVEL MEASUREMENTS

Water level measurements and standing water volume calculations will be conducted in the following fashion.

1. Open the well.
2. Screen the air space in the well with an instrument that measaures volatile organic compounds.
3. Measure the inside diameter of the well casing upriser.
4. Determine the distance between the established point of reference (top of well upriser, top of protective casing, etc.) and the surface of the standing water contained in the well. This measurement should be accurate to within 0.05 feet.
5. If the possibility of floating or sinking non-aqueous phase liquids exists, probe the well for these materials.
6. Determine, via direct measurement or historic data, the distance between the well's point of reference and the well bottom.
7. Compute the height of standing water present in the well by subtracting the distance to the surface of groundwater measurement from the distance to well bottom measurement.
8. Calculate the static volume of water present in the well.
9. Decontaminate the probe and cord thoroughly after each use to avoid possible cross contamination between wells.

4.3 WELL PURGING

Procedures used to purge or evacuate a well are dependent upon the equipment available, the accessibility of the well, and the physical characteristics of a well. A variety of pumps may be used, including hand-operated or motor-driven suction pumps, peristaltic pumps, and compressed gas or battery driven pumps. In some cases, hand bailing is the best method. If the device being used does not have a flow meter, a graduated plastic pail can be used to measure the total volume discharge. Devices that can alter or contaminate groundwater samples should not be used for purging or sampling operations. Sampling devices that promote sample constituent loss, should not be used during sampling. Whenever possible, sampling equipment that is dedicated to use at a single well is preferred, although multiple use equipment can be used as long as proper decontamination procedures are used between wells.

1. Remove at least three well volumes of water from the well prior to sample collection. In most cases, removal of three well volumes will result in the collection of a "representative" groundwater sample from the well which should not be influenced by stagnant water remaining in the well casing. In cases where it is suspected that the removal of three well volumes may result in under-evacuation or over-evacuation of

a well, measure the pH, specific conductance, and temperature after each well volume has been removed. Establish and document when the well appears to stabilize for all parameters of concern. Record the volume of water removed in the field notebook.

2 Once purged, prepare to sample the well. If slow recharging wells are encountered, return several hours or even one day later to collect the sample. Alternatively, pump slow recharging wells to dryness, and then sample the well as it recharges. For fast recovering wells, sample the well immediately after purging the required volume.

4.4 SAMPLING

The following procedure is recommended for collecting groundwater samples from monitoring wells.

1. Numerous kinds of equipment are available for sampling wells. Usually the same piece of equipment used to purge the well is used to sample groundwater from it. In selecting equipment for use, consideration should be given to materials of construction, analytes of interest, and possible pathways of sample contamination or loss. If there is any potential for sample quality being compromised, then alternative devices or materials of construction should be used. In many situations the best sampling device available is a bailer that is constructed of teflon, polyethylene, or stainless steel. Other devices include a positive pressure pump, peristaltic pump, bladder pump, and a Watera pump or equivalent system.
2. If a bailer is used, slowly lower the bailer into the well until it is submerged, then raise it to the surface. Pour the recovered water directly from the bailer into the sample bottle to reduce the possibility of cross-contamination or volatile species loss. Repeat this procedure until all sample bottles are filled.
3. When other forms of sampling devices are used, follow manufacturers recommended protocols during sampling while maintaining close observation of the process. If conditions indicative of sample degradation or alteration are noted, discontinue sampling until further review of the situation is completed.
4. Measure and record the pH, temperature, and conductivity of the groundwater.
5. Record the color, clarity, and any obvious odors of the water.
6. Immediately preserve and store the samples to maintain sample representativeness.
7. Decontaminate the equipment or pack it for decontamination later.
8. Ship the samples and a Chain-of-Custody form to the laboratory.

PREPARED BY: ____________________

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FIELD DECONTAMINATION

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

FIELD EQUIPMENT DECONTAMINATION

1.0 OBJECTIVE

To prevent the spread of contaminants between sampling points and from the contaminated zone. To also protect the health and safety of the field investigators on-site.

2.0 GENERAL

Although contamination avoidance is the best posture to adopt a hazardous material site, certain equipment used in remedial actions or sampling will unavoidably become contaminated. These items must either be properly decontaminated before being removed from the site or, in the case of sampling equipment, thoroughly cleaned before the next use. Wherever possible, disposable sampling equipment should be utilized to minimize the quantities of equipment to be cleaned and volume of decontaminants and rinse solutions to be disposed. Likewise, disposable plastic tarpaulins can be placed over certain items of equipment to minimize subsequent cleaning.

3.0 PROCEDURES

3.1 EXPLORATION AND OTHER HEAVY EQUIPMENT

3.1.1 Introduction

The decontamination of vehicles and large pieces of equipment, such as pumps, will be done on a decontamination pad constructed so that cleaning solutions and wash water can be collected for later disposal. It is important that all portions of the equipment including the under carriage, chassis, and cab be thoroughly cleaned.

3.1.2 Equipment

1) Decontamination Pad
2) Shovels
3) Steam Cleaner
4) Potable Water

3.1.3 Procedure

1. An area or areas will be selected where decontamination pads can be established. If one area is selected this site will be 50 x 50 feet in size, placed in an area where a collection sump can be placed in soil, and near a source of electricity (or a generator will be provided) and potable water. If two locations are provided, each will be 25 x 50 feet in size, in a place where a sump can be placed, and near a source of electricity and potable water. These locations must be free of general vehicular and pedestrian traffic and accessible at all hours of the day. The pads will be located in areas of concern to avoid contaminating other areas on site, should an accidental release occur. MAIN will manage installation and operation of the decontamination areas. Each pad will consist of a level, sloped are covered with plastic sheeting. The sump will be placed in a hole at the base of the slope to collect the water produced by steam cleaning.
2. Construct the pad by excavating a level, sloped area approximately 25 x 50 feet in size that slopes from ground surface to approximately two feet deep at the deep end. A sump deep enough for a bucket will be dug at the deep end. Heavy plastic sheeting will be laid out in the pad and on the sides. Lumber, or other appropriate material, will be used to hold the plastic down along the edge.
3. Place the heavy equipment on the decontamination pad.
4. Remove any loose material, such as soil or grout, from the equipment.
5. Steam clean the equipment. When the equipment first comes on site and before it leaves the site all portions of the equipment will be steam cleaned including the under carriage, chassis, cab, downhole equipment, water tanks (inside and outside), hoses, and tires. When decontaminating equipment between uses, decontaminate the downhole equipment and other equipment that comes in contact with the soil or water, such as the tires or equipment that is splashed.
6. Steam clean the decontamination pad so that the water and solids flow into the sump.
7. When necessary, remove the water and solids from the sump for disposal.

3.2 SAMPLING EQUIPMENT

3.2.1 Introduction

The decontamination of non-disposable sampling equipment requires a great deal of care to minimize the cross-contamination of samples. This equipment includes bailers, pitchers, split spoons, and outer gloves.

3.2.2 Equipment

1) Plastic buckets (preferably 5 gallon capacity)
2) Soft-bristle brushes
3) Long-handled bottle brushes for cleaning the inside of bailers
4) Paper towels

5) Detergent (such as Alkanox) or other cleaner specific to the material to be removed
6) Squirt bottles
7) Distilled water
8) Potable water
9) Methanol (Pesticide analysis-grade)
10) Hexane (Technical or reagent-grade)
11) Aluminum foil

3.2.3 Procedures

1. Remove petroleum hydrocarbons or other materials with paper towels, if necessary.
2. Remove petroleum hydrocarbons by rinsing with hexane, if necessary.
3. Wash the equipment with a brush and potable water mixed with detergent or an alternate decontamination agent.
4. Rinse with potable water (No further decontamination will be performed on split spoons).
5. Rinse with methanol.
6. Rinse with distilled water.
7. Allow the excess water to drain off the equipment.
8. If possible, allow the equipment to air-dry.
9. Wrap the equipment in unused aluminum foil if it will be stored before being used.
10. If necessary, collect the methanol separately from the wash and rinse waters for later disposal off-site.

3.3 PERSONNEL SAFETY EQUIPMENT

The level of protection selected for a site study and the specific pieces of clothing worn in the exclusion zone dictate the items required and the layout of the decontamination equipment. Each level of protection presents a different situation with respect to the type of decontamination procedure required. Figures 10-1, 10-2 and 10-3 outline the decontamination procedures for each level of protection, A, B, and C respectively.

The reason for leaving the exclusion zone determines the need for and extent of decontamination. Also, the time required for personnel decontamination should be ascertained and incorporated in the scheduling of site activities. A worker leaving the exclusion zone to pickup or drop off tools or instruments and immediately returning may not require decontamination. A worker leaving to get a new air cylinder or change a respirator or canisters, however, would require some degree of decontamination. Personnel wearing self-contained breathing apparatuses must leave their work areas with sufficient air to go through decontamination. Individuals departing the area at breaktime, lunchtime, or the end of the day must be thoroughly decontaminated.

Decontamination equipment, materials and supplies are generally selected on the basis of availability. The ease of equipment decontamination and disposability are also considered.

Most equipment and supplies can be easily procure. Soft-bristle scrub brushes or longhandled brushes are used to remove contaminants. Buckets of water or garden sprayers are used for rinsing. Large galvanized wash tubs, stock tanks, or children's wading pools can also be used a containers for wash and rinse solutions. Large plastic garbage cans or similar containers lined with plastic bags are useful for the storage of contaminated clothing and equipment, and metal or plastic cans or drums are convenient for the temporary storage of contaminated liquids. Other gear includes paper or cloth towels for drying protective clothing and equipment.

Protective equipment, will be decontaminated by scrubbing with detergent water using a soft-bristle brush, followed by rinsing with copious amounts of water. While this process may not be fully effective in removing some contaminants (in some cases, the contaminants may react with water), it is a relatively safe option compared to the use of decontaminating solution. The contaminant must be identified before a decon chemical is used, and reactions of such a chemical with unidentified substances or mixtures could be especially troublesome. A decontamination solution must be selected in consultation with an experienced chemist.

Once decontamination procedures have been established, all personnel requiring decontamination will be given instruction and, if necessary, practice moving through the decontamination procedure.

3.4 CLOSURE OF THE DECONTAMINATION PAD

When the decontamination pad is no longer needed, it will be closed down. All disposable clothing and plastic sheeting used during the operation will be double-bagged and either contained on site or moved to an approved off-site disposal facility. Decon and rinse solutions will be collected for future disposal. Reusable clothing will be dried and stored for future use. If gross contamination had occurred, additional decontamination of these items may be required. All wash tubs, pails, containers, etc. will be thoroughly washed, rinsed and dried prior to removal from the site. The dismantled decontamination pad will be fenced in so it can be used in the future or closed by backfilling the area to the original grade.

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FIGURE 10-1

DECONTAMINATION LAYOUT
LEVEL A PROTECTION

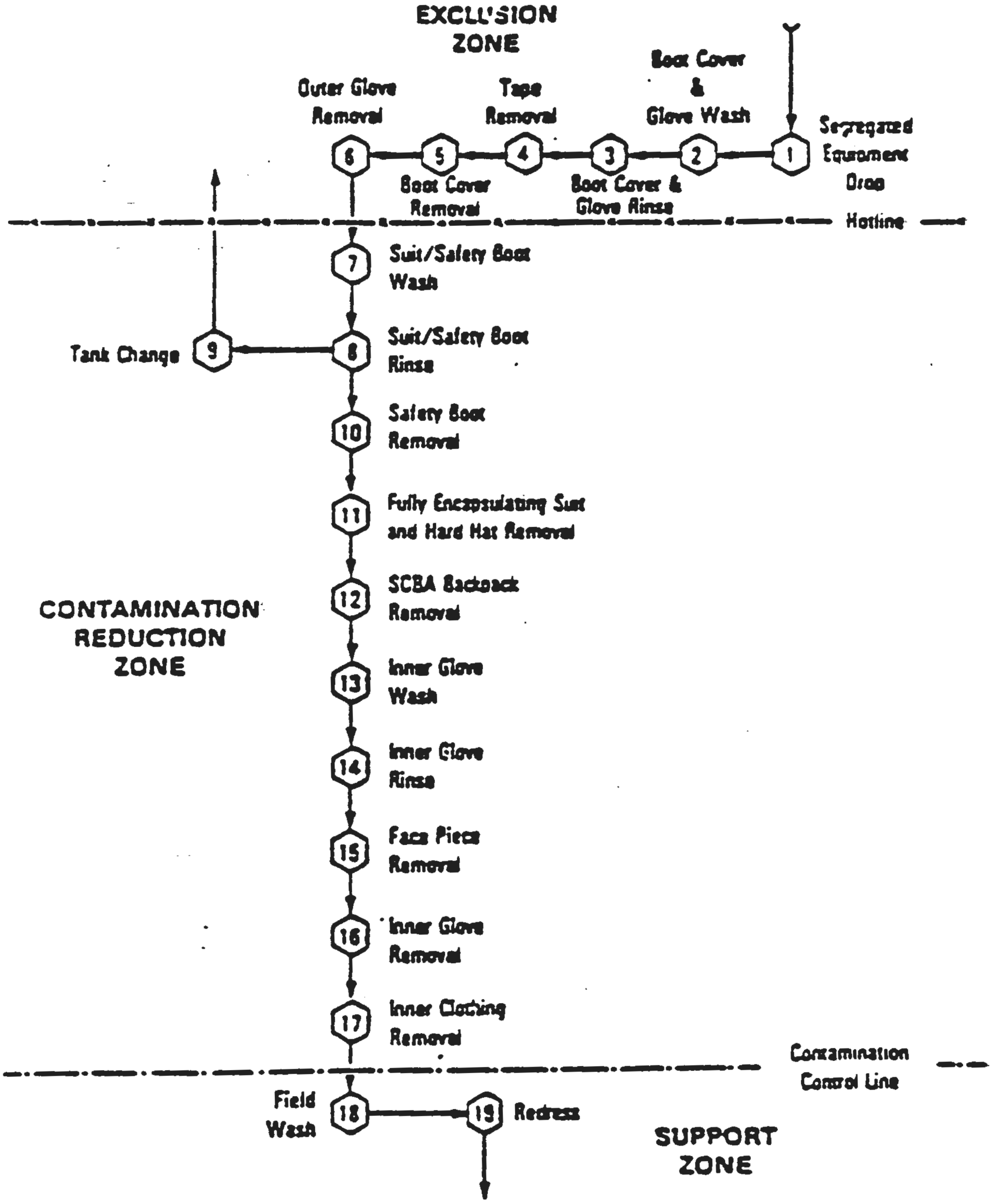


FIGURE 10-2

DECONTAMINATION LAYOUT
LEVEL B PROTECTION

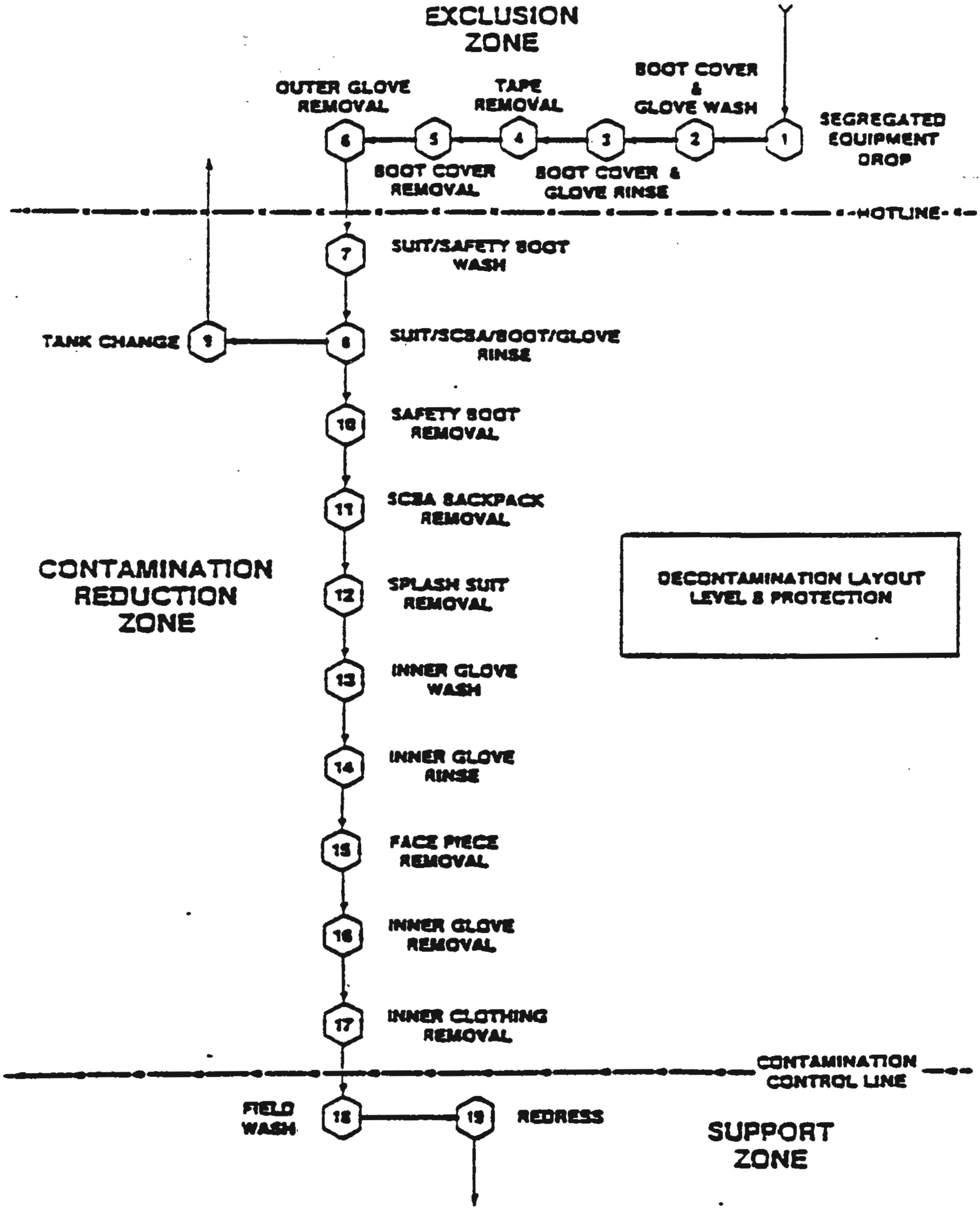
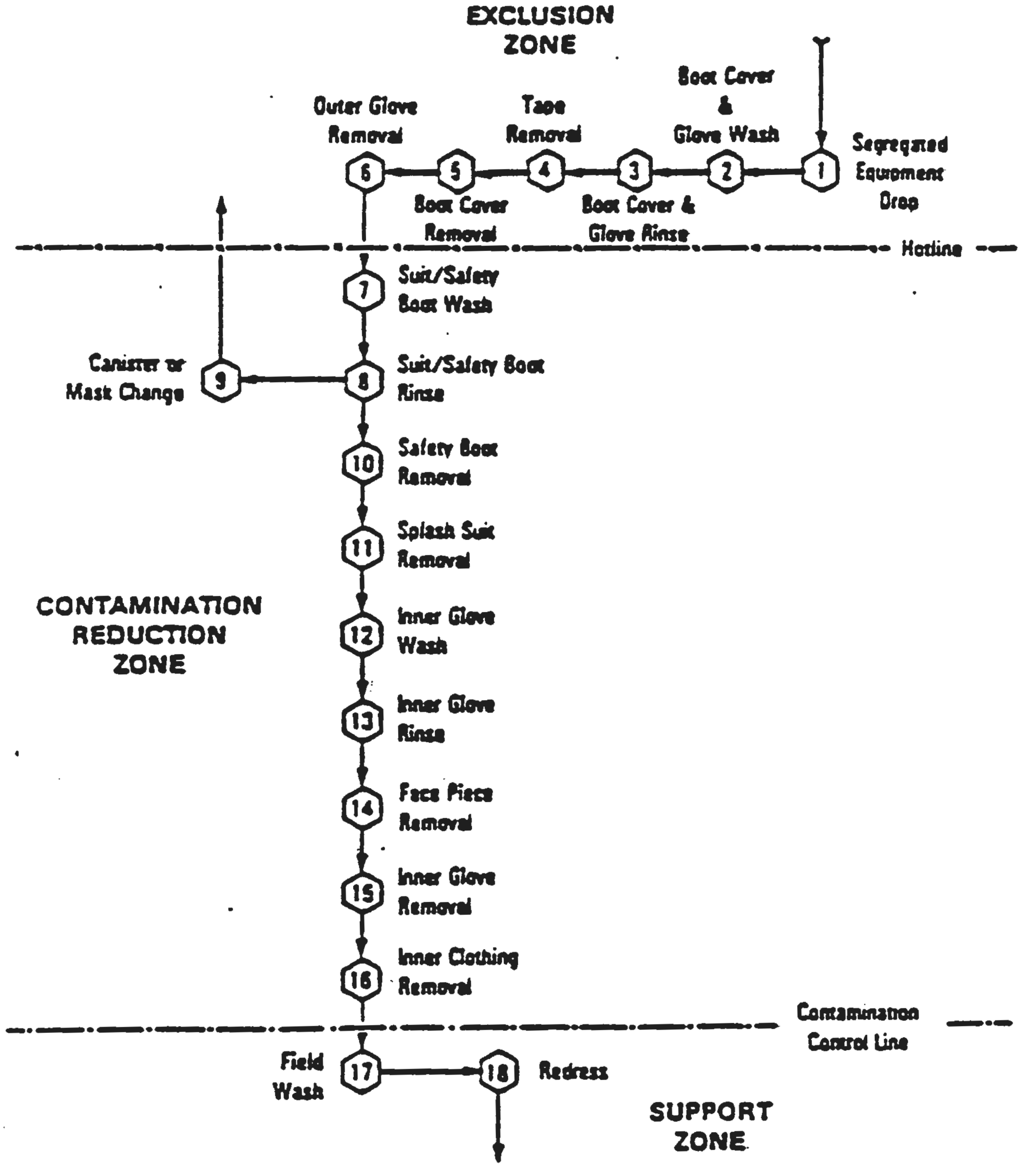


FIGURE 10-3

DECONTAMINATION LAYOUT LEVEL C PROTECTION



SAMPLE PACKAGING AND SHIPPING

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

SAMPLE PACKAGING AND SHIPPING

1.0 OBJECTIVE

Once the samples have been collected, prepared, preserved, and appropriately stored, they must be packaged and shipped. This section outlines procedures for the packing and shipping of environmental samples, hazardous samples not from closed containers, and hazardous samples from closed containers.

2.0 EQUIPMENT

1) Metal or plastic picnic cooler.
2) Fiberglass tape (1 inch wide minimum)
3) Vermiculite or other absorbent material
4) Foam or bubble pack to wrap bottles
5) Indelible marker
6) Ziplockable plastic bags (sandwich-sized and quart-sized)
7) Elastics
8) Shipping labels
9) "This End Up", "Fragile", and "Liquid in Glass" labels
10) Custody seals
11) Ice or freezable gel packs

The following additional equipment is used for packing and shipping hazardous samples.

1) Metal paint cans (half or one gallon).
2) Labels such as "Flammable Liquids", "Corrosive", "Poisonous Gas", etc.
3) DOT-specified 3A1800 or 3AA1800 metal, compressed gas cylinder.
4) Tags with metal wires.

3.0 SUPPORTING SOPs

SOP No.	Title
720	Chain-of-Custody Procedures
565	Field Equipment Decontamination

4.0 PROCEDURES

4.1 PACKAGING AND SHIPPING PROCEDURES FOR ENVIRONMENTAL SAMPLES

All sample containers must be placed in a sturdy, insulated shipping container for transport to the laboratory. A metal or plastic picnic cooler is recommended. The following is an outline of the procedures to be followed.

1. Using fiberglass tape, secure the drain plug, if present, at the bottom of the cooler to ensure liquid from sample container breakage or melting ice does not leak from the cooler.
2. Line the bottom of the cooler with a layer of absorbent material such as vermiculite.
3. Use pieces of carved-out plastic foam or individually wrapped glass containers to help prevent breakage.
4. Hand tighten all screw caps. Place a signed custody seal on each bottle so that the seal contacts the cap and neck of the bottle if the samples are for regulatory or legal purposes.
5. Pack sample bottles in the cooler.
6. Pack small containers, such as 40 milliliter vials, in small plastic sandwich bags. Put 2 or 3 vials in each bag, seal the bag, then put an elastic around the bag and vials. When shipping these with larger containers, cushion the vials to minimize breakage.
7. Pack additional cushioning material, such as vermiculite or bubble pack, between the sample containers.
8. Pack ice, sealed in plastic bags, or freezable gel packs on top of the samples in the cooler when samples must be kept cold.
9. Seal the completed Chain-of-Custody form in a plastic bag and attach it to the inside of the cooler lid with tape.
10. Close the lid of the cooler; be sure it is tightly fastened.
11. Seal the container with fiberglass reinforced tape. Wrap the tape vertically around the cooler: two wraps each on the long and short dimensions.
12. Attach a shipping label with a return address to the outside of the cooler on the lid, along with arrows indicating "This End Up" on all four sides, and "This End Up" label on the top of the lid.
13. Apply additional labels such as "Fragile" or "Liquid In Glass" as necessary.
14. Apply two signed custody seals between the lid and body of the cooler: one on the front and one between the hinges on the back.
15. Ship samples packaged in this way by commercial carrier so it arrives the next morning. Staff should be prepared to open and reseal the cooler for inspection when offering them for shipment. Be aware that some commercial carriers have limits for the number of pounds per item that can be shipped.
16. Notify the laboratory of the name of the carrier, the containers' Bill of Lading numbers, and it's expected delivery date.

4.2 PACKING AND SHIPPING HAZARDOUS SAMPLES EXCLUDING THOSE FROM CLOSED CONTAINERS

The hazardous nature of these samples will be decided based on available information (site use, chemical data, historical information, etc.) and the observed soil quality.

1. Decontaminate the sample container if the sampled material is on the outside of the container by washing it with soapy water (detergent such as Alkanox), rinsing it with water, and drying it off.
2. Place a signed custody seal on each bottle so that the seal contacts the cap and neck of the bottle if the samples are for regulatory or legal purposes.
3. Place one, decontaminated, labeled sample container in a 2-mil-thick self-sealing plastic bag. Care should be taken to position the sample label so that it may be read through the bag.
4. Place some vermiculite in the bottom of a half-gallon or gallon metal paint can to absorb shock and leaking material in the event of sample breakage. The sealed sample bag is then placed in the can. Additional vermiculite is added to fill the remaining space in the can. Close the can lid and seal in place with clips.
5. Attach address and return mailing labels to each can. Attach additional Department of Transportation Labels as are required by provisions of 49 CFR 171, 172, 173, or 178. Such labels may include "Flammable Liquid", "Flammable Solid", "Corrosive", etc.
6. Place the can in a cooler that has been partially filled with vermiculite. Additional vermiculite should then be placed where needed to secure the metal can. If more than one can is being shipped, this should be specified in the carrier's bill of lading. Pack ice or frozen gel packs on top of the samples in the cooler. Seal a copy of the chain-of-custody record in a plastic bag, place it in the cooler, and shut and fasten the cooler lid.
7. Mark the top of the cooler with a "This End Up" label. The outside must display the same labels as are present on the metal can inside; In addition, arrows pointing to the top must appear on all four sides. Attach a label marked "Laboratory Samples" to the lid.
8. Secure the drain plug and lid of the cooler with fiberglass tape.
9. Custody seals as described in Section 4.1.
10. Check to be sure that the carrier's bill of lading is completed and signed. The sampler's certification for restricted articles must also be completed and signed.
11. Personnel should be prepared to open and reseal the cooler if requested by the carrier. If transported by air, samples should be shipped by cargo aircraft only so it arrives the next morning, if possible.
12. Notify the laboratory of the name of the carrier, the containers' Bill of Lading numbers, and it's expected delivery date.

4.3 PACKING AND SHIPPING UNANALYZED HAZARDOUS SAMPLES TAKEN FROM CLOSED CONTAINERS

Current EPA National Enforcement Investigation Center Guidelines provide that, in the absence of reliable data which excludes the possibility of the presence of substances that are listed as DOT Poison A (49 CFR 173.326), unanalyzed samples taken from closed containers must be packaged according to the following worst case procedure.

1. The sample container should be narrow enough to fit through the valve hole of a DOT specified 3A1800 or 3AA1800 metal compressed gas cylinder.
2. The metal cylinder is prepared by removing the valve assembly and partially filling it with vermiculite.
3. The decontaminated sample container, with sample tag affixed, is lowered into the cylinder by means of a string attached to the neck of the bottle. Additional vermiculite is placed in the cylinder surrounding the sides of the sample container to prevent breakage. A maximum of one sample container per cylinder is allowed.
4. The cylinder is then filled to the top with vermiculite and the end of the string left on top to facilitate sample removal.
5. The cylinder valve assembly is replaced and tightened. The valve protector is then replaced. A signed custody seal is placed between the value and neck of the cylinder.
6. The cylinder is marked and labeled as follows: 1) a tag is wired to the valve protector with the laboratory name and address and the words "Poisonous Liquid or Gas, N.O.S. and 2) a label "Poisonous Gas" is placed on the outside of the cylinder.
7. If the cylinder is placed in an outside container such as a wooden crate, the container must have the same labels as the cylinder, and the following additional labels must appear on the outside of the container:
   1) Laboratory Sample; 2) Inside Packages Comply with Prescribed Specifications; 3) Arrows pointing up must appear on four sides; and
   4) "This Side Up" should be placed on the top of the container.
8. Samples prepared for shipment in this manner can only be shipped by ground transportation or government aircraft; they may not be carried via commercial rental, or private aircraft.
9. Notify the laboratory of the name of the carrier, the containers' Bill of Lading numbers, and it's expected delivery date.

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GROUNDWATER LEVEL MEASUREMENT

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

GROUNDWATER LEVEL MEASUREMENTS

1.0 OBJECTIVE

The objective of these guidelines is to provide procedures on groundwater level measurement.

2.0 EQUIPMENT

A battery-operated water level indicator.

3.0 SUPPORTING SOPs

SOP No.	Title
565	Field Equipment Decontamination

4.0 PROCEDURES

1. Decontaminate probe.
2. Press test switch to insure proper operation of electronic indicator. A light will come on and/or a buzzer will sound.
3. Lower the probe slowly into the well until the buzzer and/or light signals.
4. Slowly raise probe until buzzer and/or light turns off.
5. Repeat steps 3 and 4 until the water surface consistently measures the same.
6. Record time, water level and well designation on Groundwater Level Measurement Form (see Figure 600-1)

5.0 MAINTENANCE

1. The probe should be routinely cleaned with alconox and distilled water.
2. Battery levels should be checked.

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Figure 600-1

CHAS. T. MAIN, INC. | **GROUNDWATER ELEVATION REPORT**

WELL NUMBER ________
ELEVATION (TOC) ____________________
JOB NO. ____________
PAGE NO. ____________

DATE	TIME	DEPTH OF WATER FROM ________	ELEVATION OF WATER	REMARKS	READ BY

PH MEASUREMENT

SOP No.: 640
Revision No.: 0
Date: January 31, 1992
Page 1 of 2

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

pH MEASUREMENTS

1.0 OBJECTIVE

To obtain a representative pH of an aqueous sample while in the field using both a pH meter and pH paper.

2.0 EQUIPMENT

1) Portable pH meter
2) Combination pH electrode and temperature probe
3) pH indicator paper, such as Hydrion, to cover the pH range 1 through 10. pH paper is available in a variety of ranges, depending on the accuracy required. However, if fairly accurate results are required, an instrument measurement is preferred.
4) Distilled or deionized water

3.0 SUPPORTING SOPs

SOP No.	Title
565	Field Equipment Decontamination

4.0 PROCEDURES

It is important to obtain a pH measurement soon after obtaining a sample and thus avoid sample changes such as precipitation, temperature fluctuation, or oxidation which can affect the pH of the sample.

pH Meter

1. Immerse the electrode and probe in the unknown solution.
2. Read and record the pH of the solution.
3. Rinse the electrodes with the water.
4. Keep the electrode immersed in water at all times when not in use or put the end cap (partially filled with water) on the tip of the electrode.

Indicator Paper

This technique will only be used to obtain an approximate pH, such as when preserving a sample.

1. Place a small amount of the unknown solution onto a strip of indicator paper.
2. Compare the color with the indicator colors given on the pH paper container.
3. Record the pH. (Note: If the indicator paper is suspected of being old or deteriorated, immerse it in an appropriate buffer and check the color that develops against the standards given.)

5.0 METER MAINTENANCE

1. General maintenance: Store electrodes according to procedures given on the electrode instruction sheet.
2. Monthly maintenance: Check the battery level, and replace batteries as needed.
3. After-use maintenance: Check batteries after each use.
4. Functional maintenance: Refer specific maintenance or repair needs to the manufacturer or other qualified service personnel.

6.0 METER CALIBRATION

The meter will be calibrated before readings are made that day. Calibration will be checked with pH 7 buffer midway through the day and with both buffers at the end of the day.

1. Immerse the tip of the electrode in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use.
2. Rinse the electrode with distilled or deionized water.
3. Immerse the electrode and temperture probe in pH 7 buffer solution.
4. Adjust the pH meter to read 7.0 (Note: If the sample is known to have a very acidic or alkaline pH, also standardize the meter with pH 4 or pH 10 buffer, respectively).
5. Rinse off the electrode and temperature probe with the water.
6. Immerse the electrode and probe in pH 4 or pH 10 buffer depending on whether the readings are expected to be acidic or basic.
7. Calibrate the pH meter to read the pH of the buffer solution.
8. Remove the elctrode from the buffer and rinse them thoroughly with distilled or deionized water.

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SPECIFIC CONDUCTANCE MEASUREMENTS

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

SPECIFIC CONDUCTANCE MEASUREMENTS

1.0 OBJECTIVE

This guideline details the steps required to measure the specific conductance of an aqueous sample while in the field. It is important to obtain a specific conductance measurement soon after taking a sample since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air (or degassing of carbon dioxide to the air) all affect the specific conductance.

2.0 EQUIPMENT

1) Specific conductivity meter.
2) Specific conductivity probe.

3.0 SUPPORTING SOPs

SOP No.	Title
565	Field Equipment Decontamination

4.0 PROCEDURES

1. Adjust meter zero (if necessary) by turning the bakelite screw on the meter face so that the meter needle coincides with the zero on the conductivity scale.
2. Calibrate the meter by turning the MODE control to REDLINE and adjusting the REDLINE control so the meter needle lines up with the redline on the meter face. If this cannot be accomplished, replace the batteries.
3. Plug the probe into the probe jack on the side of the instrument.
4. Put the probe in the solution to be measured. (See Probe Use). Gentle agitation by raising and lowering the probe several times during a measurement insures flow of specimen solution through the probe and improves the time response of the temperature sensor.

5. Switch to X100. If the reading is below 50 on the 0-500 range (5.0 on the 0-50 mS/m range), switch to X10. If the reading is still below 50 (5.0 mS/m), switch to the X1 scale. Read the meter scale and multiply the reading appropriately. The answer is expressed in micromhos/cm (mS/m). Measurements are not temperature compensated.

   Example
   Meter Reading: 247 (24.7 mS/m)
   Scale: X10
   Answer: 2470 micromhos/cm (247.0 mS/m)

6. When measuring on the X100 and X10 scales, depress the CELL TEST button. The meter reading should fall less than 2%; if greater, the probe is fouled and the measurement is in error. Clean the probe and re-measure.

If the specific conductance measurements become erratic or inspection shows that any of the platinum black has flaked off the electrode, replatinization of the electrode is necessary. See the manufacturer's instruction for details.

5.0 MAINTENANCE

Replace batteries when necessary.

6.0 CALIBRATION

1. Calibrate meter and probe using the calibration control and the red-line on the meter dial (Y.S.I. S-C-T Meter, Model No. 33).
2. Turn the function switch to read conductivity x 10 and then depress the call test button, noting the deflection. If the needle falls more than 2 percent of the reading, clean the probe and retest.
3. Using at least two buffer solutions, which will most likely bracket the expected values for conductivity, note accuracy of the water and probe and clean probe if necessary.

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TEMPERATURE MEASUREMENTS

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE

FOR

TEMPERATURE MEASUREMENTS

1.0 OBJECTIVE

This procedure describes the steps required to measure the temperature of a groundwater or surface water sample.

2.0 EQUIPMENT

1) Portable pH meter with pH electrode and temperature probe or
2) Thermometer with liquid such as alcohol (not mercury).
3) Certified calibrated mercury thermometer.

3.0 SUPPORTING SOPs

SOP No.	Title
565	Field Equipment Decontamination

4.0 PROCEDURES

4.1 pH METER

The following procedure is used for measuring temperature with a pH meter:

1. Immerse temperature probe in sample.
2. Read and record temperature when reading on meter stabilizes.

4.2 THERMOMETER

1. Decontaminate thermometer.
2. Immerse the tip of thermometer in the sample.
3. Record temperature when reading on thermometer stabilizes.

5.0 MAINTENANCE

5.1 pH METER

1. General maintenance: Store electrodes according to procedures given on the electrode instruction sheet.
2. Monthly maintenance: Check the battery level, and replace batteries as needed.
3. After-use maintenance: Check batteries after each use.
4. Functional maintenance: Refer specific maintenance or repair needs to the manufacturer or other qualified service personnel.

5.2 THERMOMETER

None

6.0 CALIBRATION

Verify the calibration of the temperature probe and thermometer by comparing the certified thermometer reading to the probe and thermometer readings in an ice-and-water bath and in a hot water bath. If the readings vary more than 1°C from the certified thermometer reading, then replace the thermometer and adjust the probe according to the owner's manual.

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CHAIN-OF-CUSTODY

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE
FOR
CHAIN OF CUSTODY

1.0 OBJECTIVE

The objective of these guidelines is to provide general reference information on chain-of-custody procedures.

2.0 EQUIPMENT

N/A

3.0 PROCEDURES

A chain-of-custody record is a preprinted multi-part form that accompanies a sample or group of samples and documents custody transfer from person to person. Figure 710-1 provides a typical chain-of-custody form, others may be used. Since the chain-of-custody process beging with the laboratory cleaning of sampling equipment, MAIN generally uses chain-of-custody forms provided by the laboratory.

As soon as practicable after sample collection, preferably after decontamination, the following information must be entered on the chain-of-custody form. All information is to be recorded in ink.

1. Project number. Enter designation that identifies the project site.
2. Project name. Enter the site name.
3. Samplers. Sign the names(s) of the sampler(s).
4. Station or location identification number. Enter the number for each sample in the shipment. This number must correspond to that on the sample label.
5. Date. Enter the month, day and year of sample collection.
6. Time. Enter a four-digit number indicating the military time of collection; for example, 1354.
7. Composite or grab. Indicate the type of sample.
8. Number of containers. For each sample number, enter the number of sample bottles that are contained in the shipment.
9. Remarks. Enter any appropriate remarks.

Instructions for transferring custody of samples to a common carrier are given below.

1. Sign, date, and enter time under "Relinquished by" entry.
2. Enter name of carrier (e.g., UPS, Federal Express) under "Received by".
3. Enter bill-of-lading or Federal Ex[ress airbill number under "Remarks".
4. Place the original of the chain-of-custody form in the appropriate sample shipping package. Retain a copy with field records.
5. Sign and date the custody seal, a 1 x 3 inch white paper label with black lettering and an adhesive backing. Figure 2 provides an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field.
6. Wrap the seal across filament tape that has been wrapped around the package at least twice.
7. Fold the custody seal over on itself so that it sticks together.
8. Complete other carrier-required shipping papers.

Common carriers will usually not accept responsibility for handling chain-of-custody forms; this necessitates packing the record in the sample package.

If samples are to be split with a government agency, the site owner, or with another interested party, a separate chain-of-custody form must be completed for each of these custodians.

Record chain-of-custody and other sampling information in the field logbook.

Prepare sample labels and custody seals with indelible ink.

PREPARED BY: ____________________

APPROVED BY: ____________________
Chief Hydrogeologist

APPROVED BY: ____________________
Project Manager

FIGURE 1

MAIN
1893

CHAIN OF CUSTODY RECORD

PAGE OF

JOB NO.
PROJECT
CONTACT

LABORATORY
ADDRESS
CONTACT

DELIVERY DATE
DATE FINAL REPORT DUE
PROJECT MANAGER'S INITIALS

SAMPLE NO.	LABORATORY SAMPLE NO.	SAMPLING		SAMPLE DEPTH	SAMPLE TYPE	ANALYSES										NO. OF CONTAINERS	COMMENTS (Special instructions, cautions, etc.)
		DATE	TIME			VOA	ABN	METALS	PEST/PCB	PET. ID	O & G						

Sampled and Relinquished by
Sign
Print
Firm
Date Time

Received by
Sign
Print
Firm
Date Time

Relinquished by
Sign
Print
Firm
Date Time

Received by
Sign
Print
Firm
Date Time

Relinquished by
Sign
Print
Firm
Date Time

Received by
Sign
Print
Firm
Date Time

Evidence Samples tampered with? ☐ No ☐ Yes

If Yes, explain in remarks.

VOA Vial											LIQUID
Glass Bottle											
Plastic Bottle											
Preservative											
Container Volume											
VOA Vial											SOLID
Glass Jar											
Plastic Jar											
Preservative											
Container Volume											

Note: Sample bottles supplied by lab, unless indicated.

PRESERVATION KEY: A - Sample chilled,
B - Filtered, C - Acidified with
D - NaOH, E - NaThiosulfate, F - Other

REMARKS: (Sample storage, nonstandard sample bottles)

RECORD KEEPING

SOP No.: 720
Revision No.: 0
Date: January 31, 1992
Page 1 of 1

CHAS. T. MAIN, INC.

STANDARD OPERATING PROCEDURE
FOR
RECORD KEEPING

1.0 OBJECTIVE

To store the project documents.

2.0 PROCEDURES

All the forms filled out in the field, field notebooks, correspondence, telephone communications, reports, report originals, electronic data (i.e., computer diskettes) and other information produced and received by MAIN for the project will be stored in files separate from other projects.

PREPARED BY: ______________________________

APPROVED BY: ______________________________
Chief Hydrogeologist

APPROVED BY: ______________________________
Project Manager

APPENDIX 5F

INTERIM STATUS GROUNDWATER MONITORING INSTRUCTIONS FOR COLLECTION, PREPARATION AND SHIPMENT OF SAMPLES

US ARMY GROUND-WATER MONITORING
AND ASSESSMENT PROGRAM

INSTRUCTIONS

FOR

COLLECTION,

PREPARATION AND SHIPMENT

OF SAMPLES

US ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD
SEPTEMBER 1981

REVISIONS MADE SEPTEMBER 1985

ENCL
3

Instr for Collection, Prep and Shpmt of Samples

I. PURPOSE. This document is written to provide guidance to personnel at US Army installations who will be sampling ground-water monitoring wells. It has been prepared primarily to assist those installations which are being provided support by the US Army Environmental Hygiene Agency (USAEHA) in meeting monitoring requirements at sanitary landfills and hazardous waste landfills and surface impoundments.

II. GENERAL. Sections III through VI and Section VIII of this document provide instructions on collection and preparation of samples and data reporting. Section VII provides information on chemical analysis methods. The contents of this document may be used by installations monitoring hazardous waste landfills and surface impoundments to prepare the Sampling and Analysis Plan required by regulation (40 CFR 265.92).

Questions concerning these instructions or sampling and sample preparation should be referred to Kim M. Fleischmann, Ground-water + Solid Waste Branch, Waste Disposal Engineering Division, this Agency, AV 584-2024 or (301) 671-2024.

III. SAMPLE CONTAINERS. The USAEHA will provide all sample containers to be used for shipment of samples. The only sample containers to be provided by the installation are the 1-gallon plastic jugs to be used to hold the samples prior to filtering. The number of sample containers needed for each well sample will depend on the number of parameters and filtering and preservation requirements. Inclosure 1 identifies the parameters and the separate containers which will be used when samples are taken from monitoring wells.

Only containers provided by USAEHA should be used. These containers will be properly cleaned and prelabeled with installation name, site identification, parameters and preservation information. The containers will normally be shipped by USAEHA in boxes.
The boxes should be kept by the installation because some will be used as shipping boxes for samples. Under some circumstances containers of a different size than those shown in Inclosure 1 will be used. These substitutions will be made because volume requirements will depend upon the number of parameters to be measured.

IV. SAMPLING AND FIELD OBSERVATIONS.

A. Water Level Measurement. Prior to sampling a well, the water level must be measured and recorded on the field data log sheet. When the field crew visits the well they should have information available concerning well depth, depth to top of screen, and screen length. Water levels are most commonly measured with a clean steel tape. The tape should be lowered into the well until the end is a couple feet below the water surface. The wetted situations where the monitoring wells have more than one screened interval or a sediment trap.[1] When a well contains a sediment trap the final portion of purged water should be pumped from within the sediment trap section (do not lower pump into sediment in the bottom of the trap). When a well is constructed with more than one screen, the purged water should be pumped from the unscreened sections, beginning with the uppermost. Manufacturer's literature should be consulted to obtain specific instructions concerning the operation of sampling pumps. Questions may also be referred to the Ground-water and Solid Waste Branch, Waste Disposal Engineering Division, US Army Environmental Hygiene Agency, AUTOVON 584-2024. When pumping or sampling a well great care must be exercised to insure that contaminants are not introduced into the well or a sample. A sampler or sample tubing, or a bailer or bailer cable must not be allowed to contact the ground or a dirty surface in a vehicle or sampling equipment box. Plastic sheeting may be used to rest hoses, lines, and samplers upon. New sheeting should be used for each well sampled. Sampling equipment must be thoroughly cleaned before it is placed in its storage case. In those situations when there is windblown dust at the sampling site, it will be impossible to obtain a good sample. Sampling should be postponed until a more favorable time.

C. <u>Sampling</u>.

1. The sample containers in which unfiltered water is to be shipped should be filled first (see Inclosure 1.). These containers should be rinsed several times with a small amount of water pumped from the well prior to filling (except for samples for grease and oil analysis). All of these containers (except grease and oil) must be filled to overflowing so that no headspace remains. Samples should be protected from light and kept cool from the time they are collected. Sample container labels should be completed using a waterproof pen before they are filled when the container is dry. The portion of the sample which must be filtered should be collected in polyethylene gallon bottles. For hazardous waste site wells monitored during 1981 and 1982 two of these gallon containers should be filled. The number required at sanitary landfill wells depends upon the parameters. These containers should also be rinsed and filled to overflowing. Containers should be labeled with a waterproof pen. Sample containers should be filled in a manner which does not agitate or aerate the sample. This is important to prevent loss of volatile contaminants, and to prevent chemistry changes due to either CO_2 loss with pH increase or oxygenation of the sample. Containers are filled to overflowing for the same reasons. Some wells which do not recharge while they are pumped may not

---

[1] A sediment trap is an unscreened section at the bottom of the well.

3. complete sample filtration system,
4. pH meter with accessories (if pH measurement required),
5. distilled water,
6. cleaning supplies including nitric acid and acetone,
7. chemical preservative ampules (provided by USAEHA), and
8. Sample kits containing appropriate containers (provided by USAEHA).

B. Sample Storage. Samples should be placed in a cool, dark place (preferably a refrigerator) until ready for shipment. Those containers filled in the field should be placed into such storage as soon as they are brought to the work area. The polyethylene gallon containers should also be kept in cool and dark storage when not being used. When containers are received from sample collectors they should be checked for proper labeling.

C. pH Measurement. The sample pH should be measured as soon as possible after the sample is taken. When a sample is exposed to the air the pH level may change. This change is primarily due to loss of dissolved CO_2 from the sample. A pH measurement taken at the work area soon after the sample is taken will normally be more accurate than a field measurement as long as a significant pH change has not occurred. Visible evidence of precipitate forming in the sample between the time of sample collection and the time of pH measurement at the work area would indicate that the pH has changed and that an accurate measurement would have to be taken in the field as soon as the sample is taken. To be sure that accurate measurements are being obtained, it is recommended that pH measurements also be taken in the field with a portable meter during the initial sampling periods. For those sites where pH is not a required parameter (some sanitary landfills), it is recommended that pH be measured if an installation has a meter. For hazardous waste sites, pH measurement of four portions of the same sample are required. Sanitary landfill samples will only require one measurement. The following instructions should be followed when measuring pH.

1. Initially calibrate the pH meter in accordance with the manufacturers' specifications. The internal filling solution should cover the internal reference element in the combination electrode.

2. Standardize the meter with two buffer solutions, either pH 4.00 and 7.00, or 7.00 and 9.00. If samples are expected to be acidic, the lower range should be used. The buffer solutions should be placed into 150-mL beakers for measurement, and enough should be used so that the electrode is submerged at least 1 inch. The buffer and sample temperatures should be nearly the same when measurements are made. Ground water temperatures are

forcep, prefilters, and membrane filters. The order for assembling the filtering system is as indicated below:

1. The tubulated ground glass base is fitted over the I-liter flask.

2. A membrane filter is carefully placed over the fritted glass area of the base and then overlaid by a prefilter. The prefilter and membrane filter shall be handled with forceps.

3. The funnel is placed on top of the prefilter and fastened to the base by the spring clamp.

4. Vacuum tubing is connected from the vacuum pump to the side arm nipple of the base.

5. The pump is turned on and sample is gently poured into the funnel. The filtration rate is dependent on the nature of the sample. It may be necessary to replace the filters if they are fairly well clogged or if the filtration rate is extremely slow. If this is done, great care must be exercised so as not to contaminate the sample and not allow any suspended matter to enter the already filtered portion.

The second filtration procedure which may be used is performed with the "Millipore Hazardous Waste Filtration System." It uses compressed nitrogen instead of a vacuum pump. Large volumes can be filtered in a relatively short time period with this system. If this system is purchased, a detailed manual will be provided by the company. If, however, problems arise with the system, USAEHA will assist in resolving them. This system also uses the membrane filters and prefilters, only they are much larger than those with the vacuum system because of the larger filtration surface area. The third filtration procedure is also based on compressing a liquid sample through a membrane filter using nitrogen gas. Also with this procedure large volumes can be filtered in a relatively short time period. The procedure is known as the Barrel Pressure Filtering Apparatus and is manufactured by Leonard Mold and Die Works. The instructions are fairly simple and are inclosed with the purchased equipment. The USAEHA will assist if any problems develop with the equipment. The membrane filters must be soaked in distilled water for 24 hours prior to using. They should also be handled only with the purchased forceps, never with one's fingers. Care must be exercised when handling the membrane filter to avoid making any tears or pin holes. Before a sample bottle is filled with a filtered sample, it should be rinsed once with a small amount of the filtered sample and then that portion discarded. Sample bottles should not be rinsed or cleaned in any other manner because they will have been appropriately cleaned by USAEHA prior to shipment. Smaller containers should be filled before the large 1-gallon cubitaner for radiochemistry parameters. All containers should be filled to nearly full, but not overflowing because perservative must be added to some. The samples

500-mL squeeze bottle and then washed thoroughly with hot detergent water prior to the tap water and distilled water rinsings. It is imperative that no acetone or detergent remain on the apparatus after the water rinsings.

2. In addition to the above rinsings, all parts of the filtration system (except prefilters and membrane filters) shall be rinsed with a 50 percent nitric acid solution between samples from different facilities. If only one facility is being monitored, the acid rinse should precede the first sample. After the 50 percent nitric acid rinsing, the apparatus must be thoroughly rinsed with tap water and then rinsed three times with distilled water. All traces of the nitric acid must be removed. The 50 percent nitric acid solution (nitric acid mixed with distilled water on a one to one basis) should be made up in the rigid, leakproof, 1-gallon size, polyproplene jug purchased by the installation. The disposable rubber gloves should be worn when making up this solution. First fill the jug half-way with distilled water. To it, carefully add concentrated nitric acid to near the top. Cap and mix gently. The solution will become hot, but the jug will withstand the thermal shock. This solution should be labeled and protected from all sampling bottles. Rubber gloves should also be worn when rinsing the filtering system.

3. More frequent 50 percent nitric acid solution rinsings are not desired because they are time consuming and because of the risk of acid residue affecting nitrate analysis results. In some situations USAEHA may direct that the acid rinsing be performed between all samples (such as for sites with heavy metal ground-water contamination).

4. These instructions do not include procedures to be used to protect against cross contamination with organic compounds because these sample portions are not going to be filtered (pesticides, herbicides, total organic halogen). In those special cases where samples for organics analysis will be filtered, special cleaning instructions will be provided by USAEHA. This cleaning will normally involve cleaning with acetone or other organic solvents.

VI. SAMPLE SHIPMENT.

A. Packaging. All glass sample containers must be enclosed in their styrofoam packing and this packing wrapped with tape. Insulated coolers must be used as shipping containers for those sample portions which must be kept cool (see Inclosure 1). }. To maintain a low temperature during shipping, several reuseable ice packs should be placed in the cooler with the samples. Those sample portions which do not require cooling (metals and radiochemistry parameters) may be shipped to the lab in the cardboard shipping containers used to ship the containers to the installation. Those installations with only a few wells and no radiochemistry analysis requirements may find it as convenient and no more costly to ship all sample containers in the coolers.

getting wet. When the laboratory custodian receives the samples, that individual will sign all copies of the form. The original will be returned to the installation where it must be held on file.

VII. CHEMICAL ANALYSIS.

A. Analytical Procedures. The analytical procedures to be employed during this monitoring program are listed in Inclosure 6. The methods of analysis for specific hazardous wastes will be identified as necessary in assessment plans prepared by USAEHA.

B. Quality Control. A quality control program will be strictly followed by the laboratory to insure the validity of all results. The USAEHA will maintain quality control data records.

C. Bacterial Analysis. Coliform bacteria analysis will be performed onsite by US Army Health Services Command medical activities or centers. The MEDDACs/MEDCENs will attempt to schedule their visit such that they are onsite when sampling for other parameters is performed. Sampling equipment must be made available for their use.

VIII. SCHEDULING AND DATA REPORTING.

A. Scheduling. To insure a reasonably uniform flow of samples into the laboratory, USAEHA will schedule sampling by installations. This schedule will be established in coordination with installation personnel, and there will be some flexibility to meet installation specific requirements.

Sample containers will be shipped to the installation environmental coordinator about 2-3 weeks prior to the scheduled sampling date. The scheduled date will always be a Monday or a Tuesday and will identify the week when samples are to be taken. If is necessary for the installation to postpone sampling, telephone notification should be given to Kim M. Fleischmann, AV 584-2024, USAEHA. Similarly, USAEHA will notify the installation if laboratory scheduling problems require postponement of sampling.

02 JUL 85

	CODE	ABBREV	PARAMETER OR ANALYSIS NAME	PRESERVATION & SHIPMENT INFORMATION
1	AS	ARSENIC	ARSENIC	FILTERED SAMPLE
	BA	BARIUM	BARIUM	PRESERVATION: NITRIC ACID
	CD	CADMIUM	CADMIUM	CONTAINER: 1 QT CUBE
	CR	CHROMIUM	CHROMIUM	
	PB	LEAD	LEAD	
	SE	SELENIUM	SELENIUM	
	AG	SILVER	SILVER	
	FE	IRON	IRON	
	MN	MANGANESE	MANGANESE	
	NA	SODIUM	SODIUM	
	HARD-C	HARD(CALCUL)	CALCULATED HARDNESS	
	CU	COPPER	COPPER	
	ZN	ZINC	ZINC	
	K	POTASSIUM	POTASSIUM	
	MG	MAGNESIUM	MAGNESIUM	
	CA	CALCIUM	CALCIUM	
	NI	NICKEL	NICKEL	
	V	VANADIUM	VANADIUM	
	SB	ANTIMONY	ANTIMONY	
	BE	BERYLLIUM	BERYLLIUM	
	TL	THALLIUM	THALLIUM	
	B	BORON	BORON	
	CO	COBALT	COBALT	
	AL	ALUMINUM	ALUMINUM	
	SN	TIN	TIN	
	MO	MOLYBDENUM	MOLYBDENUM	
2	ENDRIN	ENDRIN	ENDRIN	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED
	LINDAN	LINDANE	LINDANE	PRESERVATION: COOL(4 DEG C)
	TOXAPH	TOXAPHENE	TOXAPHENE	CONTAINER: 1 QT GLASS NARROW NECK
	METHOX	METHOXYCHLOR	METHOXYCHLOR	
	24D	2,4-D	2,4-D	
	SILVEX	SILVEX	SILVEX	
3	TOX	TOX	TOTAL ORGANIC HALIDE	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED
	POX	POX	PURGEABLE ORGANIC HALIDE	PRESERVATION: COOL(4 DEG C)
	NPOX	NPOX	NON-PURGEABLE ORGANIC HALIDE	CONTAINER: 1 QT GLASS NARROW NECK
4	GALPHA	GROSS ALPHA	GROSS ALPHA	FILTERED SAMPLE
	RAD226	RADIUM-226	RADIUM-226	PRESERVATION: NITRIC ACID
	RAD228	RADIUM-228	RADIUM-228	CONTAINER: 1 GAL CUBE
	GBETA	GROSS BETA	GROSS BETA	
	STRN90	STRONTIUM-90	STRONTIUM-90	
	TRITIU	TRITIUM	TRITIUM	
	URAN	URANIUM	URANIUM	

Incl 1

14	CL	CHLORIDE	CHLORIDE	FILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 8 OZ PLASTIC
	SO4	SULFATE	SULFATE	
15	NO3-N	NITRATE-N	NITRATE AS NITROGEN	FILTERED SAMPLE 24 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 16 OZ PLASTIC
	NO2-N	NITRITE-N	NITRITE AS NITROGEN	
	OPO4-P	ORTHO PHOS-P	ORTHOPHOSPHATE AS PHOSPHORUS	
16	MBAS	SURFACTANTS	SURFACTANTS	FILTERED SAMPLE 24 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 16 OZ PLASTIC
	COLOR	COLOR	COLOR	
17	TOC	TOC	TOTAL ORGANIC CARBON	FILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: SULFURIC ACID, 4 DEG C CONTAINER: 1 QT GLASS NARROW NECK
18	TOC-UF	TOC(UNFILT)	TOTAL ORGANIC CARBON(UNFILTERED SAMPLE)	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: SULFURIC ACID, 4 DEG C CONTAINER: 1 QT GLASS NARROW NECK
19	PHENOL	PHENOL	TOTAL RECOVERABLE PHENOLICS	FILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: SULFURIC ACID, 4 DEG C CONTAINER: 1 QT GLASS NARROW NECK
20	NO2NO3	NO2+NO3 AS N	NITRATE + NITRITE AS NITROGEN	FILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: SULFURIC ACID, 4 DEG C CONTAINER: 16 OZ PLASTIC(QT CUBE IF ALL)
	COD	COD	CHEMICAL OXYGEN DEMAND	
	NH3-N	AMMONIA-N	AMMONIA AS NITROGEN	
	TKN	TOT KJEL N	TOTAL KJELDAHL NITROGEN	
	PO4-P	PHOSPHATE-P	TOTAL PHOSPHATE AS PHOSPHORUS	
22	PH-LAB	PH(LAB)	PH(LAB)	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 16 OZ PLASTIC
	COND	SPEC COND	SPECIFIC CONDUCTIVITY	
23	TSS	SUSP SOLIDS	TOTAL SUSPENDED SOLIDS	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 1 QT CUBE
24	TDS	TDS	TOTAL DISSOLVED SOLIDS	UNFILTERED SAMPLE 48 HR SHPMT REQUIRED PRESERVATION: COOL(4 DEG C) CONTAINER: 16 OZ PLASTIC
	TS	TOT SOLIDS	TOTAL SOLIDS	

```
36  UREA    UREA          UREA                                             UNFILTERED SAMPLE 48 HR SHPMT REQUIRED
                                                                           PRESERVATION:  COOL(4 DEG C)
                                                                           CONTAINER:  16 OZ GLASS NARROW NECK


37  NQ      NQ            NITROGUANIDINE                                   UNFILTERED SAMPLE 48 HR SHPMT REQUIRED
    MELAMN  MELAMINE      MELAMINE                                         PRESERVATION:  COOL(4 DEG C)
                                                                           CONTAINER:  16 OZ GLASS NARROW NECK


38  FORM    FORMALDEHYDE  FORMALDEHYDE                                     UNFILTERED SAMPLE 48 HR SHPMT REQUIRED
                                                                           PRESERVATION: 3 DROPS METHANOL,DONT COOL
                                                                           CONTAINER:  40 ML VIAL (1)
```

GROUND-WATER SAMPLING FIELD DATA LOGSHEET

Installation: Big Bang AAP   Well I.D.: L F 4

WATER LEVEL MEASUREMENTS (BEFORE PURGING)

Date: 25 Sept 85   Time: 1300   Method (check one): ___ steel tape   X electric meter   ___ well sounder   ___ other (specify)

Reference Point (check one): X top of well casing   -or-   ___ top of protective casing

(a) Depth of water from reference point: 25.1   Units (check one) X Feet ___ Meters

(b) Height of reference point above ground surface: 2.2

(c) Depth to water from ground surface (a-b): 22.9

PURGING

Date: 25 Sept 85   Time: 1305   Method: bailer type ___   pump type geofilter

Inside diameter of well 2 inches

Calculated amount to be purged:

5 volumes = (35.0 feet (total depth of well) - 22.9 feet (depth of water from ground (c above))) X .82 (conversion factor*) = 9.9 gallons

*conversion factors: for a 2-inch well = .82   -or-   for a 4-inch well = 3.27

Amount actually purged: 10 gallons   Well pumped dry? ___ yes X no

SAMPLING

Date: 25 Sept 85   Time: 1315   Method: bailer type Teflon   pump type ___

component materials (e.g., tubing, pump parts, bailer material) ___

List containers filled in the field:

(a) Unfiltered Samples (specify parameters)

GCMS-V   cond

GCMS-A   TDS

GCMS-B

TOX

(b) Samples to be filtered (specify container type, e.g. glass, polyethylene, etc.)

2 gal polyethylene

Sampler's Name: Janet Ethen

IELD MEASUREMENTS

Temperature: 12 °C	pH: 7.6	4 Replicates if a hazardous waste site	Conductivity: 1200
	7.5		1210
	7.6		1200
	7.6		1210
Time: 1325	1326		1330
eter Type: thermometer	Fisher Accumet		Myron

AMPLE PREPARATION

ate: 25 Sept 85   Time Completed: 1500   Filtering Method: Millipore Haz Waste Filtration

equired Preservation Completed: ✓   Sample Preparer's Name: Fred Cohen

OMMENTS AND OBSERVATIONS (Notes concerning well, samples, procedures, etc.)

sample very turbid

04 SEP 85 GROUND-WATER MONITORING PROGRAM -- SAMPLE CHAIN OF CUSTODY FORM PAGE 1 OF 1

WATERVLIET ARSENAL, NY SEP 85 SAMPLING PERIOD IND WASTE SLUDGE BEDS

PARAMETER GROUPS	WELL OR SAMPLE LOCATION IDS SP1	SP2	SP3	SP4			
SAMPLING DATE:	16 Sept 85	16 Sept 85	16 Sept 85	17 Sept 85			
BA CD CR PB FE MN	(1✓)	(1✓)	(1✓)	(1✓)			
CN	(1✓)	(1✓)	(1✓)	(1✓)			
COND	(1✓)	(1✓)	(1✓)	(1✓)			
GCMS-V	(1✓)	(1✓)	(1✓)	(1✓)			

MARK ON THIS FORM THOSE SAMPLE BOTTLES ENCLOSED IN THIS SHIPPING CONTAINER

	SIGNATURE	DATE	COMMENTS:
SAMPLE COLLECTOR	Charlie Brown	17 Sept 85	Federal X-press 1 day service
SAMPLE PREPARER	Larry Mays	17 Sept 85	
LABORATORY CUSTODIAN			

PARAMETER	PRIMARY METHODOLOGY	ALTERNATE METHODOLOGY
Acidity	305.1	
Alkalinity	310.1	
Hardness EDTA	130.2	
Total Solids	160.3	
Total Suspended Solids	160.2	
Total Dissolved Solids	160.1	
Chloride	325.2	325.3
Sulfate	375.2	375.1
Surfactants	425.1	
Chemical Oxygen Demand	410.4	Ampule Method [3]
Turbidity	180.1	
Color	110.2	
Endrin	Methods for Organochlorine [4]	
Lindane	Methods for Organochlorine	
Toxaphane	Methods for Organochlorine	
Methoxychlor	Methods for Organochlorine	
2, 4-D	Methods for Organochlorine	
2, 4, 5, T-P (Silvex)	Methods for Organochlorine	
Oil & Grease	413.2	
Biochemical Oxygen Demand	405.1	
Gross Alpha	SM[5] 703	
Radium-226	SM 706	
Radium-228	SM 705	
Gross Beta	SM 703	
Strontium-90	SM 704	
Tritium	SM 707	

6 – "Laser Induced Phosphorescence Procedure for Uranium", Radiation Management Corp, Philadelphia, PA 19104, 1981.

7 – EPA methods Listed in Federal Register, Vol. 44, No. 233, Guidelines Establishing Test Procedures for the Analysis of Pollutants; Proposed Regulations, Monday, December 3, 1979.

8 – Standard Methods for the Examination of Water, Sewage, and Industrial Wastes, 10th ed., American Public Health Association, American Water Works Association, Federation of Sewage & Industrial Wastes Associations, New York 19 NY, 1955.

Paragraph V.E.

6. Ground-water samples requiring analysis for any or all of the following explosives: 2,4,6-TNT, 2,4-DNT, 2,6-DNT, RDX, HMX, and Tetryl should be filtered (0.45 micron membrane filter) and then transferred to a clean 16-ounce glass bottle (narrow neck w/teflon-lined cap enclosed in a styrofoam pack). After transferring the sample to the bottle, add 10% sulfuric acid (H_2SO_4) drop-wise to obtain a sample pH of 4-5. If the sample already has a pH in the 3-6 range, don't add any acid to it. A commercial pH paper roll having an expanded scale range from about pH 3 to 7 can be used for this measurement. It is inoperative not to overacidify the sample. The H_2SO_4 should be prepared from a reagent grade or "more pure" grade concentrated H_2SO_4; a 10% concentration is achieved by adding 10 parts H_2SO_4 to 90 parts distilled or deionized water. In most cases, a full bottle of sample is not necessary. If difficulty results in obtaining a fairly full bottle, 100-200 milliliters of sample will be sufficient for explosive analysis.

7. Ground-water samples requiring analysis for volatile organic compounds, whether they are halogenated organics or purgeable non-halogenated aromatic or aliphatic compounds, must be collected in the specially designed and cleaned 40 ml glass vials equipped with a teflon-faced silicone septum and screw cap. These samples must be collected right at the sampling well immediately after extracting the samples from the well. Special care must be taken to insure completely filled vials, so that no bubbles or head space occurs. Also, the teflon-lined side of the septum must face the sample. It is imperative that these vials not be used for any other purpose, and if a vial is accidently soiled, it should not be used. A sample blank vial containing the installation's organic free water should accompany every batch of volatile organic samples.

8. The filled sample containers for explosives, volatile organics, pesticides/herbicides, and any other samples for organics analysis must be kept cold and protected from light.

Paragraph V.F.

5. The filtering apparatus used for filtering samples for the explosive parameters should be rinsed with reagent grade acetone or equivalent and then thoroughly rinsed with distilled or deionized water between each sample filtering. It is important that no acetone be left on the apparatus as it may come in contact with the membrane filter and dissolve it.

Paragraph VI.B.

5. Samples for explosives or volatile organics analysis must be shipped as soon as possible after sampling (within 24 hours) and a 24 hour delivery service must be used. These samples will be analyzed either by USAEHA or the contract laboratory on a case by case basis.

APPENDIX 6

PROTECTION OF THE ATMOSPHERE SUPPLEMENTAL INFORMATION

APPENDIX 6

TABLE OF CONTENTS

1. Estimate of 24 hour PM_{10} impacts.

2. NYSDEC - Applications for restricted Burning Permits.

3. Letter from Stephen Absolom (Chief, Engineering/Environmental Management Division) to Daniel Walsh (Senior Engineer, Air Resources, Region 8, NYSDEC) dated June 5, 1991.

4. Letter from Andrew Bellina (Chief, Hazardous Waste Facilities Branch) to Randall Battaglia (Environmental Coordinator, SEAD) dated March 19, 1992.

MAIN
1893

Client: Seneca Army Depot (SEAD) Job No. ____ Sheet 1 of 5
Subject: Estimate of 24-hour PM10 impacts at Central School from OD activities By J.P. Date 4/15/92
Ckd. ____ Rev. ____

Problem: Estimate maximum short-term PM10 impacts at Central School from OD activities at SEAD

Approach: Conduct screening calculations for an instantaneous source in accordance with recommendations in "A Workbook of Screening Techniques for Assessing Impacts of Toxic Air Pollutants" (USEPA, 1988 (draft)).

The sections of this document which are referenced include:

Section 5.3.2 : Horizontal And Vertical Dispersion Parameters For Instantaneous Sources
Section 5.6.6 : Dispersion Model For Instantaneous Releases
Appendix E : Averaging Period of Concentration Estimates

Techniques referenced in these sections are generally derived from recommendations contained in "Estimating Concentrations Downwind Of An Instantaneous Puff Release" (W. Petersen, USEPA, 1982).

The nearest sensitive receptor identified is the Central School in Romulus, NY. The school is located approximately 5.8 km from the site of OD activities at SEAD.

Standard operating procedures (SOP) for OB/OD activities at SEAD allow for these activities to occur only if:

20 mph < wind speed < 3 mph
cloud cover < 80%
ceiling height ≥ 2000 ft
No thunderstorms in area

In addition, OB/OD activities occur only during daylight hours.

Figures 5.3-3 and 5.3-4 in section 5.3.2 provide horizontal (σ_r) and vertical (σ_z) dispersion parameters as a function of distance for instantaneous sources for three stability categories: unstable (includes Pasquill-Gifford (PG) classes A, B, and C); neutral (PG class D); and stable (PG classes E and F).

The absence of OD activities at night eliminates the stable PG classes from consideration. Neutral and slightly unstable (PG classes D and C, respectively) conditions

Client SEAD Job No. Sheet 2 of 5
Subject 24-hour PM10 impacts By J.P. Date 4/15/92
Ckd. Rev.

are possible and most likely to occur during OB/OD activities given the climatology at SEAD and the SOP restrictions on these activities.

The following two conditions are assumed representative of potential worst-case meteorology during OD activities:

(1) Neutral conditions, moderate wind speed (5 m/s)
(2) Unstable conditions, light wind speed (2.5 m/s)

Impacts will be predicted for an OD episode for each condition, A wind direction from SEAD to the Central School is assumed. A downwind distance of 5.8 km is assumed to account for the separation between the Central School and the OD site at SEAD.

First, estimate dispersion parameters for each case from Figures 5.3-3 and 5.3-4:

neutral: $\sigma_r \simeq 183$ m; $\sigma_z \simeq 60$ m
unstable: $\sigma_r \simeq 400$ m; $\sigma_z \simeq 300$ m

Neglect effect of buoyancy induced dispersion. As explained in section 5.4, neglecting buoyancy induced dispersion will yield a more conservative (higher) predicted concentration.

The cloud resulting from OD activities will be modeled as a volume source. From observations of OD activities, typical cloud dimensions have been estimated.

Cloud width $\simeq$ 100 ft $\simeq$ 30 m
Cloud depth $\simeq$ 300 ft $\simeq$ 90 m

Using the notation in section 5.5.2, $H_v = 90$ m (cloud depth)
$W = 30$ m (cloud or source width)

Next, use the techniques in sections 5.5.1 and 5.5.2 to determine horizontal virtual source distances (X_v) and vertical virtual source distances (X_{vz}) for a volume source.

Initial horizontal dispersion parameter $\sigma_{y_0} \equiv W/4.3 \simeq 7$ m
Initial vertical dispersion parameter $\sigma_{z_0} \equiv H_v/2.15 \simeq 42$ m

From Figure 5.3-3, $X_v \simeq 170$ m (neutral); $X_v \simeq 70$ m (unstable)
From Figure 5.3-4, $X_{vz} \simeq 3800$ m (neutral); $X_{vz} \simeq 360$ m (unstable)

Client SEAD Job No. Sheet 3 of 5
Subject 24-hour PM_{10} impacts By J.P. Date 4/15/92
Ckd. Rev.

In accordance with section 5.5.2, determine horizontal dispersion parameters for the distance $X_y = X_r + X_v$ and vertical dispersion parameters for the distance $X_z = X_r + X_{vz}$. In this context, X_r is the actual downwind distance (5800 m).

For neutral conditions, $X_y \simeq 5800\text{ m} + 170\text{ m} \simeq 5.97\text{ km}$
$X_z \simeq 5800\text{ m} + 3200\text{ m} \simeq 9.0\text{ km}$

For unstable conditions, $X_y \simeq 5800\text{ m} + 70\text{ m} \simeq 5.87\text{ km}$
$X_z \simeq 5800\text{ m} + 360\text{ m} \simeq 6.16\text{ km}$

From Figures 5.3-3 and 5.3-4, the following dispersion parameters are estimated for the distances calculated above:

Neutral conditions: $X_y \simeq 5.97\text{ km} \Rightarrow \sigma_r \simeq 190\text{ m}$
$X_z \simeq 9.0\text{ km} \Rightarrow \sigma_z \simeq 90\text{ m}$

Unstable conditions: $X_y \simeq 5.87\text{ km} \Rightarrow \sigma_r \simeq 400\text{ m}$
$X_z \simeq 6.16\text{ km} \Rightarrow \sigma_z \simeq 330\text{ m}$

Now, in accordance with section 5.6.6, calculate instantaneous peak concentration.

$$C = \frac{0.127\,Q_t}{\sigma_z \sigma_y^2} \exp\left[-0.5(H/\sigma_z)^2\right]$$

where Q_t = release amount (g)
H = effective height (m)
$\sigma_y = \sigma_r$

Set $H = H_v/2$ (assume effective height corresponds to center of cloud)
$H \simeq 45\text{ m}$

Neutral conditions: $C = \frac{0.127\,Q_t}{(190)(190)^2} \exp\left[-0.5(45/90)^2\right] = 3.45 \times 10^{-8}\,Q_t$

Unstable conditions: $C = \frac{0.127\,Q_t}{(330)(400)^2} \exp\left[-0.5(45/330)^2\right] = 2.38 \times 10^{-9}\,Q_t$

Client SEAD Job No. Sheet 4 of 5
Subject 24-hour PM_{10} impacts By J-P. Date 4/15/92
Ckd. Rev.

Next, estimate mean concentrations for an averaging period of 24-hours using procedures in Appendix E.

$$C\,(\text{mean}) = C\,(\text{instantaneous}) \times F$$

$$F = (A - 0.5)/(0.3989\,N)$$

A = area under Gaussian distribution within N standard deviations

$$N = \frac{Tu}{2\sigma_r}$$

T = averaging time in seconds = 86,400

u = transport wind speed (m/s)

Neutral conditions : $u = 5$ m/s

$N \simeq 1137$; $A \simeq 1$

$F \simeq 0.0011$

$C\,(24\text{-hr}) = 3.80 \times 10^{-11}\, Q_t$

Unstable conditions : $u = 2.5$ m/s

$N \simeq 270$; $A \simeq 1$

$F \simeq 0.00464$

$C\,(24\text{-hr}) \simeq 1.10 \times 10^{-11}\, Q_t$

From Table D.8.4.3-15 in Appendix VIII, $Q_t = 2.57 \times 10^6$ g for PM_{10}

For neutral conditions : $C(24\text{-hr}) \simeq 98\ \mu g/m^3$

For unstable conditions : $C(24\text{-hr}) \simeq 28\ \mu g/m^3$

These calculations are based on the PM_{10} emission rate for Scenario 5 in Table D.8.4.3-15. The text in section D.8.4.3.2 of Appendix VIII appears to indicate that PM_{10} emissions could be double the amount considered due to a second set of detonations in ten pits.
If it is assumed that the same worst-case meteorological conditions occur for each set of ten detonations (same wind speed and stability category and a wind direction directly from SEAD towards the Central School), then the concentration estimates should be doubled.

The following worst-case 24-hour PM_{10} concentrations are then predicted to be:

Client SEAD Job No. Sheet 5 of 5
Subject 24-hour PM$_{10}$ impacts By. J.P. Date 4/15/92
Ckd. Rev.

For neutral conditions: $C(24\text{-hr}) \simeq 196\ \mu g/m^3$

For unstable conditions: $C(24\text{-hr}) \simeq 56\ \mu g/m^3$

These concentrations should be regarded as conservative, worst-case estimates. Changes in wind direction or increased wind speeds would lead to lower estimates. There are also several conservative assumptions inherent in the modeled emission term. For example, the particulate emissions are based on particles with diameters less than or equal to 20 μ (microns). The National Ambient Air Quality Standard for particulates applies to particles with diameters less than or equal to 10 μ. Therefore, the modeled emissions and the predicted impacts include particles with diameters between 10 μ and 20 μ for which the ambient standard does not apply. Potential loss of mass from the cloud due to gravitational settling of particles has also not been accounted for.

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

INSTRUCTIONS
APPLICATIONS FOR RESTRICTED BURNING PERMITS

PROHIBITED - No open burning permitted.

Part 215 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR 215) prohibits:

1. Open burning of garbage, rubbish for salvage and refuse at refuse disposal areas. This includes refuse disposal areas serving towns, villages and cities. There are no exemptions.
2. On-site open burning of leaves and rubbish generated by residential activities in cities or villages; or in any town with a population exceeding 20,000. The governing body of a county, city or village; or town with a population greater than 20,000 may petition the Commissioner of Environmental Conservation to allow on-site burning of certain types of residence generated rubbish within their area of jurisdiction. Such burning, if permitted, shall be limited to rubbish consisting of paper, paper products, cartons, tree trimmings, leaves, or lawn and garden debris.
3. On-site open burning of rubbish generated by industrial or commercial activities. This applies to any open burning by any person on any site where such rubbish is generated except a site used exclusively as a residence. There are no exemptions.

RESTRICTED - Open burning by permit only.

A. Part 215 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR 215) restricts the following open burning. A permit is required for:

   1. Open burning of toxic, explosive or dangerous materials for which there is no other safe or economical methods of disposal.
   2. Open burning of land clearing and/or demolition rubbish. If permitted, such open burning will be limited to a single location remote from any populated area.
   3. Open burning of some types of rubbish at a designated burning area serving a county, city, town or village. Rubbish which may be burned is limited to trees, tree trimmings, leaves and brush.
   4. Persons desiring to conduct restricted open burning on a continuing basis at a specified site using a forced air overfire unit may also apply for a permit. In such cases, a permit may be issued for a period not to exceed one year when there is no other practicable alternative method of rubbish disposal. On expiration and reapplication, the permit may be re-issued if past performance at that site has not resulted in air pollution or contravention of any ambient air quality standard.

4. HAK - OB/OD Permit

76-11-3 (10/78) (over)
Formerly AIR 127.1

B. The Environmental Conservation Law and Part 191 of Title 6 of the Official Compilation of Codes, Rules and Regulations of the State of New York (6 NYCRR 191) restricts open burning of all types of rubbish, including agricultural, in Fire Towns and in certain towns within Fire Districts. See form 70-00-2 (page 1) for listings of such towns.

NO DEPARTMENT OF ENVIRONMENTAL CONSERVATION PERMIT REQUIRED

With the exception of Fire Towns and certain Towns within Fire Districts, no permit from the State Commissioner of Environmental Conservation is needed for on-site burning of rubbish generated by residential activities in towns with a population of 20,000 or less. Local ordinances may, however, prohibit or restrict such open burning.

APPLICATION PROCEDURES

Any person desiring to conduct restricted open burning, is required to have a "Permit for Restricted Burning" issued by the State Commissioner of Environmental Conservation. The applicant for a "Permit for Restricted Burning" is to complete items 1 through 18 of form 76-19-1, and sign and date the application. The applicant then detaches and retains the last copy of the application and submits the remaining copies, along with a plot plan if required (see section C below), as instructed below:

A. In Fire Towns and Certain Towns within Fire Districts. (See form 70-00-2)

A person may apply for a "Permit for Restricted Burning" by submitting application form 76-19-1 and a plot plan, if required, (see section C below) to a Forest Ranger. Applications may be obtained from the Forest Ranger in the area where restricted burning is to take place. See form 70-00-2 (page 1) for locations and phone numbers of Forest Rangers.

B. All Areas of the State Except Fire Towns and Certain Towns within Fire Districts.

A person may apply for a "Permit for Restricted Burning" by submitting application form 76-19-1 and a plot plan, if required, (see section C below), to the New York State field representative for the air pollution control program (open fires). Applications may be obtained from the field representative for the county in which restricted burning is to take place. See form 70-00-2 (page 2) for addresses of field representatives.

C. Applications Requiring Plot Plans.

Except for on-site burning of rubbish generated by residential activities conducted in Fire Towns and certain Towns within Fire Districts, with a population of 20,000 or less, each application shall consist of a form 76-19-1 (with the required copies), and an accompanying plot plan. The plot plan must show the location of the proposed burning site, the location of the nearest receptors, the distance from the burning site to the nearest receptors, and the direction of the prevailing wind.

04/14/92 18:08 ☎607 869 1362 SENECA - DEH ☑002

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0868
RUN DATE: 01/08/87

C 453089 0046 0801B W R
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
INCINERATOR UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(3) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 04/29/86
PRIOR CO ISSUE DATE 07/01/82
PRIOR CO EXPIRATION DATE 06/01/87

FACILITY EMIS-CLASS / PGM-CODE: C1
POINT EMIS-CLASS / PGM-CODE:

EMISSION POINT 0801B
(41)UTM-E: 346.0 KM. (42)STACK HEIGHT: 17 FT. (43)EXIT VELOCITY: 23.00 FT/SEC (44)SIC: 3483 (45)AGENCY-CODE-1:
(46)UTM-N: 732.3 KM. (47)HT ABV STRUC: FT. (48)EXIT FLOW: 1286.00 ACFM (49)CO FEE: $40.00 (50)AGENCY-CODE-2:
(51)GRND ELEV: 640 FT. (52)STK DIAM: 13 IN. (53)EXIT TEMP: 1000 DEGR F (54)CO CONDITIONS: 1 5

UNIT B
(55)TYPE: 803 MULTIPLE CHAMBER,INLINE (56)MFG: CONSUMAT SYSTEMS INC MODEL C-32 (57)ENCON-ID: (58)FURN FEED: 03 DIRECT FED
(59)SOURCE CODE: 8190 OTHER INCINERATOR
(60)BLDG: 801 (61)FLOOR NAME: 1 (62)RULE 1: 219.00 (63)RULE 2:

(64)SOLID TYPE: (65)SOLID QUANTITY: TONS/YR (66)PERCENT SULFUR: %
(67) OIL TYPE: (68) OIL QUANTITY: THOUSANDS GAL/YR (69)PERCENT SULFUR: %
(70) GAS TYPE: 72 LP GAS (71) GAS QUANTITY: 173.0 THOUSANDS CF/YR (72)BTU/CF: 2520 BTU/CF

REFUSE DATA (73)REFUSE TYPE: 0 (74)% TYPE 5: % (75)CAPACITY: 150 LBS/HR (76)HOURS/DAY: 2.0 (77)% OP BY SEASON: 25 25 25 25
(78)RADIOACTIVE: NO (79)% TYPE 6: % (80)AMT CHARGED: 100 LBS/HR (81)DAYS/YEAR: 250

AUXILIARY EQUIP. DATA (91)TYPE: 801 PRIMARY CHAMBER BURNER (92)MFG: ECLIPSE NC-1 (93)NO. OF UNITS: 1 (94)TEMP. ACTUATED: YES
(95)FUEL TYPE: 72 LP GAS (96)RATED BURNER CAPACITY: 75000.0 BTU/HR

AUXILIARY EQUIP. DATA (97)TYPE: 802 SEC. CHAMBER BURNER (98)MFG: ECLIPSE NC-3 (99)NO. OF UNITS: 1 (100)TEMP. ACTUATED: YES
(101)FUEL TYPE: 72 LP GAS (102)RATED BURNER CAPACITY: 125000.0 BTU/HR

CONTROL EQUIPMENT (103)TYPE: 099 NONE

AIR CONTAMINANTS	CAS NUMBER	EMISSIONS				% CONTROL EFFICIENCY	HRLY ACTUAL LBS/HOUR	ANNUAL EMISSIONS (LBS/YEAR)		
		ACTUAL	UNIT	HOW DET	PERMISSIBLE			ACTUAL	10^x	PERMISSIBLE
PARTICULATES	(115) NY075-00-0	(116) .043	(117) 14	(118) 03	(119) .300	(120)	(121) .056	(122) 28.000	(123) 0	(124) 28.008

CONTINUED ON NEXT PAGE

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0869
RUN DATE: 01/08/87

C 453089 0046 0801B W R
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
INCINERATOR UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(3) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 04/29/86
PRIOR CO ISSUE DATE 07/01/82
PRIOR CO EXPIRATION DATE 04/01/87

PAGE 2
CONTINUED FROM PREVIOUS PAGE

(15) PRIOR COMMENTS (16) BY TLH (17) DATE 08/23/85
1. INSPECTED BY EPA R. KOUSTAS
2.
3.
4.
5.

(18) CURRENT COMMENTS (19) BY ________ (20) DATE / /
1. ________
2. ________
3. ________
4. ________
5. ________

(27) LAST INSPECTION DATE / /
(21) INSPECTION STATUS 5
(22) DATE OF NEXT ACTION / /
(23) ISSUE DATE 04/01/87
(24) EXPIRATION DATE 04/01/92
(25) CO FEE 50

FIRM REP'S SIGNATURE: Gary W Kittell
DATE: 25 Jan 88
ISSUING OFFICER'S SIGNATURE: Albert W. APR 26 1988

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0862
RUN DATE: 01/08/87

C 453089 0046 0709B W R
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
INCINERATOR UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(3) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 09/03/85
PRIOR CO ISSUE DATE 07/01/82
PRIOR CO EXPIRATION DATE 04/01/87

FACILITY EMIS-CLASS / PGM-CODE: C1
POINT EMIS-CLASS / PGM-CODE:

EMISSION POINT 0709B
(41) UTM-E: 346.3 KM.
(42) STACK HEIGHT: 17 FT.
(43) EXIT VELOCITY: 25.00 FT/SEC
(44) SIC: 3483
(45) AGENCY-CODE-1:
(46) UTM-N: 732.3 KM.
(47) HT ABV STRUC: FT.
(48) EXIT FLOW: 1286.00 ACFM
(49) CO FEE: $40.00
(50) AGENCY-CODE-2:
(51) GRND ELEV: 632 FT.
(52) STK DIAM: 13 IN.
(53) EXIT TEMP: 1000 DEGR F
(54) CO CONDITIONS: 1 3
EDIT: REV. REQ.

UNIT R
(55) TYPE: 003 MULTIPLE CHAMBER,INLINE
(56) MFG: CONSUMAT SYSTEMS INC MODEL C-32
(57) ENCON-ID:
(58) FURN FEED: 03 DIRECT FED
(59) SOURCE CODE: 8190 OTHER INCINERATOR
(60) BLDG: 709
(61) FLOOR NAME: 1
(62) RULE 1: 219.00
(63) RULE 2:

(64) SOLID TYPE:
(65) SOLID QUANTITY: TONS/YR
(66) PERCENT SULFUR: %
(67) OIL TYPE:
(68) OIL QUANTITY: THOUSANDS GAL/YR
(69) PERCENT SULFUR: %
(70) GAS TYPE: 72 LP GAS
(71) GAS QUANTITY: 173.0 THOUSANDS CF/YR
(72) BTU/CF: 2520 BTU/CF

REFUSE DATA
(73) REFUSE TYPE: 0
(74) % TYPE 5: %
(75) CAPACITY: 130 LBS/HR
(76) HOURS/DAY: 2.0
(77) % OP BY SEASON: 25 25 25 25
(78) RADIOACTIVE: NO
(79) % TYPE 6: %
(80) AMT CHARGED: 100 LBS/HR
(81) DAYS/YEAR: 250

AUXILIARY EQUIP. DATA
(91) TYPE: 001 PRIMARY CHAMBER BURNER
(92) MFG: ECLIPSE MC-1
(93) NO. OF UNITS: 1
(94) TEMP. ACTUATED: YES
(95) FUEL TYPE: 72 LP GAS
(96) RATED BURNER CAPACITY: 75000.0 BTU/HR

AUXILIARY EQUIP. DATA
(97) TYPE: 002 SEC. CHAMBER BURNER
(98) MFG: ECLIPSE MC-3
(99) NO. OF UNITS: 1
(100) TEMP. ACTUATED: YES
(101) FUEL TYPE: 72 LP GAS
(102) RATED BURNER CAPACITY: 125000.0 BTU/HR

CONTROL EQUIPMENT
(103) TYPE: 099 NONE

AIR CONTAMINANTS	CAS NUMBER	EMISSIONS				% CONTROL EFFICIENCY	HRLY ACTUAL LBS/HOUR	ANNUAL EMISSIONS (LBS/YEAR)		
		ACTUAL	UNIT	HOW DET	PERMISSIBLE			ACTUAL	10×	PERMISSIBLE
PARTICULATES	(115) NY075-00-0	(116) .043	(117) 14	(118) 03	(119) .300	(120)	(121) .056	(122) 28.000	(123) 0	(124) 28.000

SPECIAL CONDITIONS
(165) CONDITION 1.

CONTINUED ON NEXT PAGE

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0963
RUN DATE: 01/08/87

C 453089 0046 07098 W R
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
INCINERATOR UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(3) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 09/03/85
PRIOR CO ISSUE DATE 07/01/82
PRIOR CO EXPIRATION DATE 04/01/87

PAGE 2
CONTINUED FROM PREVIOUS PAGE

(15) PRIOR COMMENTS (16) BY TLM (17) DATE 08/23/85
1. INSPECTED BY EPA R. KOUSTAS
2.
3.
4.
5.

(18) CURRENT COMMENTS (19) BY ______ (20) DATE _/_/_
1.
2.
3.
4.
5.

(27) LAST INSPECTION DATE _/_/_
(21) INSPECTION STATUS 5
(22) DATE OF NEXT ACTION _/_/_
(23) ISSUE DATE 04/01/87
(24) EXPIRATION DATE 04/01/92
(25) CO FEE 50

FIRM REP'S SIGNATURE: Gary W. Kittell
DATE: 26 Jan 88
ISSUING OFFICER'S SIGNATURE: Albert W. Butkus
D APR 26 1988

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0841
RUN DATE: 01/09/87

C 453089 0046 00367 W I
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
PROCESS, EXHAUST OR VENTILATION SYSTEM UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(3) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 08/27/85
PRIOR CO ISSUE DATE 04/01/82
PRIOR CO EXPIRATION DATE 04/01/87

FACILITY EMIS-CLASS / PGM-CODE: C1
POINT EMIS-CLASS / PGM-CODE:

EMISSION POINT 00367
(41)UTM-E: 346.0 KM.
(42)STACK HEIGHT: 32 FT.
(43)EXIT VELOCITY: 26.60 FT/SEC
(44)SIC: 3483
(45)AGENCY-CODE-1:
(46)UTM-N: 732.3 KM.
(47)HT ABV STRUC: 16 FT.
(48)EXIT FLOW: 2700.00 ACFM
(49)CO FEE:
(50)AGENCY-CODE-2:
(51)GRND ELEV: 730 FT.
(52)STK DIAM: 20 IN.
(53)EXIT TEMP: 225 DEGR F
(54)CO CONDITIONS: 1 3
EDIT: REV. REQ.

UNIT I
(55)HOURS/DAY: 8.0
(56)DAYS/YEAR: 125
(57)% OP BY SEASON: 25 25 25 25
(58)SOURCE CODE: A0000
(59)BLDG: 367
(60)FLOOR NAME: 1
(61)RULE 1: 212.00
(62)RULE 2:

(63)SOLID TYPE:
(64)SOLID QUANTITY: TONS/YR
(65)PERCENT SULFUR: %
(66) OIL TYPE: 32 NO 2 OIL - VIRGIN
(67) OIL QUANTITY: 16.0 THOUSANDS GAL/YR
(68)PERCENT SULFUR: 1.00 %
(69) GAS TYPE:
(70) GAS QUANTITY: THOUSANDS CF/YR
(71)BTU/CF: BTU/CF

PROCESS/UNIT DESCRIPTION
(72)DESCRIPTION
1. DISPOSAL OF STOCKS OF OBSOL & UNSERVICEABLE AMMUNITION
2. MEANS OF BURNING IN A SPECIALLY-DESIGNED ROTARY KILN
3. FURNACE IDENTIFIED AS THE APE 1236 DEACTIVATION
4. FURNACE

CONTROL EQUIPMENT
(73)TYPE: 001 FAN
(74)MFG:
(75)ID:
(76)DATE INSTALLED: 06/76
(77)DISPOSAL METHOD:
(78)USEFUL LIFE:

CONTROL EQUIPMENT
(79)TYPE: 008 FABRIC COLLECTOR
(80)MFG: MIKRO-PULSAIRE BAGHOUSE
(81)ID:
(82)DATE INSTALLED: 06/76
(83)DISPOSAL METHOD: 01 LANDFILL - ONSITE
(84)USEFUL LIFE:

AIR CONTAMINANTS	CAS NUMBER	ENV RATING	EMISSIONS ACTUAL	EMISSIONS UNIT	EMISSIONS HOW DET	EMISSIONS PERMISSIBLE	% CONTROL EFFICIENCY	HRLY ACTUAL LBS/HOUR	ANNUAL EMISSIONS (LBS/YEAR) ACTUAL	ANNUAL EMISSIONS (LBS/YEAR) 10x	ANNUAL EMISSIONS (LBS/YEAR) PERMISSIBLE
PARTICULATES	(085) NY075-00-0	(086) B	(087) .050	(088) 20	(089)	(090) .050	(091)	(092) 1.120	(093) 1120	(094) 0	(095) 1157
CARBON MONOXIDE	(096) 00630-08-0	(097) D	(098)183.000	(099) 01	(100)	(101)183.000	(102)	(103)183.000	(104) 183000	(105) 0	(106) 183000
CARBON DIOXIDE	(107) 00124-38-9	(108) D	(109)730.000	(110) 01	(111)	(112)730.000	(113)	(114)730.000	(115) 730000	(116) 0	(117) 730000

CONTINUED ON NEXT PAGE

N.Y.S. DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF AIR

SEQNC NO: 8-R-0842
RUN DATE: 01/08/87

C 453089 0046 00367 W I
LOCATION FAC EP

CERTIFICATE TO OPERATE AN AIR CONTAMINATION SOURCE
PROCESS, EXHAUST OR VENTILATION SYSTEM UNIT
RENEWAL APPLICATION

OWNER
(1) SENECA ARMY DEPOT
(2) SENECA ARMY DEPOT
(5) ROMULUS (4) NY
(5) 14541

FACILITY
(6) SENECA ARMY DEPOT
(7) W SMITH FARM RD GOV'T LANDS
(8) ROMULUS (9) 14541
(10) REP: GARY KITTELL

(11) CONFIDENTIAL STATUS NON-CONFIDNTL
(12) APPLICATION STATUS IN COMPLIANCE
DATE OF LAST CHANGE 08/27/85
PRIOR CO ISSUE DATE 04/01/82
PRIOR CO EXPIRATION DATE 04/01/87

PAGE 2
CONTINUED FROM PREVIOUS PAGE

(15) PRIOR COMMENTS (16) BY TLM (17) DATE 08/23/85
1. INSPECTED BY EPA-R. KOUSTAS
2.
3.
4.
5.

(18) CURRENT COMMENTS (19) BY ______ (20) DATE / /
1.
2.
3.
4.
5.

(27) LAST INSPECTION DATE / /
(21) INSPECTION STATUS 5
(22) DATE OF NEXT ACTION / /
(23) ISSUE DATE 04/01/87
(24) EXPIRATION DATE 04/01/92
(25) CO FEE 50

FIRM REP'S SIGNATURE: Gary W Kittell DATE: 25 Jan 88

ISSUING OFFICER'S SIGNATURE: DATE: APR 26 1988

COPIES:
1. Original
2. Regional Office
3. Forest Ranger
4. Central Office
5. Applicant

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

APPLICATION FOR RESTRICTED BURNING PERMIT

R	LOCATION	PERMIT NUMBER
5 B	453[illegible]	91[illegible]5

n 76-11-3 for filing instructions and form 70-00-2 for address of office where application may be filed.

1. NAME OF APPLICANT: Seneca Army Depot
2. Street Address: Route 96
3. City, Town or Village: Romulus, New York | Zip: 14541-5001 | County: Seneca
4. PERSON SIGNING APPLICATION: 1. ☒ Employee of Applicant 2. ☐ Applicant
5. DATE OF APPLICATION: 9 Jun 87
6. NAME: Gary W. Kittell
7. TITLE: Director of Engineering & Housing
8. NAME OF PERSON SUPERVISING OPEN BURNING: James Jones
9. Phone: 869-1405
10. Street Address: Route 96, Seneca Army Depot
11. City, Town or Village: Romulus, New York | Zip: 14541-5001 | County: Seneca
12. TYPE OF RESTRICTED BURNING PROPOSED
    1. ☐ Residential on-site
    2. ☐ Land clearing
    3. ☐ Agricultural (fire town or town in Fire District)
    4. ☒ Designated burning area serving a county, city, town or village
    5. ☐ Designated site for burning of toxic, explosive or dangerous materials
    6. ☐ Other (Describe)

13. LOCATION OF OPEN FIRE: Seneca Army Depot Munitions Demo Grounds

LAT 42 deg 46" 41"N
LONG 46 deg 53' 18"W

14. TYPE AND AMOUNT OF MATERIAL TO BE BURNED: Approx 100 tons of propellants, explosives, pyrotechnics and ammunition
15. METHOD OF STARTING FIRE (SEE CONDITIONS ON REVERSE): Sawdust and propellant fuse electrically ignited with squib.
16. REASONS NECESSITATING BURNING OF MATERIAL: Open Burning of obsolete, unserviceable and/or deteriorated ammunitions.
17. AMOUNT OF TIME REQUIRED FOR RESTRICTED OPEN BURNING AND EXPECTED COMPLETION DATE: Ongoing
18. EMERGENCY METHOD FOR EXTINGUISHING FIRE (Describe): SEAD Fire Dept. with not less than 6 duty persons, 24 hr call, 2-500gpm pumper, 2-750gpm pumper, crash truck, heavy equip, etc.

19 - [illegible] mgt [illegible]

[illegible] TO ABIDE BY ALL CONDITIONS OF THE PERMIT. (See Reverse Side and Below)

DATE	APPLICANT'S SIGNATURE	TITLE
5 Jun 91	X Gary W Kittell	Director of Engineering & Housing

19. RECOMMENDED ACTION: 1. ☐ Approved 2. ☐ Disapproved
20. DATE:
21. SIGNATURE: X
22. REMARKS:

PERMIT FOR RESTRICTED BURNING

(ISSUED PURSUANT TO 6NYCRR 191, 215 AND ENVIRONMENTAL CONSERVATION LAW)

23. DATE ISSUED	24. BURNING DATES PERMITTED	25. SIGNATURE OF APPROVAL	26. TITLE
7/15/91	7/15/91 – 7/15/92	X Thomas L. Marriott	RAPCE

THE FOLLOWING CONDITIONS APPLY IN ADDITION TO THOSE SPECIFIED ON THE REVERSE SIDE:

Applicant must conform to limits outlined in letter dated 6/5/91 to Daniel Walsh from Stephen Absalom with attachments.

– AGENCY USE ONLY –

76-19-1 (6/79)

(OVER)

CONDITION:

1. Where local ordinances restrict open fires, the permit holder shall also obtain permission from local fire department or other local authority having jurisdiction.
2. Tires, fuel oil or similar materials which cause visible emissions shall not be used to ignite or to sustain an open fire.
3. Tree trunks, stumps and roots shall not be burned.
4. A restricted open fire is allowed only when the prevailing winds are away from populated areas. Fires shall not be started during heavy winds.
5. The permit holder shall not conduct open burning during any stage of an air pollution episode or when a period of high fire danger is announced by the State Commissioner of Environmental Conservation.
6. The permit holder shall notify the local fire department prior to burning and shall show this permit to any person who requests to see it.
7. Rubbish piles to be ignited shall be isolated to prevent fire spreading.
8. No fire shall be unattended at any time or be left unattended until entirely extinguished.
9. The permit holder shall be liable for damage to trees or other property resulting from fires ignited by him.
10. Should it become necessary to extinguish any fire, the permit holder shall pay the entire cost of suppression.
11. This permit is non-transferable and may be suspended if the permit holder fails to comply with permit conditions.
12. Restricted burning shall not cause contravention of any applicable ambient air quality standard or cause air pollution.
13. This permit is valid only where the permit holder owns the site of open fire or where he has secured permission from the site owner. This permit authorizes no trespass on private property.

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE ARMY
SENECA ARMY DEPOT
ROMULUS, NEW YORK 14541-5001

REPLY TO
ATTENTION OF:

June 5, 1991

Office of Engineering/Environmental
Management Division

Mr. Daniel E. Walsh, P.E.
Senior Engineer
Air Resources, Region 8
New York State Department of Environmental Conservation
6274 East Avon-Lima Road
Avon, New York 14414

Dear Mr. Walsh:

This correspondence is in regards to Seneca Army Depot's Restricted Air Permit requirements and the meeting we had on April 23, 1991.

As discussed in the meeting, enclosed is Seneca's application for a Restricted Open Burning (OB) Permit. This permit is being requested for specific waste streams. The chemical composition of these items are also enclosed. This office will report one (1) week in advance of any OB activity from the pre-approved waste stream. We will provide information as to time of burning, item to be burned and quantity.

This office also understands that any items, which are not on this list, must be approved on a case by case basis. As time and conditions dictate, additional items, for this pre-approved list, will be submitted for your approval and incorporation into the waste streams.

This application differs significantly from our other applications as we have not included open detonation. A review of the governing regulations indicate that controlled detonations, as performed at the open detonation grounds, would not appear to require an open burning permit. This activity involved the destruction of munitions by means of explosives. This action is accomplished when the item or items are buried or packed into holes approximately eight (8) feet deep, covered with earth and exploded with specific charge. I believe this activity is similar to controlled detonations on construction projects when rock removal is required. This procedure follows strict Army guidelines for safety and community concerns.

If the determination on open detonation is not correct, please advise this office as to the applicable sections of the governing regulations.

Should you need additional information on processing the permit, please feel free to contact Mr. Randall Battaglia at (607) 869-1450.

Sincerely,

Stephen M Absolom

STEPHEN M. ABSOLOM
Chief, Engineering/Environmental
Management Division

Enclosures

Copy Furnished:

Commander, United States Army Depot System Command, Attention: AMSDS-IN-E (MR. Villinger), Chambersburg, Pennsylvania 17201-4170

6/5/91

COMPOSITION AND PROPERTIES OF PROPELLANTS

	M1	M2	M5	M6	M7	M8	M9	M10	M31	M30	IMR	M18
Nitrocellulose (NC), %	85.00	77.45	81.95	87.00	54.6	52.15	57.75	98.00	20.00	28.00	100.00	80.00
% Nitrogen in NC	13.15	13.25	13.25	13.15	-	13.25	-	13.15	12.60	12.60	13.15	13.15
Nitroglycerin, %	-	19.50	15.00	-	35.5	43.00	40.00	-	19.00	22.50	-	10.00
Barium nitrate, %	-	1.40	1.40	-	-	-	-	-	-	-	-	-
Potassium nitrate, %	-	0.75	0.75	-	-	1.25	1.50	-	-	-	-	-
Potassium sulfate, %	-	-	-	1.0	-	-	-	1.00a	-	-	1.00a	-
Lead carbonate, %	-	-	-	-	-	-	-	-	-	-	-	-
Nitroguanidine, %	-	-	-	-	-	-	-	-	54.70	47.70	-	-
Dinitrotoluene, %	10.00	-	-	10.00	-	-	-	-	-	-	8.00b	-
Dibutylphthalate, %	5.00	-	3.00	-	-	-	-	-	4.50	-	-	9.00
Diethylphthalate, %	-	-	-	-	-	3.00	-	-	54.70	47.70	-	-
Diphenylamine, %	1.00a	-	-	1.00a	-	1.00	-	-	-	-	0.70	1.00
Ethyl centralite, %	-	0.60	0.60	-	0.9	-	0.75	-	1.50	1.50	-	-
Graphite, %	-	0.30	0.30	-	-	-	-	0.10b	-	0.10b	-	-
Cryolite, %	-	-	-	-	-	-	-	-	0.30	0.30	-	-
Potassium Perchlorate,%	-	-	-	-	7.8	-	-	-	-	-	-	-
Carbon Black, %	-	-	-	-	1.2	-	-	-	-	-	-	-
Ethyl alcohol (residual)%	0.75	2.30	2.30	0.90	-	0.40	-	1.50	0.30	0.30	1.50	0.50
Water (residual), %	0.50	0.70	0.70	0.50	-	-	-	0.50	-	-	1.00	-
Isochoric flame temp Tv,K	2,417	3,319	3,245	2,570	-	3,695	-	3,000	2,599	3,040	2,835	2,577

a - Added
b - Glaze Added
c - Ball Propellant

NOTE:

"Ethyl Centralite" or "Centralite I" (a stabilizer) is symmetrical diethyldiphenylurea.

"Methyl Centralite" or Centralite II" (not included in this submission) is symmetrical dimethyldiphenylurea.

"Cryolite" is sodium aluminum flouride (Na3Al6F)

657

WASTE STREAM FOR OPEN BURNING

Rocket Motor Ignitor, M20A1

Primer, M28B2

Charge, Propelling, 8", M188A1

M6 Propellant, Charge, Propelling, 8" (1320-D674)

Propellants - M1, M2, M5, M6, M7, M8, M9, M10, M31, M30, IMR, M18

6/7/84

ROCKET MOTOR IGNITER, M20A1

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Black Powder	98.18	236.7218
Charcoal	.33	.7957
Egyptian Lacquer	.18	.4340
Lead Thiocyanate	.585	1.4105
Potassium Chlorate	.725	1.7480

CHARGE, PROPELLING, 8 IN (1320-D674)

PROPELLANT, M6 (Base Charge)

COMPOUND	COMPONENT CONCENTRATION (LBS/MUNITION)	PERCENTAGE OF PEP	TOTAL PEP (LBS X 3)
Nitrocellulose	6.74	87.0	20.22
Dinitrotoluene	0.86	10.0	2.58
Dibutylphthalate	0.02	3.00	0.06
Diphenylamine	0.01	1.00*	0.03

* Added

PRIMER, M28B2

COMPOUND	COMPONENT CONCENTRATION (GRNS/MUNITION)	PERCENTAGE OF PEP	TOTAL PEP (GRNS X 15)
Potassium Nitrate	220.80	73.60	3312.0
Sulfur	30.60	10.20	459.0
Charcoal	45.60	15.20	684.0
Lead ~~Led~~ Thiocyanate (Sulphocyanate)	0.75	0.25	11.25
Antimony Sulfide	0.51	0.17	7.65
Potassium Chlorate	1.59	0.53	23.85
Trinitrotoluene	0.15	0.05	2.25

CHARGE, PROPELLING, 8 IN, M188A1

PROPELLANT, M31

COMPOUND	COMPONENT CONCENTRATION (LBS/MUNITION)	PERCENTAGE OF PEP	TOTAL PEP (LBS X 5)
Nitrocellulose	9.60	20.00	48.0
Nitroglycerin	9.12	19.00	45.6
Nitroguanadine	26.26	54.70	131.3
Dibutylphthalate	2.61	4.50	10.8
Ethyl Centralite	0.72	1.50	3.6
Croyolite	0.14	0.30	0.7

SDSSE-CP (200-1a) 18 Jul 90

MEMORANDUM THRU Director of Ammunition Operations CWR

FOR Environmental Protection Officer Rec'd 24 JUL 90 RWB

SUBJECT: Request for Open Burning Authorization

1. Safety in Storage Inspection has revealed a quantity of HC grenade bodies which are considered unsafe for continued storage (encl 1). HQ, DESCOM concurs that the deteriorated condition of these grenade bodies necessitates immediate disposal (encl 2).

2. The following information is provided for submittal to state environmental autorities:

Quantity - 3,816

Explosive weight per unit - 1.29 lb

Total explosive weight - 4,922.64 lbs

CHEMICAL COMPOUND

Filler 19 ounces = 1.2 lbs

Starter Mixture 1.5 ounces = .09 lb

FILLER = 1.2 lb x 3816 = 4,579.2

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Zinc Oxide	46.47%	2127.9542
Hexachlorethane	44.53%	2039.1178
Aluminum	9 %	412.1280

STARTER MIXTURE = .09 x 3816 = 343.44

Dry mix - 83.3% 286.0855

Binder - 16.7% 57.3545

SDSSE-CP
SUBJECT: Request for Open Burning Authorization

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Dry mix		
Silicon	26%	74.3822
Potassium Nitrate	35%	100.1299
Charcoal	4%	11.4434
Aluminum	13%	37.1911
Iron Oxide Black	22%	62.9388
Binder		
Nitrocellulose	6%	3.4413
Acetone	94%	53.9132

3. Destruction will be accomplished by burning in demo grounds burning tray. Residue will be collected and properly contained.

4. Burning operation can be completed in one week and may commence as soon as authorization is granted.

5. POC is Tony Carcirieri, X-41262.

2 Encls

DON K. JONES
Chief, PP&C Division

Randy

SDSSE-HE (200-1c)

12 SEP 1991

MEMORANDUM THRU

D/EH

D/AO

FOR D/AO, PP&C Division

SUBJECT: Demil SOP's

1. Reference:

a. 40CFR Subpart X

b. SOP #SE-0000-G-004, Demilitarization by Detonation

c. SOP #DE-0000-H-005, Demilitarization by Burning

d. Memorandum, SDSSE-HE, 30 Jul 91, subject: Open Burning Permit Operating Compliance

2. The Open Detonation (OD) SOP (reference b) has been reviewed by this of[illegible] ; since some comments also pertain to Open Burning (OB), changes for the [illegible] (reference c) are also recommended. Comments are as shown below.

3. For both OB and OD, change the SOP's as follows:

a. Due to the amount of environmental requirements, include a "General Environmental Requirements" section similar to the General Safety Requirements section. List all environmental requirements as follows:

(1) Waste Disposal - Waste paints, thinners, pentachlorophenol PENTA) residues, oily rags, ash residue, and other hazardous materials, will e disposed of as a hazardous waste IAW SEAD-R 420-2, Hazardous Waste anagement.

(2) If any evidence of unexploded explosives material (lumps, esidue, etc.) or unburned propellant are found, the Environmental Protection fficer, ext. 41-450, will be notified.

(3) Pentachlorophenol (PENTA) treated pallets, ammunition boxes, or ther wood will not be open burned or open detonated.

(4) Except in emergency situations, OB/OD of HC, colored smoke, WP, P, and riot control agents is prohibited. Specific approval is required by C, DEC and EPA as appropriate for emergency situations.

(5) Seneca's Subpart X of 40 CFR Part 264, Application for Miscellaneous Unit to Treat, Store, and Dispose of Hazardous Wastes, will be included as an Appendix to this SOP. All personnel involved with OB/OD will be familiar with the requirements and comply with the specifications in the application (and the permit itself when finalized).

(6) All personnel involved with OB/OD operations will attend Seneca's annual hazardous waste training refresher course.

(7) Other requirements, as specified in AMC-R 755-8, Demil of Class V material, should be listed here.

b. Environmental requirements in the Specific Instructions may be deleted when they are included in the General Environmental Requirements Section, except for notifications of the Environmental Protection Officer.

4. For Open Detonation, add the following to the General Environmental Requirements:

a. OD of hazardous waste is prohibited except (as allowed by 40 CFR 265.382) for the OD of waste explosives.

[illegible] OD operations will be accomplished such that high-order detonations a[illegible]chieved.

c. D/AO will provide, by memorandum to DEH, a detailed chemical composition of all candidates for OD (received by DEH one month minimum) prior to demil operation.

d. D/AO will maintain a list of pre-approved OD materials (reference .(d)) as an appendix to this SOP. Approval by DEC only requires a reasonable waiting period after providing chemical composition information. OD is exempt from air permit requirements, this information is a courtesy submittal. If air OD emissions are a concern, DEC will call and may delay demil in this ase.

. For Open Burning, add the following to the General Environmental equirements:

a. D/AO will maintain a list of pre-approved OB materials (reference (d)) as an appendix to the SOP.

b. Only items on the pre-approved list will be open burned. New tems/munitions' approval will be requested by memorandum to DEH on a routine non-urgent) basis. DEH will request approval by DEC, and provide D/AO with pproval, when received. Urgent approvals will only be requested in emergency ituations (reference 1(d)).

c. D/AO will provide DEH with prior notification (to be received by DEH so as to provide DEC notification one (1) week prior to scheduled burn, ten (10) days total time will normally be sufficient). This notification will include the:

(1) Exact quantity per day of PEP to be burned.

(2) Date(s) of burns.

(3) The number of burns per day if multiple burns can be accomplished safely.

(4) The pre-approved PEP to be burned.

d. OB operations should take place as stated in SEAD's notice to DEC. Only weather or other safety concerns should delay or change the scheduled burns. DEH will be notified when there is more than two (2) days variance from the request.

e. An after action report will be provided to DEH whenever the General Environmental Requirements are not met, stating the cause/reasons and actions taken.

[illegible]. OB operations will not be conducted on the ground, but only in the t[illegible]y.

g. The cover will be placed on the tray after all operations when it is safe to do so (but at the end of every day) to prevent rainfall from entering the trough.

h. Ash residues in the trough will be HEPA-vacuumed at the end of each day, if the tray is sufficiently cooled. If the ash/tray is too hot to vacuum at the end of the day, the cover will be placed on the tray, and the tray will be HEPA-vacuumed at the <u>start</u> of the next available day.

i. Ash residues will be containerized as a hazardous waste. The hazardous waste label will state "Hazardous Waste Solid, N.O.S.", NA9189, Test Required (type of PEP). DOT approved containers smaller than 55 gallon drums may be used. DEH will test the residues IAW SEAD-R 420-2.

j. DAO will cordinate with DEH for evaluation of quantity limit of PEP in the tray.

. POC is the Environmental Protection Officer, Randall Battaglia, at ext. 1-450.

Stephen M Absolom

STEPHEN M. ABSOLOM
Chief, Engineering/Environmental
Management Division

SDSSE-CP (200-1a) 11 Jan 91

MEMORANDUM FOR Environmental Protection Officer

SUBJECT: Initiating Explosive

1. In order to enhance ignition of combustible bed during the burning of HC smoke grenades, propellant increment bags are required.

2. The following information is provided as requested:

Nomenclature - Bag loading assembly, M5 propellant
Quantity 100
Explosive weight per unit .0076 lb
Total explosive weight .76 lb

CHEMICAL COMPOSITION

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X Total Wt)
Nitrocellulose	81.95	.6228
Nitroglycerin	15	.1140
Ethyl Centralite	.6	.0046
Barium Nitrate	2.15	.0163
Graphite	.3	.0023

3. POC is the undersigned, SDSSE-CP, X-41262/441.

Anthony J. Carcirieri Jr.
TONY CARCIRIERI
Industrial Specialist
PP&C, D/AO

SDSSE-CP (200-1a) 30 Aug 90

MEMORANDUM FOR Environmental Protection Officer

SUBJECT: Request for Open Detonation Authorization

1. Request for assistance from Directorate of Special Weapons (encl) includes a number of items containing conventional explosives which require demilitarization.

2. The following information is provided for submittal to state environmental authorities:

CHEMICAL COMPOUND

Black Powder - 15 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Potassium Nitrate	74.0	11.1
Sulfur	10.4	1.56
Charcoal	15.6	2.34

PETN - 45 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Pentaerythritetetranitrate (PETN)	100	45

Comp B Grade A - 160 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Cyclotrimethylenetrinitramine (RDX)	59.47	95.152
Nitric Acid	.03	.048
Trinitrotoluene (TNT)	39.5	63.2
Desensitizer wax	1.0	1.6

Initiating Explosives

Charge, Demo Block, C-4
Explosive Weight per unit - 1.25 lbs
Quantity - 50
Demo Block, C-4 - 62.5 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Cyclotrimethylenetrinitramine (RDX)	91.0	56.875
Polyisobutylene	2.1	1.3125
Motor Oil	1.6	1.0
Di (2 Ethylhexyl) Sebacate	5.3	3.3125

Cord, Detonating
Explosive Weight per foot - .007 lb
Quantity - 300 ft
Det cord .007 x 300 ft = 2.1 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Pentaerythritetetranitrate (PETN)	100	2.1

3. Destruction will be accomplished by detonation under a minimum of 8 feet of earth cover. Scrap/residual metal will be collected and contained.

4. Destruction period will be one week.

5. POC is Tony Carcirieri, X-41262.

Encl

CARSON W. LANKFORD
Director of Ammunition Operations

SDSSE-NO (755) 7 August 1990

SUBJECT: Request for Assistance

MEMORANDUM THRU

Director of Special Weapons

FOR

Director of Engineering and Housing
Direction of Ammunition Operations

1. Request permission to destroy the following items by demolition.

a. 260 each locking devices, inert metal parts 3000 lbs.

b. 45 each gas pressure generators, 353 lbs aluminum and 15 lbs black powder.

c. 89 each explosive generators, 805 lbs metal, and 20 lbs PETN.

d. Deton Cord 3600 ft, PETN 25 lbs.

e. 137 each adaption kits, 6,850 lbs inert aluminum parts.

f. 100 each radar fuzes, 10,000 lbs inert metal parts.

g. 48 each inert aluminum training items, 25,200 lbs.

h. 288 each fire plugs, inert metal parts 822 lbs.

i. Spotting rounds 1440 lbs metal parts, and 160 lbs Comp B Grade A.

2. POC this activity is Ray Forde, ext 30320.

GERALD R. MAINE
Chief, PP&C Division
Director of Special Weapons

ENCL

SDSSE-CP (200-1a) 14 Mar 90

MEMORANDUM THRU Director of Ammunition Operations

FOR Environmental Officer Rec'd 19 Mar 90

SUBJECT: Request for Open Burning Authorization

1. Special inspection of 5 inch, 38 caliber propellant charges has yielded a quantity of unserviceable rounds which require disposal.

2. The following information is provided for submittal to state environmental authorities:

Quantity	4
Explosive Weight per unit	15.285 lbs
Total Explosive Weight	61.14 lbs

CHEMICAL COMPOSITION

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Nitrocellulose	99%	60.5286
Diphenylaminal	1%	.6114
Potassium Sulfate		

3. Destruction will be accomplished by burning in demo grounds burning tray. Residue will be collected and properly contained.

4. Request additional authorization to burn propellant charges with black powder scrap, reference memorandum, SDSSE-CP, dated 28 Feb 90, SAB (encl). Burning operation can be completed in one day and may commence as soon as authorization is granted.

5. POC is Tony Carcirieri, SDSSE-CP, X-41262/441.

Don K Jones

DON K. JONES
Chief, PP&C Division

Encl

file

Mr. Carcirieri/bk/41262

SDSSE-CP (200-1a) 28 Feb 90

MEMORANDUM THRU Director of Ammunition Operations

FOR Environmental Protection Officer

SUBJECT: Request for Open Burning Authorization

1. Maintenance operation has generated a quantity of black powder expelling charges. The deteriorated nature of this scrap black powder necessitates immediate disposal.

2. The following information is provided for submittal to state environmental authorities:

Quantity	2,568
Explosive weight per unit	.21 lb
Total explosive weight	539.3 lbs

CHEMICAL COMPOSITION

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% x Total Wt)
Potassium Nitrate	74.0%	399.1
Sulfur	10.4%	56.1
Charcoal	15.6%	84.1

3. Destruction will be accomplished by burning in demo grounds burning tray. Residue will be collected and properly contained.

4. Burning operation can be completed in one day and may commence as soon as authorization is granted.

5. POC is Tony Carcirieri, SDSSE-CP, X-41262.441.

DON K. JONES
Chief, PP&C Division

SDSSE-C (200-1a) 21 Jun 91

MEMORANDUM FOR Environmental Coordinator

SUBJECT: Request for Open Burning Authorization

1. A quantity of 14,598 expended cartridge cases require flashing (exposure to high intensity heat) in order to decontaminate possible explosive residue IAW para 3-6d(1)(a) of AMC-R 755-8. Cartridge cases were generated during weapons firing at various posts, camps and stations and possess no significant, visible amounts of propellant or primer mixture.

2. Two cartridge case NSN's requiring decontamination along with related information are provided for submittal to state environmental authorities:

a. NSN - 1315-00-837-3232

Nomenclature - Case, Cartridge 105mm

Quantity - 5,089

b. NSN - 1315-01-056-3057

Nomenclature - Case, Cartridge 75mm

Quantity - 9,509

3. Decontamination will be accomplished by open burning at demil grounds burning tray. Decontaminated cartridge cases will be transferred to Defense Reutilization Marketing Office. All residual matter generated during open burning will be collected and contained.

4. Decontamination will be accomplished over a one month period.

5. POC is Tony Carcirieri, X-41262/441.

CARSON W. LANKFORD
Director of Ammunition Operations

Mr. Carcirieri/bk/41262

SDSSE-CP (200-1a) 30 Aug 90

MEMORANDUM FOR Environmental Protection Officer

SUBJECT: Request for Open Detonation Authorization

1. Request for assistance from Directorate of Special Weapons (encl) includes a number of items containing conventional explosives which require demilitarization.

2. The following information is provided for submittal to state environmental authorities:

CHEMICAL COMPOUND

Black Powder - 15 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Potassium Nitrate	74.0	11.1
Sulfur	10.4	1.56
Charcoal	15.6	2.34

PETN - 45 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Pentaerythritetetranitrate (PETN)	100	45

Comp B Grade A - 160 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Cyclotrimethylenetrinitramine (RDX)	59.47	95.152
Nitric Acid	.03	.048
Trinitrotoluene (TNT)	39.5	63.2
Desensitizer wax	1.0	1.6

Initiating Explosives

Charge, Demo Block, C-4
Explosive Weight per unit - 1.25 lbs
Quantity - 50
Demo Block, C-4 - 62.5 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Cyclotrimethylenetrinitramine (RDX)	91.0	56.875
Polyisobutylene	2.1	1.3125
Motor Oil	1.6	1.0
Di (2 Ethylhexyl) Sebacate	5.3	3.3125

Cord, Detonating
Explosive Weight per foot - .007 lb
Quantity - 300 ft
Det cord .007 x 300 ft = 2.1 lbs

COMPOUND	PERCENTAGE OF PEP	TOTAL PEP (% X TOTAL WT)
Pentaerythritetetranitrate (PETN)	100	2.1

3. Destruction will be accomplished by detonation under a minimum of 8 feet of earth cover. Scrap/residual metal will be collected and contained.

4. Destruction period will be one week.

5. POC is Tony Carcirieri, X-41262.

Encl

CARSON W. LANKFORD
Director of Ammunition Operations

SDSSE-NO (755) 7 August 1990

SUBJECT: Request for Assistance

MEMORANDUM THRU

Director of Special Weapons

FOR

Director of Engineering and Housing
Direction of Ammunition Operations

1. Request permission to destroy the following items by demolition.

   a. 260 each locking devices, inert metal parts 3000 lbs.

   b. 45 each gas pressure generators, 353 lbs aluminum and 15 lbs black powder.

   c. 89 each explosive generators, 805 lbs metal, and 20 lbs PETN.

   d. Deton Cord 3600 ft, PETN 25 lbs.

   e. 137 each adaption kits, 6,850 lbs inert aluminum parts.

   f. 100 each radar fuzes, 10,000 lbs inert metal parts.

   g. 48 each inert aluminum training items, 25,200 lbs.

   h. 288 each fire plugs, inert metal parts 822 lbs.

   i. Spotting rounds 1440 lbs metal parts, and 160 lbs Comp B Grade A.

2. POC this activity is Ray Forde, ext 30320.

GERALD R. MAINE
Chief, PP&C Division
Director of Special Weapons

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II
26 FEDERAL PLAZA
NEW YORK, NEW YORK 10278

MAR 19 1992

23 MAR REC'D

Mr. Randall W. Battaglia
Chemical Engineer
Environmental Coordinator
Senaca Army Depot
Romulus, New York 14541-5001

Re: Senaca Army Depot, EPA I.D. No.: NY0213820830
RCRA Subpart X NOD Meeting, January 23, 1992

Dear Mr. Battaglia:

The purpose of this letter is to review the major issues and concerns raised in the Resource Conservation and Recovery Act (RCRA) Subpart X notice of deficiency (NOD) meeting held on Thursday, January 23, 1992, at the U.S. Environmental Protection Agency (EPA) Region II offices, in New York City. These are listed and discussed below:

Deadline Extension

An extension of the deadline for submission of NOD responses was requested. An extension of 30 calendar days from the date of this letter is granted.

Air Modeling

The air modeling programs for gaseous emissions at open burning/open detonation (OB/OD) operations acceptable to EPA are the IMPUFF or ISC models. The ISC model is the preferred one for calculating the dispersion of particulate emissions.

Closure

Subpart X units such as OB/OD areas should follow the interim status closure procedures. The closure plan must include a procedure to determine whether or not the unit is decontaminated.

If the unit is found to be contaminated, then the unit would have to be clean closed, e.g., removal of all contamination, or closed as a landfill, and a post-closure permit would be required. As a result, a post-closure application would be required as a part of the closure procedure. Clean closure involves removal of the contaminated material and decontamination to health based risk levels. This is followed by three years of groundwater monitoring.

<u>Groundwater Monitoring</u>

Groundwater monitoring for metals should include both filtered and unfiltered samples. Enclosed are the groundwater monitoring recommendations of SW-846 to further assist you in developing an acceptable groundwater monitoring plan. The open burning (OB) area is required to have groundwater monitoring as stipulated in 40 CFR 264.602.

It is hoped that the above information will be helpful in assisting you to prepare the responses to the RCRA Subpart X NOD. Any further questions or comments regarding this matter, may now be referred to Mr. John N. Brogard, P.E., of my staff, at (212) 264-7461.

Sincerely yours,

EP Doering for A Bellina

Andrew Bellina, P.E.
Chief, Hazardous Waste Facilities Branch

Enclosures

cc: N.G. Kaul, NYSDEC w/o encls.
Bert O'Connell, A.T. Kearney w/o encls.

SENECA ARMY DEPOT

BLDG 123

ROMULUS, N.Y.

14541

DIRECTORATE of ENGINEERING and HOUSING

DATE: 3/24/92 TIME: ______ # of PAGES W/ COVER SHT: ____

21/92

TO: Mike Duchesneau FROM:

OFFICE/CO.: CT Main

SENECA ARMY DEPOT
FAX# (607) 869-1362
PHONE# (607) 869-1532

FAX# 617-859-2575

COMMENTS: Note Deadline for NOD response is 17 April 1992

* NOTE: sending ~~30~~ 25 pages at a time! please place together (239 pages total)

APPENDIX 7

DESCRIPTION OF SOLID WASTE MANAGEMENT UNITS

SCR. DESCRIPTNS
INCL. IN
SUBMITTED APPLIC.

APPENDIX 8

RESPONSE TO COMMENTS

RESPONSE TO COMMENTS
RCRA PART B PERMIT APPLICATION, OPEN BURNING/OPEN DETONATION FACILITY
SENECA ARMY DEPOT
Romulus, New York
EPA I.D. No. NY0213820830

B. FACILITYDESCRIPTION

B-2 Topographic Map

B-2a General Requirements: 270.14(b) (19)

Comment #1 Correct the wind rose reference on page B-6. The wind rose is located in Appendix VII, Figure D.8.4.2-1,not in Section E in Appendix E-1 as indicated on page B-6.

Response #1 ***Resolved.*** *The wind rose is located in Section D as Figure D-19.*

Comment #2 The application states that wells are shown on Figures B-2 and B-3. These Figures show no wells. The locations of all wells at SEAD must be shown in the application. Because a potential exists for contamination of the surface water in Reeder Creek, the application should also show private water supply wells off the depot in the vicinity of the Creek, as well as the location of private water supply wells along the western boundary of the reservation adjacent to the OB/OD area.

Response #2 ***Resolved.*** *A new figure B-5 which is located in Appendix 1 has been added which shows the location of water supply wells.*

Comment #3 The application must provide a detailed picture of the surface drainage at the OB/OD site. Figure B-2 is not adequate. Provide a topographic map with a contour interval of 2 feet and a scale of 1"=50' covering the area of the OB/OD sites and the area within a radius of 1000 feet of the sites.

Response #3 ***Resolved.*** *A new figure, B-2, has been included which is located in Section B.*

Comment #4 Provide a detailed description of the flow characteristics of Reeder Creek. Provide measurements or estimates of discharge and how this varies over short periods, such as during storms, and how the discharge varies over the year.

Response #4 ***Resolved.*** *A description of Reeder Creek is located in Section B-2m(3). No seasonal variation flow or storm flow estimates have been included.*

Comment #5	Provide a history of flooding for Reeder Creek.
Response #5	***Resolved.*** *A history of local flooding is included as Section B-2m(4).*
B-3	**<u>Location Information:</u> 270.14(b) (11)**
B-3b	**<u>Floodplain Standard:</u> 270.14(b) (11) (iii), 264.18(b)**
Comment #6	Provide a Federal Insurance Administration Map or equivalent maps and calculations which clearly show whether or not the facility is located within the 100-year floodplain. The application's reference to a "Flood Hazard Boundary" map (page B-9) is not adequate. This map must be provided along with the application document.
Response #6	***Resolved.*** *The Federal Emergency Management Administration (FEMA) 100-year floodplain boundaries have been added to the SEAD area map (Figure B-3). FEMA calculations will not be obtained. A description of flooding history has been included in Section B-2m(4).*

C. WASTE CHARACTERISTICS

C-1 Chemical and Physical Analyses: 270.14(b)(2), 264.13(a)

Comment #7 Provide a description of the waste ash generated at the OB/OD facility. This description must include information of hazard characteristics and the basis for hazard designation. Also provide a laboratory report detailing the chemical and physical analyses of representative samples of the ash material. The application describes procedures for testing waste ash but does not provide representative data. This information must be provided in order to fully assess the environmental risks.

Response #7 ***Resolved.*** *No chemical or physical analysis of the waste ash generated from the OB/OD facility is available. The quantities of ash generated to date have been very small. The ash generated has been deemed non reactive, drummed and stored and managed in accordance with existing procedure for Hazardous Waste. Final disposition of the ash will be made when sufficient quanities have been generated to make off-site disposal in accordance with all applicable regulations, practical. See also Section C-2.*

C-1g Waste in Miscellaneous Treatment Units: 270.23(d)

Comment #8 For each treatment unit, provide a report demonstrating the effectiveness of treatment based on laboratory, bench scale, pilot scale, or field data. While Section C-1g of the permit application provides and adequate description of the methods used to characterize wastes before they are treated in the OB/OD units, it does not provide a demonstration of the effectiveness of such treatment. If the information in Appendix V is intended to satisfy this criteria, provide a demonstration that the waste sampled in this test is representative of the waste generated at the SEAD OB/OD facility.

Response #8 ***Resolved.*** *Hazardous materials are bieng treated at SEAD to remove the hazardous characteristic of reactivity. After open burning or open detonation, ash/residue is collected, as discussed in Section C, and a determination is made if the materials are still reactive, they receive additional treatment. If the materials are still reactive. If the materials are not reactive a further determination is made in regards to its toxicity (TCLP testing).*

Experience at SEAD has demonstrated that OD and OB treatment of reactive materials is highly successful.

In addition, the Army has on-going program which is attempting to develop testing procedures which could be used in the future to determine treatment effectivenenss (See U.S. Army, "Consolidated report on the test program for the identification and *characterization of products and residues from the Open Burning/Open Detonation of munitions", U.S. Army Arrangement Munitions Chemical Command, Rock Island, IL (1987).*

The results from this program will be given to the EPA when they become available. See Section D-8C also.

C-2 Waste Analysis Plan: 270.14(b)(3), 264.13(b) and (c), 268.7

Comment #9 Nitroglycerin was misclassified as D003 in Table C-3. According to 40 CFR 261.33 nitroglycerin is classified as P081. Provide the necessary changes to Table C-3 and the Part A Permit application.

Response #9 ***Not applicable.*** *Per conversations with the EPA, materials which are treated by open burning or open detonation are considered hazardous materials only because of their characteristic reactivity.*

C-2a Parameters and Rationale: 264.13(b)(1)

Comment #10 Update the EP Toxicity parameters listed in Table C-7. Include all of the parameters listed in the revised listing published in the Federal Register on March 29, 1990 as the final rule for the identification and listing of hazardous waste.

Response #10 ***Resolved.*** *Ash and residue will be tested for the characteristics of reactivity and toxicity in accordance with methods described in Section C-2b.*

C-2b Test Methods: 264.13(b)(2)

Comment #11 Include the test methods used to analyze each additional parameter to be listed in Table C-7 in response to comment C-2a.

Response #11 ***Not applicable.*** *See comment/response #10.*

C-2f Additional Requirements for Ignitable, Reactive or Incompatible Wastes: 264.13(b)(6), 264.17

Comment #12 Modify the SOPs to address the handling, accumulation, and ultimate disposal of the ash/residue referenced on page C-35.

Response #12 ***Resolved.*** *SOPs are included in Appendix 4.*

C-3 **Waste Analysis Requirements Pertaining to Land Disposal Restrictions:** 270.14(b)(3), 264.13, 268.7, 268.8, 268.30, 268.31, 268.32, 268.33, 268.34, 268.41, 268.42, 268.43, 268.50, Part 268 Appendix I

C-3a **Waste Characterization: 264.13(a)(1), 268.7**

Comment #13 Provide an analysis of the ash residue stored on site to determine whether it meets treatment standards under 40 CFR 268 for disposal. The regulations require that the facility provide a detailed analysis to be used to correctly treat, store or dispose of each waste type. If the waste material does not meet treatment standards, specify that a certification to the receiving facility is provided with each waste type as required by 40 CFR 268.7(a).

Response #13 ***Resolved.*** *See Comment Response #7.*

C-3a(2) **Waste Characteristics: California List Wastes: 264.13(a), 268.7(a), 268.32, RCRA Section 3004(d), 52 FR 25767-25768**

Comment #14 Provide information on the ash waste material to be land disposed which will determine its status as a California list waste. Non-liquid hazardous wastes containing HOCs in total concentrations greater than or equal to 1,000 mg/kg are California list wastes and are prohibited from land disposal. If the waste material is classified as a California list waste and is land disposed, provide the necessary information which would allow the waste material to be land disposed. Prohibitions do not apply if any one of the following conditions exists:

- An exemption has been granted pursuant to 268.6;
- A case-by-case extension has been granted pursuant to 268.5; and
- The wastes meet the applicable standards in 268.42, where treatment standards are not specified, the wastes are in compliance with the applicable prohibitions in 268.32 or RCRA Section 3004(d).

Response #14 ***Resolved.*** *The ash/residue generated is not a California list waste. The waste generated will be tested for the characteristics of reactivity and toxicity as described in Section C-2.*

C-3a(b) **Wastes Characteristics: Soft Hammer Wastes: 268.33(f), 268.34(h)**

Comment #15 If ash residues are classified as a restricted waste, provide information to be included in the Permit application that specifies the treatment technology to be used. Effective August 8, 1990, soft hammer wastes are regulated under 40 CFR 268.35 as the Third Third wastes.

Response #15 ***Resolved.*** *The ash/residue generated is not a listed waste. The waste generated will be tested for the characteristics of reactivity and toxicity as described in Section C-2.*

C-3b Notification and Certification Requirements: 268.7

Comment #16 In the event the treatment residues are classified as restricted waste, provide a detailed outline of the procedures for preparing the necessary notifications and the type of notifications. Regulations require that treatment facilities which generate treatment residues must prepare applicable notifications and certifications to the receiving facility. The waste analysis plan must present procedures for preparing and/or maintaining applicable notifications and certifications for all wastes which are regulated for land disposal.

Response #16 ***Resolved.*** *Included in Section C is Table C-2, SEAD Regulations No. 420-2, "Hazardous Waste Management", and a typical Hazardous Waste Manifest.*

C-3b(3) Notification and Certification for Soft Hammer Wastes Not Subject to California List Prohibitions: 268.7(b)(7)

Comment #17 In the event the treatment residues are classified as restricted waste but are not subject to California list prohibitions, provide an example of the notice that will be sent to all subsequent treatment, storage, or disposal facilities describing the applicable prohibitions in 268.33(f). The notice must be submitted with each shipment of waste and must include the information listed in 268.7(b)(7)(i) through (iv).

Response #17 ***Resolved.*** *See Response #16.*

C-3b(4) Additional Notification and Certification Requirements for Treatment Facilities: 268.7(b) (4), (5), and (8).

Comment #18 In the event that treatment residues are classified as restricted waste, provide an example of the notice that will be submitted to each land disposal facility with each shipment of restricted waste or treatment residue of a restricted waste. The notice must include the information listed in 268.7(b) (4) (i) through (iv).

Provide an example of the certification to be submitted to each land disposal facility with each shipment of a restricted waste or treatment residue of a restricted waste. The certification must state that the waste or treatment residue has been treated to comply with the applicable treatment standards and prohibition levels.

Response #18 ***Resolved.*** *See Response #16.*

C-3b(4)(a) Wastes with Treatment Standards Expressed as Concentrations: 268.7(b)(5)(i)

Comment #19 In the event that treatment residues are classified as restricted waste, provide an example of the certification to be submitted to each land disposal facility in accordance with 268.7(b)(5)(i) for wastes with treatment standards expressed as concentrations in the waste extract or in the waste (268.41 and 268.43).

Response #19 ***Resolved.*** *See Response #16.*

C-3b(4)(b) Wastes with Treatment Standards Expressed as Technologies: 268.7(b)(5)(ii)

Comment #20 In the event that treatment residues are classified as restricted waste, provide an example of the certification to be submitted to each land disposal facility in accordance with 268.7(b)(ii) for wastes with treatment standards expressed as technologies (268.42).

Response #20 ***Resolved.*** *See Response #16.*

C-3b(4)(c) California List Wastes not Subject to Treatment Standards: 268.7(b)(5)(i)

Comment #21 In the event that treatment residues are classified as California list wastes which are not subject to treatment standards, provide an example of the certification to be submitted to each land disposal facility in accordance with 268.7(b)(5)(i).

Response #21 ***Not applicable.*** *The waste generated is not a listed waste.*

D. PROCESS INFORMATION

D-8 Miscellaneous Units: 264.601, 270.23

D-8a Description of Miscellaneous Units: 270.23(a)

Comment #22 Provide a detailed description of the open burning area, open detonation area, and the area surrounding the burning trays. The application describes the burning trays in some detail but fails to adequately address the area in which they are located. The descriptions must include the dimensions of each unit, information on any design features, such as containment description, and description of the open burning area surface material. In addition, the permit application must describe the procedure for handling accumulated rainwater in any of the devices or secondary containment structures if such structures exist.

Response #22 ***Resolved.*** *Section D has been revised accordingly. See Section D-1.*

Comment #23 Provide a more detailed drawing of the open burning area, open detonation area, and the area surrounding the burning trays. While Figures B-2 and B-3 do indicate the location of each unit within the facility, they do not provide an adequate description of the individual units. More detailed drawings must indicate the dimensions of each unit, include smaller contour intervals (2 feet is adequate), and indicate the location of the tree line and any unusual surface features (such as protective dirt mounds and protective bunkers).

Response #23 ***Resolved.*** *Section D has been revised to include a more comprehensive description of the facility. Figure B-3 includes one foot contours.*

D-8b Waste Characteristics: 264.601(a)(1), 264.601(b)(1), 264.601(c)(1)

Comment #24 Provide information on the volume of ash/residue generated at the OB/OD facilities. Also provide information on the physical and chemical characteristics of the ash/residue (see comment C-1) in order to determine: (1) the toxicity of the waste; (2) the ability of the waste to be contained, immobilized, degraded or attenuated or to migrate in various soils and materials; and (3) the probability of reactions taking place among wastes or between wastes and liners or other containment structures.

Response #24 ***Resolved.*** *See comment Response #7.*

D-8c **<u>Treatment Effectiveness:</u> 270.23(d)**

Comment #25 For each treatment unit, provide a report demonstrating the effectiveness of the treatment <u>based on laboratory, bench scale, pilot scale, or field data</u>. If the information in Appendix V is intended to satisfy this criteria, provide a demonstration that the waste sampled in this test is representative of the waste generated at the SEAD OB/OD facility.

Response #25 ***Resolved.*** *Refer to EPA Comment Response #8.*

D-8d **<u>Environmental Performance Standards for Miscellaneous Units</u> 264.601(a), 270.23(b) and (c)**

D-8d(1) **<u>Protection of Groundwater and Subsurface Environment</u>. 264.601(a), 270.23(b) and (c).**

D-8d(1)(a) **<u>Environmental Assessment</u>. 264.601(a); 270.23(b) and (c).**

Comment #26 Section E contains a diagram, Figure E-1, which shows a general approach to the groundwater evaluation process. It is not clear why this figure is included in this section. Provide a detailed explanation of how this process applies to the SEAD or otherwise explain how this figure relates to this permit application.

Response #26 ***Resolved.*** *This figure will be removed.*

Comment #27 With regard to Environmental Performance Standards, this section states that existing documentation conducted by the US Army Environmental Hygiene Agency (USAEHA) concludes that a detailed assessment will not be required. Provide, in this permit application, a thorough discussion of the reasons and justification for this conclusion.

Response #27 **Resolved.** Environmental Assessment and Performance Standards are presented in Sections D-8d(1) through (4).

Comment #28 In Section E-1(a) provide an East/West geologic cross section through the OB/OD site extending from the Lake to the Western boundary of the facility. Provide a map showing the surficial geology and soils at and in the vicinity of the OB/OD site. Show the thickness of the glacial deposits on this map.

Response #28 ***Resolved.*** *A cross section is shown on Figure D-3 and D-4.*

Comment #29 In Section E-1(d) show the location of the seven groundwater monitoring wells and provide details on age and construction, including depth and screened intervals. Explain the purpose of the wells. Describe the sampling program, including the analyses performed and the reasons for selection of analyses. Discuss the relation between monitoring parameters and waste constituents treated at the site as well as constituents generated and released by OB/OD.

Response #29 ***Resolved.*** *Well locations are shown on Plate 1. A description of the site conditions, the results of previous investigations, and chemical constituent migrations are included in Section D-8d(1)(a).*

Comment #30 Provide a map of water table contours.

Response #30 ***Resolved.*** *Figure D-9 includes groundwater contours.*

Comment #31 To assess the potential for release to groundwater, provide information on waste characteristics in Section E-2 or provide a reference to where the information can be found.

Response #31 ***Resolved.*** *See Response #7.*

D-8d(1)(b) **Performance Standards: 264.601, 270.23(b).**

Comment #32 Based on the assessments, performance standards must be developed and maintained, unless the facility can demonstrate that they are not applicable. These must include: (1) design and operating requirements; (2) detection and monitoring requirements of 264.602; and (3) requirements for responses to releases of hazardous waste or hazardous constituents from the unit.

Response #32 ***Resolved.*** *Refer to Section D-8d(1)(g).*

D-8d(2) **Protection of Surface Water, Wetlands, and Soil Surface: 264.601(b), 270.23(b), and (c).**

D-8d(2)(a) **Environmental Assessment: 264.601(a), 270.23(b) and (c).**

Comment #33 Section E-1(b) refers to burning pads and demolition ranges. Show the locations of, and identify, all burning pads and demolition ranges at the facility on a topographic map.

Response #33 ***Resolved.*** *Locations are shown on Figures B-2 and Plate 1.*

Comment #34 In Section E-1(c), provide a soil map of the facility. Show where the soil samples mentioned in this section were taken and the methods used to sample. Describe the methods used for the lab and field permeability measurements.

Response #34 ***Resolved.*** *Soil maps are included as Figures D-5 and D-6.*

Comment #35 Section E-1(e) describes Reeder Creek, which is a significant surface water feature adjacent to the OB/OD sites. Any contamination reaching the creek, either by a direct release or carried to the creek by surface run-off, can migrate the length of the creek and into the Lake. The application must provide a detailed description of Reeder Creek, particularly its flow characteristics. This should include average and extreme discharge and estimates of return periods, as well as a detailed description of stream morphology, vegetation, and sediments. Include also a discussion of the relation between the stream and local shallow subsurface water.

Response #35 ***Resolved.*** See Comment Response #4.

Comment #36 Provide a separate map showing the drainage area for Reeder Creek to the point where it enters the Lake.

Response #36 ***Resolved.*** ***See Figure D-18.***

Comment #37 To assess the potential for release to surface water and soils, provide information on waste characteristics in Section E-2 or provide a reference to where the information can be found.

Response #37 ***Resolved.*** *See Comment Response #7*

Comment #38 In Section E-3(a) show the soil sampling locations on a map and provide a brief discussion of the sampling methodology, selection of parameters for analysis, and the origin of PEP and heavy metals at the site.

Response #38 ***Resolved.*** *Sampling locations shown in Figures D-11, 12 and 13. In addition, the OB and OD grounds are currently undergoing RCRA Corrective Action and CERCLA Investigations (OB). Reports will be issued to the EPA which will discuss these issues.*

Comment #39 The application claims that certain OB/OD units are exempt from groundwater monitoring requirements (page E-6). State the source of the authority for this exemption, identify which State and Federal authorities concur with this exemption, and exactly how this exemption applies to OB/OD at SEAD.

Response #39 ***Resolved.*** *A groundwater monitoring program will be established for the OD Grounds as described in Section E. The OB grounds are exempt per the requirements specified under 40 CFR 264.90(b)(2) as described in Section E-1.*

Comment #40 In Section E-3(c), provide a complete description of the surface water sampling program, including number of samples, sampling methods, parameters selected for analysis, reasons for selecting parameters, analytical methods used, QA/QC procedures and results.

Response #40 ***Resolved.*** *The referenced AEHA report has not been obtained and references to the surface water sampling program have been removed from the application.*

D-8d(2)(b) Performance Standards: 264.601

Comment #41 Based on the results of environmental assessments, performance standards must be developed and maintained. These must include: (1) design and operating requirements (structures that should be considered include liners, dikes, diversion ditches, and cut-off walls); (2) detection and monitoring requirements of 264.602; and (3) requirements for responses to release of hazardous waste or hazardous constituents from the unit.

Response #41 ***Resolved.*** *Refer to Section D-8d(2)(f).*

D-8d(3) Protection of the Atmosphere: 264.601(c), 270.23(b) and (c).

D-8d(3)(a) Environmental Assessment: 264.601(c), 270.23(b), and (c).

D-8d(3)(a)(1) Waste Characteristics and Volume, Including Potential for Emission and Dispersal of Gases, Aerosols, and Particulates

Comment #42 Identify whether there is a potential for the emission and dispersion of gases, aerosols, and particles for the waste before the burning of the waste.

Response #42 ***Resolved.*** *See Section D-8d(3)(b).*

D-8d(3)(a)(4) Atmospheric, Meteorological, and Topographic Characteristics of the Unit and the Surrounding Area

Comment #43 Provide and summarize the climatological information from the closest representative monitoring station for 24-hour rainfall, evaporation, and frequency of inversions data to augment the data provided in Table D.8.4.2-1 of Appendix VII.

Response #43 ***Resolved*** *Daily precipitation data measured at the Aurora Research Farm in Aurora, New York for the period (1957-1991) were obtained from the Northeast Regional Climate Center at Cornell University. The maximum 24-hour precipitation event during this 35-year period of record is summarized in Table D-31 for each month. The maximum 24-hour precipitation measured at this station during this period was 3.91 inches on September 26, 1975.*

Values of 35 inches for mean annual pan evaporation and 28 inches for annual lake evaporation were already reported in Table D.8.4.2-1 of Appendix VII. An independent value of 27 inches for mean annual evaporation from open water surfaces was estimated from an isoplethed figure in "Water Atlas of the United States" (Water Information Center, 1973).

Information on the frequency of inversion episodes for a number of National Weather Service stations is summarized in "Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States" (George C. Holzworth, US EPA, 1972). The closest stations for which inversion information is available are Albany, New York and Buffalo, New York. The Buffalo station is nearer to SEAD but almost certainly exhibits influences from Lake Erie. These influences would not be expected to be as noticeable at SEAD.
Tables D-32 and D-33 provide information concerning inversion episodes and episode-days at Albany and Buffalo, respectively, for the five year period (1960-1964). Frequency information is provided for each station for various combinations of maximum mixing height, wind speed ranges, and minimum episode duration.

D-8d(3)(a)(5) Existing Air Quality, Including Other Sources of Contamination and Their Cumulative Impact on the Air

Comment #44 Provide information on other major sources of air emissions within one mile of the OB/OD facilities at the Seneca Army Depot including the quantity, nature, and frequency.

Response #44 ***Resolved.*** *Refer to Figure D-21 and Section D-8d(3)(a).*

D-8d(3)(a)(6) Potential for Human Health Risks Caused by Exposure to Waste Constituents

Comment #45 Provide information on the population density, land use, and sensitive receptors (if any) within one mile of the OB/OD area at SEAD.

Response #45 ***Resolved.*** *Refer to Section D-8d(3)(f).*

Comment #46 Provide information on the estimate of exposed individuals to air emissions for the operations at the SEAD OB/OD area.

Response #46 *Resolved. Refer to Section D-8d(3)(f).*

Comment #47 Based on the modeling analysis performed for the operations at the SEAD OB/OD area, provide information on the lifetime cancer risk from exposure to the lead and PM_{10} emissions from the OB/OD operations. The results of this analysis should be compared with applicable standards and EPA health-based criteria. Provide all supporting data and calculations.

Response #47 *Resolved. Refer to Section D-8d(3)(f).*

D-8d(3)(a)(7) Potential for Damage to Domestic Animals, Wildlife, Crops, Vegetation, and Physical Structures Caused by Exposure to Waste Constituents.

Comment #48 Provide information concerning the potential damage to domestic animals, wildlife, crops, vegetation, and physical structures from the OB/OD operations at the SEAD. Provide supporting information and calculations for this information.

Response #48 *Resolved. Refer to Section D-8d(3)(f).*

D-8d(3)(a)(8) Potential Magnitude and Nature of Exposures to Humans or Environmental Receptors to Hazardous Waste or Hazardous Constituents

Comment #49 Provide EPA and State certification for the use of the ISC model for this analysis.

Response #49 *Resolved. The USEPA Guideline On Air Quality Models (Revised) identifies air quality models and modeling techniques which USEPA considers acceptable for use for regulatory applications. Specific models are identified as preferred and recommended for use for particular modeling situations.*

The ISC model is identified by USEPA in the Guideline On Air Quality Models as the preferred model for assessing impacts from complicated sources in simple terrain. Complicated sources include area and volume sources. The emissions from OB/OD activities at SEAD are modeled as area and volume sources. (See also the letter from Andrew Bellina, Chief Hazardous Waste Facilities Branch to Randall Battaglia, dated March 19, 1992 - Appendix 6.)

Comment #50 EPA has approved ~~the use of an exponential~~ function to correct or convert impact concentrations from one time frame, such as a one-hour concentration, to another time frame, such as an annual average concentration. Provide justification for the use of the linear correction factors utilized in this analysis and described on pages 5 and 6 of section D.8.4.4.1.4of Appendix VII.

Response #50 ***Resolved.*** *The exponential function mentioned in Comment #50 is not referenced or identified clearly. An exponential function for relating concentrations for different averaging periods is provided in the "Workbook of Atmospheric Dispersion Estimates" (Bruce Turner, USEPA, 1970) and is referenced in other USEPA documents.*

This exponential relationship applies to concentrations monitored from individual continuous sources. Since the OB/OD emissions at SEAD are intermittent and not continuous, this relationship is inappropriate for use.

The rationale for the "linear" correction factors used in the analysis is described in section D.8.4.4.1.4. The approach recognizes that the OB/OD activities at SEAD do not represent a continuous source of emissions; rather, they are short-term, intermittent events. The approach accounts to some extent for the short-term or instantaneous nature of these activities.

The modeling approach employed in Appendix VII is conservative in that it overestimates the duration and the amount of emissions associated with these events by assuming that they persist for a full hour at the short-term rate characteristic of the actual emission period. Therefore, the 1-hour concentrations have been scaled to reflect only the portion of the hour during which emissions actually occur. Similarly, the annual concentrations yielded by the model have been scaled to reflect impacts only for the number of hours for which OB/OD emissions occur. This approach assumes that the predicted concentrations apply during the period of OB/OD emissions and that impacts from OB/OD emissions are zero for the fraction of the averaging period for which there are no emissions from OB/OD activities.

Comment #51 The reference to Scenario 6 in the last paragraph of page 2 in Section D.8.4.4.2 should be a reference to Scenario 5 if the information in Table D.8.4.4-1 is being discussed.

Response #51 ***Resolved.*** The text has been revised accordingly.

Comment #52 The impact analysis performed for the OB/OD operations at the SEAD should include the use of 3 to 5 years of meteorological data. It appears that only one year of data was used in the analysis presented.

Response #52 ***Resolved.*** *The modeling used a 1-year set of hourly meteorological data based on observations from Geneva Air Force Base and from Rome, New York. This was the most representative and complete data set available for the area near SEAD. Incorporating additional years of meteorological data in the analysis would require the* *use of data less representative of the area near SEAD. This would be counterproductive. Although USEPA prefers the use of five years of representative meteorological data when estimating concentrations with an air quality model, language in the USEPA Guideline On Air Quality Models makes it clear that the use of five years of NWS data is required only if the source is large (e.g., a 500 MW power plant). The main purpose of using multiple years of meteorological data is to increase the likelihood that "worst-case" meteorological conditions will be represented in the data base and in the model results. Experience has shown that predictions of maximum short-term concentrations using multiple years of meteorological data typically vary by less than a factor of two. The interannual variability in model results decreases as averaging time is increased.*

Comment #53 Provide information and supporting data on the non-inhalation pathways for air emissions from the OB/OD operations at the SEAD.

Response #53 ***Resolved.*** Refer to Section D-8d(3)(f).

Noise Considerations

Because the open detonation of explosives in structures similar to that employed at the SEAD facility are frequently initiated with accompanying high noise levels, the application should address the following elements related to noise:

Comment #54 Estimate the distance from the OD area to the nearest off-site buildings and population.

Response #54 ***Resolved.*** *See Figure D-20 located in Section D-8d(3)(a).*

Comment #55 Provide information on the maximum air blast pressure measurements from OD operations at the SEAD facility at distances up to the nearest off-site buildings. Provide sufficient supporting information concerning these maximum pressure measurements.

Response #55 ***Resolved.*** *See Response #57.*

Comment #56 Provide information on a method to determine the maximum ground vibration from SEAD OD operations.

Response #56 ***Resolved.*** *See Response #57.*

Comment #57	Propose a minimum protective distance to provide for the protection of human health and the environment from noise generated by OD operations at SEAD.
Response #57	***Resolved.*** *A study to evaluate the effects of noise associated with open detonation is currently bieng conducted at SEAD. This study should be completed in the next 6 to 9 months at which time the results will be made available to the EPA.* *While incomplete, siginficant data has been obtained. Included in this submittal is a noise contour map which is located in section D-9. Also included in Appendix 9 is AR 200-1 which describes the Army's Environmental Noise Abatement Program. Note that this program does not specifically address the issue of air blast pressure or ground vibrations. However, complaints from these phenona would be addressed as if they were noise complaints under AR 200-1 Chapter 7-3 "Noise Complaints".*

E. GROUNDWATER MONITORING

E-1 Exemption from Groundwater Protection Requirements: 270.14(c)

Comment #58 The facility is not exempt from groundwater protection requirements.

Response #58 ***Resolved.*** *See Response to Comment #39.*

E-2 Interim Status Groundwater Monitoring Data: 270.14(c)(1), 265.90 to 265.94

E-2a Description of Wells: 265.91

Comment 59 Hazardous constituents have been detected in monitoring wells that the facility is sampling under an agreement with the New York DEC. Describe this program and clarify its purpose. The applicability and results of this sampling effort will define the type of monitoring program to be implemented in the future. Provide a summary of the groundwater monitoring data obtained during the interim status period, including:

- A copy of the topographic map provided for Section 270.14(b) on which the location and identification of each interim status monitoring well is indicated;
- An indication of which wells are downgradient of the disposal area, and which are upgradient; and
- Details of the design and construction of each interim status monitoring well (e.g., screen and casing depths, water levels at time of drilling, any water level changes within 24 hours, filter pack and sealing materials placement, dates of construction, boring logs, etc.).

Response #59 ***Resolved.*** *This information is included in Section E.*

E-2b Description of Existing Sampling/Analysis Procedures.

Comment #60 A copy of the facility's groundwater sampling and analysis plan (required under §265.92(a), that includes the procedures used and the protocol followed in:

- Sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain of custody control

Response #60 ***Resolved.*** *A copy of the Sampling and Analysis Plan is included in Appendix 5F.*

E-2c **Monitoring Data: 265.92**

Comment #61 Provide all interim status monitoring results, including the following:

- Copies of each quarterly (from first year) analytical results for each well;
- Copies of subsequent (annual or semi-annual) analytical results for each well;
- Copies of any notification of significant change in analysis parameters made to the Regional Administrator (or State Director) pursuant to 265.93;
- Results of groundwater surface elevation measurements for each sampling event; and
- Calculations of the initial background arithmetic mean and variance for each indicator parameter based on replicated measurements from upgradient wells during the first year.

Response #61 ***Resolved.*** *A summary of groundwater elevation measurements and analysis results are included in Appendix 5B. The initial background arithmetic mean and variance values for each indicator parameter are presented in Table E-2. Refer to Section E-2c for details of the sampling and analysis program.*

E-2d **Statistical Procedures: 265:93**

Comment #62 Provide information relating to statistical procedures used to interpret the data collected including the following:

- A description of the statistical procedures used (if applicable) in processing the data submitted (as in the use of a Student t-test and the level of significance used); and
- Results of statistical comparisons between upgradient and downgradient well sampling results and first year background values for each indicator parameter.

Response #62 ***Resolved.*** *A description of the statistical analysis procedure used and the results of the analysis are discussed in Section E-2d.*

E-2e **Existing Groundwater Assessment Plan: 265.93(d)(2)**

Comment #63 If required, based on statistical results, provide the specific plan for a groundwater quality assessment program along with results obtained from implementation of the plan. When required, include results of the following determinations made under the groundwater quality assessment (considering at a minimum, the hazardous constituents listed in Appendix VIII to 40 CFR Part 261).

- Whether hazardous waste or hazardous constituents have entered the groundwater;
- The rate and extent of migration of hazardous waste or hazardous waste constituents in the groundwater; and
- The concentration of hazardous waste or hazardous waste constituents in the groundwater.

Response #63 ***Resolved.*** *The changes in the groundwater monitoring program implemented as a result of a statistically significant increase at the downgradient wells as compared to background well, are discussed in Section E-2e.*

E-3 **General Hydrogeologic Information: 270.14(c)(2)**

Comment #64 Identify the uppermost aquifer and any hydraulically interconnected underlying aquifers (i.e., all likely subsurfaces flow paths for hazardous constituents which may leak from the facility), and describe their hydrogeologic properties (e.g., hydraulic gradient, groundwater flow, rate and direction), provide the supporting data to identify this information (i.e., the information obtained from hydrogeologic investigations of the facility area). This identification must include a report written by a qualified hydrogeologist on the hydrogeologic characteristics of the facility property supported by at least the drilling logo of on-site borings and wells and the available professional literature. Include description of the regional geologic and hydrogeologic setting. In addition, include the following site-specific data:

- An analysis of topographic or geomorphic features that might influence the groundwater flow system;
- A classification and description of the hydrogeologic properties (hydraulic conductivity, porosity, texture, thickness, etc.) of all of the hydrogeologic units found at the site (i.e., the aquifers and any intervening saturated and unsaturated units);

- Using the §270.14(b)(19) topographic map as a base, isopach and structural contour maps and a geologic cross section showing the extent of the hydrologic units contained in the uppermost aquifer, and any intervening aquitards or other units within the facility boundary; and
- A description of the field methods used in the study, and a summary of which data were collected by each method.

Response #64 ***Resolved.*** *Refer to Section E-3 and Section D-8d.*

E-4 **<u>Topographic Map Requirements</u>: 270.14(c)(2),(3),(4)(i)**

Comment #65 Provide the following information on the topographic map:

- Groundwater flow direction and rate (isometric graph);
- Point of compliance;
- Groundwater monitoring wells;
- The extent of any plume (horizontal and vertical);
- Hazardous waste management areas; and
- Property boundary.

The following required information may be incorporated into the topographic map if possible, or at least should be discussed in the text:

- Boundaries of uppermost aquifer; and
- Underlying interconnection between uppermost aquifer and lower aquifer.

(Although many of these items can be shown on a single map, it is allowable to use additional maps to display some of the information. Presentation of all of this information on a single map may sacrifice clarity.)

Response #65 ***Resolved.*** *Refer to Section E-4.*

E-5 **<u>Contaminant Plume Description</u>: 270.14(c)(2),(4), and (7)(ii); Part 261, Appendix VIII**

Comment #66 Provide a description of any plume of contamination that has entered the groundwater from the open burning/open detonation units:

- Delineates the extent of the plume on the topographic map of §270.14(b)(19);
- Identifies the concentration of each constituent listed in Appendix VIII of Part 261 throughout the plume or identifies the maximum concentrations of each Appendix VIII constituents in the plume; and
- Delineates the vertical extent of the plume in cross section.

This requirement is applicable to all existing facilities where interim status monitoring shows the presence of hazardous constituents downgradient from the regulated units, unless it can be proven that such constituents are coming from another source. In addition, this requirement may be applied to other existing facilities where interim status monitoring data are non-existent or deficient if these facilities are suspected of contaminating groundwater.

Response #66 ***Resolved.*** *Groundwater monitoring data does not point to the presence of a groundwater plume.*

E-6 **General Monitoring Program Requirements: 270.14(c)(5), 264.97, 264.90 (b)(4)**

Comment #67 Provide detailed plans and an engineering report describing the proposed groundwater monitoring program to meet the general groundwater monitoring requirement. The following information is required:

- Number of wells;
- Location;
- Depths;
- Materials of construction (casing, screens, etc.);
- Assurance of unaffected background groundwater measurement; and
- Assurance of compliance point groundwater measurement.

Response #67 ***Resolved.*** *Refer to Section E-6.*

E-6b Description of Sampling/Analysis Procedures: 264.97(d), (e), (f)

Comment #68

- Sample collection methods;
- Sample preservation/shipment;
- Analytical procedures;
- Chain-of-custody control;
- Documentation of proper sampling and analysis procedures; and
- Procedure for determining of groundwater elevation with each sample.

Response #68 ***Resolved.*** *Refer to Section E-6b.*

E-6c Procedures for Establishing Background Quality: 264.97(a)(1)(g)

Comment #69

- Groundwater samples must be representative of background quality not affected by releases from the regulated unit;
- Background water quality must be established from each monitoring parameter or constituent; and
- Procedures for establishing background quality may include wells not hydraulically upgradient of the waste management area where:
  - upgradient cannot be determined due to hydrogeologic conditions; and
  - other wells provide background groundwater quality that is representative of background than upgradient wells.

Response #69 ***Resolved.*** *Refer to Section E-6c.*

E-6d Statistical Procedures: 264.97(h); (i)1(1), (5), and (6)

Comment #70 Provide a description of the statistical procedures that will be used in evaluating groundwater monitoring data. The description provided must demonstrate compliance with the following performance standards:

- Method should be appropriate for distribution of chemical parameters or hazardous constituents. More than one method may be needed if distributions differ;

- Method must account for data below the detection limit;

- Any practical quantification limit (PQL) used in the method shall be the lowest concentration level within levels of precision and accuracy for routine lab operations; and

- Method shall include procedures to control or correct for seasonal and spatial variability and temporal correlation in data.

The following statistical methods [E-6d(1) - (5)] have been approved by EPA for use in evaluating groundwater monitoring data for each hazardous constituent.

E-6d(1) **<u>Parametric Analysis of Variance (ANOVA)</u>: 264.97(h)(1), (i)(2)**

ANOVA followed by multiple comparisons procedures:

- Include estimation and testing of contrasts between each compliance well's <u>mean</u> and the background <u>mean</u> levels for each constituent; and

- If using individual well comparison procedure, Type 1 error level of no less than 0.01 shall be maintained. If using multiple comparison procedure, Type 1 error level no less than 0.05 for each testing period must be used.

E-6d(2) **<u>Non-parametric ANOVA (based on Ranks)</u>: 264.97(h), (i)(2)**

ANOVA based on Ranks followed by multiple comparison procedures:

- Estimation and testing of compliance well's <u>median</u> and background <u>median</u> levels for each constituent; and
- If using individual well comparison procedures, Type 1 error of no less than 0.01 shall be maintained. If using multiple comparison procedure, Type 1 error level no less than 0.05 for each testing period must be used.

E-6d(3) **<u>Tolerance or Prediction Interval Procedure</u>: 264.97(h)(3), (i) (4)**

- Establish interval for each constituent based on distribution of background data;

- Compare level for each constituent in each compliance well to the upper tolerance or prediction limit, and

- Prepare levels of confidence and/or percentage of the population that the interval must contain considering number of samples in the background data base, data distribution, and range of concentration values for each constituent of concern.

E-6d(4) <u>Control Chart Approach</u>: 264.97(h)(4), (i) (4)

- Control limits for each constituent; and
- Specify type of control chart and associated parameter values.

E-6d(5) <u>Alternative Approach</u>: 264.97(h)(5), (i)

An alternative approach can be proposed with compliance with all performance standards set in 264.97(i).

Response #70 ***Resolved.*** *Refer to Section E-6d.*

E-7 <u>Detection Monitoring Program</u>: 270.14(c)(6), 264.91(a)(4), 264.98

Comment #71 Provide sufficient information, supporting data, and analyses documenting the absence of hazardous constituents in the groundwater to support the implementation of a detection monitoring program at this time. If such a demonstration can be made, provide all of the details required by 264.98 on the proposed detection monitoring program.

Response #71 ***Resolved.*** *Refer to Section E-7.*

E-8 <u>Compliance Monitoring Program</u>: 270.14(c)(7), 264.99

Comment #72 If the presence of hazardous constituents has been detected in the groundwater at the point of compliance, a compliance monitoring program must be implemented. Provide all of the details required by 264.99 on the proposed compliance monitoring program.

Response #72 ***Resolved.*** *Refer to Section E-7.*

F. PROCEDURES TO PREVENT HAZARDS

F-4 Preventive Procedures, Structures, and Equipment: 270.14(b)(8)

F-4c Water Supplies: 270.14(b)(8) (iii)

Comment #73 The application states that the U.S. Army Environmental Hygiene Agency (USAEHA) postulates that detonation of waste explosives do not pose a significant threat to water supplies; however, more detail is required to support this claim. Describe how USAEHA has formulated this conclusion on a site specific basis. Otherwise, identify the procedures, structures or equipment used to prevent contamination of water supplies.

Response #73 ***Resolved.*** *In regarding to the OD grounds, a groundwater quality monitoring program and a surface water sampling program will be instituted in accordance with Section D. The OB grounds includes a double contained structure (a burning platform and a concrete pad) as well as a stainless steel cover. These structures are designed to prevent the contamination of groundwater. This coupled with restrictions in use of these facilities during periods of precipitation will prevent the contamination of water supplies.*

Section F-4C has been revised to include this information.

G. CONTINGENCY PLANS

G-2 Emergency Coordinators: 264.52(d), 264.55

Comment #74 The permit application identifies emergency coordinators and their office and home telephone numbers; however, more detailed information is needed. Provide addresses for each emergency coordinator, and identify the duties of primary and alternate coordinators.

Response #74 ***Resolved.*** *See Table G-1 located in Section G.*

G-4 Emergency Actions: 264.56

G-4a Notification: 264.56(a)

Comment #75 Identify the home phone numbers of Installation Response Team Members Brenda Moskal and Shirley Kaufman.

Response #75 ***Resolved.*** *See table G-3 located in Section G. Missing phone numbers cannot be included due to employee privacy considerations.*

G-4c Assessment: 264.56(c), 264.56(d)

Comment #76 The application states that the assessment of a release, fire or explosion will consider both direct and indirect effects in accordance with the 1984 Department of Transportation (DOT) Guidebook; however, the application itself must list the criterion used to assess these direct of indirect effects.

Response #76 ***Resolved.*** *See Section G-4.3. The 1984 DOT Guidebook will be used by the emergency coordinator to:*

1. *Identify the material(s) involved*
2. *Find the potential hazards associated with the material(s)*
3. *Initiate emergency action called for in the guidebook*

This guidebook does not list the criteria upon which it bases its guidance, nonetheless, SEAD utilizes it to assess and respond to emergencies such as a release, fire or explosion. In MAIN's opinion this meets the requirements of §264.56(c and d).

G-4f Storage and Treatment of Released Material: 264.56(g)

Comment #77 Provide information on the disposition of recovered wastes from a fire, explosion of release specific to OB/OD operations. Identify whether these wastes will be treated, stored or disposed.

Response #77 ***Resolved.*** *See Section G-4.6.*

G-4g Incompatible Waste: 264.56(h)(1)

Comment #78 Describe procedures for preventing incompatible wastes from being treated, stored or located in the affected area until clean-up procedures are completed.

Response #78 ***Resolved.*** *See Section G-4.7.*

G-4h Post-Emergency Equipment Maintenance: 264.56(h)(2)

Comment #79 Provide procedures for ensuring that all emergency equipment listed in the contingency plan is cleaned and fit for its intended use before operations continue.

Response #79 ***Resolved.*** *See Section 4.9.*

G-6 Coordination Agreements: 264.52(c), 264.37

Comment #80 The permit application states that agreements with local authorities are not required because the Depot is equipped to handle all emergency situations; however, more detail is needed to assess whether Depot response teams are familiar with the types of emergencies which may arise. Provide details pertaining to the arrangements which have been made with the various Depot operating sections (security, fire department, FED or Ammunition Division) pertaining to the layout of the facility, properties of hazardous wastes managed at the Depot and the associated hazards, places where the facility personnel are normally working, and possible evacuation routes. Identify the type of training or expertise each of the emergency operating sections possess pertaining to the hazardous emergencies which may arise. Also, provide information on arrangements made to familiarize local hospitals with the properties of hazardous wastes handled by the facility and the types of illness/injury which may result from release, fire, or explosion at the facility.

Response #80 ***Partially resolved.*** *SEAD to provide training program details, training recordkeeping procedures, and to describe hospital arrangements in a future submittal.*

G-7	**Evacuation Plan: 264.52(f)**
Comment #81	Identify the specific signals for evacuation and reentry or how they differ.
Response #81	***Unresolved. These signals will be identified in a future submittal.***

H. **PERSONNEL TRAINING: 270.14(b)(12), 264.16**

H-1 **Outline of the training Program: 254.16(a)(1)**

H-1c **Training Director: 264.16(a)(2)**

Comment #82 The permit application identifies that the training coordinator has received training through numerous training sessions. However, the facility must provide a list of the specific training courses relevant to hazardous waste management procedures taken by the training coordinator.

Response #82 ***Resolved.*** *See Table H-3*

H-1d **Relevance of Training to Job Position: 264.16(a)(2)**

Comment #83 Demonstrate that trained facility personnel are instructed in hazardous waste management practices relevant to their job positions.

Response #83 ***Unresolved.*** *SEAD will provide this information in a future submittal.*

H-2 **Implementation of Training Program: 264.16(b), (d)(4) and (e)**

Comment #84 Identify the location where training records are maintained on-site.

Response #84 ***Unresolved.*** *SEAD will provide this information in a future submittal.*

I. CLOSURE PLANS, POST CLOSURE PLANS, AND FINANCIAL REQUIREMENTS

I-1 Closure Plans: 270.14(b)(13), 264.112(a)(1) and (2)

Comment #85 Include a copy of a written closure plan consistent with I-1a through I-1g as applicable. The plan must include a description of how each hazardous was management unit will be closed and a description of how final facility closure will be conducted. Describe the maximum extent of operations which will be left unclosed during the active life of the facility.

Response #85 ***Resolved.*** Refer to Section I.

1-1d(1)(a) Extension for Closure Time: 264.113(a) and (b)

Comment #86 Demonstrate that all steps have and will be taken to prevent threats to human health and environment from the unclosed but inactive facility.

Response #86 ***Resolved.*** Refer to Section I.

I-1e Closure Procedures; 264.12, 264.114

Comment #87 See comments I-1e(1) to I-1e(2).

Response #87 ***Resolved.*** Refer to Section I.

I-1e(1) Inventory Removal: 264.112(b)(3)

Comment #88 Discuss the methods for storing removed hazardous waste prior to being shipped off-site. Also identify the types of hazardous waste management units to be used for all wastes removed. This includes contaminated soil as well as contaminated rinse water.

Response #88 ***Resolved.*** Refer to Section I.

I-1e(2) Disposal or Decontamination of Equipment, Structures, and Soils: 264.112(b)(4), 264.114.

Comment #89 Provide clear and detailed information on the criteria used to determine when the trays are considered to be decontaminated. It appears that the trays are considered to be decontaminated when the water used to rinse them is not contaminated.

Provide a justification for this assumption. Also provide a description of the procedures that will be used to decontaminate equipment and materials used in the closure process.

Response #89 ***Resolved.*** Refer to Section I.

I-2 **<u>Post-Closure Plan/Contingent Post-Closure</u>**

I-2g **<u>Post-Closure Contact</u>: 264.118(b)(3)**

Comment #90 Provide the name, address, and phone number of the person or office to contact about the hazardous waste disposal unit or facility during the post-closure care period.

Response #90 ***Resolved.*** Refer to Section I.

J. CORRECTIVE ACTION FOR SOLID WASTE MANAGEMENT UNITS

J-1 Solid Waste Management Units: 264.101

Comment #91 Identify all solid waste management units at the facility including inactive units (i.e., former burning pads), if known.

Response #91 ***Resolved.*** *Section K has been revised to include a brief synopsis of the SWMU/AOC status. (see also Appendix 7). This section also refers to documents which provide more detailed information including the SEAD RI/FS workplan; MAIN, 1991).*

J-1a Characterize the Solid Waste Management Unit

Comment #92 Characterize each solid waste management unit as to the type of unit, location, engineering designs/drawings, dimensions, materials of construction, operational dates, and waste type and quantify of waste managed.

Response #92 ***Resolved.*** *See the response to Comment #91.*

J-1b No Solid Waste Management Units

Comment #93 Provide a methodology used to determine that the facility has no existing or former solid waste management units.

Response #93 ***Resolved.*** *See the response to Comment #91.*

J-2 Releases

Comment #94 Provide any an all information available to identify releases from each solid waste management unit. A release can include: spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, or dumping into the environment. It does not include releases otherwise permitted or authorized under law or discharges into the injection zone of a UIC permitted Class I injection well.

Response #94 ***Resolved.*** *See the response to Comment #91.*

J-2a Characterize Releases

Comment #95 For each release at each solid waste management unit, provide information including: date of release, types of wastes released, nature of the release, volume of release, groundwater monitoring information, physical evidence of distressed vegetation or soil contamination, historical evidence of releases, any state, local, or federal enforcement actions, any public citizen complaints, and any information showing migration of the release.

Response #95 ***Resolved.*** *See the response to Comment #91. (See also Section D).*

J-2b **No Releases**

Comment #96 Provide the methodology used to determine that releases from solid waste management units are not present (e.g., review of groundwater monitoring data).

Response #96 ***Resolved.*** *See the response to Comment #91.*

K. <u>OTHER FEDERAL LAWS:</u> 270.14(B)(20), 270.3

Comment #97 Identify how the facility has achieved compliance with the requirements of applicable Federal laws such as the Wild and Scenic Rivers Act, National Historic Preservation Act of 1966, Endangered Species Act, Coastal Zone Management Act, and Fish and Wildlife Coordination Act.

Response #97 ***Resolved.*** *See the revised Section J.*

L. PART B CERTIFICATION: 270.11

Comment #98 The RCRA Part B Application for Subpart X units certification must be signed by the appropriate ranking official.

Response #98 ***Unresolved.*** *SEAD must provide complete certification form.*

SENECA ARMY DEPOT
Romulus, New York
EPA I.D. No. NY0213820830

SPECIFIC COMMENTS
RCRA PART B NOD RESPONSE REVIEW

B-2a	General Requirements:	270.14(b)(19)
Comment #1:	Provide a date on the topographic map of the OB/OD area located in Section B, Figure B-2.	
Response #1:	Resolved. Figure B-2 has been replaced and a date added.	
Comment #2:	Correct the wind rose reference on page B-4. The wind rose is in section D, Figure D-19, not Figure D-17. Also, indicate whether the wind rose is based on seasonal or annual data.	
Response #2:	Resolved. The Wind Rose in Figure D-19. The text has been changed to note the Rose is based upon annual data.	
Comment #3:	Only one water supply well is shown within the SEAD property, in Figure B-5. If that is the only such well within the property boundary, so state in the text or give the number of water supply wells on the property.	
Response #3:	Resolved. The text has been modified in Section B to clarify the number of wells on SEAD property.	
C-1	Chemical and Physical Analysis:	270.14(b)(2), 264.13(a)
Comment #4:	Provide a description of the waste ash/residue generated at the OB/OD facility. This description must include information on hazard characteristics and the basis for hazard designation. Also provide a recent laboratory report detailing the chemical and physical analyses of representative samples of the ash material. The revised application and NOD response (Response #7) describe procedures for testing waste ash/residue, but do not provide representative data. This information must be provided in order to fully assess environmental risks.	
Response #4:	Resolved. A description of the Ash/Residue handling procedures has been included. The text also indicates that Ash/Residue will be tested in October, 1992.	

D-8d(2) Protection of Surface Water, Wetlands, and Soil Surface: 264.601(b), 270.23 (b) and (c)

D-8d(2)(b) Performance Standards: 264.601

Comment #5: Flow characteristics for the Reeder Creek are not adequately described in Section B-2m(3). Provide seasonal variation in flows or storm flow estimates. Provide further discussion of vegetation and sediments in the creek and the relation between the stream and local shallow subsurface water.

Response #5: Resolved. Section D-8d(2)(b) has been modified to include additional description information on the seasonal flow characteristics, and physical description of Reeder Creek.

Comment #6: The application asserts that the OB and OD grounds are undergoing RCRA Corrective Action and CERCLA investigations, and that the resulting reports issued to EPA will discuss sampling methodology, selection of parameters for analysis, and the origin of PEP and heavy metals at the site. Provide a date by which the report will be submitted.

Response #6: Resolved. Section D-8d(2)(d) has been modified to add a reference to the Preliminary Site Characterization Report (PSCR) issued by MAIN (April, 1992).

D-8d(3)(a)(8) Noise

Comment #7: Provide a date by which the report on the AEHA noise survey will be submitted. This report must contain a description of the methodologies used and quantitative data on the maximum noise levels, air blast levels, and ground vibration levels found together with the location of such maxima.

Response #7: Resolved. A draft copy of the AEHA noise survey at SEAD has been issued. Section D-8d(3)(a)(8) has been modified to include the pertinent results of that study. The final version of the report is expected in October, 1992 and will be forwarded to EPA under seperate cover.

E-1 Exemption from Groundwater Protection Requirements: 270.14(c)

Comment #8: 40 CFR 264.90(b) sets forth conditions for an exemption from groundwater monitoring requirements for land-based units. However, the application fails to show that there will be no migration of waste or waste constituents from the OB unit. Although Figure D-1 shows concrete tray supports which elevate the burning tray, the design of the slab does not appear to provide adequate containment. There are no berms associated with the concrete slab. Therefore, since there is potential for surface water and groundwater contamination downstream of the OB site, a groundwater monitoring program for the OB site must be implemented.

Include in this application a detailed proposal for a groundwater monitoring system capable of detecting migration of wastes from the OB unit. Include a description of:

- Number, location and depth of upgradient and downgradient wells;
- Well construction materials;
- Indicator parameters to be monitored;
- Proposed sampling and analysis procedures;
- Procedures for establishing background quality; and
- Statistical procedures to be used in evaluating groundwater monitoring data.

Response #8: As a result of further discussions with EPA and A.T. Kerney, EPA's consultant, ES and SEAD have clarified several aspects of the OB operations pertaining to groundwater monitoring exemption. These aspects include the following:

1. The current burn tray is located at the former open burning pads. The operation of open burning on the pads has been discontinued and is currently under a CERCLA investigation. Thirty-three (33) groundwater monitoring wells have been installed at this facility and long term monitoring will be performed under CERCLA. It will be difficult if not impossible toi seperate current open burning operational impacts from former operational impacts.

2. The current environmental operational requirements for open burning restricts burning during the possibility (>50%), of an impending rain event, see Appendix 4 Page 22 and B-1.

3. The burning iperation is a dry operation. No liquids are burned in the tray, and therefore no release of liquids can occur. The only liquid release to groundwater would be as a result of ash/residue leaching from interaction with precipitation. The possibility of this occurring is remote since burning is not performed during a possible rainstorm event, nontheless, it is still possible that a rain event could occur following a burn SEAD requires a cool down period, normally 2-3 hours following a burn when, if it rained it would be possible for the rain to interact with the ash. Any ash in the tray would be prevented from leaching by placing the cover over the tray. Any ash which may exist on the concrete pad will be HEPA vacummed immediately when safe to approach. SEAD has issued a memorandum outlining modifications to the SOP's to address this issue, see Appendix 4, Appendix C.

E-2c <u>Monitoring Data</u>: 265.92

Comment #9: Appendix 5B does not provide the results of groundwater surface elevation measurements for each sampling event, as implied in response #61 to comment #61 of the previous NOD. Provide this data.

Response #9: Resolved. Appendix 5B has been modified to include updated water level information.

E-2d Statistical Procedures 265.93

Comment #10: In section E-2d it is stated that a statistically significant increase in TOC and TOX, above the first year background, was noted. A groundwater assessment plan implemented (E-2e) detected none of the explosives analyzed at any of the monitoring wells; however, it is not proven that the elevated TOC and TOX came from another source. Provide details of the groundwater assessment implemented and show how the conclusion in E-2e is reached. Discuss also the possible explanations of the high values shown in the background well.

Response #10: The source of the statistically significant increase of TOC in Aug. 1983 and TOX in Feb. 1984 is unknown but ES believes that it is not related to OD operations. This conclusion is based upon the groundwater monitoring data collected in response to the observed increases. In June 1984, as a result of the increases, SEAD increased the monitoring parameters and began analyzing groundwater for explosives in addition to the normal quarterly monitoring constituents. Although the detection limits varied slightly for each explosive, the detection limits were in the part-per-billion range, see Appendix 5, which would have been sensitive enough to identify the component which was responsible for the observed increase. This monitoring program has been on-going since 1984 and has not detected the presence of explosives in any of the wells during these subsequent sampling rounds. Since the only organic materials treated at this site are high explosives, it is reasonable to conclude that there has not been a release at this facility as a result of open detonation activities.

During the statistical analysis ES compared the TOX and TOC concentration of the upgradient well MW-4 from the baseline monitoring period, 1982, with the TOX concentration of the same well, MW-4, from Aug. 1983 and Feb. 1984, in order to determine if the upgradient concentration had possibly changed. In both cases, Aug. 1983 and Feb. 1984, the statistical analysis indicated that at the upgradient well location the concentrations were different at the 99% confidence level, suggesting a possible upgradient release had occurred. The possibility of an upgradient source responsible for this increase has been considered. As would be expected with an operation which detonates explosives, the OD ground is located in a remote section of the SEAD facility. No other buildings or operations which could be a possible upgradient sources of the increased TOC or TOX concentrations exist within 2500 feet of this area. Further, MW-4, the upgradient well for the OD area, is located at or near the highest surface elevation point between Reeder Creek to the east and Seneca Lake to the west. Accordingly, ES expects that a groundwater divide should exist at the highest ground elevation, since the groundwater aquifer in the till is pheratic. The distance between MW-4 and the groundwater divide is not accurately known since no well exists upgradient of MW-4. However, based upon the most recent contour topographic map,

the upgradient area between MW-4 and the groundwater divide is approximately 100 to 200 feet. Since no known source exists in this upgradient area, it is unlikely that the increases in concentration during these sampling rounds were due to an upgradient release.

Finally, since groundwater velocity is slow, ranging between 25 and 60 feet per year, the presence of a groundwater plume should be measured during several sampling rounds. Since the concentration of both TOX and TOC decreased dramatically following these observed increases and has not reappeared it is unlikely that a release has occurred since subsequent quarterly sampling has failed to confirm the presence of a plume which, based upon the groundwater velocity, should be present for many years following a release.

Since the concentrations of TOX and TOC decrease dramatically in Sept. 1984 and in the case of TOX, were not detected during all of 1985, 1986 and 1987 it appears that the one-time increases in groundwater concentrations are not related to the operations at this facility. ES believes that the increases are likely laboratory or sampling related. Contamination, either during sampling, shipment or improperly operating laboratory equipment are probably responsible for the observed increases.

F-3a(3) Emergency Equipment: 264.32(c)

Comment #11: Correct the reference to the list of equipment, inspection frequency and types of problems. This list is located in Section F, Table F-2, not Table F-1 as indicated on page F-9.

Response #11: Resolved. The correct reference is Table F-2.

G-4 Emergency Actions: 264.56

Comment #12: Fill in the blanks left in the application with the appropriate information in the following sections: G-4d, page G-13 (evacuation signal blasts); G-4f, page G-21 (volume and location); G-4h, page G-26 (alarm signals).

Response #12: Resolved. The blanks on pages G-13, G-21, and G-26 have been filled in.

G-4c Assessment: 264.56(c), 264.56(d)

Comment #13: Provide a copy of the 1984 U.S. Department of Transportation (DOT) Hazardous Response Guidebook or provide a synopsis of the steps outlined in this guidance for conducting assessment of potential hazards to human health or the environment as a result of a fire, explosion or release.

Response #13: Resolved. The citation in Section G-4c, page G-12 has been changed to the 1990 U.S. Department of Transportation (DOT) Emergency Response Guidebook.

G-5 Emergency Equipment: 264.52(e)

Comment #14: Correct the reference to the list of emergency equipment available for containing and cleaning spills. This list is located in Section G, Table G-6, not Table G-5 as indicated on page G-26.

Response #14: Resolved. The correct reference is Table G-6.

G-6 Coordination Agreements: 264.52(c), 264.37

Comment #15: SEAD asserts that, in their situation, the specially trained internal emergency response units make external coordination agreements unnecessary. Although these units do have more expertise and capability in handling explosives than an external unit is likely to have, coordination agreements must be entered into with external medical, fire and police departments. These entities must be familiarized with facility operations, hazards, and emergency scenarios so they are equipped to adequately respond to incidents for which additional support is necessary and to ensure the needs of the surrounding community are addressed. SEAD would have the lead in such emergency situations, and would have the prerogative whether or not to ask for the assistance is requested, SEAD would direct the response.

Response #15: Resolved. SEAD has provided additional information in Section G-6, page G-27 on the types of coordination agreements in place and the emergency response exercises that SEAD and an external authorities have participated in.

G-7 Evacuation Plan: 264.52(f)

Comment #16: In Appendix 8 of the application, it is indicated that the specific signals for evacuation and re-entry will be identified in a future submittal. Provide the date when SEAD plans to identify the specific evacuation and reentry signals.

Response #16: Resolved. The specific evacuation and re-entry signals are described in Section G-4d, page G-13.

H-1b Training Content, Frequency, and Technologies: 264.16(c) and (d)(3)

Comment #17: It is necessary for all hazardous waste handlers to receive an 8-hour training update annually. The statement on page H-13 that NYC 373.22(h) does not require such training appears to be inaccurate. Describe how this requirement for update training will be implemented.

Response #17: Resolved. Section H-2, page H-13 has been clarified to indicate that Hazardous Waste personnel will receive an 8 hour Hazardous Waste refresher course pursuant to 40 CFR 264.

I-1d Schedule for Closure: 264.112(b)(6)

Comment #18: Correct the reference on page I-6 from Figure I-1 to Section I-1 or provide Figure I-1.

Response #18: Resolved. The reference has been changed to Section I-1.

I-2g Post-Closure Contact: 264.118(b)(3)

Comment #19: Provide the name, address and phone number of the individual who will act as the facility contact during the post-closure care period.

Response #19: Resolved. The name, address and phase number of the post-closure facility contact has been provided in Section I-2.

J-1a Characterize the Solid Waste Management Unit

Comment #20: Provide the date by which the quantity of waste managed at each of the solid waste management units (SWMU) will be submitted.

This data is to be derived from the on-going RCRA Corrective Action Program.

Response #20: Resolved. Table J-1 has been modified to identify the dates by which Site Investigations or Final Rod's will be issued for many of the SWMU's.

J-2a Characterize Releases

Comment #21: Provide a data by which the following release characterization information for each of the SWMUs will be submitted: nature of release, volume of release, groundwater monitoring information and physical evidence of distressed vegetation or soil contamination. This data is to be derived from the on-going RCRA Corrective Action Program.

Response #21: Resolved. See Comment #20.

L PART B Certification: 270.11

Comment #22: Provide a signed and dated certification for the April 17 revision to the RCRA Part B Application for the Subpart X units.

Response #22: Resolved. A signed and dated RCRA Part B Application for the Subpart X units has been included in Section L.

APPENDIX 9

NOISE CONSIDERATIONS SUPPLEMENTAL INFORMATION

APPENDIX 9

TABLE OF CONTENTS

AR 200-1 CHAPTER 7

Chapter 7
Environmental Noise Abatement Program

7–1. Scope

a. The Army's environmental noise abatement program goal is to achieve compliance with applicable noise regulations in a man- r consistent with mission accomplishment. To achieve this goal, e Army will—

(1) Control environmental noise to protect the health and welfare of military personnel and their dependents, Army civilian employees, and the public adjacent to Army installations.

(2) Reduce community annoyance from environmental noise to the extent feasible, consistent with Army training and materiel testing activities.

b. This chapter implements—

(1) The Quiet Communities Act of 1978 (PL 95–609).

(2) The Noise Control Act of 1972 (PL 92–574), as amended.

(3) Federal regulations issued per above acts.

(4) DOD Air Installation Compatible Use Zone (AICUZ) Instruction 4165.57.

(5) DOD Instruction 5100.5.

(6) AR 95–1.

(7) DA memorandum from Director of the Army Staff, 20 January 1983, subject: Installation Compatible Use Noise Zone (ICUZ) Program Implementation.

(8) DA memorandum from Director of the Army Staff, 14 July 1987, subject: Installation Compatible Use Zone (ICUZ) Program Implementation.

c. The policies and guidance provided in this chapter pertain only to the control of environmental noise within the United States.

d. OCONUS MACOMs will develop environmental noise abatement programs per the provisions of SOFAs and other international agreements. The programs will incorporate the philosophy and spirit of the guidance in this chapter.

e. Policy and guidance related to the control of noises hazard- hearing are in TB MED 501.

7–2. Environmental noise abatement program requirements

Under the environmental noise abatement program, DA will—

a. Assess the impact of noise that may be produced by proposed Army actions/activities, and will lessen harmful or objectionable impacts to the greatest extent practicable.

b. Comply with applicable Federal laws and regulations respecting the control and abatement of environmental noise. Questions regarding the applicability of State and local laws and regulations should be referred to the command legal officer and through channels HQDA (DAJA–EL) WASH DC 20310–2210 if necessary for ultimate resolution.

c. Maintain an active ICUZ program to protect the present and future operational capabilities of the installation or facility. Encroachment problems may be caused by land uses that are not compatible with the existing and future noise environments, or noise environments that are not compatible with existing and future on-post land uses. Predictions for long-range planning purposes can be made for several decades into the future. ARNG and other part-time operations will base their future predictions on a reasonable level of operations, but as if they operated year round.

d. Coincident with ICUZ reviews, assess the effect of noise from those on-post noise sources studied as a part of the ICUZ re- ew and of off-post noise sources, such as commercial airports nd highways and on-post noise-sensitive land uses. This assess- ent will use the ICUZ zones and measures delineated in para- aph 7–5, and mitigation measures for incompatible on-post land es will be identified.

nize environmental noise impacts by—

oise reduction engineering.

(2) Administrative and operational controls.

(3) Appropriate siting and design of facilities and ranges.

(4) Development and procurement of weapons systems and other military combat equipment that produce less noise, when consistent with operational requirements.

(5) Procurement of commercially manufactured products, or those adapted for general military use that produce less noise and that comply with regulatory noise emissions standards.

(6) Appropriate land use controls, which include—

(a) Assisting in the development of protective off-post land use planning.

(b) Assisting in the development of protective off-post structural requirements to mitigate noise impacts.

(c) Controlling land uses through easement or fee purchase. Acquisition of property rights solely on the basis of unacceptable noise levels will be considered only after all possibilities of achieving acceptable levels have been exhausted and the operational integrity of the mission is threatened. If programming actions become necessary, the provisions of DOD Instruction 4165.57, paras D2b(2) and (3) will be followed.

(d) Developing protective on-post land use planning.

(e) Developing protective on-post structural requirements to mitigate noise impacts.

f. Forward ICUZ studies to HQDA (ENVR–E) WASH DC 20310–2600, for final review and approval when zone III goes off the installation or when the ICUZ situation is controversial. All other ICUZ studies will be approved at the MACOM level.

g. Reduce building interior noise levels through architectural and engineering controls when noise-sensitive activities such as medical treatment, education, and general living are located in noise impacted areas.

h. Assess noise using the measures, criteria, and procedures of paragraph 7–5.

(1) To conform to this regulation and to other DOD regulations, sites located in zone I (as described in para 7–5*d* below) are acceptable for residences and other noise-sensitive land uses.

(2) DA noise assessment policy is based on adverse impacts as indicated by objective noise levels. Complaints may be an indicator of situations where adverse impact exists, but the correlation between the two is poor at best. The occurrence of complaints from areas in zone I does not constitute an adverse impact. Conversely, the absence of complaints from zones II or III does not mean that a noise problem does not exist.

7–3. Noise complaints

A noise complaint procedure will, as a minimum, ensure that—

a. A log is maintained of all noise complaints.

b. Complaints are investigated without delay.

c. The complainant is aware of the installation's mission and that every effort will be made to correct the problem, mission permitting.

d. Complaints are routed to the office responsible for the type of activity that resulted in the noise complaint. The PAO will require a response for the purpose of providing information to the complainant.

e. A copy of the complaint and response is provided to the ICUZ committee. The ICUZ committee will provide technical assistance to the PAO and the activity generating the noise (para 7–5*b*).

f. The noise-generating activity will complete a follow-up by identifying the cause of the noise and any action taken to correct the deficiency. A copy of the follow-up documentation will be provided to the ICUZ committee.

7–4. Standards

a. General. Any military equipment or weapons designed for combat use are excluded from the requirements of section 6 of the Noise Control Act of 1972, "Noise Emission Standards for Products Distributed in Commerce." The following environmental noise standards apply to the subject matter of this regulation—

(1) The Noise Control Act of 1972, which requires compliance with State and local noise laws and ordinances.