RCRA FACILITY ASSESSMENT

of

RADFORD ARMY AMMUNITION PLANT
RADFORD, VIRGINIA

Prepared for:

U.S. Environmental Protection Agency
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

Prepared by:

A. T. Kearney, Inc.
699 Prince Street
Alexandria, VA 22313

EPA Contract No. 68-01-7038
Work Assignment No. R03-08-07

June 8, 1987

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I. INTRODUCTION

This report presents the results of a RCRA Facility Assessment (RFA) of the Radford Army Ammunition Plant (RAAP), located in Radford, Virginia. The RFA is designed to evaluate releases of hazardous waste or hazardous constituents and to implement corrective actions, as necessary, under the broad authorities of the 1984 Hazardous and Solid Waste Amendments (HSWA). The RFA identifies information on solid waste management units (SWMUs) and other areas of concern at RCRA facilities, evaluates the potential for release to the environment, and determines the need for further investigation. The intent of this authority is to address previously unregulated hazardous constituent releases to air, surface water, groundwater, and soil, and the generation of subsurface gas. In order to accomplish this objective, a RFA is performed consisting of a preliminary data review and evaluation, a Visual Site Inspection (VSI), and, when warranted, sampling and analyses.

The RFA involved a review of information available to EPA as of August 29, 1986 and information submitted by RAAP on September 11, 1986. This report summarizes all available information, as well as information obtained during the VSI performed April 7-9, 1987. Section II of this report describes the facility and its operations. Information pertaining to the regional and the environmental setting is presented in Section III. Section IV consists of a detailed description of the individual SWMUs, and Section V consists of a detailed description of other Areas of Concern identified during the VSI. Section VI presents an evaluation of the release potential to soil, groundwater, surface water, air, and the potential generation of subsurface gas at the facility, along with conclusions and suggested further actions for the SWMUs.

II. FACILITY AND PROCESS DESCRIPTION

The Radford Army Ammunition Plant (RAAP) is a government-owned industrial complex located in southwestern Virginia. RAAP lies approximately eight miles southwest of Blacksburg and three miles north of Radford (see Figures 2-1 and 2-2). The main manufacturing area of RAAP is located south of the New River meander in Montgomery County, and the "Horseshoe Area" of RAAP is located within the New River meander in Pulaski County (Ref. 1, p. 2).

Although RAAP is owned by the U.S. Government, it has been operated under contract by Hercules, Inc. since 1941. This facility, which contains 1,696 buildings and occupies 3,649,965 square feet, is the top manufacturer of solid propellants in the United States. The major products manufactured at this facility are solvent and solventless propellants that include single-phase (nitrocellulose), double-phase (nitrocellulose and nitroglycerin), and triple-phase (nitrocellulose, nitroglycerin, and nitroguanidine) propellants; cast propellants; and high-energy propellants. Table 2-1 summarizes the propellants which are manufactured at RAAP (Ref. 1, p. 2).

These propellants are ultimately used in small arms, anti-tank weapons, anti-aircraft weapons, rockets, torpedoes, missile systems, igniters, and other numerous ordnance-related items (Ref. 1, p. 2).

The production of the propellants discussed in Table 2-1 requires the synthesis of large quantities of sulfuric and nitric acids. Sulfuric acid is produced at the oleum plant and nitric acid is produced at the ammonia oxidation plant. These acids are then used to produce nitrocellulose (NC), nitroglycerin (NG), and trinitrotoluene (TNT). The acid wastewater which results from the production of the above propellants is neutralized at one of the wastewater treatment facilities located on site. Hydrated lime is added to the acidic wastewater and the resulting sludge (usually calcium sulfate) is placed in a landfill (Ref. 1, p. 2).

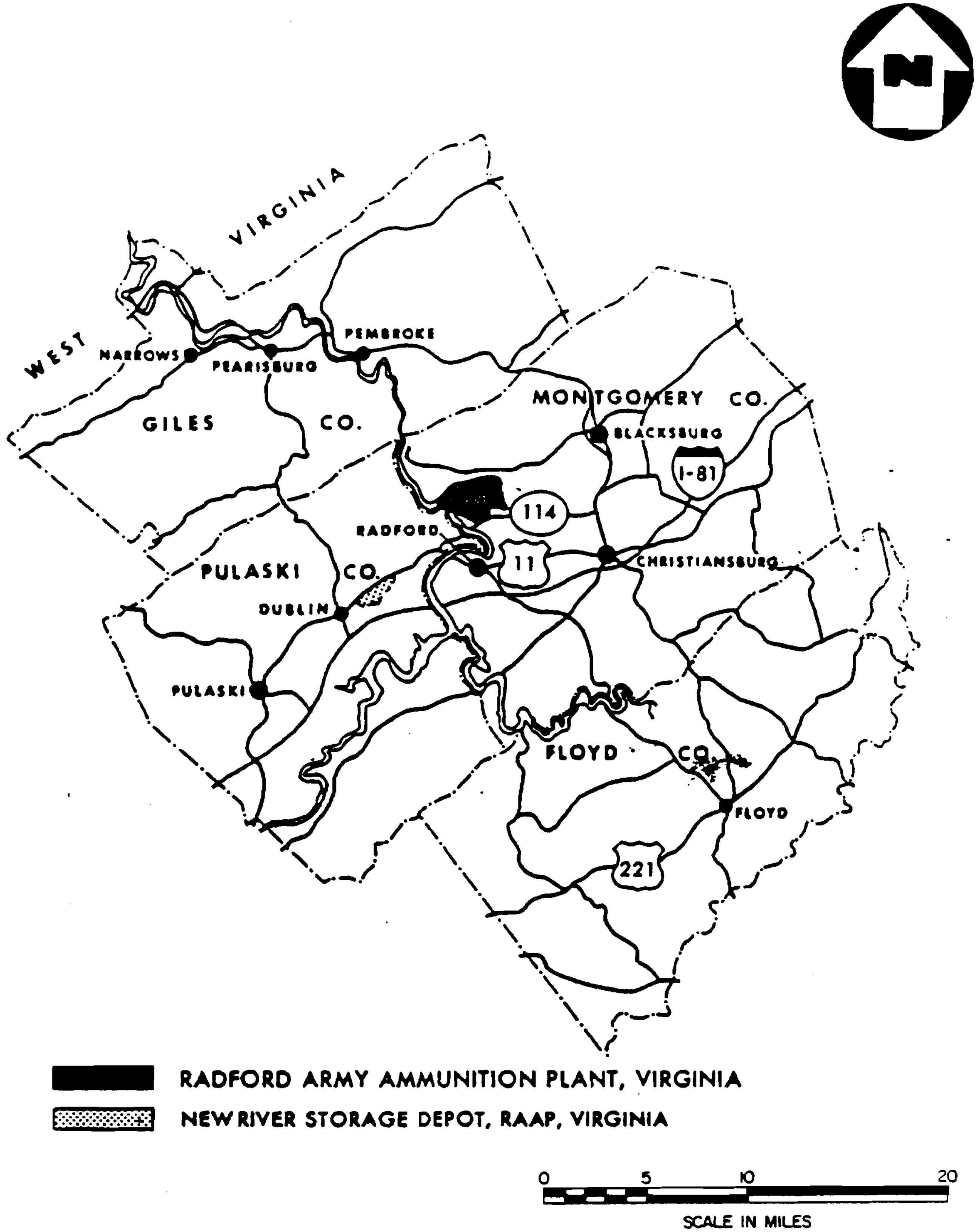
TABLE 2-1

PROPELLANTS MANUFACTURED BY RAAP

Categories of Propellant	Number of Propellants Manufactured	Major Chemical Constituent(s)	Weight Percent	Organic Solvents used in the Production of Solvent-Propellants
o Single-base propellants	15	nitrocellulose	40-100	diethyl ether ethyl alcohol
o Double-base propellants	31	nitrocellulose nitroglycerin	25-84 10-45	ethyl alcohol acetone
o Triple-base propellants	4	nitrocellulose nitroglycerin nitroguanidine	19-29 18-24 45-55	ethyl alcohol acetone
o Cast and extruded propellants	3	nitrocellulose nitroglycerin	49-54 31-37	nitroglycerin triacetine
o Miscellaneous	4	nitrocellulose nitroglycerin acetone propylene glycol dinitrate	0-65 0-16 0-59 0-77	acetone

Source: RCRA Part B Permit Application

(Ref. 1, p. 3)

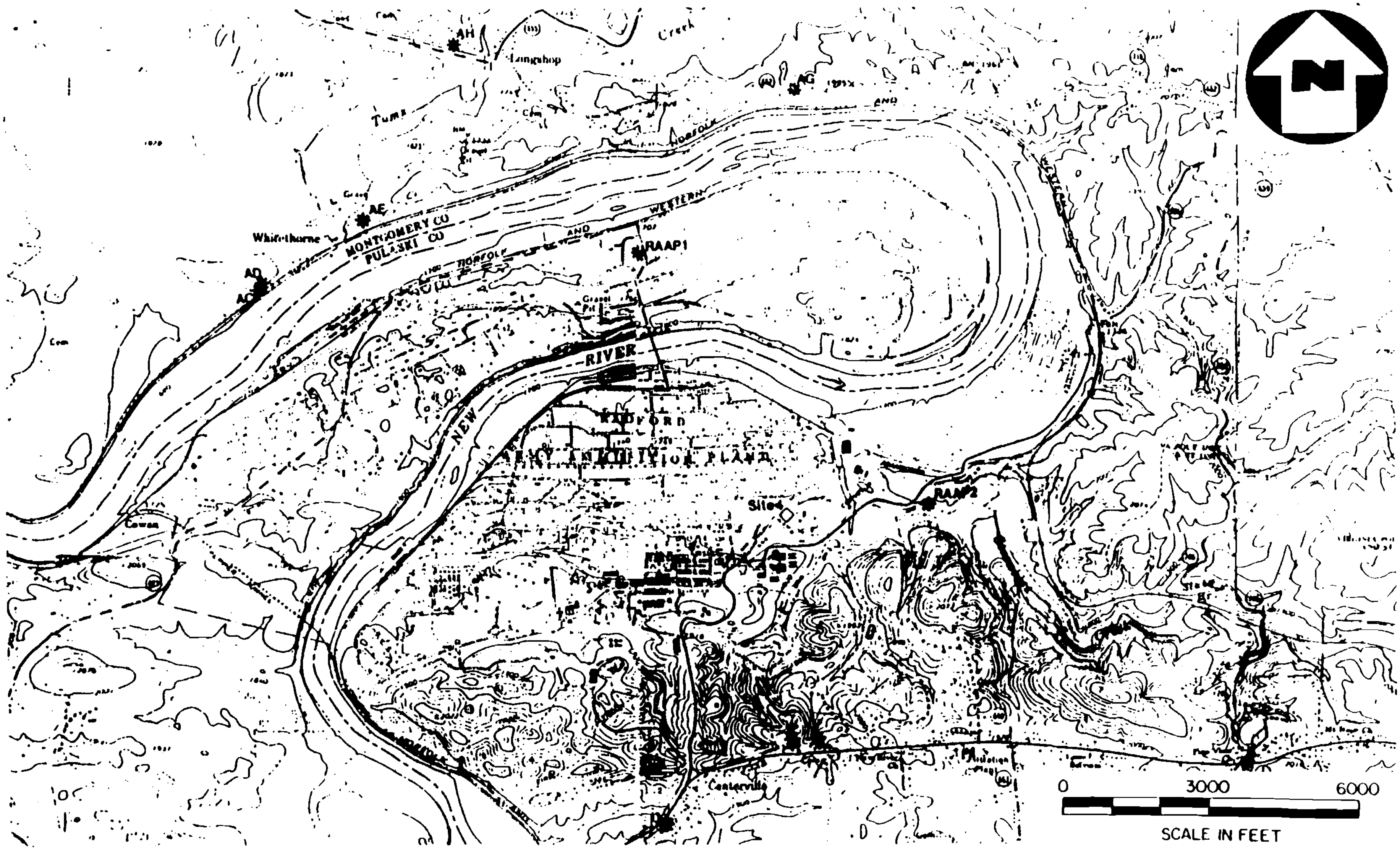


SOURCE: LAND DISPOSAL STUDY No. 38-26-0128-81
RAAP, RADFORD, VA, 1980

FIGURE 2-1

VICINITY MAP
RADFORD ARMY AMMUNITION PLANT

(Ref. 1, p. 4)



BASE MAP IS A PORTION OF THE USGS RADFORD NORTH, VA QUADRANGLE (7.5 MINUTE SERIES, 1965 – PHOTOREVISED 1984) AND A PORTION OF THE BLACKSBURG, VA QUADRANGLE (7.5 MINUTE SERIES, 1965 – PHOTOREVISED 1983) CONTOUR INTERVAL 20 FEET

FIGURE 2-2

TOPOGRAPHIC MAP
RADFORD ARMY AMMUNITION PLANT

(Ref. 1, p. 5)

The manufacturing processes at RAAP sometimes result in the production of sub-standard propellants. These propellants are destroyed by incineration. At present, RAAP has three incinerators, two of which are currently operational. The waste propellants are first taken to a storage facility and then transferred to the incinerator unit where they are destroyed. The ash is taken to the hazardous waste landfill and the scrubber water is sent to wastewater ponds (Ref. 1, p. 2).

As with any large industrial complex which employs a large number of people, wastes resulting from the interaction of people are generated. Sanitary sewage is processed at the two RAAP sewage treatment plants. Sanitary putrescible wastes are disposed of in one of several sanitary landfills found on site (Ref. 1, p. 6).

Relatively small quantities of laboratory wastes are generated at RAAP on-site facilities. These laboratory wastes are generated as a result of research and quality control protocols, and are taken to the hazardous waste landfill for on-site disposal (Ref. 1, p. 6).

Based upon the findings of the VSI, the following SWMUs and Other Areas of Concern were identified at RAAP. Appendix C provides the location of each SWMU and Other Area of Concern at the facility. Table 2-2 lists the wastes generated at RAAP. Detailed waste generation information for each SWMU is presented in Section V. The SWMUs and other areas of concern identified at RAAP during the April 1987 inspection are as follows:

I. Solid Waste Management Units:

SWMU Number	Unit Name
1.	Redwater Storage Tank
2.	TNT Wastewater Equalization Basin(s) a. Equalization Tanks (5) b. Stainless Steel Flumes and Concrete Secondary-Containment Gutter c. Sump Gallery

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Solid Waste Management Units (Continued):

SWMU Number	Unit Name
3.	TNT Wastewater Treatment Unit a. Primary Neutralization Tank(1) b. Sludge Settling/Equalization Basin No. 1 c. Neutralization Mix Tank d. Diatomaceous Earth Filter e. Treated Water Surge Tanks f. Activated Carbon Columns (2) g. Spent Carbon Storage Area h. Final Equalization Basin No. 2 i. Final Neutralization Tank j. Parshall Flume k. Activated Carbon Dust Collector
4.	Acidic Wastewater Lagoon (southeast corner of RAAP)
5.	Acidic Wastewater Lagoon (central section of main manufacturing area)
6.	Acidic Wastewater Lagoon (central section of main manufacturing area, near the Administration Building)
7.	Acidic and Caustic Wastewater Lagoon
8.	Calcium Sulfate Settling Lagoon (2) (A-B Line Acidic Wastewater)
9.	Calcium Sulfate Settling Lagoon (2) (C-Line Nitrocellulose Wastewater)
10.	Biological Treatment Plant and Equalization Basin a. Equalization Basin b. Surface Aerators (4) c. Jet-Injector Type Aerators (2) d. Rotating Biological Contactors (6) - Two Parallel Trains e. Rotating Biological Contactors (8) f. Weir Clarifiers (2) g. Aerobic Sludge Digestors (3) h. Sludge Thickener i. Belt Filter Press

Solid Waste Management Units (Continued):

SWMU Number	Unit Name
11.	Nitroglycerin 1 Pretreatment Plant a. Sluice Waterway Gutter b. Lift Station Storage Tank c. Nitroglycerin Acidic Water Storage Feed Tanks (3) d. Batch Reaction Tanks (3) e. Lime Mix Tanks (4) f. Neutralization Tank g. Lime Batch Clarifiers (2) h. Sludge Holding Tank i. Sludge Hopper
12.	Nitroglycerin Wastewater Pretreatment Plant a. Lime Mix Tanks (4) b. Batch Reaction Tanks (2) c. Flocculation Tanks (2) d. Outside Batch Reaction Tanks (2) e. Flash In-Line Mixers (2)
13.	Waste Propellant Burning Ground a. Burning Pans (7) b. Former Open Ground Burning Area(s) c. Run-off Settling Basin d. Mobile and Temporary Storage Unit
14.	Waste Incinerator a. Wet Grinder (Building (442) Storage Tanks (2) (Building 442) Storage Tank (Building 430) b. Incinerator (Building 429B) Incinerator (Building 440) Incinerator (Building 441) c. Afterburner d. Water Quench Precooler e. Wet Scrubber
15.	Waste Propellant Storage Facility
16.	Hazardous Waste Landfill
17.	Contaminated Waste Burning (Air Curtain Destructor) a. Stage and Burn Area b. ACD Staging Pad and Pit c. Air Curtain Destructor d. Ash Staging Area e. ACD Run-off Drainage Basin

Solid Waste Management Units (Continued):

SWMU Number	Unit Name
18.	Sulfuric Acid Recovery Plant - Waste Acid Treatment a. Vacuum Filters (2) b. Lime Silos (2) c. Neutralization Tanks d. Clarifiers (2) e. Steel Feed Tank
19.	The A-B Line Acidic Wastewater Treatment Plant a. Wastewater/Lime-Slurry Mix Tank b. Neutralization Tank Equipped with Six Rotary Mixers c. Lime-Slurry Mix Pit d. Lime Silo, Hopper, and Slaker e. Bucket Conveyor System f. Sludge Drying Bed
20.	C-Line Acidic Wastewater Treatment Plant a. Acid-Brick-Lined Influent Sumps (2) b. Acid-Brick-Lined Mix/Neutralization Tank c. Acid-Brick-Lined Effluent Sump d. Lime Silo and Slaker in a Cinder-Block Building
21.	Continuous Automated Single-Base Line Wastewater Treatment Plant
22, 23, 24, 25.	Wastewater Holding Lagoons
26.	Fly Ash Landfill No. 1
27.	Calcium Sulfate Landfill
28.	Sanitary Landfill
29.	Fly Ash Landfill No. 2
30.	Asbestos Disposal Trench No. 1
31.	Bottom Ash Settling Lagoon a. Sluice Waterway b. Primary Settling Lagoon c. Secondary Settling Lagoon d. Tertiary Settling Lagoon e. Concrete Sump f. Equalization Basin

Solid Waste Management Units (Continued):

SWMU Number	Unit Name
32.	Inert Waste Landfill No. 1
33.	Treatment Plant for Solids from Water Plant
34.	Treatment Plant for Solids from Water Plant
35.	Calcium Sulfate Drying Bed (Northeast Section)
36.	Calcium Sulfate Drying Bed (Northeast Section)
37.	Calcium Sulfate Drying Bed (Northwest Section)
38.	Calcium Sulfate Drying Bed (Northwest Section)
39.	Incinerator Wastewater Ponds (2)
40.	Sanitary Landfill (Nitroglycerine Area)
41.	Red Water Ash Landfill (Southeast of Barracks)
42.	Red Water Ash Landfill (Eastern Edge of Main Manufacturing Area)
43.	Sanitary Landfill (Adjacent to New River)
44.	Toluene Spill Site
45.	Sanitary Landfill (West of Main Bridge)
46.	Waste Propellant Disposal
47.	Inert Waste Landfill No. 2
48, 49, 50.	Oily Wastewater Disposal, Red Water Ash Disposal, and Calcium Sulfate Disposal
51.	TNT Neutralization Sludge Disposal
52.	Closed Sanitary Landfill
53.	Activated Carbon Disposal
54.	Disposal Area for Ash from Burning of Waste Propellants

Solid Waste Management Units (Continued):

SWMU Number	Unit Name
55.	Sewage Treatment Plant (Northeast Section)
56.	Sewage Treatment Plant (Northwest Section)
57.	Pond by Building No. 4931
58.	Rubble Pile
59.	Bottom Ash Pile
60.	Rubble Pile East of Administration Building
61.	Mobile Waste Oil Tanks
62.	Contaminated Flammable Liquid Mobile Cart
63.	C-Line Boiling Tub House Settling Pits
64.	Nitrocellulose C-line Collection Sump
65.	Nitrocellulose A-B Line Acidic Water Settling Pits
66.	Nitrocellulose A-B Line Neutral Water Settling Pits
67.	Main Acid Sewer Lines
68.	Chromic Acid Treatment Plant Tanks
69.	Pond by Chromic Acid Treatment Plant Tanks
70.	Heavy Equipment Maintenance Shop Tractor Steam Cleaning Area
71.	Flash Burn Parts Area (Sanitary Landfill)
72.	Oleum Plant Acidic Wastewater Sump
73.	Main Lab Waste Container Storage Area
74.	Inert Landfill No. 3
75.	Waste Oil Underground Storage Tank (A-421)

Solid Waste Management Units (Continued):

SWMU Number	Unit Name
76.	Waste Oil Underground Storage Tank (South of Oleum Plant)
77.	Garbage Incinerator
78.	Rubble Pile Southwest of Unit 51
79.	Asbestos Disposal Trench No. 2
80.	"Drainage Ditch" for C-Line Wastewater Treatment and Plant Runoff
81.	Red Water Treatment Plant
	a. Concrete Basin b. Tanks (5) c. Drum Staging Area d. Overflow Basin e. Soda Ash Mix Tank

II. Other Areas of Concern

A. Nitrocellulose Line A Rainwater Ditch

B. Nitrocellulose Line A Activated Carbon Recovery Unit

C. C-Line Mix House

D. Drum Container Storage Area (Sanitary Landfill)

E. Drum Container Storage Area (266-2)

F. Drum Container Storage Area (9387-2)

G. Refractory Rubble Pile

H. Former Site of TNT A-Line

I. Former Location of Red Water Incinerator Kilns

J. Roll-off Dumpsters

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Other Areas of Concern (Continued):

K. Solvent Distillation Operations

L. Underground Storage Tanks

M. Subcontractors Equipment Storage Area

N. Product Storage Area

O. Underground Fuel Oil Spill

P. Scrap Metal Salvage Yard

Q. Alleged Abandoned Lagoon

TABLE 2-2

WASTES GENERATED AT
RADFORD ARMY AMMUNITION PLANT

Production Wastes	Hazardous Waste Identification Number
Acidic Wastewater (blends of nitric and sulfuric acid)	D002
"Red Water" from TNT production	K047
Toluene	F005
Acetone	F003
Diethyl Ether	F003
Ethyl Alcohol	--
Nitroglycerin	D003
Nitrocellulose	D003
Nitroguanidine	D003
2,4-dinitrotoluene	U105
2,6-dinitrotoluene	U106
NG Slums (propellant-contaminated wood)	D003/F003
Calcium Sulfate Sludge	--
Waste Propellant Incinerator Ash	D003/D008
Waste Propellants (see Appendix A)	D003
"Red Water" Ash	Unknown
TNT Wastewater Sludges	K044

OTHER WASTES

Municipal Refuse (paper, garbage)
Food Wastes
Asbestos
Demolition Wastes (concrete, earth, etc.)
Flyash
Activated Carbon

(Ref. 1, p. 7)

III. ENVIRONMENTAL SETTING

A. Meteorology

In winter the average temperature is 32°F, and the average daily minimum temperature is 22°F. In the summer the average temperature is 69 degrees. The total precipitation is 40 inches. Of this, 21 inches, or 53 percent, usually falls in April through September. In two years out of ten, the rainfall in this period is less than 19 inches. Average seasonal snowfall is 28 inches. The prevailing wind is from the west. Average windspeed is highest, eight miles per hour, in March (Ref. 2, p. 2).

B. Floodplain and Surface Water

All of RAAP is in the drainage basin of the New River. The southeastern portion, including Unit 4, is drained by Stroubles Creek which discharges to the New River (Ref. 3, p. 9). All run-off in the vicinity of RAAP enters the New River, or a tributary of the New River (see Figure 3-1). The New River is a large river which flows in a northerly direction. Measurements at the Claytor Lake Power Dam, located south of RAAP, indicate that the average flow of the river is 3,800 cubic feet/sec., with a maximum discharge of 218,000 cubic feet per second observed on August 14, 1940. A rather prominent meander of the New River is located in the vicinity of RAAP. The meander loop is orientated in an east/west direction, with the closed end of the meander pointing to the east. Because of the meander, water in the New River first flows to the east (in the southern section of the meander) and then abruptly flows to the west (in the northern section of the meander) (Ref. 1, p. 6).

Hazardous waste management units 14A, 14B, and 15 are located within the 100-year floodplain. Hazardous waste management unit 4 is not located within the 100-year floodplain (Ref. 3, p. 19). Wastes treated at Unit 14B (incinerators) and wastes stored at Unit 15 (container storage facility) are both above the 100-year floodplain elevation (1704 feet MSL) (Ref. 3, p. 25).

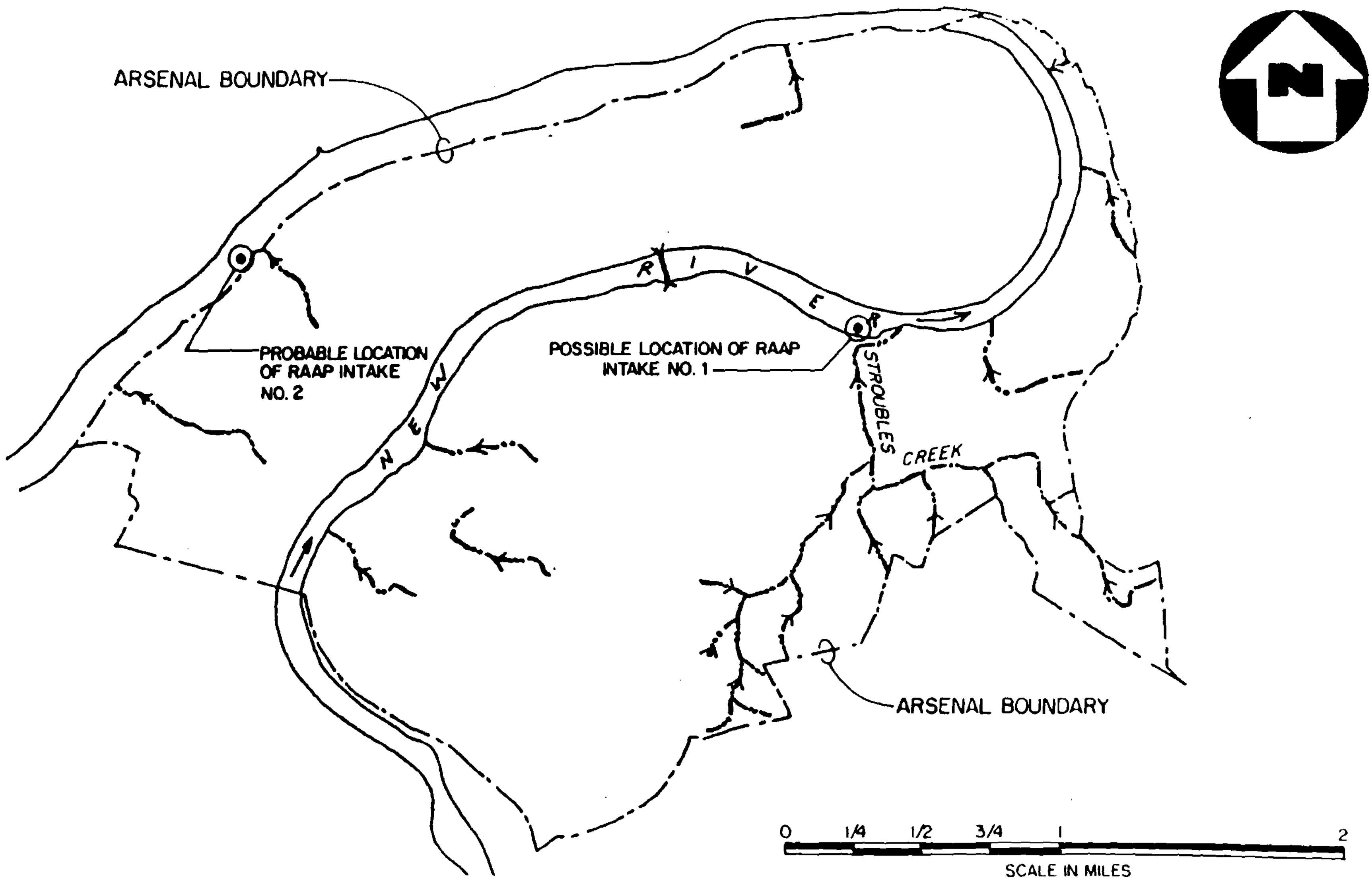

FIGURE 3-1

SURFACE DRAINAGE
RADFORD ARMY AMMUNITION PLANT

(Ref. 1, p. 8)

C. Geology and Soils

RAAP lies within the Valley and Ridge physiographic province of the Appalachian Highland Region. The Valley and Ridge physiographic province is made up of elongated, narrow, flat-tipped ridges of the resistant sandstone or metamorphised sandstone (quartzite) and valleys composed of less resistant limestone and shale (Ref. 1, p. 9).

Present-day landforms within the vicinity of RAAP are the result of a complex sequence of faulting and folding, which has occurred over the past 100 million years. The Pulaski Thrust Fault has caused older Cambrian limestone formations (the Elbrook and the Rome Formations) to overlie younger Mississippian sandstone and shale formations (McCrady/Price Formations). The carbonate formations exposed at the surface through faulting have undergone extensive chemical weathering. This weathering has resulted in karst landforms (sinkholes, caves, and solution cavities), which are found in the vicinity of the site (Ref. 1, p. 9).

RAAP is underlain by a complex sequence of both unconsolidated deposits and rock. The unconsolidated deposits consist of residual soils, river alluvium, and terrace deposits (Ref. 1, p. 9).

The residual soil, which consists of reddish-brown to pale yellow silty sand and gravel lenses, or yellowish-brown to brown silty loam containing sand and rock fragments, is caused by the weathering of limestone, dolomite, shale, and terrace deposits. The river alluvium which lies along stream valleys, consists primarily of clay, silt, and sand with pebble and cobble lenses. Well logs of monitoring wells drilled in the area indicate that the alluvial deposits can be up to 30 feet thick. Terrace deposits, which mantle much of the RAAP area, consist of poorly sorted, well-rounded, brown to reddish-brown cobbles (known locally as "River Jack") entrenched in a matrix of sand, silt, and clay. These deposits, which may be over 50 feet thick, were deposited by the New River between the later Tertiary and early Pleistocene. The cobbles, which consist of vein quartz, metaquartzite, and feldsparthic sandstone, originate from the Blue Ridge Mountains (Ref. 1, p. 9).

The bedrock that underlies the unconsolidated material consists of the Elbrook Formation, the Rome Formation, and the McCrady/Price Formation (Ref. 1, p. 9).

The Elbrook Formation, found throughout the entire RAAP area, is composed of thickly bedded, blue-gray dolomite, interbedded with blue-gray to white limestone and some shale (mudstone). The Elbrook Formation ranges from 1,400 - 2,000 feet in thickness (Ref. 1, p. 16).

The Rome Formation underlies the Elbrook Formation. It is made up of red and green shale (mudstone), sandstone, dolomite, and pure limestone. A distinctive red shale unit marks the base of the Rome Formation. Thickness of the Rome Formation ranges from 1,000 - 2,000 feet (Ref. 1, p. 10).

The McCrady/Price Formation outcrops in a fenster (window) east of the main manufacturing area. This formation consists of fossiliferous shale and sandstone (Ref. 1, p. 10).

D. Groundwater

Groundwater in the vicinity of the RAAP area is found in both unconsolidated and consolidated aquifers. Table 3-1 summarizes the hydrogeologic characteristics of the different aquifers in the area. The groundwater found in these aquifers originates from the downward infiltration of the precipitation in recharge areas located in topographically high areas. The movement of groundwater through the unconsolidated aquifers (i.e., alluvium and terrace deposits) is through the pore spaces that lie between the particles making up the deposits. The movement of groundwater in the consolidated aquifers (limestone and dolomite bedrock) is through a complex system of solution cavities produced by the solution of bedrock caused by the rapid movement of groundwater through rock fractures (Ref. 1, p.10).

At RAAP, groundwater generally flows from topographically high regions to topographically low regions. Groundwater in the vicinity of RAAP ultimately discharges into the New River. Although the above statement is

TABLE 3-1

LITHOLOGIC AND HYDROLOGIC PROPERTIES OF AQUIFERS IN THE VICINITY OF THE RAAP

Era	System	Formation	Thickness (Feet)	Lithologic Description	Water-Bearing Characteristics
Cenozoic	Quaternary/ Recent	Alluvium	0 - 30	Floodplain deposits of sand, silt, clay; pebble and cobble lenses	Considered alone, these sediments are poor aquifers and function primarily to recharge lower aquifers.
	Quaternary(?)	Terrace Deposits	0 - 20	Unconsolidated deposits of cobble, gravel, and some poorly sorted, fine-grained sediments	Considered alone, these sediments are poor aquifers and function primarily to recharge lower aquifers.
Paleozoic	Mississippian	Price	1,500	Mudstone, siltstone, sandstone, and coal sequences	Poor to fair water supplies generally available at depths of 50-100 feet. Groundwater flow along bedding planes and joints; water is moderately hard.
	Devonian	Undivided	0 - 3,000	Interbedded sequences of sandstone, siltstone, mudstone and some chert layers; tightly folded and sheared in some beds	Poor to fair water supplies generally available at depths of 50-100 feet. Groundwater flow along bedding planes and joints; water is moderately hard.
	Ordovician	Undivided	0 - 4,000	Mudstone, sandstone, chert, dolostone, and limestone sequences	Good yields from solution channels; excellent yields where overlain by Quaternary sediments and close to streams. High dissolved solids content and water is very hard.

TABLE 3-1
LITHOLOGIC AND HYDROLOGIC PROPERTIES OF AQUIFERS
IN THE VICINITY OF THE RAAP
PAGE TWO

Era	System	Formation	Thickness (Feet)	Lithologic Description	Water-Bearing Characteristics
Paleozoic (Cont.)	Cambrian	Copper Ridge	0 - 1,200	Interbedded sandy dolostone and massive dolostone; basal sandstone bed	Good yields from solution channels; excellent yields where overlain by Quaternary sediments and close to streams. High dissolved solids content and water is very hard.
		Elbrook	1,500	Upper portions contain interbedded sandy dolostone with thin lenses of sandstone and limestone. Amounts of quartzose and limestone decrease downward. Lower portions contain cyclic sequence of fine- to coarse-grained dolostones, some limestone. Basal 25-50 feet of fine-grained dolomitic mudstone. Locally thrust faulted on top of Mississippian beds.	Good yields from solution channels in carbonate rocks; excellent yields where overlain by Quaternary sediments and close to streams. High dissolved solids content and water is very hard. Groundwater encountered at 100-300 feet below land surface.

TABLE 3-1
LITHOLOGIC AND HYDROLOGIC PROPERTIES OF AQUIFERS
IN THE VICINITY OF THE RAAP
PAGE THREE

Era	System	Formation	Thickness (Feet)	Lithologic Description	Water-Bearing Characteristics
Paleozoic (Cont.)	Cambrian (Cont.)	Rome	30 - 1,000	Interbedded mudstone, sandstone, siltstone, and dolostone; extensively fractured; slickensides. Total thickness unknown because of extensive folding folding and shearing. Locally thrust faulted on top of Mississippian beds.	Good yields from solution channels in carbonate rocks; excellent yields where overlain by Quaternary sediments and close to streams. High dissolved solids content and water is very hard. Groundwater encountered at 100-300 feet below land surface.

Source: As originally described in Ref. 6.

TABLE 3-2

LOCATION OF SOME SUPPLY WELLS NEAR RADFORD ARMY AMMUNITION PLANT

Map ID	State Water Control Board Well No.	Ground Surface Elevation (ft)	Total Depth (ft)	Static Water Level (ft)	Zone or Screen Levels (ft)	Yield (gpm)	Formation	Lithology	Type
A	160-00255	1,889	223	50	130-132	30	CE	LS	DOM
B	160-00256	1,760	205	30		20	CR	SH	DOM
C	160-00257	1,750	119			12	CR	SH	DOM
D	160-00258	1,720	90	20		10	CR	SH	DOM
E	160-00196	1,700					CR	SH	
F	160-00077	1,910	250	100	200-201	6	CE	LS	DOM
G	160-00068	2,020					CE	LS	DOM
H	160-00069	2,040					CE	LS	DOM
RAAP#1		1,715	200			140			IND
RAAP#2		1,715	170			5			

CE - Elbrook Formation
CR - Rome Formation

LS - Limestone (or dolomite)
SH - Shale

DOM - Domestic
IND - Industrial

ft - feet
gpm - gallons per minute

Refer to Figure 2-4 for the location of supply wells.
Source: Exposure Information Report, Hazardous Waste Management Site 4 (attached to August 6, 1985, letter from C. Curtis to R. Greaves).

Source: As originally described in Ref. 6.

generally true throughout much of the year, it may not be true in periods when the New River is at flood stage. Although no data exists to prove this, it is likely that water from the New River, which has a higher elevation during flood stage than groundwater in adjacent formations, will enter these formations and cause a temporary reversal of gradient. Normal groundwater flow conditions resume after the flood waters recede (Ref. 1, p. 10).

Groundwater in the carbonate aquifers which exhibits a calcium bicarbonate chemical signature, is generally very hard and has a high total dissolved solid content (Ref. 1, p.10).

Groundwater velocities in the vicinity of RAAP can range from less than a tenth of a foot per day in some of the clayey hydrostratigraphic units, to several feet per second in some of the larger solution cavities in the carbonate aquifers. The rapid movement of groundwater through large solution cavities makes carbonate aquifers very susceptible to groundwater contamination (Ref. 3, p. 14).

Local usage of groundwater is limited. Table 3-2 and Figure 3-2 summarize the well data that has been obtained at the time of this writing (May 1987) (Ref. 3, p. 14).

E. Receptor Information

RAAP is located in the Valley and Ridge physiographic province of the Appalachian Highland Region in Montgomery County, Virginia. This area is predominantly agricultural with residential areas bordering the facility. The New River and Stroubles Creek are potential receptors of surface and groundwater release from RAAP.

TABLE 3-2

LOCATION OF SOME SUPPLY WELLS NEAR RADFORD ARMY AMMUNITION PLANT

Map ID	State Water Control Board Well No.	Ground Surface Elevation (ft)	Total Depth (ft)	Static Water Level (ft)	Zone or Screen Levels (ft)	Yield (gpm)	Formation	Lithology	Type
A	160-00255	1,889	223	50	130-132	30	CE	LS	DOM
B	160-00256	1,760	205	30		20	CR	SH	DOM
C	160-00257	1,750	119			12	CR	SH	DOM
D	160-00258	1,720	90	20		10	CR	SH	DOM
E	160-00196	1,700					CR	SH	
F	160-00077	1,910	250	100	200-201	6	CE	LS	DOM
G	160-00068	2,020				–	CE	LS	DOM
H	160-00069	2,040					CE	LS	DOM
RAAP#1		1,715	200			140			IND
RAAP#2		1,715	170			5			

CE - Elbrook Formation
CR - Rome Formation

LS - Limestone (or dolomite)
SH - Shale

DOM - Domestic
IND - Industrial

ft - feet
gpm - gallons per minute

Refer to Figure 2-4 for the location of supply wells.
Source: Exposure Information Report, Hazardous Waste Management Site 4 (attached to August 6, 1985, letter from C. Curtis to R. Greaves).

(Ref. 1, p. 15)

The New River is a drinking and production water resource for RAAP. The first RAAP surface water intake is reportedly located directly upstream of the confluence of the New River and Stroubles Creek; the second RAAP surface water intake is reportedly located approximately five miles downstream of the confluence of the New River and Strouble Creek. Other local usage of the New River includes crop irrigation, boating, and sport fishing (Ref. 1, p. 6).

One New River tributary, Stroubles Creek, is worth noting since it drains approximately one-third of the RAAP main manufacturing area. Stroubles Creek, which is located in the eastern section of the main manufacturing area, flows in a northerly direction and enters the New River near the vicinity of SWMU No. 21. A large portion of the flow in Stroubles Creek is attributable to effluent from the Blacksburg Municipal Sewage Treatment Plant. No domestic drinking or recreational usage of this stream is occurring at this time (Ref. 3, p. 9).

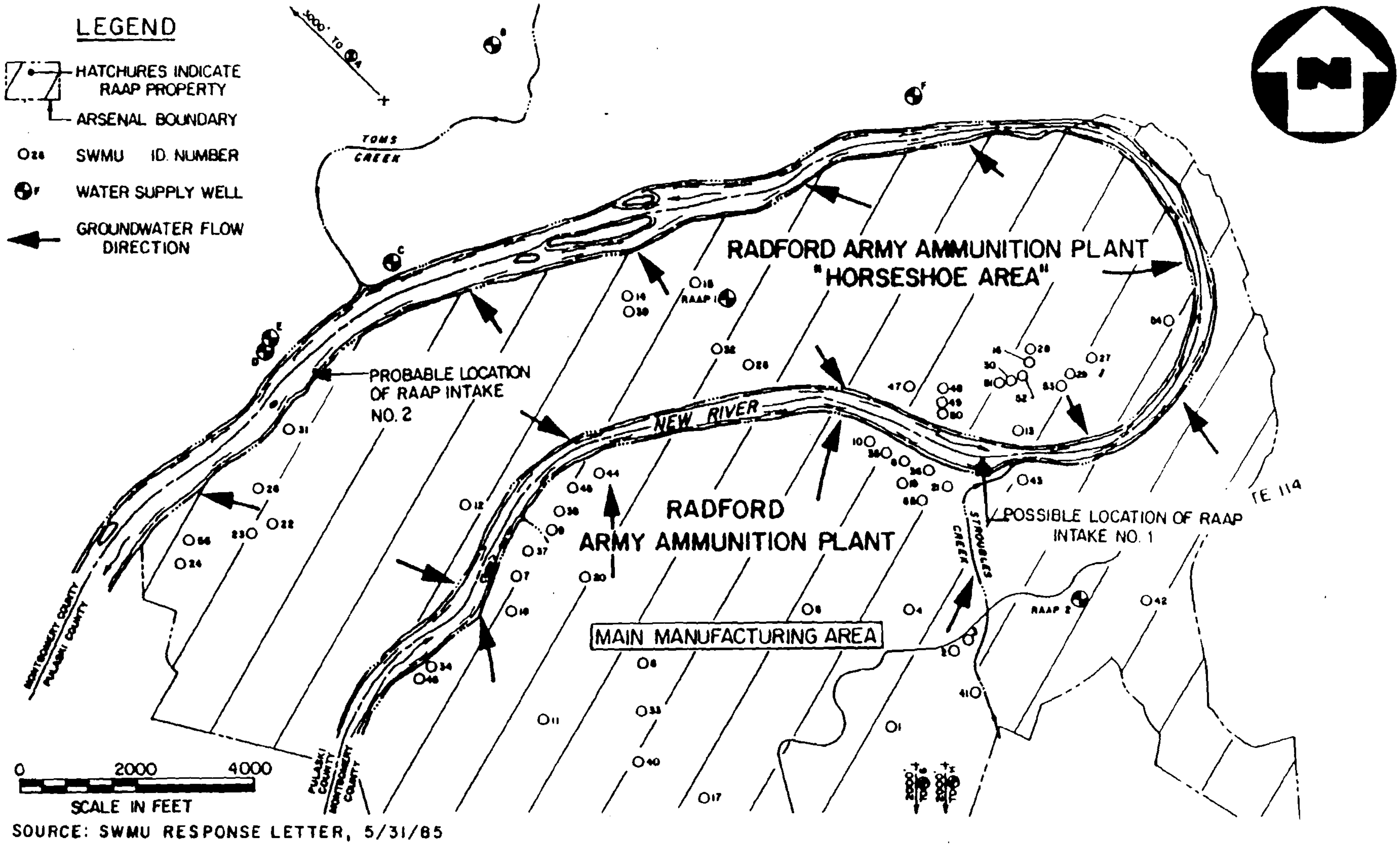

FIGURE 3-2

LOCATION OF WATER SUPPLY WELLS
RADFORD ARMY AMMUNITION PLANT

(Ref. 1, p. 16)

IV. SOLID WASTE MANAGEMENT UNITS

1. UNIT NAME: Red Water Storage Tank

Unit Description: This RCRA regulated unit is located in the south-eastern corner of the RAAP, approximately 6000 feet south of the Barracks complex. It is a 40 foot diameter, 32 foot high flat bottomed, closed head, welded stainless steel tank of approximately 250,000 gallon capacity. It is situated on a reinforced concrete footing/slab, inside a 78 foot by 78 foot by 8.5 foot high secondary containment dike. Since approximately 1970 this unit has been used for the temporary storage of Red Water, prior to shipment off-site, typically to paper mills for reuse in their digestors. Prior to 1970 and since its installation in 1968 it had been used for temporary storage of liquid wastes prior to incineration of its contents in one of five kilns (Area of Concern I). The unit is equipped with a 3 inch discharge line which runs along the floor of the diked area and over the west wall; this line is used to fill transport vehicles for shipment off-site. The tank is filled via aboveground pipes/gutters with hinged gutters from each of the remaining two TNT production areas (Ref. 6). Volume is tracked based on known redwater generation rates and compared against shipping loss for the off-site shipment of the waste.

Date of Start-Up: 1968 (Ref. 6).

Date of Closure: This unit is currently inactive. It has been inactive since the first quarter of calendar year 1987. Facility representatives were uncertain as to its ultimate fate. Trinitrotoluene production at RAAP is currently inactive. The facility is constructing a recovery system to recover sodium sulfite for reuse. Facility representatives were unable to clarify whether this unit was to be incorporated into the new system and/or remain as a contingency in the event of system failure, excess capacity, etc. (Ref. 5).

2224E-AM

1. UNIT NAME: Red Water Storage Tank (Cont'd)

Waste Managed: This unit manages waste water called "Red Water" generated in the manufacture of trinitrotoluene (TNT). Originally the facility operated 3 production lines for this material. One line (A line) exploded in May 1974 and has not been rebuilt (Area of Concern H), the remaining two lines (B and C) are currently inactive. Under normal operating conditions, the facility generates 45,000 to 50,000 gallons of redwater per day (Ref. 5).

Trinitrotoluene is produced when toluene is mixed with a solution of nitric and sulfuric acids under proper temperature conditions. Nitrate groups are gradually added to the toluene until the product consists of trinitrotoluene isomers. The product is then washed free of residual acids, crystallized and purified with sodium sulfite. The impure beta and gamma isomers are washed out of the alpha trinitrotoluene as soluble sulfonates, and the purified product is remelted, flaked and packaged. The water that is used to wash the impure TNT (beta and gamma TNT) from pure TNT (alpha TNT) is intensely red in color and is thus referred to as "Red Water." "Red Water" contains numerous TNT byproducts, including alpha, beta and gamma TNT isomers, and TNT sodium disulfonates. "Red Water" has an EPA hazardous waste identification number of K047. "Red Water" has a pH of approximately 8, specific gravity of 1.12 and is typically approximately 30% solids (Ref. 5 and 6).

Release Controls: The unit is located inside a 78 foot by 78 foot reinforced concrete containment dike of approximately 8.5 foot height, on a reinforced concrete continuous slab footing (Ref. 6).

Release History: No visible signs of release were observed during the VSI (Ref. 5).

2. UNIT NAME: TNT Wastewater Equalization Basin(s)

Unit Description: This RCRA regulated unit consists primarily of five (5) identical, contiguous below grade reinforced concrete equalization basins (Unit 2a). Each unit is approximately 80-100 feet long, 15-20 feet wide, and 10-15-feet deep. It is located approximately 600 feet east of the Barracks Complex, at an elevation of approximately 1700 feet Mean Sea Level (MSL), at the base of the hill on which the TNT production areas are situated. The unit is constructed so that the four outside walls of the continguous basins are completely visible; only the interior surfaces of the abutting or common walls are visible. A reinforced concrete, steel grated sump gallery (Unit 2c) runs along the entire length of one wall, at its base. This gallery is approximately 4 feet wide and 1-2 feet deep. It accommodates valves and piping between the basins and the final discharge pipe leading to the TNT waste- water treatment system (Unit 3) (Ref. 5 and 6). The units operate in series, with each flowing into the next via piping and valving located in the Sump Gallery (Unit 2C).

Wastewater is gravity conveyed to this unit from the TNT production area via an 8-inch (approximately) stainless steel gutter (Unit 2B) constructed with welded joints, gasketted expansion joints and equipped in some places with hinged covers. Use of these gutters versus conventional pipes is primarily to accommodate ease of maintenance and cleaning since when above the saturation point TNT will solidify. These gutters are mounted in secondary containment concrete flumes, approximately 3 feet wide by 6-8 inches deep (Ref. 5 and 6).

Date of Start-Up: 1968 (Ref. 6).

Date of Closure: This unit is currently inactive due the inactive state of the TNT manufacturing operation. The units were being cleaned and decontaminated during the VSI (Ref. 5). All of the basins were observed to be essentially empty, except for

2. UNIT NAME: TNT Wastewater Equalization Basin(s) (Cont'd)

minimal volumes of accumulated storm water and residual sludge deposits on the interior surfaces of the basins.

Waste Managed: This unit manages wastewaters from the handling of TNT in the TNT manufacturing areas. It is referred to as "Pink Water". "Pink Water" is differentiated from "Red Water" in that the former is essentially dilute TNT versus the latter having various other contaminants than just TNT (Unit 1, waste managed). "Pink Water" is a listed hazardous waste (K047) with a pH of approximately 2 to 3 (Ref. 6).

Release Controls: The unit is a contiguous series of reinforced concrete basins, whose four outside walls are entirely visible. The unit is equipped with a concrete sump gallery to accommodate process piping/valves and any overflow or unit rupture. The appurtenant gutters are mounted inside a concrete flume to capture any overflow or rupture (Ref. 5 and 6).

Release History: Some visible signs of degradation and release to the sump gallery were observed during the April 1987 VSI. Such degradation was most noticeable at the wall joints of the first two (2) basins. No visual evidence of release was observed during the VSI from the stainless steel gutters and/or concrete flumes. No visual signs of cracking or degradation were obeserved during the VSI on the floors of the five settling basins.

3. UNIT NAME: TNT Wastewater Treatment Unit

Unit Description: This RCRA regulated unit is located immediately north and adjacent to the TNT Wastewater Equalization Basins (Unit 2). It manages the equalized "Pink Water" effluent from that unit. It consists of the following series of components prior to discharge through NPDES permitted outfall No. 012 to the New River (Ref. 5).

a. Primary Neutralization Tank (1)
b. Sludge Settling/Equalization Basin No. 1
c. Neutralization Mix Tank
d. Diatomaceous Earth Filter
e. Treated Water Surge Tanks (~~2~~ 1) and untreated [illegible]
f. Activated Carbon Columns (2)
g. Spent Carbon Storage Area
h. Final Equalization Basin No. 2
i. Final Neutralization Tank
j. Parshall Flume
k. Activated Carbon Dust Collector

The unit's purpose is to neutralize "Pink Water," filter it to remove organics prior to commingling/dilution with noncontact cooling water and subsequent discharge via the NPDES outfall (Ref. 5).

a. Primary Neutralization Tank

This unit is an above ground carbon steel tank located on a concrete footing, with no secondary containment. It is approximately 8-10 feet high and 6-8 feet in diameter. It receives the initial influent from Unit 2 and accomplishes the primary neutralization by mechanical mixing with soda ash. It discharges to the Sludge Settling/Equalization Basin No. 1 (Unit 3b).

3. <u>UNIT NAME</u>: TNT Wastewater Treatment Unit (Cont'd)

b. <u>Sludge Settling/Equalization Basin No. 1</u>

This unit is a 2 compartment, abovegrade, reinforced concrete basin. It is approximately 40 feet long by 15-20 feet wide and 6 to 8 feet deep. The influent (sludge settling) side is covered with corrugated fiberglass and receives neutralized pink water from Unit 3a. The sludge precipitates out and the wastewater overflows into the equalization basin No. 1, which is uncovered. This unit discharges to the Neutralization Mix Tank (Unit 3c). 7

c. <u>Neutralization Mix Tank</u>

This unit is located immediately north and slightly downgradient from Unit 3b. It is identical in construction and purpose to Unit 3a.

d. <u>Diatomaceous Earth Filters</u>

These units are located inside the Treatment Building on the north side of the building. This unit serves to remove any residual/ propellant from the wastewater. Approximately 100 lbs/day of sludge is generated by this unit. This sludge is temporarily stored in 20 gallon open-head containers prior to conveyance via truck to the Open Burning Ground (Unit 13) for incineration.

e. <u>Treated Water Surge Tanks</u>

These tanks are above ground closed-head carbon steel, flat bottomed storage tanks, situated on a concrete footing with no secondary containment, immediately outside the southern wall of the Treatment Building. They serve to equalize and moderate flow between the Diatomaceous Earth Filter (Unit 3d) to the Activated Carbon Columns (Unit 3f).

3. <u>UNIT NAME:</u> TNT Wastewater Treatment Unit (Cont'd)

f. <u>Activated Carbon Columns</u>

These two columns are standard recirculating flow-through units, approximately 5 feet in diameter and 60 feet high, mounted on the southern wall of the treatment building. They receive influent from Unit 3e and discharge to the Final Equalization Basin No. 2 (Unit 3h). The retention time in the unit is unknown.

g. <u>Spent Activated Carbon Storage Area</u>

During the April 1987 VSI this unit was located on the ground floor of the Treatment Building. It is a open, concrete-floored area, approximately 20 feet by 40 feet, with no secondary containment, except for that afforded by the outside structural walls of the building. Approximately 40-50 50-gallon containers of K045 and/or K047 hazardous waste were observed to be stored in this area during the April 1987 VSI.

The prior VSI (July 1986 - Ref. 6) had identified this area as outside and behind the Treatment building, but no containers were observed outside of the building during the April 1987 VSI.

h. <u>Final Equalization Basin No. 2</u>

This unit is identical in construction and dimensions to Unit 3a. It receives effluent treated wastewater from Unit No. 3f, the Activated Carbon Columns and cascades and gravity flows to Unit 3i, the Final Neutralization tank.

i. <u>Final Neutralization Tank</u>

This unit is identical in basic purpose and materials of construction to Units 3a and 3c. It provides final neutralization with soda ash prior to discharge to the New River via the Parshall flume (Unit 3i).

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3. UNIT NAME: TNT Wastewater Treatment Unit (Cont'd)

j. Parshall Flume

This unit is a standard design, concrete Parshall flume that serves as the final discharge monitoring point for TNT wastewater prior to discharge to the New River.

k. Activated Carbon Dust Collector

This unit serves as a dust collector for activated carbon fines generated during recharging of the two activated carbon columns (Unit 3f). It is located immediately outside of the Treatment building. Facility representatives indicated that its collection bin was emptied on an as needed basis. Any captured material was placed into a spent carbon container and returned to the supplier for regeneration. Unit operates similarily to a small baghouse by exhausting air from the recharge point and drawing it through this unit to capture fugitive dusts (Ref. 5).

Date of Start-up: Unknown.

Date of Closure: This unit is currently active (Ref. 5).

Waste Managed: "Pink Water" is formed during the TNT purification and handling process. It typically has a pH of 3 and is currently a characteristic hazardous waste (D002). The facility has received approval on an exclusion petition with respect to the delisting of its "pink water" as a reactive waste (Ref. 5 and 6).

Release Controls: The only release controls for any of these units, except for those located inside the building (Units 3d and 3g), are the design characteristics of the units themselves. There are no secondary containment provisions for any of the units located outside.

3. <u>UNIT NAME</u>: TNT Wastewater Treatment Unit (Cont'd)

Release History: No visual signs of release were observed during the April 1987 VSI (Ref. 5). The previous VSI (July 1986) noted some leakage from the sides of the Equalization Basins (Unit 3b, 3h) however this was not evident during the April 1987 VSI. Some minor spillage was observed inside the building in the Diatomaceous Earth Filtration Area.

4. UNIT NAME: Acidic Wastewater Lagoon (Southeast Corner - RAAP)

Unit Description: This RCRA regulated unit is a below grade polymeric membrane lined surface impoundment, located in the southeast corner of the RAAP, approximately 1000 feet north of the barracks complex. Table 4-1 describes the construction details for this unit (Ref. 1).

Date of Start-Up: 1974 (Ref. 6).

Date of Closure: This unit is currently active. The RAAP is currently seeking a RCRA permit for this unit (Ref. 5).

Waste Managed: This unit receives acidic wastewater from nitrocellulose lines A and B as well as acidic runoff from the Acidic Wastewater Lagoon (Unit 5) located in the central section of the main manufacturing area. The wastewater exhibits the characteristics of a corrosive liquid and is identified as a D002 hazardous waste. It contains nitric acid, sulfuric acid and nitrocellulose fines in varying ratios dependent upon the grade of nitrocellulose manufactured. The total acidity of the wastewater is generally less than 170 mg/l and the pH is usually between 1.5 and 1.6. Facility representatives were unable to provide information relative to compatibility of the liner material and the acidic wastewaters. They were also unable to describe historical wastewater management practices.

Release Controls: Table 4-1 describes the materials of construction and release controls for this unit.

Release History: Tables 4-2 and 4-3 provides evidence of release from this unit to groundwater.

TABLE 4-1

SUMMARY OF DATA FOR SWMU NO. 4
RADFORD ARMY AMMUNITION PLANT

Type of Facility:	Lined surface impoundment.
Use:	Acidic wastewater equalization basin.
Dimensions:	Top of Berm: 306' x 226' Impoundment Base: 245.5' x 165.5' Height: 10'
Capacity:	Operating: 2,700,000 gallons Maximum: 4,100,000 gallons
Waste Description:	Acid tank washdown waters, spills, and runoff from HWM 5 as well as nitrocellulose wash waters containing H_2SO_4 and HNO_3. Wastes are characterized as D002 (Corrosive).
Type of Primary Liner:	Chlorinated polyethylene
Thickness:	Impoundment Base: 30 mil, reinforced Impoundment Sides: 36 mils, unreinforced
Liner Cover Material:	12 inches of sand at the base of the impoundment; 6 inches of sand covered with 6 inches of Type B riprap on side slopes.
Submonitoring Zone:	None
Secondary Liner:	None
Subbase Materials:	In-place soils, top 6" compacted to 92% of maximum density
Liquid Elevations:	1,732 feet to 1,737 feet
Elevation at Top of Berm:	1,740 feet
Freeboard:	3 feet

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

TABLE 4-2

SWMU NO. 4
RESULTS OF STATISTICAL COMPARISONS,
GROUNDWATER CONTAMINATION INDICATOR PARAMETERS
RADFORD ARMY AMMUNITION PLANT

	Specific Conductance	Total Organic Carbon	Total Organic Halogen	pH
Classical Student's t-Test				
Upgradient Well Comparison				
HWM 4 - Well W-1 (S4W1)	--- Upgradient Well ---			
HWM 4 - Well W-3 (S4W3)	N	N	N	N
HWM 4 - Well W-4 (S4W4)	N	N	N	SH
Each Well Compared to Itself				
HWM 4 - Well W-1 (S4W1)	N	N	N	SL
HWM 4 - Well W-3 (S4W3)	N	N	N	N
HWM 4 - Well W-4 (S4W4)	N	N	N	N
Cochran's Approximation				
Upgradient Well Comparison				
HWM 4 - Well W-1 (S4W1)	--- Upgradient Well ---			
HWM 4 - Well W-3 (S4W3)	SH	N	N	N
HWM 4 - Well W-4 (S4W4)	SH	N	N	SH
Each Well Compared to Itself				
HWM 4 - Well W-1 (S4W1)	N	N	N	SL
HWM 4 - Well W-3 (S4W3)	SH	SH	N	N
HWM 4 - Well W-4 (S4W4)	N	N	N	N

N - No significant change
SH - Significantly higher
SL - Significantly lower

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

TABLE 4-3

SWMU NO. 4
PHASE 1 ASSESSMENT RESULTS
GROUNDWATER ANALYTICAL DATA
RADFORD ARMY AMMUNITION PLANT

Parameter	Analytical Results			
	Well Number			
	P-3	W-4B	W-3	W-2B
pH	7.4	6.7	7.0	7.4
Specific Conductance (μmhos/cm)	550.0	2,300.0	520.0	640.0
Sulfate (mg/L)	69.0	580.0	54.0	33.0
NO_2 + NO_3 as N (mg/L)	<0.05	138.0	0.21	2.70
Total Dissolved Solids (mg/L)	408.0	2,340.0	329.0	422.0

Source: RAAP Part B Permit Application (Ref. 3).

(No information was available on the exact location of these wells.)

5. UNIT NAME: Acidic Wastewater Lagoon (Central Section of Main Manufacturing Area)

Unit Description: This RCRA regulated unit is located in the central section of the main manufacturing area. Table 4-4 provides unit dimensions and construction details. It is a hypalon lined surface impoundment designed to serve as a holding basin for runoff, spills, and washdown water from the acid tank farm; its effluent gravity flows via an underground pipe to Unit 4, the Acidic Wastewater Lagoon, located in the southeast corner of the RAAP. Influent to this unit flows via gravity in an underground pipe from basins in the tank farm (Ref. 6).

Date of Start-Up: 1974 (Ref. 6).

Date of Closure: The facility is seeking a closure/post-closure permit from the State of Virginia as a component of their RCRA Part B permitting process (Ref. 6). It is unknown what the plans are for waste removal from the unit (Ref. 5).

Waste Managed: Table 4-5 provides an analysis of the wastewater typically managed in this unit. The wastewater exhibits the characteristics of a corrosive liquid and is classified as a D002 hazardous waste (Ref. 6).

Release Controls: Table 4-4 provides a description of the unit's construction details, which serve as the primary release controls. The unit overflows into Unit 4, thereby typically maintaining adequate freeboard as depicted in the photo log. According to Facility representatives, under normal operating conditions the unit is maintained with a two foot freeboard (Ref. 5).

Release History: Tables 4-6 and 4-7 depict evidence of release from this unit to groundwater and surrounding soils (Ref. 6).

TABLE 4-4

SUMMARY OF DATA FOR SWMU NO. 5
RADFORD ARMY AMMUNITION PLANT

Type of Facility:	Lined Surface Impoundment
Use:	Acidic wastewater holding basin
Dimensions:	Top of Berm: 160' x 90' Bottom: 136' x 66' Height: 6'
Capacity:	Operating: 140,000 gallons Maximum: 300,000 gallons
Waste Source:	Acid leaks and spills and rainwater
Waste Type:	Corrosive (EPA Hazardous Waste No. D002)
Liner Material:	Hypalon
Liner Thickness:	Sides: 60 mil Bottom: 60 mil
Liner Cover Material:	12 inches of granite sand in the bottom 6 inches of granite sand with 6 inches granite riprap on the side slopes
Liner/Waste Compatability:	Rated "good" according to a report written by Wyss, et al.
Operating Range (liquid level elevations):	1,774 to 1,776 ft. Mean Sea Level (MSL)
Elevation at top of berm:	1,778 ft. MSL
Freeboard:	2 feet

Source: RAAP Part B Permit Application (Ref. 3).

TABLE 4-5

SWMU NO. 5
RESULTS OF ANALYSIS OF INFLUENT WASTE SAMPLE
TAKEN DURING LOW FLOW
(USAEHA, December 1981)
RADFORD ARMY AMMUNITION PLANT

Parameter	Measurement
pH	1.5
As	Not Detected (ND)
Ba	ND
Cd	0.029 mg/l
Cr	0.20 mg/l
Pb	ND
Hg	0.020 mg/l
Se	ND
Ag	ND

Source: RAAP Part B Permit Application (Ref. 3).

TABLE 4-6

SUMMARY OF GROUNDWATER DATA STATISTICAL ANALYSIS
FOR SWMU NO. 5
RADFORD ARMY AMMUNITION PLANT

	Specific Conductance	Total Organic Carbon	Total Organic Halogen	pH
Classical Student's t-Test				
Upgradient Well Comparison				
HWM 5 - Well W-8 (S5W8)	--- Upgradient Well ---			
HWM 5 - Well W-5 (S5W5)	N	SH	N	SH
HWM 5 - Well W-6 (S5W6)	N	N	N	SH
HWM 5 - Well W-7 (S5W7)	N	SH	N	SH
Each Well Compared to Itself				
HWM 5 - Well W-8 (S5W8)	N	SH	N	N
HWM 5 - Well W-5 (S5W5)	N	N	N	SH
HWM 5 - Well W-6 (S5W6)	N	SH	N	SH
HWM 5 - Well W-7 (S5W7)	N	N	N	SH
Cochran's Approximation				
Upgradient Well Comparison				
HWM 5 - Well W-8 (S5W8)	--- Upgradient Well ---			
HWM 5 - Well W-5 (S5W5)	N	SH	N	SH
HWM 5 - Well W-6 (S5W6)	N	N	N	SH
HWM 5 - Well W-7 (S5W7)	N	SH	N	SH
Each Well Compared to Itself				
HWM 5 - Well W-8 (S5W8)	N	SH	N	SL
HWM 5 - Well W-5 (S5W5)	SH	N	N	SH
HWM 5 - Well W-6 (S5W6)	N	SH	N	SH
HWM 5 - Well W-7 (S5W7)	N	N	N	SH

SH - Significantly higher
SL - Significantly lower
N - No significant change

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

TABLE 4-7

MONITORING RESULTS INDICATING GROUNDWATER
QUALITY AT SWMU NO. 5
RADFORD ARMY AMMUNITION PLANT

Groundwater[1] Monitoring Parameter	Upgradient Wells		Downgradient Wells			Drinking Water Standards
	W8B	W8	W5B	W6	W7B	
Nitrate (mg/l)	5.30	285	56	26	104	10
Sulfate (mg/l)	1.0	2125	100	149	210	250
Chloride (mg/l)	NC	35	62	14	49	250
Maganese (mg/l)	0.068	44.2	0.296	0.605	9.090	0.05
pH (units)	4.9	3.4	5.6	5.0	3.2	6.5-8.5
Spec.Cond. (UMC)	110	3900	710	493	1825	-
Arsenic[2] (mg/l)	ND ND	0.174 2.670	ND 0.286	ND ND	0.148 0.156	0.05
Chromium[2] (mg/l)	ND ND	0.097 0.132	0.02 0.010	0.003 0.004	0.085 0.101	0.05
Mercury[2] (UGL)	ND ND	0.2 11.8	0.02 0.6	0.2 ND	0.3 ND	2.0

1 From samples collected August 28, 1984, except for sulfate and chloride, analyzed from April 26, 1983 samples.

2 Results of filtered and unfiltered sample analyses, respectively.

NOTES: ND - Not detected
NC - Not collected
Spec. Cond. - Specific conductance
UMC - Micromhos per centimeter
UGL - Micrograms per liter

Source: RAAP Part B Permit Application (Ref. 3).

(No information was available on the exact location of these wells.)

6. UNIT NAME: Acidic Wastewater Lagoon

Unit Description: This unit lies in the central part of the main manufacturing area, approximately 2,000 feet northwest of the administration area. The unit is a tear-drop shaped catch pond for run-off from the nitrocellulose operation. The lagoon is approximately 80 by 30 feet at its widest point (Ref. 1, p. 34). The depth of the unit is unknown.

Date of Start-Up: The unit began operation in 1974 (Ref. 1, p. 34).

Date of Closure: The lagoon has not been operated since 1980. No apparent closure has taken place at this unit (Ref. 1, p. 39).

Waste Managed: The unit received wastewater flows similar to those of Unit 5. Potential constituents were primarily lead, nickel, and chromium. Nitrocellulose from surface run-off in the area may have been contained within influent wastewater (Ref. 4, p. 6).

Release Controls: The unit is unlined. There are no overflow controls, under normal operating conditions the unit is inspected by facility personnel (Ref. 5).

Release History: Soil samples taken at the site show trace amounts of nitrocellulose in three of six samples (Ref. 4, p. 6).

7. UNIT NAME: Acidic and Caustic Wastewater Lagoon

Unit Description: This RCRA regulated unit is located in the western part of the main manufacturing area, approximately 175 feet southeast of the New River. The unit is an unlined surface impoundment used as a retention and neutralization basin for spills, stormwater, and washdown water from acid tanks in the Oleum plant area. Table 4-8 provides the construction details of the unit. Wastewater is conveyed to this unit from various diked areas in the Oleum plant via gravity flow in 12 inch diameter underground vitrified clay process sewer pipes (Ref. 6).

Waste caustic (lime or soda ash) is hauled to this unit via transport trucks and mixed with the acidic waters with two air diffusers, to effect neutralization of the two waste streams. After neutralization, the resultant slurry is pumped to the Calcium Sulfate Settling Lagoons (Unit 9) via an approximately 30 foot length of hose and portable pump arrangement (Ref. 6).

Date of Start-Up: Unknown.

Date of Closure: This unit is currently active. RAAP was conducting pumping and cleaning operations during the April 1987 VSI (Ref. 5) in anticipation of closure/post-closure activities, currently under consideration by the State of Virginia as a component of the Part B Permit application.

Waste Managed: This unit managed acidic wastewater which resulted from the Oleum production operations. Waste caustic from the propellant drying operations is used to neutralize the acidic wastewaters. Table 4-9 provides a characterizations of these wastewaters. The Part B application indicates that the pH of the unit's contents is frequently acidic or basic and therefore exhibits the characteristics of corrosive liquid and is thus designated as a D002 hazardous waste (Ref. 6).

TABLE 4-8

SUMMARY OF DATA FOR SWMU NO.7
RADFORD ARMY AMMUNITION PLANT

Type of Facility:	Unlined Surface Impoundment
Use:	Acidic and caustic wastewater holding basin
Dimensions:	Top of berm: 160' x 90' Bottom: 110' x 40' Height: 12'
Capacity:	Operating: * Maximum: *
Waste Source:	Oleum plant leaks and spills, rainwater
Waste Type:	Corrosive (EPA Hazardous Waste No. D002)
Liner Material:	N/A **
Liner Thickness:	Sides: N/A Bottom: N/A
Liner Cover Material:	None
Operating Range (liquid level elevations):	1,700 to 1,710 ft. MSL
Elevation at top of berm:	1,712 ft. MSL
Freeboard:	2 feet

* Data were not provided in the Part B Permit Application. The SWMU response letter indicates a volume of 0.6 million gallons.

** The Part B Permit Application table from which this information was obtained erroneously indicated a Hypalon liner for this unit. The text, however, stated that this unit is unlined.

Source: RAAP Part B Permit Application (Ref. 3).

TABLE 4-9

RESULTS OF ANALYSIS OF LAGOON WATER
AND SEDIMENT SAMPLES FROM SWMU NO. 7
RADFORD ARMY AMMUNITION PLANT

Parameter	Lagoon Water	Sediment
pH	11.4	--
As	Not Detected	ND
Ba	ND	0.33 mg/l
Cd	0.016 mg/l	0.027 mg/l
Cr	ND	0.73 mg/l
Pb	ND	0.58 mg/l
Hg	ND	ND
Se	ND	ND
Ag	ND	0.027 mg/l

Source: RAAP Part B Permit Application (Ref. 3).

7. <u>UNIT NAME</u>: Acidic and Caustic Wastewater Lagoon (Cont'd)

<u>Release Controls</u>: The lagoon is unlined. The unit's details of construction are provided in Table 4-8 (Ref. 6).

<u>Release History</u>: Visual observations during the April 1987 VSI indicate significant soil discoloration and white chalky residue deposits on the lagoon embankments (Ref. 5). Table 4-10 documents the evidence of release to the groundwater and thereby the soils from this unit (Ref. 6).

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TABLE 4-10

MONITORING RESULTS INDICATING GROUNDWATER QUALITY AT SWMU NO. 7 RADFORD ARMY AMMUNITION PLANT

Groundwater[1] Monitoring Parameter		Upgradient Well	Downgradient Wells			Drinking Water Standards
		W-12B	W-9	W-10B	W-11B	
Nitrate	(mg/l)	4.70	138	23	301	10
Sulfate	(mg/l)	149	1336	1943	2593	250
Chloride	(mg/l)	6.0	16	-	21	250
Manganese	(mg/l)	.246	6.05	.625	2970	0.05
pH	(units)	7.5	6.9	7.0	4.3	6.5-8.5
Spec. Cond.	(UMC)	740	3000	3400	5200	-
TOC	(mg/l)	1.5	5.0	6.5	19	-
TDS	(mg/l)	501	3139	3518	5096	-
Cadmium[2]	(UGL)	ND	1.0	ND	13.3	10
		ND	1.5	ND	13.7	
Chromium[2]	(mg/l)	0.005	0.002	0.001	0.078	0.05
		0.008	0.027	0.002	0.080	

1 From samples collected August 29, 1984, except for chloride, analyzed from May 2, 1983 samples.

2 Results of duplicate sample analysis.

NOTES: ND - Not detected
TOC - Total Organic Carbon
TDS - Total Dissolved Solids
UMC - Micromhos per centimeter
UGL - Microgram per liter

Source: RAAP Groundwater Monitoring Data compiled by BCM, 1984 RAAP Part B Permit Application (Ref. 3).

8. UNIT NAME: Calcium Sulfate Settling Lagoon (2) (A-B Line Acidic Wastewater)

Unit Description: This unit is located in the northeast section of the main manufacturing area, and is comprised of 2 unlined below grade earthen lagoons (Units 8a and 8b). Each lagoon is approximately 200 feet long by 150 feet wide by 10 feet deep. The units are operated on an alternating basis to accommodate maintenance and cleaning (dredging) operations. These units receive treated wastewater from the Acidic Wastewater Treatment Plant (Unit 19) (Ref. 6).

The waste water flows through a series of weir gates and is subsequently discharged to the New River via NPDES outfall 007, adjacent to the unit. Calcium sulfate sludge precipitates and settles to the bottom of the lagoon. Sludge is dredged on a periodic basis when the other lagoon is put into service. Sludge is placed in adjacent drying beds (Units 35 and 36), located to the east of unit 8a and to the west of 8b (Ref. 6).

Date of Start-Up: Unknown.

Date of Closure: This unit(s) is currently active (Ref. 5).

Waste Managed: This unit manages neutralized, formerly acidic wastewater from the A-B Line Acidic Wastewater Treatment Plant, (Unit 19) (Ref. 5).

The calcium sulfate sludge results from the neutralization of H_2SO_4. The chemical equation shown below describes the reaction that occurs:

$CA(OH)_2$	+	H_2SO_4	$\rightleftharpoons$	$CaSO_4$	+	$2H_2O$
(Hydrated Lime)		(Sulfuric Acid)		(Calcium Sulfate)		(Water)

Sludge analyses are described in a January 14, 1982 memo from T. W. Ewing to R. J. Jenrettee. According to this memo, the sludge was analyzed for reactivity. The results of this test are summarized in Tables 4-11 and 4-12. The data

TABLE 4-11

CHEMICAL ANALYSIS OF SLUDGE FROM
A-B SETTLING LAGOON (403-2)
SWMU NO. 8
RADFORD ARMY AMMUNITION PLANT

1. Microscopic examination indicated that each of 6 samples tested contained less than one percent visible nitrocellulose fibers and that the majority of solids are calcium sulfate.

2. Percent of solids remaining after drying sludge samples at 100°C (212°F):

	Sample Number					
	1	2	3	4	5	6
Percent solids left after 100°C drying	27.1	26.97	26.26	23.86	22.30	25.54

2. Percent of solids volatized when a dried sludge sample was placed into a muffle furnace at 816°C (1500°F):

	Sample Number					
	1	2	3	4	5	6
Percent Volatized at 816°C	27.37	27.36	27.46	27.81	27.88	27.74

<u>NOTE</u>: Calcium sulfate at 100°C contains 20.93 percent water. Therefore, a major portion of the volatile material is water driven off from the samples during heating to 816°C. The remaining 6 to 7 percent of volatized materials include nitrocellulose (NC) and other organics.

4. Samples placed into a Bunsen burner flame showed no visual evidence of burning.

5. Tests detected no nitrates or nitrate esters in the samples.

Source: RAAP Part B Permit Application (Ref. 3).

TABLE 4-12

IGNITION SENSITIVITY OF NC LINE
SETTLING LAGOON SLUDGES
SWMU NO. 8
RADFORD ARMY AMMUNITION PLANT

Test 1/	Result
1. Sample subjected to temperature of 75°C (167°F) for 48 consecutive hours.	No reaction
2. Sample exposed to flame produced by a 3-gram bag igniter 2/	Some scorching on top of sample. No evidence of sample reaction.
3. Sample subjected to detonation reaction of a No. 8 blasting cap.	No reaction
4. Sample impacted by an 8-pound weight 3/ from a 10-inch drop height.	No noise; no explosion; some smoke and odor from 9 of 10 trials; samples essentially intact after trials.

NOTES:

1/ Sample tested was sludge from A-B-Line Settling Lagoon (see Table 1) with 26 percent NC (12.6 percent N) added.

2/ Igniter consists of a 50:50 mixture of FFFG black powder and 2056D casting powder, and a M100 Atlas Match.

3/ The standard Bureau of Explosives Impact Apparatus was used for this test.

Source: As originally described in Ref. 6.

8. UNIT NAME: Calcium Sulfate Settling Lagoon (2) (A-B Line Acidic (Wastewater) (Cont'd)

show that the sludge is not a reactive waste. However, the reactivity test is only one of a series of tests that must be performed in order to determine the waste characteristics of the sludge (Ref. 6).

During the NUS investigation, a sludge sample was collected from Unit 8 and found to be non-hazardous for E.P. Toxicity, reactivity, corrosivity, and ignitability. However, only one sample was analyzed and no attempt was made to search for those compounds listed as hazardous under 40 CFR Part 261 Appendix VIII (Ref. 6).

It is likely that the sludge contains some organic compounds since organic compounds are used to manufacture the propellants produced at RAAP.

Release Controls: This unit consists of two (2) unlined earthen surface impoundment/lagoons. The overflow weir gate serves to moderate flow into the NPDES outfall. The alternate use of the associated two subunits affords some measure of release control since influent/effluent can be diverted into the other unit should the need arise (Ref. 5).

Release History: No visible signs of release were noted during the April 1987 (Ref. 5). Tables 4-13 and 4-14 provide documentation of releases to groundwater/ soils from this unit (Ref. 6).

TABLE 4-13

SUMMARY OF GROUNDWATER QUALITY DATA FOR SWMUs NO. 8 AND 9
RADFORD ARMY AMMUNITION PLANT

Parameter (mg/l)	Maximum Contaminant Level: Health Related[1]	Maximum Contaminant Level: Nonhealth Related[2]	Range: SWMU No. 8 Wells	Range: SWMU No. 9 Wells	Wells Exceeding the Contamination Level Specified: SWMU No. 8 Upgradient	SWMU No. 8 Downgradient	SWMU No. 9 Upgradient	SWMU No. 9 Downgradient
Fluoride	1.4-2.4		0.6 - 1.8	3.8 - 35	X	X	X	X
Iron		0.3	0.06 - 10	0.06 - 0.25	X	X		X
Manganese		0.05	0.02 - 0.41	<0.02 - 1.3	X	X		X
Nitrate	10		0.2 - 15	3.5 - 145	X	X		X
Dissolved Solids		500	224 - 1485	758 - 2580	X	X	X	X
Sulfate		250	11 - 830	210 - 1200		X		X

Sample Collection Date: October 2, 1980
Sample Analysis Date: November 12, 1980

1. Extracted from National Interim Primary Drinking Water Regulations (40 CFR Part 141)
2. Extracted from National Secondary Drinking Water Regulations (40 CFR Part 143)

Source: NUS Corporation, January 1981, Hydrogeologic Evaluation at RAAP

Source: As originally described in Ref. 6.

TABLE 4-14

ORGANIC COMPOUNDS FOUND IN GROUNDWATER SAMPLES FROM WELLS AT SWMUs NOS. 8 AND 9

Parameter (ug/l)	SWMU No. 8 Wells Up	SWMU No. 8 Wells Down	SWMU No. 9 Wells Up	SWMU No. 9 Wells Down
Benzene	<1	<1	<1	<1
1,2-dichloroethane	1			
1,1,1-trichloroethane	<1			
chloroform	3	2	1	2
1,1-dichloroethene	<1			
methylene chloride	5	3	2	3
pentachlorophenol				1
bis(2-ethylhexyl)phthalate	8	12, 10	259	299
butyl benzyl phthalate	2	1, 1	1	
di-n-butyl phthalate		5, 4	4	
di-n-octyl phthalate	<1			<1

Source: NUS Corporation, January 1981. Hydrogeologic Evaluation at RAAP. As originally described in Ref. 6.

9. UNIT NAME: Calcium Sulfate Settling Lagoons (2) (C Line Nitrocellulose Wastewater)

Unit Description: This unit is in the northwest area of the RAAP manufacturing facility. It consists of two (2) below grade unlined, earthen lagoons; (Unit 9a and 9b) each with approximate dimensions of 150 feet in length, 75 feet width and an 8-10 foot depth. They are operated in a similar manner to Unit 8 in that while one is operating the other is being dredged and maintained (Ref. 6).

The unit manages neutralized wastewater from the C Line Acidic Wastewater Treatment Plant (Unit 20). Influent is gravity-fed into the unit via an underground process sewer pipe, flows through a series of weir gates which facilitate the precipitation and settling of the calcium sulfate sludge. The effluent overflows a weir and is subsequently discharged to the New River via NPDES outfall No. 005. Sludge is dredged from the temporarily inactive units and placed in adjacent/drying beds (Ref. 6).

Date of Start-Up: Unknown.

Date of Closure: This unit is currently active (Ref. 5).

Waste Managed: This unit manages neutralized, formerly acidic wastewater from the C Line Nitrocellulose Acidic Wastewater Treatment Plant (Unit 20) (Ref. 6).

The calcium sulfate sludge results from the neutralization of H_2SO_4. The chemical equation shown below describes the reaction that occurs:

$Ca(OH)_2$	+	H_2SO_4	$\rightleftharpoons$	$CaSO_4$	+	$2H_2O$
(Hydrated Lime)		(Sulfuric Acid)		(Calcium Sulfate)		(Water)

During the NUS investigation, a sludge sample was collected and analyzed, and found to be non-hazardous for E.P. Toxicity, reactivity, corrosivity, and ignitability. Only one sample

9. UNIT NAME: Calcium Sulfate Settling Lagoons (2) (C Line Nitrocellulose Wastewater) (Cont'd)

was analyzed and no attempt was made to search for those constituents specifically listed as hazardous under 40 CFR Part 261 Appendix VIII (Ref. 6).

Release Controls: This unit consists of two (2) unlined earthen surface impoundments/lagoon. The overflow weir gate moderates flow into the associated NPDES outfall. The alternate use of the two (2) sub-units affords some measure of release control, since influent/effluent could be diverted into the temporarily inactive unit, should the need arise (Ref. 5).

Release History: No visible signs of release were noted during the April 1987 VSI (Ref. 5). Tables 4-13 and 4-14 provide documentation of releases to the ground-water and underlying soils (Ref. 6).

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10. UNIT NAME: Biological Treatment Plant and Equalization Basin

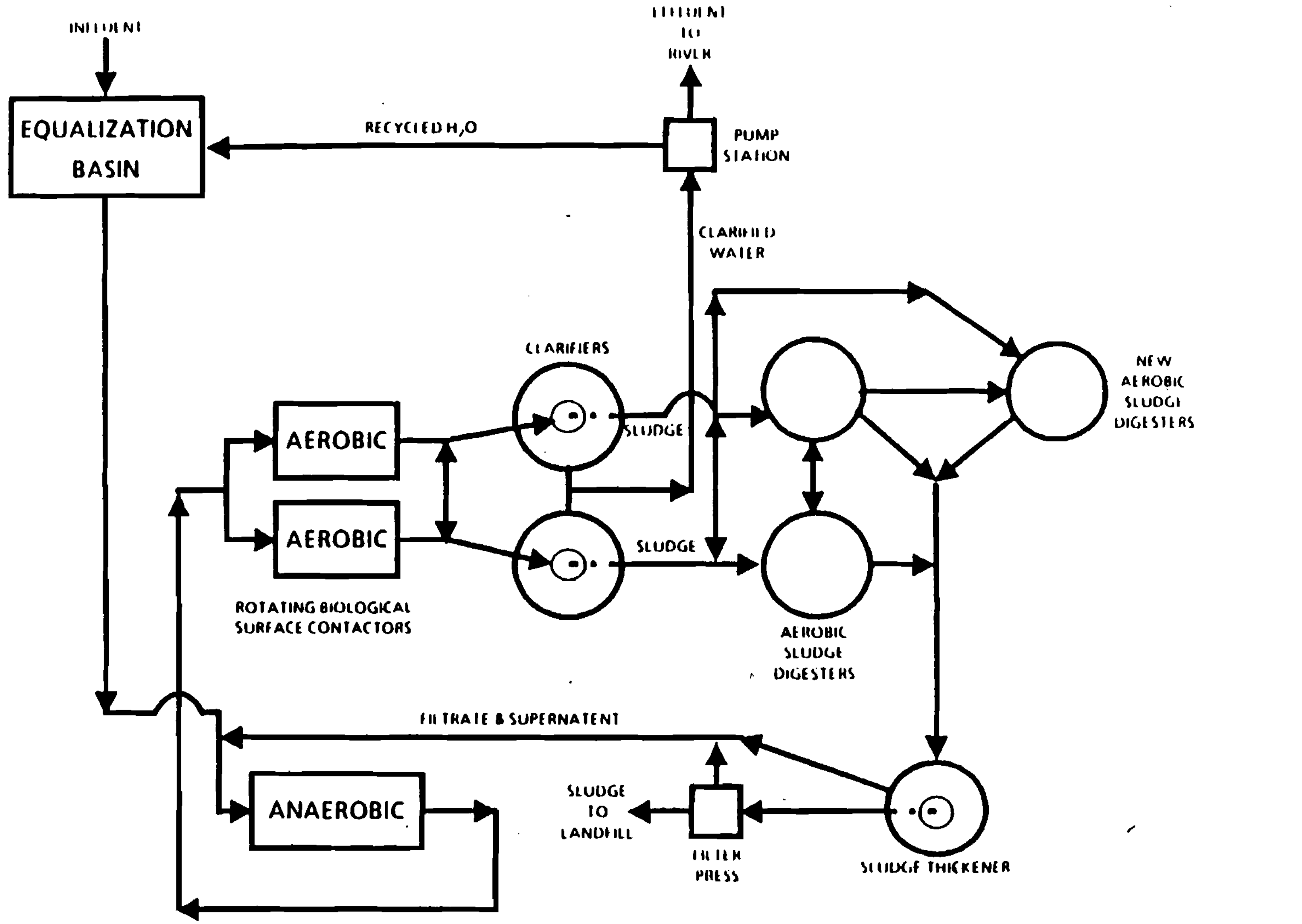
Unit Description: Unit No. 10 lies along the New River in the north central part of the main plant area. The following description of this facility is excerpted from NPDES file information:

The Biological Treatment Plant receives nonacidic wastewaters from propellant manufacturing (on both a batch and continuous basis) and pretreated wastewaters from nitroglycerin manufacturing (0.2 mgd) and alcohol rectification (1.48 mgd). A flow diagram of the biological treatment plant, as originally designed, is presented in Figure 4-1. Source specific volumes were unavailable for the propellant manufacturing operation. The treatment plant also receives wastes from the recovery of ethylether (Ref. 5).

Influent to the plant flows into an aerated equalization basin, which has a design capacity of 1,350,000 gallons. Aeration is provided by four surface aerators and two jet-injector type aerators, which have a combined horsepower of 60. From the equalization basin, the wastewater is pumped at a constant rate to the biological treatment system. As originally designed, the biological treatment system originally consisted of two parallel trains of six rotating biological contactors (RBCs). The first two RBCs in each train were designed to operate anaerobically; the remaining four units were to operate aerobically. Following start-up, it was discovered that the anaerobic RBCs were hindering plant performance; these units were subsequently taken offline. At the present time, the plant is operating with 8 aerobic RBCs online; these units have a total surface area of 611,200 ft^2. Plant personnel report that the RBCs are run as 3-stage systems, with the first two RBCs in each train operated as a single stage (Ref. 6).

From the RBC trains the wastewater flows to two circular, centerfeed, peripheral weir clarifiers. Clarified effluent is discharged to the New River at NPDES outfall 012 (Ref. 6).

Sludge handling consists of aerobic digestion, chemical conditioning, and belt press dewatering. Sludge is presently landfilled onsite at Unit 16. Solids' handling recycle streams flow to the head end of the RBC trains.



SOURCE NPDES FILE INFORMATION, 1986

FIGURE 4-1
SCHEMATIC DIAGRAM OF THE BIOLOGICAL TREATMENT PLANT & EQUALIZATION BASIN RADFORD ARMY AMMUNITION PLANT, RADFORD, VA

Source: As originally described in Ref. 6.

10. UNIT NAME: Biological Treatment Plant and Equalization Plant (Cont'd)

Unit Description: For the purposes of evaluating the unit the system consists of the following components:

a. Equalization Basin
b. Surface Aerators (4)
c. Jet-Injector Type Aerators (2)
d. Rotating Biological Contactors (6) - Two Parallel Trains
e. Rotating Biological Contactors (8)
f. Weir Clarifiers (2)
g. Aerobic Sludge Digestors (3)
h. Sludge Thickener
i. Belt Filter Press

10a. Equalization Basin

The equalization basin is approximately 80 feet wide by 150 feet long and of an undetermined depth. The containment walls are concrete and the basin is lined with a soil/cement/clay liner. Visual observation suggests that the unit was constructed by building the earthen berms so that the base of the unit is at or slightly below the natural grade of the south side of the basin. The basin's northern and eastern outside embankments are reinforced with rip rap. The basin is compartmentalized by suspended polymeric dividers to accommodate aeration/equalization (Ref. 5).

10b. Surface Aerators

The eastern and central compartments of the basin (Unit 10a.) are equipped with 2 surface aerators/compartment. These are propellant type subsurface aerators (Ref. 5).

10c. Jet Injector Type Aerators

The western compartment of the basin is equipped with a surface jet injection type aerator, prior to discharge to the rotating biological contactors (Ref. 5).

10d. and e. Rotating Biological Contactors

These units are located inside the treatment building and have been explained in the process description above.

10. UNIT NAME: Biological Treatment Plant and Equalization Basin (Cont'd)

Unit Description: 10f. Weir Clarifiers

The secondary clarifiers are inground concrete tanks. Each has a diameter of approximately 40 feet (Ref. 6). Facility representatives were unable to provide capacity and operational parameters for this unit.

10g. Sludge Digestor Tank (3)

The sludge digestor tanks are approximately 20 feet in diameter by 25 feet in height. They are constructed of welded steel and are situated on a concrete pad, with no secondary containment (Ref. 6).

10h. Sludge Thickener Tank

This tank is approximately 10-12 feet high of approximately equal diameter situated outside on a gravel base. It is used as the feed tank for the belt filter press.

10i. Belt Filter Press

This unit is located on the mezzanine level inside the treatment building and is equipped with an exhaust hood.

Date of Start-up: Unknown.

Date of Closure: This unit is currently active (Ref. 5).

Wastes Managed: The treatment plant receives wastes from the recovery of ethyl ether. This waste stream is classified as a RCRA F003 Hazardous Waste (Ref. 6). The Biological Treatment Plant receives non-acidic wastewaters from propellant manufacturing (on both a batch and continuous basis) and pre-treated wastewaters from nitroglycerin manufacturing (0.2 mgd) and alcohol rectification (1.48 mgd). Source specific volumes were unavailable for the propellant manufacturing operation (Ref. 5).

10. UNIT NAME: Biological Treatment Plant and Equalization Basin (Cont'd)

Waste Managed: According to the May 31, 1986 SWMU response letter, sludge samples from the treatment plant were evaluated in accordance with EPA SW-846 on two occasions: once during 1982 and once during 1983. A November 10, 1982 memorandum from M. R. Everett to John T. Bolen states that the sludge contained no nitroglycerin and less then 0.05 percent nitrocotton and did not exhibit explosive reactivity. The report also stated that the biomass byproduct sludge, after digestion, contained 90 percent organic material in the following ratio: $C_5H_7O_2N$. The remaining 10 percent consisted of inorganic oxides of phosphorus, sulfur, sodium, calcium, magnesium, potassium, and iron. The analysis also notes that the material is nonexplosive and relatively inert. A September 28, 1983 memorandum from G. W. Ayers to F. T. Kristoff indicates that sludge from the basin was evaluated in accordance with EPA SW-846. It is noted that the chemical analyses of this sludge indicates the following values: nitroglycerin, 0.01 percent; silicon dioxide, 0.5 percent; moisture, 6.3 percent; silicon dioxide, 69.0 percent; iron oxide, 1.3 percent; lead, 0.03 percent; and copper, 0.01 percent. Ayers notes that the "absence of large explosive" and "the sludge ... is not a reactive waste as defined by the USEPA SW-846 (1980) test criteria." The results of the EP toxicity test were also in this memo and are as follows:

EP Toxicity:

Silver	<0.1 mg/l	<0.1 mg/l
Arsenic	0.010 mg/l	0.008 mg/l
Barium	1.1 mg/l	0.9 mg/l
Cadmium	<0.1 mg/l	<0.1 mg/l
Chromium	0.3 mg/l	<0.1 mg/l
Mercury	0.0010 mg/l	0.0009 mg/l
Lead	0.2 mg/l	0.1 mg/l
Selenium	0.012 mg/l	0.0010 mg/l

Ignitability:	Not Ignitable at 60°C	Not Ignitable at 60°C
Corrosivity:	Not Corrosive	Not Corrosive
Reactivity:	Not Reactive	Not Reactive

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10. UNIT NAME: Biological Treatment Plant and Equalization Basin (Cont'd)

Release Controls: Except for the subunits located inside the treatment building (Rotating Biological Contactors and the Belt Filter Press) the only release controls for the other subunits are the design characteristics and integrity of the units themselves (Ref. 5).

Release History: No visible signs of release were observed during the April 1987 VSI (Ref. 5).

11. UNIT NAME: Nitroglycerin 1 Pretreatment

Unit Description: This facility is located within the main manufacturing area, approximately 350 feet northeast of the Rolled Powder Area. The function of this facility is to deactivate soluble nitroglycerin. The RAAP SWMU response letter reports that this unit treats 0.11 million gallons/day of soluble nitroglycerin. This is accomplished by raising the pH to greater than 11 with sodium hydroxide and then reducing the pH to approximately 9 with sulfuric acid. Lime slurry was formerly used in place of sodium hydroxide (Ref. 1, p. 53). The facility contains a series of components which are included as one SWMU; these components are listed as follows (Ref. 6):

11a. Sluice Waterway Gutter
11b. Lift Station Storage Tank
11c. Nitroglycerin Acidic Water Storage Feed Tanks (3)
11d. Batch Reaction Tanks (3)
11e. Lime Mix Tanks (4)
11f. Neutralization Tank
11g. Lime Batch Clarifiers (2)
11h. Sludge Holding Tank
11i. Sludge Hopper

A simplified interpretation of the treatment process is as follows: Desensitized nitroglycerin wastewater from Premix Area No. 1, containing primarily diethyleneglycol, is discharged to a Wooden Flume (Unit 11a) and transported to the Lift Station (906) Storage Tank (Unit 11b). This Lift Station Storage Tank is an open below-grade tank, constructed of stainless steel with unit dimensions of approximately five feet in diameter and eight feet deep. From the Lift Station Storage Tank the nitroglycerin wastewater is pumped to one of three Storage Feed Tanks (Unit 11c), as necessary. These are closed-top tanks constructed of stainless steel. Two of the tanks have an approximate capacity of 25,000 gallons, and the other approximately 20,000 gallons. Two

11. UNIT NAME: Nitroglycerin 1 Pretreatment (Cont'd)

Unit Description: of the tanks are steam-jacketed for heat addition and temperature control. All three tanks are constructed on cement supports with no secondary containment structure around the units (Ref. 5). From the storage feed tanks, the treatment process takes place in a concrete building housing three Batch Reaction Tanks (Unit 11d) and four Lime Mix Tanks (Unit 11e). The reaction tanks are constructed of stainless steel and are situated on elevated concrete pads. Two of the tanks have closed tops and one an open top (Ref. 5).

After the nitroglycerin is deactivated, the akaline wastewater is neutralized with sulfuric acid before being sent to the Biological Treatment Plant (Unit 10). The neutralization takes placed outside the building in an open-top steel Mix Tank (Unit 11f), which is situated on a concrete pad with no secondary containment (Ref. 5).

Several non-operating units remain from the former usage of lime as a caustic addition. These units include: four Lime Mix Tanks housed inside the pretreatment building, two Lime Batch Clarifiers, a Sludge Holding Tank, and a Sludge Hopper. The Clarifiers (Unit 11g) are below-grade, constructed of cement, and located outside the pretreatment building. The Sludge Holding Tank (Unit 11h) is located adjacent to the Clarifiers. This unit has an open top, and is constructed of stainless steel with an estimated capacity of 10,000 gallons. The Sludge Hopper (Unit 11i) is located adjacent to Unit 11h. Sludge from the holding tank was pumped to the hopper, then dumped to a truck for removal (Ref. 5).

Date of Start-Up: The sodium hydroxide reaction procedure has been in use since 1982-83. It is unknown when the lime units began operating (Ref. 5).

11. UNIT NAME: Nitroglycerin 1 Pretreatment (Cont'd)

Date of Closure: RAAP discontinued using and emptied units 11e, 11g, 11h and 11i in 1982-83; all other units are presently active (Ref. 5).

Waste Managed: Acidic nitroglycerin wastewaters with diethylene glycol (Ref. 5).

Release Controls:

11a. This unit is lined with stainless steel and covered top to prevent spills (Ref. 5).

11b. The unit is closed within a secondary containment structure with a concrete base and concrete walls (Ref. 5).

11c. The tanks are completely closed to the atmosphere. They are not enclosed within a secondary containment structure (Ref. 5).

11d. These tanks are located inside a building with a concrete base and floor drains that are connected to the Biological Treatment Plant (Unit 10) (Ref. 5).

11e. These tanks are located inside a building with a concrete base and floor drains that are connected to the Biological Treatment Plant (Unit 10) (Ref. 5).

11f. No secondary containment is provided for this tank. (Ref. 5).

11g. The clarifiers are constructed with spill over weirs that are connected by a below-ground pipe to the Neutralization Tank (Unit 11f) (Ref. 5).

11h. The unit is constructed on a concrete base with no secondary curbing to catch spills (Ref. 5).

11i. The unit is constructed above a paved area with no secondary curbing to catch spills (Ref. 5).

Release History: No releases were observed during the VSI from any of the units (Ref. 5).

12. UNIT NAME: Nitroglycerin Wastewater Pretreatment Plant

Unit Description: This facility is located within the south-central section of the "Horshoe Area" at an elevation of 1820 feet above MSL. The unit reportedly treats 0.15 million gallons/day of soluble nitroglycerin (Ref. 1, p. 54). The facility contains a series of components which are included as one SWMU; these components are:

12a. Lime Mix Tanks (4)
12b. Batch Reaction Tanks (2)
12c. Flocculation Tanks (2)
12d. Outside Batch Reaction Tanks (2)
12e. Flash In-line Mixers (2)

The former pretreatment process used at this facility was the treatment of influent acidic nitroglycerin wastewater with lime. Inside the pretreatment plant (9410) are four stainless steel Lime Mix Tanks (Unit 12a). These tanks, of an unknown capacity, are on concrete supports surrounded by the concrete flooring of the building. After the wastewater was mixed with lime, the product was pumped to one of two Flocculation Tanks (Unit 12c) located within the building. These flocculation tanks (Unit 12c), of an undetermined capacity, are constructed of stainless steel and built on steel supports raised more than 15 feet off the cement floor of the building. These units (12a and 12c) are no longer used (Ref. 5).

The present pretreatment process employs the use of sodium hydroxide to raise the pH to a level greater than 11.5. Two Batch Reaction Tanks are located inside the building (Unit 12b) and two are located outside the building (Unit 12d). The two located inside (Unit 12b) are approximately 20,000 gallons each. The two batch tanks located outside (Unit 12d) are built below grade, inside a secondary concrete containment structure (Ref. 5).

After the wastewater is mixed with sodium hydroxide, the effluent is treated with sulfuric acid in one of two Flash In-line Mixer Tanks

12. UNIT NAME: Nitroglycerin Wastewater Pretreatment Plant (Continued)

(Unit 12e) located outside of Building 9410. The mixers are built below grade and are of an undetermined capacity. One of the mixing tanks is constructed of fiberglass and the other of stainless steel (Ref. 5).

Date of Start-Up: Operations at the pretreatment plant reportedly started in 1977. The caustic reaction procedure has been in use since the early 1980s. The batch reaction tanks located outside the plant (Unit 12d) began operation in 1986 (Ref. 5).

Date of Closure: RAAP discontinued using Units 12a and 12c in the early 1980s. The other units are active (Ref. 5).

Waste Managed: Acidic nitroglycerin wastewater with diethylene glycol (Ref. 5).

Release Controls: Any release from the tanks located inside the building would be collected by the floor drain and pumped to the Biological Treatment Plant (Unit 10) (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

13. UNIT NAME: Waste Propellant Burning Ground

Unit Description: This unit is located in the southeastern section of the "Horseshoe Area" and is situated on the banks of the New River at an elevation of approximately 1705 feet above MSL. Waste propellant, contaminated by rocks, dirt, metal, or other extraneous material accumulated in the plant, is burned here. Waste propellants are transported to this unit in steel frame, open bed carts, approximately 8-10 feet long, 5-6 feet wide, and 2-3 feet deep. These carts are equipped with canvas tarpaulin covers and removable rear gates. This unit consists of the following subunits or components.

a. Burning Pans
b. Former Open Ground Burning Areas
c. Runoff Settling Basin
d. Mobile, Temporary Storage Unit

The burning takes place in metal pans, each measuring approximately 15 feet by 4 feet by 1 foot, which are situated on elevated mounds of soil and gravel. Seven of these burning pans, spaced at approximately 50 feet, were noted during the April 1987 VSI. After being placed in the pan, the propellant is wired and ignited from a remote bunker. After burning, the material is visually inspected to ensure total combustion. The pans are covered with portable fiberglass roofs when not in use. Waste propellant is manually dumped from 20-gallon plastic containers into the pans. Any spillage is swept and placed in pans. The unit, according to the RAAP SWMU response letter, has been in operation since the 1940s. The pans were put into use in 1985. Prior to 1985, waste propellant was burned directly on the mounds (Unit 13b) or soil/ gravel. Ash from Unit 13 is disposed in Unit 16, the Hazardous Waste Landfill. Adjacent to the eastern edge of the burning ground is a runoff settling-basin. A 10-inch corrugated steel pipe connects the burning ground and this basin. The basin, which measures approximately 30 feet by 10 feet by 4 feet, is unlined and excavated below the natural grade. RAAP personnel report that this basin is periodically cleaned out to check

13. UNIT NAME: Waste Propellant Burning Ground (Cont'd)

for unburned propellants (Morris, July 1986). Unburned propellant is sorted as possible and returned to the pans for burning. Remaining solids are disposed of in Unit 16, the Hazardous Waste Landfill (Ref. 5 and 6).

Date of Start-Up: 1940s (estimated) (Ref. 6).

Date of Closure: This unit is currently active (Ref. 5).

Waste Managed: Three types of propellants are produced at RAAP: single base (nitrocellulose), double base (nitrocellulose, nitroglycerin), and triple base (nitrocellulose, nitroglycerin, and nitroguanidine). All of the above propellants are, or have been, burned at this facility. Description of waste propellants (single-, double-, and triple-based) burned at on site incinerators is found is Appendix D.

The Army Environmental Hygiene Association has sampled burning ground soils for the purpose of developing permitting standards for this type of facility. This data has not been received as of this writing (Ref. 6).

Release Controls: This area is an earthen bermed, unlined area, graded so as to channel all stormwater run-on/off into the low point located at the north end of the area, through a culvert pipe and into the adjacent settling basin. The burning pans are covered when they are not in service (Ref. 5).

Release History: Various signs of release from the pans were evident during the April 1987 VSI. Remnants of incompletely combusted propellant were scattered through the area. Several hundred, charred scintillation vials were accumulated at the mouth of the culvert pipe to the settling basin (Ref. 5).

14 and 15. UNIT NAME: Waste Incinerator and Waste Propellant Storage Facility

Unit Description: These units are located in the north-central section of the Horseshoe Area. Unit 14 consists of the following components.

a. Wet Grinder (Building 442)
   - Storage Tanks (2)
b. Incinerator (Building 429 B)
   Incinerator (Building 440)
   Incinerator (Building 441)
c. After Burner
d. Water Quench Precooler
e. Wet Scrubber

Unit 15 is located inside building 430 (Building 4601-7) formerly used to house a SWECO separator and associated storage tank. This equipment is no longer utilized but remains in place. Table 4-15 provides construction details for this unit. The building is used to contain various waste propellants. The waste propellants stored in Unit 15 are contained in 20-gallon polyethylene containers equipped with snap on sealing polyethylene lids. The maximum waste load stored at any one time in the facility is 16,360 pounds. The Part A permit application indicates that an estimated 4,048 tons of waste propellant or propellants will be stored annually in Unit 15 (Ref. 6).

Approximately 35-40 containers were observed to be stored at this unit during the April 1987 VSI (Ref. 5).

Unit 14 is a RCRA regulated unit consisting of two major subunits. Unit 14a, the Wet Grinder System, is located in Building 442. Table 4-16 provides the construction details for the two storage tanks located in Building 442. According to facility representatives these tanks were originally intended to be used for neutralized caustic waste but have never been used. The waste propellant is conveyed via truck from Unit 15 to Unit 14. There the containers are picked up on a conveyor and dumped into the Wet Grinder (Unit 14a) for grinding and slurrying prior to conveyance via an above ground overhead pipe line to the incinerators (Unit 14b) (Ref. 6).

TABLE 4-15

DESCRIPTIVE CHARACTERISTICS OF THE WASTE PROPELLANT STORAGE FACILITY (HWM15) RADFORD ARMY AMMUNITION PLANT

Accessories

- 2 exits - 4'0" x 6'6" clear opening (locked when not in use by trained operating personnel)
- 11' wide platforms across entire width of building at both ends
- 3' raised loading dock with concrete steps for access
- Timber and earth barricade surround the building to direct any explosion
- Telephone, building heat for winter operations, air vents for circulation, and lighting are available

Materials of Construction

- Tile (clay block) walls
- Corrugated aluminum roof
- Seamless flooring (Dex-o-tex Conductive Industrial 67) over concrete floor
- 3-layer wood doors with outer steel plate

Design Construction

- 58' x 34' exterior
- 1'-0" wall thickness
- 30° roof with trussed rafters for support
- 9-foot ceilings
- Conductive flooring not less than 1/4" thick

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

TABLE 4-16

RAAP HAZARDOUS WASTE STORAGE TANK SPECIFICATIONS (SWMU NO. 14)

	Grinder Building 442 Tanks (2)	Building 430 Tank
CAPACITY (gallons)		
o TOTAL	1,700	1,200
o OPERATING	1,200	800
CONSTRUCTION Material	Stainless Steel Type 304	Stainless Steel Type 304
DIMENSIONS		
o OUTER DIAMETER	6'-6"	6'-0"
o HEIGHT	8'-4"	5'-0"
o THICKNESS (inches)	0.25	0.25
SUPPORT	Steel Angle Legs 4" x 4" x 3/8" Concrete Footings 12" x 12" x 7"	Steel Cross Braces 2" x 2" x 1/4"

Source: RAAP Part B Permit Application (Ref. 3).

14 and 15. UNIT NAME: Waste Incinerator and Waste Propellant Storage Facility (Cont'd)

Unit 14b consists of three (3) incinerators. The unit housed in Building 429B is the prototype unit for the other two and is currently inactive. The other two units, located in Buildings 440 and 441, have a destructive capacity of 550 pounds/hour of energetic material (slurried waste propellant and other materials). These units are currently active (Ref. 6).

Each incinerator is equipped with a refractory lined rotary kiln into which the propellant slurry is injected and incinerated. Combustion gases are passed through an afterburner (Unit 14c) to effect total combustion. The exhaust gases then pass through a Water Quench Precooler (Unit 14d) to reduce the temperature prior to passing through a Wet Scrubber (Unit 14e) to remove noxious gasses and particulates. The gasses are exhausted and the wastewaters from both the quench towers and the scrubbers are conveyed to the Incinerator Waste Water Ponds (Unit 39). Ash and any residual/noncombustible solids are deposited in metal hoppers located below the kilns (Ref. 6).

Hot ash is allowed to open air cool prior to dumping the collected ash into temporary storage carts for conveyance to Unit 16, the Hazardous Waste Landfill. Figure 4-2 provides a schematic diagram for the process flow from Unit 15 through Unit 14 to Unit 39 and Unit 16.

The facility is seeking a RCRA Part B permit for the two (2) currently active incinerators. RAAP has elected to not proceed with permitting for the prototype unit. State of Virginia, EPA and facility representatives were unclear as to the regulatory process by which the unit would be closed (Ref. 5).

Date of Start-Up: Unknown.

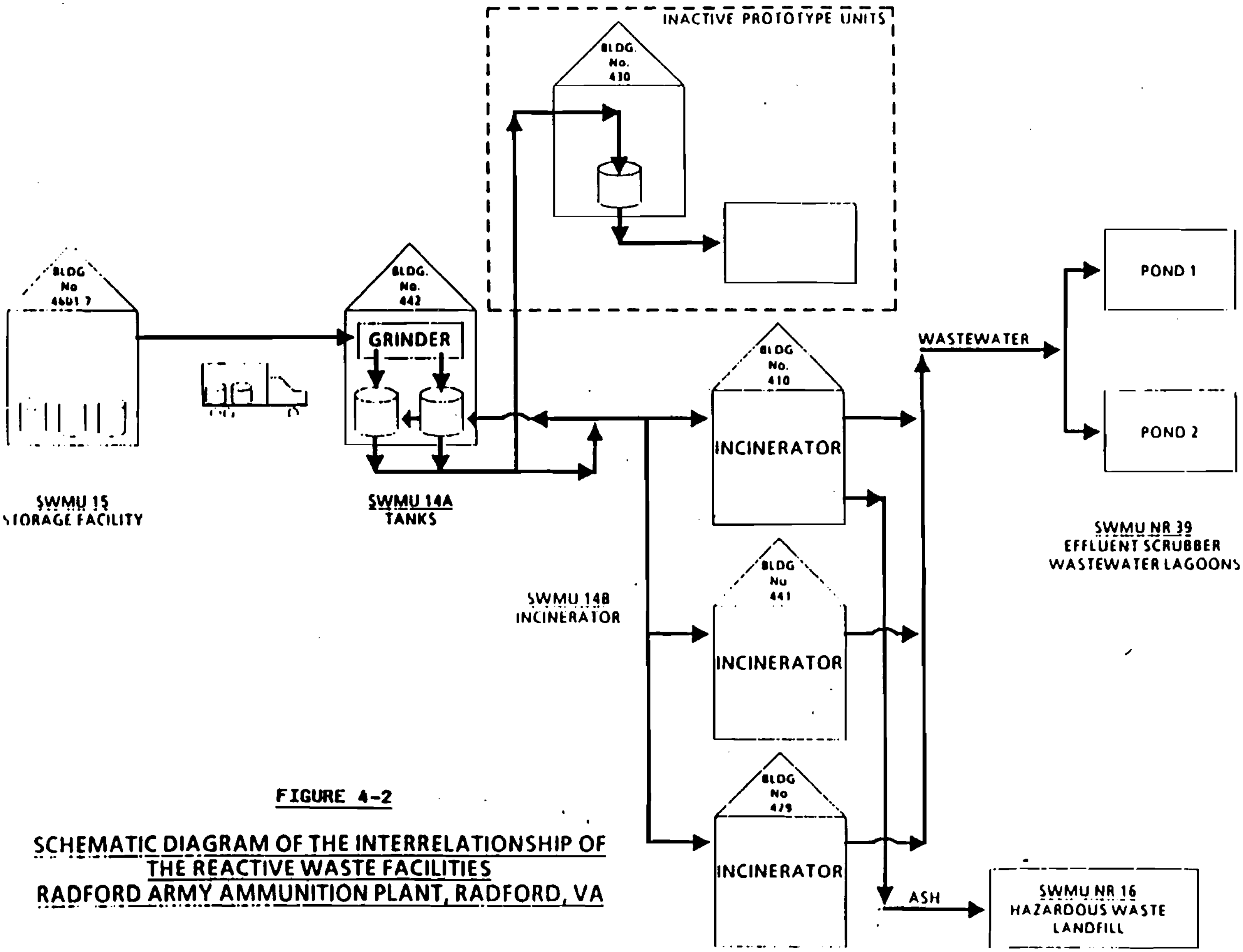

FIGURE 4-2

SCHEMATIC DIAGRAM OF THE INTERRELATIONSHIP OF
THE REACTIVE WASTE FACILITIES
RADFORD ARMY AMMUNITION PLANT, RADFORD, VA

Source: As originally described in Ref. 6.

14 and 15. UNIT NAME: Waste Incinerator and Waste Propellant Storage Facility (Cont'd)

Date of Closure: These units are currently active except for the prototype incinerator. Closure specifications for this unit are currently being negotiated by RAAP and the State of Virginia (Ref. 5).

Waste Managed: These units manage waste propellants and nitroglycerin glums (a mixture of nitroglycerin, sawdust and ethyl alcohol). These wastes exhibit the reactive characteristic and are designated as a D003 reactive hazardous waste. A typical analysis for these materials can be found in Appendix D (Ref. 6).

Release Controls: Unit 14a is housed inside Building 442 which has essentially the same construction details as Unit 15; the details are provided in Table 4-15.

Unit 14b is comprised of three incinerators and associated equipment and buildings. The incinerators are located outside on a continuous slab concrete footing. Each is equipped with a water quench precooler, wet scrubber and ash receptacle (Ref. 5).

Release History: No visible signs of release were noted during the VSI. Minor evidence of oil spillage at the fill vent of the underground fuel oil tank for the prototype incinerator was noted (See Area of Concern L).

16. UNIT NAME: Hazardous Waste Landfill

Unit Description: This unit is a RCRA-regulated Hazardous Waste Landfill and according to facility representatives, is currently undergoing closure. During the April 1987 VSI observations indicated that this unit still has an open, possibly active face at the north end of the trench. The unit is located in the south-central section of the RAAP "Horseshoe" area between Units 28 and 52. The unit consists of a trench approximately 400 feet long and 60 feet wide by 14 feet deep. The bottom of the trench consists of compacted in-situ soil. Wastes were reportedly covered with soil after placement in the unit (Ref. 6, p. 65). During the April 1987 VSI, the surface was covered with bottom ash from the coal-fired plant (Ref. 5).

Date of Start-Up: This unit began operation in 1980 (Ref. 6, p. 65).

Date of Closure: Closure plans have been prepared. According to facility representatives, this unit no longer receives hazardous waste (Ref. 5).

Waste Managed: Tables 4-18 through 4-21 summarizes wastes received by this unit (Ref. 6, p. 66-70).

Release Controls: No run-on or run-off controls were observed during the April 1987 VSI (Ref. 5).

Release History: Past or ongoing release in the vicinity of this unit have been documented (Ref. 6, p. 71). Groundwater in the vicinity has been contaminated with dinitrotoluene and halomethane compounds. Tables 4-22 and 4-23 are data from samples collected from 1982 through 1984 (Ref. 6, p. 72-73). During the April 1987 VSI, the former face of the landfill was observed to have rill and gulley erosion. Discolored leachate or run-off water was observed at the base of the former active face (Ref. 5).

TABLE 4-18

SUMMARY DESCRIPTION OF WASTES DISPOSED IN SWMU NO. 16
RADFORD ARMY AMMUNITION PLANT

Waste[a]	Rate of Generation[a] Tons/Yr	Physical[a] Form	Hazard Description	EPA Hazard[a] Number
Ash from waste propellant incineration	Unknown	Solid	Reactive, non-EP toxic[a]	D003
Residue from waste propellant burning	Unknown	Solid	Reactive, EP toxic[a]	D003, D008
Residue from explosive -- contaminated waste burning	200	Solid	Reactive[a]	D003
SAR area fume burner ash	0.1	Solid	EP toxic[a]	D006, D007
Sludge from neutralization of SAR process water	Unknown	Sludge	Nonhazardous[a]	--
Sludge from neutralization of nitrocellulose manufacturing acid process water	Unknown	Sludge	Nonhazardous[b]	--
Sludges from Bioplant, Building 470, and NG 2 Pretreatment Building 9410	50	Sludge	Nonhazardous[c,d,e]	--

[a] USAEHA (December 1981)
[b] Ewing (January 15, 1982)
[c] Everett (March 19, 1982)
[d] Everett (November 10, 1982)
[e] Jenrette (November 18, 1983)

Source: RAAP Part B Permit Application (Ref. 3)

TABLE 4-19

EP TOXICITY RESULTS FOR WASTES
DISPOSED IN HWM 16
RADFORD ARMY AMMUNITION PLANT
Concentration in mg/l

Parameter	Incinerator Ash from Waste Propellant Incinerator	Contaminated Burning Ground Ash	Propellant Burning Ground Ash	Virginia Maximum
As	ND (not detected)	ND	ND	5.0
Ba	ND	0.64	0.76	100
Cd	0.092	0.032	0.012	1.0
Cr	0.148	0.026	0.031	5.0
Pb	3.4	ND	51	5.0
Hg	ND	0.029	ND	0.2
Se	ND	ND	ND	1.0
Ag	0.037	ND	ND	5.0

Source: As originally described in Ref. 6.

TABLE 4-20

SUMMARY DESCRIPTION OF WASTES THAT ARE OPEN-BURNED PRIOR TO DISPOSAL IN HWM 16 RADFORD ARMY AMMUNITION PLANT

Waste	Physical Form	Hazard Description	EPA Hazard Number
Nitrocellulose	Solid	Reactive	D003
Laboratory explosive wastes	Solid, Liquid	Corrosive	D002
Waste propellant	Solid	Reactive	D003
NG slums	Sludge	Reactive	D003
Explosive contaminated waste	Solid	Reactive	D003

Source: USAEHA (December 1981): As originally described in Ref. 6.

TABLE 4-21

LABORATORY WASTES PLACED IN
SWMU NO. 16 - HAZARDOUS WASTE LANDFILL
RADFORD ARMY AMMUNITION PLANT

Material	Quantities Disposed of Through October 1985
Lead Alicylate	58 lbs.
Sulfur	550 lbs.
Sulfur	500 lbs.
Nitrodiphenylamine	250 lbs.
Carbolac	76 lbs.
Aluminum Powder	25 lbs.
Potassium Nitrate	100 lbs.
Cryolite	400 lbs.
Diphenylamine	650 lbs.
Chromium Nitrate Crystals	15 lbs.
Sulfur	500 lbs.
Cryolite, Synthetic	450 lbs.
Magnesium Oxide	100 lbs.
Charcoal	200 lbs.
Ferrous Ammonium Sulfate	1.1 lbs.
Phenolphthalein Powder	1 lb.
Ferrous Ammonium Sulfate	3 Bottles
Ethyl Cellulose Flake	150 lbs.
Ferrous Ammonium Sulfate	1.1 lbs.
Barium Perchlorate	3.0 lbs.
Lead Dioxide	0.5 lb.
Lead Nitrate	0.5 lb.
Carbon Black	21 lbs.
Potassium Sulfate	220 lbs.
Tetra Bromethane	3 Bottles
Stabilizer Sol. Ph 4	17 Bottles
Sodium Methoxide	11 Bottles
Chlorobenzene	9 Bottles
Yellow Ink	120 Bottles
Combat Meals	1095 Each
Alkalinity, #1, Reagent #1	2 Bottles
Alkalinity, #2, Reagent #2	2 Bottles
Buffer Salt pH 7.2 Mixture	2 Bottles
Cotton, Aseptic, Absorbent	2 Rolls
Dibutyl Phthalate	54 Gallons
1,3-Diphenylguanidine	2 Bottles
Mannitol - MP 166-167	2 Each

TABLE 4-21
LABORATORY WASTES PLACED IN
SWMU NO. 16 - HAZARDOUS WASTE LANDFILL
RADFORD ARMY AMMUNITION PLANT
PAGE TWO

Material	Quantities Disposed of Through October 1985
Mercuric Chloride	2 Bottles
Morpholine	1 Bottle
No. 2 Absorbing Reagent	2 Bottles
Nitrilotriethanol MP 20-22	2 Bottles
DEG	---
Sodium Sulfate Anhydrous	2 Bottles
Perchloric Acid 70-72 PC	1 Lot
Perfluoroelastomer	3 Packages
Phosphorus Pentoxide Powder	2 Bottles
Potassium Sulfate Powder	1 lb.
Sodium Acetate, Crystals	3 lbs.
Sodium Citrate, Crystal	3 Bottles
Sodium Cobaltinitrate Powder	1 lb.
Sodium Methoxide	1 Bottle
Sodium Oxalate Standard	2 Bottles
Stearic Acid	6 lbs.
Sucrose Rea Cry	1 Lot
Tetrahydrofuran	4 Gallons
Thymol Blue B Indicator Solution	1 Lot
Triphenyl Phosphate	9 Bottles
Uranyl Acetate	1 lb.
Zinc Metal Dust	1 Bottle
Total Count Millipore Filters	4 Packages

Source: RAAP Part B Permit Application (Ref. 3).

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TABLE 4-22

GROUNDWATER QUALITY DATA AT HWM 16 (USAEHA, 1983)
RADFORD ARMY AMMUNITION PLANT

Groundwater[1] Monitoring Parameter		Upgradient Wells C-1	Downgradient Wells C-4	CDH2	C-2[1]	Drinking Water Standards
Nitrate[2]	mg/l	6.0	4.0	0.29	-	10
Sulfate[3]	mg/l	ND[4]	7.0	22.0	-	250
Chloride[5]	mg/l	7.0	5.0	4.0	-	250
pH[3]	units	7.6	7.6	7.4	-	-
Spec. Cond.[3]	UMC	245	440	480	-	-
TOC[3]	mg/l	7.0	17	26	-	-

1 Groundwater monitoring well dry during all sample efforts.
2 Sample collected 12 June 1982.
3 Sample collected 13 June 1983.
4 Sample collected 19 April 1982.
5 Non-detectable.
NOTE: UMC - micromhos per centimeter

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

TABLE 4-23

ORGANIC PRIORITY POLLUTANTS DETECTED IN HWM 16 GROUNDWATER MONITORING WELLS[1]
RADFORD ARMY AMMUNITION PLANT

Compound[2]	Monitoring Well				
	C-1	16-2	16-3	16-4	CDH2
Bromodichloromethane	--	--	--	--	3
Chloroform	--	4	12	32	--
Dichlorofluoromethane	--	--	--	--	5-20
Methylene chloride	--	--	--	--	3
Trichlorofluoromethane	--	--	--	--	5
Diethyl phthalate	--	--	14	--	--
2,6-Dinitrotoluene	--	--	--	30	--

1 Samples collected on November 12, 1984.
2 Compounds at nondetectable levels are not shown.

Source: RAAP Part B Permit Application (Ref. 3).
HWM refers to RAAP nomenclature (i.e. Unit No.).

17. UNIT NAME: Contaminated Waste Burning [Air Curtain Destructor (ACD)]

Unit Description: This facility operation is located in the south-central part of the main manufacturing area at an elevation of approximately 1920 feet above MSL. The contaminated waste burning operation in this area is comprised of a number of components which are included as one SWMU; these include:

17a. Stage and Burn Area
17b. ACD Staging Pad and Pit
17c. Air Curtain Destructor
17d. Ash Staging Area
17e. ACD Run-off Drainage Basin

A simplified interpretation of contaminated waste burning operations at this unit is as follows: Unit 17a is a staging area for propellant-contaminated wood and metal, located approximately 600 feet northwest of the ACD in what appears to be either a sinkhole (Ref. 1, p. 71) or some other natural depression. The area is about 30 feet below grade. The scrap wood and metal are piled here prior to burning at the ACD (Unit 17c). Some open burning of the contaminated scrap material is also done in this staging area. The scrap material and occasional burning operation takes place on the bare ground (Ref. 5).

Unit 17b is a second staging area located adjacent to the ACD (Unit 17c). This unit is a partially enclosed structure used to store material prior to incineration. The staging area is divided into two bays; one bay having a covered roof and the other without any covering. The storage bays are constructed with concrete floors and six foot-high cement walls on three sides. The fourth side is without any retainer walls and is used for unloading propellant-contaminated waste in the bays. The bay with the roof is open on the side above the retainer walls. Adjacent to the uncovered storage bay is a below-grade, concrete-lined settling basin pit, believed to be used to wash any residue from the storage bays. The pit has a sump pump, used to discharge collected water. Representatives were unfamiliar with the operations of this sump (Ref. 5).

17. UNIT NAME: Contaminated Waste Burning [Air Curtain Destructor (ACD)] (Continued)

Unit 17c, the Air Curtain Destructor, is a metal building approximately 15 x 30 feet, used for burning propellant-contaminated wood and metal stored at either Unit 17a or 17b. This unit is located within 150 feet of the front of Unit 17b.

Unit 17d is a roll-off container storage area used for storing and transporting ACD ash off site. The containers (reportedly holding 30 cubic yards) are located on an unlined soil lot behind the ACD. Metals are sifted out of the ash and are sold for scrap (Ref. 5).

Unit 17e is an unlined settling basin located directly behind the Ash Staging Area (Unit 17d). The unit appears to be a natural drainage depression. No other information pertaining to this unit was available (Ref. 5).

Date of Start-Up: Twenty-five thousand pounds of waste have been incinerated in the ACD (Unit 17c) since 1976 (Ref. 1, p. 74). Date of Start-Up for the other components at the facility are unknown.

Date of Closure: All units are presently active (Ref. 5).

Waste Managed:

17a. Propellant-contaminated wood and metal (Ref. 5).

17b. Propellant-contaminated wood, metal, and cardboard drums which may have contained nitroguanidine and DNT (Ref. 5).

17c. Same as 17a (Ref. 5).

17d. Ash from Unit 17c (Ref. 5).

17e. Run-off from Units 17a, 17b, and 17d (Ref. 5).

17. UNIT NAME: Contaminated Waste Burning [Air Curtain Destructor (ACD)] (Continued)

Release Controls: Units 17a, 17d, and 17e are all unlined. The ACD staging pad and pit (Unit 17b) are constructed of concrete. The staging area has three cement retaining walls 6 feet high. There were no release controls observed around the ACD (Unit 17c) during the VSI (Ref. 5).

Release History: During the VSI, ash and potentially contaminated debris were observed on the soil in Unit 17a, around Unit 17b, and in a drainage ditch adjacent to the collection sump. Discolored soil was noticed around the ACD (Unit 17c) and the ash staging area (Unit 17d).

18. UNIT NAME: Sulfuric Acid Recovery Plant - Waste Acid Treatment

Unit Description: This RCRA regulated unit is located in the northwest section of the main manufacturing area at a surface elevation of 1720 feet (MSL). This unit consists of the following:

a. Sheet Metal Fabricated Building
b. Vacuum Filters (2)
c. Lime Silos (2)
d. Neutralization Tank
e. Concrete Clarifiers (2)
f. Steel Feed Tank
g. Concrete Discharge Station

Acidic Wastewater from the Sulfuric Acid Recovery Plant gravity flows via an underground process sewer pipe, and is pumped into the steel feed tank. The wastewater is then pumped into the neutralization tank located inside the building where it is neutralized with the lime slurry. It is then pumped into the clarifier equipped with the rake and then into the second clarifier prior to discharge through the subgrade discharge station where it flows through a culvert pipe into a concrete flume and then is discharged to the New River via NPDES outfall 004. The effluent from this unit is comingled with the effluent from the surface water retention basin/drainage ditch (Unit 80) prior to discharge to the outfall. Bottom solids are pumped to the vacuum filters; resultant waste waters are pumped back into the clarifiers, solids are deposited in a small dumpster. Exact dimensions of the dumpster and ultimate fate of the contained waste was not able to be provided by facility representatives (Ref. 5 and 6).

Due to the currently, inactive status of this unit, the building was locked and inaccessible during the April 1987 VSI. Visual inspection through a small window confirmed the existence of only the 2 lime silos (Ref. 5).

The Clarifiers (2) are open head, concrete clarifiers of approximately 10-12 feet in diameter. The unit closest to the building is

18. UNIT NAME: Sulfuric Acid Recovery Plant - Waste Acid Treatment (Cont'd)

equipped with a sweep/bottom solids rake. This unit overflows, into the second unit which is not equipped with a rotating rake (Ref. 6).

The Feed Tank is an open head, flat bottom carbon steel tank, situated on a continuous slab concrete footing, inside a concrete containment dike of undetermined capacity. The tank is approximately 15 feet in height and approximately 10 - 12 feet in diameter (Ref. 6).

The Concrete Discharge Station is a below grade, two compartment concrete sump which serves as the discharge point for this unit into an effluent pipe. Each compartment is approximately 4 feet square with an observable depth of approximately 3-5 feet (Ref. 6).

Date of Start-Up: 1976 (Ref. 6).

Date of Closure: This unit is currently inactive (Ref. 5).

Waste Managed: This unit manages acidic wastewater generated in the Sulfuric Acid Recovery Plant (i.e. process wastewater, spills washdowns, etc). These wastewaters exhibit corrosivity and are therefore classified as a D002 Corrosive Liquid (Ref. 5 and 6). It is unclear if any solids containing hazardous constituents are contained in the wastewater.

Release Controls: The neutralization tank and vacuum filters are contained inside a building on a concrete floor. It is unknown whether any floor drains and their destiny exist in this area. The steel neutralization tank is situated inside a concrete dike on a concrete slab (Ref. 6). Remaining units are not provided with secondary containment (Ref. 5).

Release History: No visible signs of release were observed during the April 1987 VSI. The July 1986 RFA (Ref. 6) indicates compliance with permitted effluent limitations at the NPDES outfall.

19. UNIT NAME: The A-B Lime Acidic Wastewater Treatment Plant

Unit Description: This RCRA regulated unit is located in the northeast section of the RAAP main manufacturing facilities at an elevation of 1,740 feet MSL, approximately 600 feet from the New River. Acidic wastewater from Units 4 and 5, and from nitrocellulose lines A and B, flows into Unit 19 where it is neutralized with lime slurry. The neutralization effluent is sent to Unit 8.

Unit 19 consists of the following parts:

a. Wastewater/lime-slurry mix tank
b. Neutralization tank equipped with six rotary mixers
c. Lime-slurry mix pit
d. Lime silo, hopper, and slaker
e. Bucket conveyer system

Unit 19a is a below grade, acid-brick-lined concrete sump, approximately 4 feet wide, 8 feet long and 8-10 feet deep. It serves to commingle the wastewater influent with lime slurry from Units 19c, d, and e, prior to flowing into unit 19b. The wastewater is conveyed to the unit via an underground process sewer system. The lime slurry is pumped form the lime slaker via above-ground pipes (Ref. 6).

Unit 19b is below grade acid-brick-lined concrete sump with approximate surface dimensions of 20 feet by 20 feet. It is equipped with six rotary mixers. Depth of the unit could not be established either from visual observation or from facility representatives. After neutralization, the effluent enters an acid-brick-lined flume and from there is discharged through underground piping to Unit 8, the Calcium Sulfate Settling Lagoon (Ref. 5 and 6).

Date of Start-Up: Unknown.

Date of Closure: This unit is currently active (Ref. 5).

19. UNIT NAME: The A-B Lime Acidic Wastewater Treatment Plant (Cont'd)

Waste Managed: The influent to this facility comes from Units 4 and 5 and nitrocellulose lines A and B. Wastewater from Units 4 and 5 is known to have a pH of 1.5 to 1.6 and to contain some nitrocellulose fines in addition to both nitric and sulfuric acid. This wastewater is classified as a corrosive waste and is assigned the EPA hazardous waste identification number D002 (Ref. 6). It is unknown if there are any hazardous constituents in the waste (Ref. 5).

Release Controls: The subgrade units are each provided with acid brick lining to prevent corrosion of the concrete basins (Ref. 5).

Release History: No visual signs of release were observed from the unit's components during the April 1987 VSI. However, an adjacent area allegedly used for temporary staging of lime slaker sludge and miscellaneous debris (i.e. stones, chunks of lime, etc.) appeared to be contaminated with materials other than just lime. Multicolored soil discoloration was observed; facility representatives could not provide an explanation of the origin nor of the fate of this material. They surmised that it may have been a result of maintenance activities at the adjacent sewage treatment plant (Unit 55) and probably would be conveyed via truck to one of the inert landfills on-site (Ref. 5).

20. UNIT NAME: C Line Acidic Wastewater Treatment Plant

Unit Description: This RCRA regulated unit is located in the northwest area of the RAAP Main manufacturing facilities at an approximate elevation of 1,740 feet above MSL. The New River lies approximately 1,000 feet to the northwest of this unit. This unit receives and neutralizes acidic wastewater from nitrocellulose line C, functioning the same way as Unit 19. The neutralized effluent from Unit 20 is sent to Unit 9.

Unit 20 consists of the following parts:

a. Two acid-brick-lined influent sumps
b. An acid-brick-lined mix/neutralization tank
c. An acid-brick-lined effluent sump/concrete Parshall flume
d. A lime silo and slaker in a cider-block building

Wastewater from the C line nitrocellulose manufacturing flows into the influent sumps and is commingled with lime slurry, from Unit 20d. The influent flows into a mechanically agitated neutralization mix tank (Unit 19b) prior to discharge through the acid brick lined sump and concrete Parshall flume. Effluent is conveyed via underground process sewer pipe to Unit 9, Calcium Sulfate Settling Lagoons (Ref. 5 and 6).

Unit 20a consists of two (2) identical acid-bricked-lined below grade concrete sumps. Each sump is approximately 5 feet by 5 feet by 8-10 feet deep.

Unit 19b is a below grade, acid brick lined concrete sump, equipped with general rotary mixers to facilitate neutralization. Its approximate surface dimensions are 20 feet by 20 feet. It was not possible to estimate depth of the unit during the April 1987 VSI (Ref. 5).

20. UNIT NAME: C Line Acidic Wastewater Treatment Plant (Cont'd)

Date of Start-up: Unknown.

Date of Closure: This unit is currently inactive due to the inactive status of the C Line nitrocellulose manufacturing area (Ref. 5).

Waste Managed: Nitrocellulose production involves the addition of nitric and sulfuric acids to cellulose. Thus, the acidic wastewater from nitrocellulose line C is assumed to contain nitric and sulfuric acids and some nitrocellulose fines. This wastewater, like that at Unit 4, 5 and 19, is probably a corrosive, D002 hazardous waste (Ref. 6). Although the unit is inactive, some influent was noted, however, it was assumed to be stormwater infiltration from the manufacturing area.

Release Controls: The subgrade units are each provided with acid brick lining to prevent corrosion of the concrete basins (Ref. 5).

Release History: No visible signs of release were observed during the April 1987 VSI (Ref. 5). A discharge observed during the July 1986 VSI was not able to be explained by facility representatives (Ref. 6).

21. UNIT NAME: Continuous Automated Single-Base Line Wastewater Treatment Plant

Unit Description: This unit is located several thousand feet east of the A-B Line Acidic Wastewater Treatment Plant (Unit 19) in the northeast section of the main manufacturing area near the confluence of the New River and Stroubles Creek. Information indicates the unit was designed to process wastewater with organic constituents, and further indicates that the unit has never been operated (Ref. 6).

During the July 1986 VSI, Hercules engineer, J. A. Morris, confirmed that this facility had never been operated. He explained that the production area for which this treatment facility was built was operated infrequently. When the facility is operating, the wastewater is sent to Unit 10 (Biological Treatment Plant) (Ref. 6).

This unit was only viewed from the outside during the July 1986 VSI. According to Hercules engineer, J. A. Morris, the unit was nonoperational and its entrance was locked. The only physical characteristics noted were that the facility is housed in a large metal-sided building and appears relatively new (Ref. 6).

EPA representatives indicated during the April 1987 VSI that it was not necessary to include this unit within the scope of this RFA (Ref. 5).

22, 23, 24, and 25. UNIT NAME: Wastewater Holding Lagoons

Unit Description: These four units are identical, located in the northwestern section of the RAAP "Horshoe Area." All of these units are below-grade emergency spill ponds measuring approximately 30 feet by 30 feet (at top) by 12 feet deep, with sides sloping approximately 15 degrees (Ref. 1, p. 79).

Date of Start-Up: According to RAAP personnel, none of the units have received any waste products. Only one of the production areas for which they were designed and built has been operating since July 1986 (Build- ing 4912-12); effluent is designed to flow to Unit 25 (Ref. 5).

Date of Closure: Unknown. None of the units have received any waste products (Ref. 5).

Waste Managed: These units when operating will contain nitro-glycerin-contaminated wastewater (Ref. 1, p. 79). These units are designed with one influent pipe. Once contained in one of these units a waste would be pumped to a tanker and taken to the nitroglycerin pretreatment plant (Unit 12) (Ref. 1, p. 30).

Release Controls: These units are lined with a chlorinated poly-ethylene (CPE) liner. Several patches of CPE have been noted on the liner of Unit 22 (Ref. 6, p. 80).

Release History: At the time of the VSI (Ref. 5) RAAP personnel reported that these units have not received any waste. Rainwater is the only liquid contained in the ponds (Ref. 5).

25. UNIT NAME: Fly Ash Landfill No. 1

Unit Description: This unit is a closed Fly Ash Landfill located in the south-central section of the "Horseshoe Area", approximately 600 feet east of the main bridge which spans the New River. This unit is situated on the north slope of an east-west trending ridge. This unit is approximately 1,100 feet long and 200 to 250 feet wide. The landfill was formed by the excavation of a large, deep pit which is flat at the bottom. The site was unlined and the in-situ soils posses permeabilities ranging from 1.0×10^{-6} to 1.0×10^{-4} cm/sec. Reportedly, the fill has been covered with 2 feet of clay and soil (Ref. 6, p. 81). During the April 1987 VSI subsidence was noted in the middle of the soil cover. An animal burrow was noted on the eastern edge of cover. Material brought to the surface by the burrowing activity, resembled fly ash. The depth to the covered material appeared to be approximately 6 inches on the slope. A good vegetative cover of native grasses was observed over most of the cap although a few bare areas were observed (Ref. 5). The operational procedures and design cri- teria during the life of the unit were unknown during the April 1987 VSI.

Date of Start-Up: Unknown.

Date of Closure: This unit was closed in mid-1985 (Ref. 6, p. 81).

Waste Managed: Unknown volumes of calcium sulfate, fly ash, and asbestos were reportedly disposed of in this unit (Ref. 6, p. 81). It is unknown whether other hazardous wastes or solids were disposed of in this unit (Ref. 5).

Release Controls: A soil berm, designed for surface water diversion, lines the downslope (Northern side) of the site (Ref. 5 and Ref. 6, p. 81).

26. UNIT NAME: Fly Ash Landfill No. 1 (Cont'd)

Release History: Monitoring well data from a 1980 investigation indicates contamination from manmade organic compounds. Concentrations are near or below the available accepted drinking water and ambient water quality standards, and Suggested No Adverse Response Levels (SNARLS). The data is reportedly inadequate to indicate the source of the organic contaminants in the landfill (Ref. 6, p. 82).

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27. UNIT NAME: Calcium Sulfate Landfill

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). This unit is a closed, unlined earthen landfill. The unit is located in the southeastern section of the RAAP "Horseshoe Area". The unit was described as closed and contiguous to Unit 29 during the July, 1986 VSI (Ref. 6, p. 83). The unit was described as triangular shaped and approximately 150 feet long during the July 1986 VSI (Ref. 6, p. 84). During the April 1987 VSI, an area in the location previously described, appeared to be a fill area. The area was level with no vegetation growth on the cover (Ref. 5).

Date of Start-Up: Use of this unit began in the 1970s (Ref. 6, p. 83).

Date of Closure: This unit was closed sometime before July 1986 (Ref. 6, p. 83).

Waste Managed: Calcium sulfate sludge generated from sulfuric acid neutralization were reportedly disposed in this unit. Reactivity characteristics of similar sludge can be found in the Tables 4-11 and 4-12. No additional characteristic data is available for this waste.

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: Monitoring well data indicate ground water in the vicinity of this landfill has been contaminated. Due to the contiguous location of this unit with Unit 29, the contamination may be from either unit. Table 4-24 summarizes ground water quality data for the monitoring wells located in the vicinity of these units.

TABLE 4-24

SWMUs NO. 27 AND 29
WATER QUALITY DATA
RADFORD ARMY AMMUNITION PLANT

Parameter	Detection Limit	Units	Monitoring Wells: Well 7	FAL 2	FAL 3	16-2	16-3	16-4
Water Levels		FT	1,747.1	1,723.6	1,682.4	1,755.3	1,767.3	1,786.0
Lead	0.005	MGL	ND	ND	ND	ND	ND	ND
NO_2+NO_3 as N	0.01	MGL	0.86	0.97	1.42	4.82	1.63	2.28
Chloride	1.0	MGL	3.0	4.0	6.0	17.0	4.0	4.0
Iron	0.10	MGL	ND	ND	ND	ND	ND	ND
Manganese	0.030	MGL	ND	ND	0.107	ND	ND	ND
Sodium	1.0	MGL	1.0	4.0	25.0	ND	ND	ND
Sulfate	2.0	MGL	1.0	47.0	66.0	6.0	13.0	2.0
pH (Field)		pH	7.0	7.6	7.8	7.0	7.4	7.9
pH (Field)		pH	7.0	7.6	7.8	7.0	7.4	7.9
pH (Field)		pH	7.0	7.6	7.8	7.0	7.4	7.9
pH (Field)		pH	7.0	7.6	7.8	7.0	7.4	7.9
pH (Lab)		pH	7.7	7.8	7.8	ND	ND	ND
Spec. Cond.	1.0	UMC	110.0	580.0	660.0	420.0	310.0	240.0
Spec. Cond.	1.0	UMC	110.0	580.0	660.0	420.0	310.0	250.0
Spec. Cond.	1.0	UMC	110.0	570.0	660.0	420.0	310.0	240.0
Spec. Cond.	1.0	UMC	110.0	580.0	660.0	420.0	310.0	240.0
TOC	0.1	MGL	7.4	2.2	1.6	5.7	9.3	0.6
TOC	0.1	MGL	7.2	2.2	1.6	5.6	9.3	0.7
TOC	0.1	MGL	7.2	2.3	1.7	5.7	9.2	0.8
TOC	0.1	MGL	7.3	2.2	1.6	5.7	9.2	0.6
COD	25.0	MGL	ND	ND	ND	ND	ND	ND
TDS	1.0	MGL	82.0	344.0	251.0	ND	ND	ND
Alkaliity	2.0	MGL	61.0	300.0	392.0	ND	ND	ND
Hardness	2.0	MGL	53.0	286.0	354.0	ND	ND	ND
Phosphate-P	0.02	MGL	0.04	0.06	0.04	ND	ND	ND

Sample taken February 18 and 19, 1985
Upgradient Wells: 16-2, 16-3, and 16-4
Downgradient Wells: 7, FAL 1, FAL 2, and FAL 3
Source: SWMU Response Letter, Attachment 4

FT = feet
MGL = milligrams per liter
UMC = micromhos per centimeter

As originally described in Ref. 6.

28. UNIT NAME: Sanitary Landfill

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). The unit is an active Sanitary Landfill. The landfill was an open trench which slopes from the top of a knoll to the roadway below in the southeastern section of the RAAP "Horseshoe Area." The unit was described as active during the July, 1986 VSI (Ref. 6, p. 86). The length of this unit is estimated to be 200 feet (Ref. 6, p. 86). The operational procedures during the life of the unit were unknown during the April 1987 VSI (Ref. 5).

Date of Start-Up: Use of this unit began in 1984 (Ref. 6, p. 86).

Date of Closure: This unit is presently active (Ref. 5).

Waste Managed: It has been reported that two tons per day of municipal refuse and trash from nearby office buildings and staff houses were placed in this landfill. Daily soil cover was placed on the refuse (Ref. 6, p. 86 and 87). It is unknown if any hazardous constituents were disposed of in the unit (Ref. 5)..

Release Controls: Soil and vegetative cover presently provide the release controls for this unit (Ref. 5).

Release History: No data indicating releases have been collected.

29. UNIT NAME: Fly Ash Landfill No. 2

Unit Description: This unit is an active, unlined earthen landfill. The unit is a geographic bowl created by a manmade earthen berm on the western side. The unit is located in the southeastern section of the RAAP "Horseshoe Area". The unit was described as active and contiguous to Unit 27 during the July, 1986 VSI (Ref. 6, p. 83). During the April 1987 VSI, the unit was observed to contain recently disposed, uncovered fly ash material. A plateau in the center of the landfill was identified by facility representatives to be the Activated Carbon Disposal area (Unit 53) (Ref. 5). A pipe, located approximately 30 feet above the lowest grade of the cell, extending through the earthen berm near the face of the fly ash fill, was reportedly meant to drain surface water which collects in the low area of the fill. A drainage ditch at the receiving end of this pipe runs to a run-off water retention pond located 300 feet away in a wooded area (Ref. 6, p. 83).

Date of Start-Up: Use of this unit began in 1982 (Ref. 6, p. 83).

Date of Closure: This unit is currently active (Ref. 5).

Waste Managed: Unknown quantities of fly ash from the coal fired plant and wastewater sludges reportedly are disposed of in this unit (Ref. 6, p. 84). During the July 1986 VSI sludge from the Biological Treatment Plant (Unit 10) was observed being disposed of in this unit (Ref. 6, p. 83). During the April 1987 VSI, facility representatives indicated that sludges from the A-B Line Acidic Wastewater Treatment Plant Drying Beds (Unit 19f) are disposed in this unit. It is unknown if any hazardous constituents are present in the waste (Ref. 5).

Release Controls: Release controls for this unit consist of the earthen perimeter berm and the stormwater run-off pipe that discharges into the retention pond.

29. <u>UNIT NAME</u>: Fly Ash Landfill No. 2 (Cont'd)

<u>Release History</u>: Monitoring well data indicate ground water in the vicinity of this landfill and Units 27 and 53 has been contaminated. Due to the contiguous location of this unit with Unit 27 and 53 the contamination may be from the other units. Table 4-24 (p. IV-73) summarizes ground water quality data for the monitoring wells located in the vicinity of these units (Ref. 6. p. 84).

30. UNIT NAME: Asbestos Disposal Trench No. 1

Unit Description: This unit is believed to be permitted by the Virginia Department of Waste Management (Ref. 7). This unit is a closed Asbestos Disposal Trench located adjacent to Units 51 and 79, in the southeastern section of the RAAP "Horseshoe Area". The trench is approximately 15 feet wide by 300 feet long. The unit was identified as active during the July 1986 VSI and 15 feet deep at its deepest point. During the April 1987 VSI the unit appeared recently graded with no vegetative cover.

Date of Start-Up: Use of this unit began in 1982 (Ref. 6. p. 88).

Date of Closure: The closure status of this unit is uncertain due to the active status of Asbestos Disposal Trench No. 2 (Unit 79). The boundary of Asbestos Disposal Trenchs Nos. 1 and 2 are indistinguishable (Ref. 5).

Waste Managed: It has been reported that 0.25 tons of asbestos per day were disposed in this unit (Ref. 6, p. 88).

Release Controls: Daily soil cover was placed on the double-bagged asbestos (Ref. 6, p. 88).

Release History: No data indicating releases have been collected (Ref. 5).

31. UNIT NAME: Bottom Ash Settling Lagoon

Unit Description: This unit has been formerly called the Fly Ash Settling Lagoon in both the draft interim RFA (Ref. 1, p. 88) and the final interim RFA reports (Ref. 6, p.88), however, RAAP representatives declared during the April 1987 VSI (Ref. 5) that this unit is a Bottom Ash Settling Lagoon system. The settling lagoons lie in the northwestern section of the "Horshoe Area" at an approximate elevation of 1,700 feet above MSL. This unit consists of three settling lagoons associated with the No. 2 Power House. The individual components which are included as one SWMU include:

31a. Sluice Waterway
31b. Primary Settling Lagoon
31c. Secondary Settling Lagoon
31d. Tertiary Settling Lagoon
31e. Concrete Sump
31f. Equalization Basin

The unit cperates as follows: Water carrying fly ash from the power house flows down a below-grade concrete-lined Sluice Waterway (Unit 31a) to the Primary Settling Lagoon (Unit 31b). The Sluice Waterway is approximately 10 feet deep, 150 feet long, and only about 2" of flow was evident during the April 1987 VSI (Ref. 5). The Primary Settling Lagoon is approximately 10 feet wide by 30 feet long and of an unknown depth. From the Primary Settling Lagoon the waste water flows through a below ground pipe to a Concrete Sump (Unit 31e). The Concrete Sump is partially below grade, approximately 18 to 20 feet deep, 2 feet of which is above grade level. The sump is approximately 4 feet wide by 8 feet long (Ref. 5). Retention times are unknown.

From the Concrete Sump (Unit 31e) water is discharged to the Secondary Settling Lagoon (Unit 31c). The secondary settling lagoon is approximately 20 feet wide by 25 feet long and of an unknown depth. From the secondary settling lagoon water is discharged to the Tertiary Settling Lagoon (Unit 31d). The dimensions of

31. UNIT NAME: Bottom Ash Settling Lagoon (Continued)

this unit were not estimated during the VSI. Discharge from the secondary lagoon enters a Concrete Equalization Basin (Unit 31f) where the water is neutralized with sulfuric acid. The equalization basin is below grade, approximately 25 feet deep, 15 feet wide by 15 feet long. The facility representative reported during the April 1987 VSI that neutralization is not occurring in this unit at the present time due to the low volume of wastewater (Ref. 5).

Date of Start-Up: The Equalization Basin (Unit 31f) was built in the late 1970s (Ref. 5). It is unknown when the other components of the settling lagoon system were built.

Date of Closure: All unit components are presently active (Ref. 5).

Waste Managed: Bottom ash from the No. 2 Power House. Solids are occasionally dredged out of the Primary Settling Lagoon (Unit 31b) and used on dirt roadways around RAAP where muddy conditions exist (Ref. 5).

Release Controls: The three settling lagoons (Units 31b-d) are unlined earthen basins. Units 31a, 31e, and 31f are all concrete lined, constructed below grade. All six components of the bottom ash settling lagoon system were observed during the April 1987 VSI to have more than two feet of freeboard.

Release History: During the April 1987 VSI, dredged solids from the primary settling lagoon were observed stockpiled adjacent to the primary lagoon on open soil (Ref. 5).

Outfall 024 is reserved for possible overflow from the settling lagoons, and the outfall has no recent history of a discharge (Ref. 6, p. 89).

32. UNIT NAME: Inert Waste Landfill No. 1

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). This unit is a closed inert waste landfill located adjacent to Unit 58 as identified by facility representatives during the April 1987 VSI (Ref. 5). However, during the July 1986 VSI the location of the unit was identified in the central section of the RAAP "Horseshoe Area" and described as active. The unit was described as a pile of waste deposited on the original ground surface with no excavation and covered with soil except for the face of the pile. This unit does not have a liner or a leachate collection system. The cover reportedly does not meet any design specifications. The dimensions of this unit were reported to be approximately 300 by 400 by 30 feet high during the July 1986 VSI (Ref. 6, p. 90). The area identified by facility representatives as this unit is contiguous to Unit 47 with no definitive boundary and covered with soil and a sparse grass cover (Ref. 5).

Date of Start-Up: This unit began receiving waste material in 1978 (Ref. 6 p. 90).

Date of Closure: This unit appeared to have been closed sometime between July 1986 and April 1987 (Ref. 5).

Waste Managed: It has been reported by the facility that 50 to 100 tons per day of earth, concrete and fiberglass were disposed in this unit. During the July 1986 VSI wastes noted were as follows: asphalt, cardboard boxes, fluorescent lamp tubes, fiberglass, bottom ash and empty laboratory containers. Laboratory containers seen, were labeled sulfuric acid, sec-butyl alcohol and lead salicylate. A load of wet coal was noted (Ref. 6, p. 90). It is unknown if any hazardous constituents are present in the waste (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5). Unit management operations during unit activity is unknown.

Release History: Groundwater monitoring data for this area are not available (Ref. 6, p. 90). No other sampling is known to have been conducted.

33 and 34. UNIT NAME: Treatment Plant for Solids from Waste Plant

Unit Description: These facilities are identical units which were designed to process water treatment sludges (Ref. 1, p. 91). The draft interim RFA report (Ref. 1, p. 91) concluded that these facilities were not SWMUs. EPA representatives stated during the April 1987 VSI that these units would not be inspected (Ref. 5).

35 and 36. UNIT NAME: Calcium Sulfate Drying Beds (Northeast Section)

Unit Description: Unit 35 and 36 are located in the northeastern section of the RAAP main manufacturing area. These units lie along the New River; one on each side of Unit 8. During the 1970s, calcium sulfate sludge was dredged from Unit 8 and placed in these units. Both of these units are excavated into the natural grade and are unlined. These units measure approximately 50 feet by 50 feet. Currently, these units are not in use and are covered with heavy vegetation. Some material which appeared to be digester sludge was present on the bottom of Unit 35. In addition to these units, several other similarly excavated units were identified during the April 1987 VSI, immediately adjacent to Units 35 and 36. These units consisted of what appeared to be three earthen, unlined impoundments for sludge drying. Two (2) were rectangular shaped with dimensions of approximately 40-50 feet wide by 200 feet long by 10-15 feet deep. The final unit was somewhat elliptical in shape with an overall length of approximately 200 feet and width of approximately 60 feet. Each of these units contained what appeared to be calcium sulfate sludge (Ref. 5 and 6). Facility representatives could not clarify unit's contents.

Date of Start-Up: Unknown.

Date of Closure: These units are currently active (Ref. 5).

Waste Managed: According to the SWMU response letter, Unit 35 received 100 tons of sludge and Unit 36 received 1,000 tons of sludge. Reactivity characteristics of similar sludge is found in Tables 4-11 and 4-12 (Ref. 6). It is unknown if hazardous constituents are present in the waste (Ref. 5).

Release Controls: The only release controls for these units are the earthen embankments of the units themselves (Ref. 5).

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35 and 36. UNIT NAME: Calcium Sulfate Drying Beds (Northeast Section) (Cont'd)

Release History: No visual evidence of release from these units was observed during the April 1987 (Ref. 5).

37 and 38. UNIT NAME: Calcium Sulfate Drying Beds (Northwest Section)

Unit Description: Units 37 and 38 are located in the northwestern section of the RAAP main manufacturing area; one on each side of Unit 9. Calcium sulfate sludge is dredged from Unit 9, the Calcium Sulfate Settling Lagoon and placed in these units. Both of these units are excavated into the natural grade and are unlined. The surface of Unit 38 is partially covered with grass, whereas the surface of Unit No. 37 is bare, cracked, with both sludge and soil present on the surface. Unit 37 measures approximately 100 feet by 80 feet, and Unit 38 measures approximately 40 feet by 225 feet; the depth of both units is assumed to be 6-8 feet based on visual observation (Ref. 5 and 6).

Date of Start-Up: Unknown.

Date of Closure: These units are currently active.

Waste Managed: Tables 4-11 and 4-12 provide a typical characterization of the wastes managed in these units. It is unknown if hazardous constituents are present in the waste (Ref. 5).

Release Controls: The only release controls for these units are the earthen embankments of the units themselves (Ref. 5).

Release History: No visual evidence of release from these units was observed during the April 1987 VSI (Ref. 5).

39. UNIT NAME: Incinerator Wastewater Ponds

Unit Description: This RCRA regulated unit is located adjacent to units 14 and 15, in the north central section of the Horseshoe Area. It consists of two unlined earthen ponds that receive scrubber and precooler quench water from incinerator exhaust. These ponds are excavated into the grade. The excavated material forms the berm of the ponds. During the July 1986 VSI, the ponds exhibited approximately 3 feet of freeboard. Rushes and ducks inhabit the ponds. A chain-link fence surrounds the ponds. An adjacent aeration pond serves as a cooling pond for non-contact cooling water for the incinerator fire eye cameras (Ref. 5 and 6).

Date of Start-Up: Unknown.

Date of Closure: These units are currently active (Ref. 5).

Waste Managed: These ponds manage scrubber and precooler quench water. Table 4-17 provides a typical characterization of the sludge from these ponds.

Release Controls: The earthen embankments serve as the only release controls for this unit (Ref. 5).

Release History: No visible signs of release were observed during the April 1987 VSI (Ref. 5).

TABLE 4-17

ANALYSIS OF A SLUDGE SAMPLE FROM INCINERATOR WASTEWATER PONDS ON SEPTEMBER 2, 1983
SWMU NO. 39 - RADFORD ARMY AMMUNITION PLANT

EP Toxicity:	
Silver	<0.1 mg/l
Arsenic	0.010 mg/l
Barium	1.1 mg/l
Cadmium	<0.1 mg/l
Chromium	0.3 mg/l
Mercury	0.0010 mg/l
Lead	0.2 mg/l
Selenium	0.012 mg/l
Ignitability:	Not ignitable at 60°C
Corrosivity:	Not corrosive
Reactivity:	Not reactive

NOTE: EP toxicity, corrosivity, and reactivity testing procedures done in accordance with the EPA hazardous waste regulations.

Source: RAAP Part B Permit Application (Ref. 3).

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40. UNIT NAME: Sanitary Landfill (Nitroglycerine Area)

Unit Description: This unit is situated approximately 1,000 feet southeast of Nitroglycerine Area No. 1, in the south central section of the main RAAP Manufacturing area. The site was used in the 1970s for the disposal of paper and municipal refuse and is now closed. The area identified as the landfill measures approximately 100 feet by 400 feet (Ref. 1, p. 94). No information was available or known by facility representatives during the April 1987 VSI about the operation methods of the unit (Ref. 5).

Date of Start-Up: The site was used in the late 1970s (Ref. 1, p. 94).

Date of Closure: Unknown.

Waste Managed: Unknown quantities of paper and municipal refuse were reportedly disposed of in the unit (Ref. 1, p. 94). It is unknown if wastes containing hazardous constituents have been placed here (Ref. 5). Ash was noted during a July, 1986 VSI (Ref. 1, p. 94). Soil debris piles at or near the boundaries of the unit were observed during the April 1987 VSI (Ref. 5).

Release Controls: The site has been closed with a soil cap and has a moderate grass cover (Ref. 5).

Release History: There are no documented releases from this unit (Ref. 5).

41. UNIT NAME: Red Water Ash Landfill (Southeast of Barracks)

Unit Description: This unit is an inactive landfill once used for disposal of red water ash. During the July 1986 VSI, facility representatives identified the location to be southeast of the barracks area in the main manufacturing area of the RAAP (Ref. 6 p. 95). During the April 1987 VSI facility representatives identified the location of this unit as an area northwest of the barracks, adjacent to the TNT Wastewater Treatment Unit (Unit 3). Approximate dimensions of the mounded area are 50 by 80 feet. The unit appears to be a bermed area with an uneven cover. Native grass vegetation was observed during the VSI (Ref. 5). It is reported that this unit does not have a liner or a leachate collection system. The cover does not meet any design criteria and no known formal closure took place (Ref. 6, p. 96).

Date of Start-Up: Use of this unit began in the 1970s (Ref. 6, p. 95).

Date of Closure: Unknown.

Waste Managed: Ash from incineration (Area of Concern I) of redwater sludge from the circulating tanks in the Red Water Treatment Plant (Unit 82). It is unknown if hazardous constituents are present in the redwater ash (Ref. 5).

Release Controls: There are no known release controls for this unit.

Release History: No data indicating releases have been collected for this unit.

42. UNIT NAME: Red Water Ash Landfill (Eastern Edge of Main Manufacturing Area)

Unit Description: This unit is an inactive landfill once used for red water ash disposal. The location of this unit reportedly is 1,500 feet south of the Rolled Powder Area on land no longer owned by RAAP. The condition of the unit is assumed to be the same as Unit 41. This unit was not seen during the July 1986 or April 1987 VSIs (Ref. 6 p. 97 and Ref. 5). However, it was determined during the April 1987 VSI that this unit is not located on Radford property.

Date of Start-Up: This unit was in use in the 1970s.

Date of Closure: This unit closed between the 1970s and 1986 (Ref. 6 p. 97).

10/21/87

Waste Managed:

If the unit rec'd. wastes after 1982 or 1983, or did not close before 1983, this unit may be a H. W. Unit. ? — are these wastes the same as those discussed in the delisting petition.

Release Controls:

Release History:

43. UNIT NAME: Sanitary Landfill (Adjacent to New River)

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). It is a series of trenches used for disposal of sanitary wastes, located adjacent to the New River in the northeastern section of the RAAP main manufacturing area. During the July 1986 VSI the unit boundaries could not be determined (Ref. 6 p. 98). During the April 1987 VSI, depressions observed indicated this unit consists of approximately 5 trenches, measuring 20 feet wide and 400 feet long. Subsidence of the soil cover, areas of sparse grass cover and an eroded gully were noted. Facility representatives were unable to provide depth of the trenches (Ref. 5).

Date of Start-Up: This unit began operation in the 1970s (Ref. 6, p. 97).

Date of Closure: This unit was closed sometime between the 1970s and the July 1986 VSI (Ref. 6 p. 97-98).

Waste Managed: This unit was reported to receive 300 tons of paper and refuse during the period of operation. It is unknown if any hazardous constituents are present in the unit (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5). Facility representatives were unable to describe operational controls during the active life of this unit.

Release History: No data indicating releases have been collected (Ref. 5).

44. UNIT NAME: Toluene Spill Site

Unit Description: The toluene spill site is located approximately 2,600 feet west of the main bridge spanning the New River. The area speculated to be the spill site is void of trees, though lower succession species of plants are prevalent in the area. The spill is believed to have occurred along the railroad tracks paralleling the river and the road. The unit is a one time accidental spill of 75,900 pounds of toluene and is not a SWMU (Ref. 6, p.99).

Date of Start-Up: This spill was a one time occurrence in 1973 (Ref. 6, p. 99).

Date of Closure: Contaminated soil was reportedly removed and deposited in a landfill shortly after the incident (Ref. 8).

Waste Managed: This area is the site of a one time train derailment of a toluene tanker car (Ref. 8).

Release Controls: An earthen dam was constructed to prevent toluene from flowing to the river. The contaminated soil was removed and deposited in a landfill (Ref. 8).

Release History: This site is the occurrence of a one time spill of toluene from a rail tanker to the open ground (Ref. 8).

45. UNIT NAME: Sanitary Landfill (West of Main Bridge)

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). The unit identified by facility representatives during the July 1986 and April 1987 VSIs was indistinguistable from the surrounding area as a landfill site (Ref. 6 p. 100 and Ref. 5). The unit is located approximately 3,000 feet west of the main bridge of the New River, in the north-central section of the RAAP main manufacturing area. During the April 1987 VSI the area to the west of this pine tree-covered area resembled a former disposal area. Soil mounds were noted as well as a possible former excavation. The area was approximately 5 feet long by 5 feet wide and 4 feet at the deepest point (Ref. 5).

Date of Start-Up: This unit began operation in the 1970s (Ref. 6 p. 100).

Date of Closure: This unit was not clearly defined, but reportedly was not active during the July 1986 VSI (Ref. 6, p. 100).

Waste Managed: It has been reported that paper and municipal refuse were the only materials placed in this unit (Ref. 6, p. 100). It is unknown if hazardous constituents are present in the landfill (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: No data indicating releases have been collected (Ref. 6 p. 101 and Ref. 5).

46. UNIT NAME: Waste Propellant Disposal

Unit Description: This unit lies along the New River in the northwestern section of the main manufacturing area. Approximately one ton of earth and propellants was dumped at this location. This information was reportedly supplied by a long time employee (Ref. 6, p. 101).

The unit lies between Unit 34 and an open area identified by a sign as a septic field. The unit appears to have numerous 2-to-3-foot high, parallel hummocks, covered with grasses (Ref. 5).

Date of Start-Up: 1950s (Ref. 6, p. 101).

Date of Closure: Dumping at this location was apparently a random, one-time occurrence and not a standard procedure (Ref. 6, p. 101).

Waste Managed: Approximately one ton of earth and propellants was dumped at this location (Ref. 6, p. 101).

Release Controls: It is not known if the waste was covered at the time it was dumped (Ref. 6, p. 101).

Release History: Asphalt has been noted on the surface of the hummocks (Ref. 6, p. 101).

47. UNIT NAME: Inert Waste Landfill No. 2

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). This unit is a closed inert waste landfill located approximately 2,600 feet east of the main bridge, in the south-central portion of the RAAP "Horseshoe Area." The dimensions of this unit are 150 by 500 feet, consisting of inert debris scattered over a flat area (Ref. 6). During the April 1987 VSI the area identified by facility representatives could not be distinguished from Unit 32. It can only be concluded at this time that these units are contiguous due to a continuous cover over the entire area. No signs of recent disposal were noted during the April 1987 VSI (Ref. 5).

Date of Start-Up: This unit began operation in the 1950s (Ref. 6).

Date of Closure: Unknown.

Waste Managed: It has been reported that 10,000 tons of concrete were placed in this unit (Ref. 6). It is unknown if hazardous constituents are present in the waste. Brick and concrete debris were evident on the surface of the unit during the April 1987 VSI (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: No data indicating releases have been collected (Ref. 5 and 6).

48, 49, and 50. UNIT NAME: Oily Wastewater Disposal, Redwater Ash Disposal, and Calcium Sulfate Disposal

Unit Description: These three units are located in the RAAP "Horseshoe Area", approximately 3400 feet east of the main bridge. These units are contiguous, and no distinction between each area can be made by visual observation. The area is sparsely vegetated, the ground was noted as soft and appeared disturbed during the July 1986 VSI. Plastic sheeting has also been noted protruding from the ground (Ref. 6, p. 103). The dimension of the units are unknown (Ref. 5).

Date of Start-Up: Disposal at these units reportedly took place in the 1970s (Ref. 6, p. 103).

Date of Closure: These units are currently inactive (Ref. 5)..

Waste Managed: These units, 48, 49, and 50 reportedly received eight tons of oil-contaminated wastewater, 10 tons of Redwater Ash, and approximately 60 tons of calcium sulfate sludge (Ref. 6, p. 103).

Release Controls: There are no known release controls for these units.

Release History: No visual signs of release were noted during the April 1987 VSI. Some residue of what appears to be calcium sulfate were noted (Ref. 5).

51. UNIT NAME: TNT Neutralization Sludge Disposal

Unit Description: This unit is located in the southeastern section of RAAP "Horseshoe Area", adjacent to Asbestos Disposal Trench No. 1 (Unit 30). The unit is a covered trench, measuring approximately 20 feet by 200 feet. The depth of the trench is not known (Ref. 6, p. 104). Facility representatives were unable to provide operational control information (Ref. 5).

Date of Start-Up: Disposal in this unit took place in the 1970s (Ref. 6, p. 104).

Date of Closure: Unknown.

Waste Managed: Disposal at this unit consisted of TNT neutralization sludge (Ref. 4, p. 5). It is unknown if hazardous constituents are present in the waste. Disposal at this unit consisted of unknown quantities of TNT neutralization sludge (Ref. 5).

Release Controls: The trench was covered to natural grade level (Ref. 6, p. 104).

Release History: Groundwater downgradient of the site has been contaminated by low levels of DNT and halomethane compounds. This contamination was detected in the groundwater monitoring system for Unit 16. It is reported that this contamination is more suggestive of Unit 51 disposal activities (Ref. 6, p. 105).

52. UNIT NAME: Closed Sanitary Landfill

Unit Description: This unit is permitted by the Virginia Department of Waste Management (Ref. 7). This unit is a closed Sanitary Landfill contiguous with Units 28 and 16. The unit is upgradient of Unit 28, at the top of the knoll in the southeastern section of the RAAP "Horseshoe Area." The unit has been described as covered with a clayey soil with a sparse vegetative cover (Ref. 6, p. 86-87). During the April 1987 VSI the boundary of this unit could not be determined due to its contiguous location relative to Unit 28. The dimensions and operational procedures of the fill while active are unknown (Ref. 5).

Date of Start-Up: Use of this unit began in 1976 (Ref. 6, p. 87).

Date of Closure: This unit was closed in 1984 (Ref. 6, p. 87).

Waste Managed: It has been reported that municipal refuse and trash from nearby office buildings and staff houses were placed in this landfill. Daily soil cover was placed on the refuse (Ref. 6, p. 86 and 97). It is unknown if hazardous constituents are present in the landfill (Ref. 5).

Release Controls: Release controls include a clayey soil cover with sparse vegetation (Ref. 6).

Release History: No data indicating releases have been collected.

53. UNIT NAME: Activated Carbon Disposal Area

Unit Description: This unit is a closed disposal area for activated carbon located within Unit 29 in the southeast section of the RAAP "Horseshoe Area." This unit was observed to be a plateau in the Fly Ash Landfill (Unit 29). The dimensions of the unit are approximately 500 feet long, and 50 feet wide and of unknown height. The soil cover was bare of vegetation and recent slippage of soil material was noted (Ref. 5). During the July 1986 VSI, a drainage culvert from Unit 27 to the stormwater retention pond was observed to bisect this unit (Ref. 6, p. 105). No evidence of the culvert was noted during the April 1987 VSI (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: This unit was closed sometime before the 1986 VSI (Ref. 6, p. 106).

Waste Managed: It is reported, but not confirmed, that activated carbon from the alcohol-recovery units was disposed here (Ref. 6, p. 105). It is unknown if hazardous constituents are present in the waste (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: Monitoring well data indicate groundwater in the vicinity of this unit (Units 27 and 29) has been contaminated (See Table 4-24). Due to the contiguous location of this unit with Unit 27 and 53, the contamination may be from any or all units (Ref. 5 and Ref. 6, p. 84).

54. UNIT NAME: Disposal Area for Ash From Burning of Propellants

Unit Description: This unit is a closed disposal area for ash from the incinerator propellant burning ground (Unit 13). The unit is located in the eastern-most section of the RAAP "Horseshoe Area." The unit was described, during the July 1986 and April 1987 VSIs, as constructed of earthen materials in an open field surrounded by a wooded area outside the RAAP fence. The boundaries of the unit are not well defined and little evidence of disposal was observed. A small amount of charred material was noted on a mounded area adjacent to abandoned trenches (Ref. 5 and Ref. 6, p. 106-107).

Date of Start-Up: It has been reported that this unit was in operation in the 1970s (Ref. 6, p. 106).

Date of Closure: This unit stopped receiving wastes sometime between the 1970s and July 1986. No known formal closure of this unit has taken place (Ref. 6, p. 106).

Waste Managed: It has been reported that probable properties of the waste propellant ash disposed in this unit is similar to the ash disposed in the Hazardous Waste Landfill (Unit 16). Refer to Table 4-19 for EP Toxicity data on this ash (Ref. 6, p. 107). Facility representatives were unable to provide information on the quantities of waste disposed of in this unit (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: Groundwater in the vicinity of Unit 16 which contains similar wastes has been contaminated with dinitrotoluene and halomethanes (Ref. 6, p. 108). However, no data for this unit have been collected (Ref. 5 and Ref. 6, p. 108).

55. UNIT NAME: Sewage Treatment Plant (Northeast/Section)

Unit Description: This Unit 55 is located in the Northeastern section of the RAAP main manufacturing area. This plant is comprised of a trickling filter, two clarifiers, and a sludge drying bed. The trickling filter is above ground and is constructed of wood staves situated on a concrete base. The clarifiers and the sludge bed are constructed of concrete and are partially below the grade. This plant has been in operation since the 1940's (Ref. 6).

According to the SWMU response letter, this unit processes approximately 1.0 million gallon of sanitary sewage daily. EPA Representatives indicated that this unit would not be included within the scope of this RFA since Sewage Treatment Plants operate under an exemption from the RCRA program (Ref. 5).

56. UNIT NAME: Sewage Treatment Plant (Northwest Section)

Unit Description: The draft interim RFA report (Ref. 1, p. 107) identified this unit as a potential SWMU. The facility processes approximately 40,000 gallons of sanitary sewage daily during peak operations. The treatment plant is located in the north-western section of RAAP "Horeshoe Area". The facility consists of a primary clarifier and an extended-aeration lagoon. Both of these units are constructed of concrete and are partially below grade. The facility has been reportedly in operation since the 1950's (Ref. 1, p. 107).

In RAAP response to additional information (Ref. 4), RAAP reported that they cannot provide confirmation that this treatment plant has not received industrial wastes. EPA representatives stated during the April 1987 VSI that this unit would not be inspected (Ref. 5).

57. UNIT NAME: Pond by Building No. 4931

Unit Description: This unit is located in the western section of the "Horseshoe Area," adjacent to Building No. 4931. The pond measures approximately 30 feet in diameter and is surrounded by a berm that is either asphalt or gravel and a 4-foot high metal fence. A pipe leading from Building No. 4931 enters the pond. This building is labeled as the Chromic Acid Treatment Building (Ref. 6, p. 109).

Date of Start-Up: Unknown.

Date of Closure: Facility representatives are unclear if this unit is active or inactive (Ref. 5).

Waste Managed: The nature of the water currently in the pond or of liquid stored here in the past is not known (Ref. 6, p. 109; Ref. 5).

Release Controls: A berm is constructed around the unit (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

53. UNIT NAME: Rubble Pile

Unit Description: This unit was identified as a Rubble Pile during the July 1986 VSI (Ref. 6, p. 120). Miscellaneous wastes were discovered in this pile. This unit is located directly west of Unit 32, approximately 2,600 feet east of the main bridge in the south central portion of the RAAP "Horseshoe Area". The dimensions of this unit are approximately 400 by 200 by 50 feet high. During the April 1987 VSI the pile appeared to consist of fill material, concrete rubble and rocks (Ref. 5). Facility representatives were unable to provide information pertaining to this unit. Erosion of the soil cover was evident.

Date of Start-Up: Unknown.

Date of Closure: This unit closed sometime between July 1986 and April 1987.

Waste Managed: It has been reported that miscellaneous wastes were discovered in this large pile (Ref. 6, p. 121). It is unknown if there are any hazardous constituents in the waste (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: No data indicating releases have been collected.

59. UNIT NAME: Bottom Ash Pile

Unit Description: This unit is a pile of bottom ash from the coal-fired plant located east of Units 48, 49, and 50 in the "Horseshoe Area" of the RAAP, approximately 3400 feet east of the main bridge. The unit is approximately 100 feet by 50 feet and 20 feet high. Recent removal of material from this unit was evident due to the slippage of wall material and apparent cavity made by heavy machinery. The bottom ash is reportedly used to top gravel roads and was observed as cover material on several landfills throughout the facility (Ref. 5).

Date of Start-Up: The exact date of start-up is unknown, but it can be assumed this pile or similar piles have existed since operation of the coal-fired power plant assumed to be in operation since the 1940s (Ref. 5).

Date of Closure: This unit is currently active (Ref. 5).

Waste Managed: Bottom ash from the coal-fired power plant. It is unknown if there are any hazardous constituents in the waste (Ref. 5).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: No data indicating release have been collected (Ref. 5).

60. UNIT NAME: Rubble Pile East of Administration Building

Unit Description: This unit is a rubble pile used as fill material for a future parking lot east of the main administration building. The unit consists of demolition debris and other undetermined wastes. The unit is covered over with soil to level the surface over (Ref. 5).

Date of Start-Up: It is assumed that this unit began receiving debris for fill within the past several years (Ref. 5).

Date of Closure: This unit is active and the area is planned to be used as a parking lot upon completion of filling in the area (Ref. 5).

Waste Managed: Fill deposited in this unit consists primarily of demolition debris from torn down buildings on-site. It is unclear if any wastes containing hazardous constituents are disposed of in the unit (Ref. 5).

Release Controls: Soil material is placed over the top of the rubble pile for surface leveling.

Release History: There are no documented releases from this unit.

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61. UNIT NAME: Mobile Waste Oil Tanks

Unit Description: These units were identified during the April 1987 VSI. The RAAP operates numerous waste oil tanks throughout the plant for collection of waste oil. Waste oil is collected in an approximately 100 gallon capacity mobile tank. These tanks are set on wooden and metal carts that can be wheeled around the facility where needed. When the tanks are full they are emptied at the Waste Oil Underground Storage Tank (Unit 78).

Date of Start-Up: Unknown. The facility owns several of these units that were purchased at different times (Ref. 5).

Date of Closure: Active (Ref. 5).

Waste Managed: Waste oil from machinery and vehicle engines (Ref. 5).

Release Controls: Tanks are constructed of steel built on either wood or metal carts (Ref. 5).

Release History: Discolored soil was observed beneath the mobile tanks by several operating buildings (Ref. 5).

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62. UNIT NAME: Contaminated Flammable Liquid Mobile Cart

Unit Description: This unit was identified during the April 1987 VSI. Stoddard 2 parts cleaning solution is collected in an approximate 100-150 gallon capacity mobile tank. This tank is constructed on a wooden base that can be wheeled around the facility. The waste parts cleaning solution is mixed with waste oil collected from the facility and either incinerated on site (Unit 14) or used as a fuel (Ref. 5).

Date of Start-Up: Unknown (Ref. 5).

Date of Closure: Active (Ref. 5).

Waste Managed: Stoddard 2 parts cleaning solution. It is unknown if any hazardous constituents are contained in the waste (Ref. 5).

Release Controls: Tank is constructed of steel (Ref. 5).

Release History: No visual stains were observed during the inspection of the unit.

63. UNIT NAME: C-Line Boiling Tub House Settling Pits

Unit Description: This unit was identified during the April 1987 VSI. The unit consists of two below grade acid brick lined, concrete reinforced basins. Each basin is approximately 20 feet long by 5 feet wide. Wastewater from the nitrocellulose C-line is pumped to the Boiling Tub Sump where nitrocellulose fines settle out and overflow is discharged to the settling pits where more setting can occur. Wastewater from the settling pits can either be discharged to the Calcium Sulfate Settling Lagoon (Unit 9) or the C-line Acidic Wastewater Treatment Plant (Unit 20). The Boiling Tub Sump is used in a recycle process (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Nitrocellulose C-line Acidic Wastewater containing nitrocellulose fines (Ref. 5).

Release Controls: The basins are constructed of acid resistant brick (Ref. 5).

Release History: No releases were observed during the VSI, however, an approximate 1 feet of freeboard was observed.

64. UNIT NAME: Nitrocellulose C-line Collection Sump

Unit Description: This unit was identified during the April 1987 VSI. The units is a below grade acid brick lined sump approximately 6 feet by 6 feet by 20 feet deep. The sump is located adjacent to the Boiling Tub House Settling Pits (Unit 63). Wastewater from the Boiling Tub House Settling Pits flow through this unit prior to being discharged to the Active Wastewater Treatment Plant (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Facility representative was unclear about the exact function of this unit, but it is speculated that C-line nitrocellulose wastewater is managed in this unit (Ref. 5).

Release Controls: The unit is constructed of acid resistant brick (Ref. 5).

Release History: Steam was evolving to the atmosphere from the sump as observed during the VSI (Ref. 5).

65. UNIT NAME: Nitrocellulose A-B Line Acidic Water Settling Pits

Unit Description: This unit was identified during the April 1987 VSI. The unit consists of four below grade acid brick lined basins. Each basin is approximately 20 feet long by 5 feet wide. Wastewater from either the Nitrocellulose A-line or Nitrocellulose B-line is pumped to the A and B Boiling Tub Sumps where nitrocellulose fines settle out and overflow is discharged to the A or the B-line Settling Pits, respectively. Water is reportedly pumped back into the production process. Wastewater from the Settling Pits is pumped to the Acidic Wastewater Lagoon (Unit 4). The A and B Boiling Tub Sumps are used in a recycle process (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: The Nitorcellulose A-line was not active during the VSI, however, the B-line is active (Ref. 5).

Waste Managed: Nitrocellulose A-B line Acidic rinse wastewater which contains nitorcellulose fines (Ref. 5).

Release Controls: The basins are constructed of acid resistant brick (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

66. UNIT NAME: Nitrocellulose A-B Line Neutral Water Settling Pits

Unit Description: This unit was identified during the April 1987 VSI. The unit consists of four below grade concrete line basins. Each basin is approximately 50 feet long by 20 feet wide. Neutral wastewater from either the Nitrocellulose A or B lines is discharged to the basins.

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Nitrocellulose A-B Line neutral rinse wastewater (Ref. 5).

Release Controls: The basins are constructed of concrete with an weir overflow (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

67. UNIT NAME: Main Acid Sewer Lines

Unit Description: This unit was identified during the April 1987 VSI. The unit consists of two below grade acid brick lined sumps. There sumps are located adjacent to Building 2019 approximately 20 feet apart from each other. The sumps are approximately 40 feet deep.

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Potentially acidic wastewater from the main acid area. The acidity of the wastewater is dependent upon any leaks in the production operation lines. The wastewater is reportedly neutralized at the A-B Line Acidic Wastewater Treatment Plant (Unit 19). It is unclear if any hazardous constituents are contained in this waste (Ref. 5).

Release Controls: The unit is constructed of acid resistant brick (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

68. UNIT NAME: Chromic Acid Treatment Tanks

Unit Description: This unit was identified during the April 1987 VSI. The unit is comprised of two open-top steel tanks, built above ground, located in the vicinity of Building 4931. The tanks are estimated to be 10 feet tall by 8 feet in diameter and supported by above-ground steel legs several feet high. Facility representatives report the tanks were formerly used for spent chromic acid used to clean rocket encasements (motors). Oakite 33 rust stripper has been used by RAAP since 1974 to replace the use of chromic acid (Ref. 5). Less than two feet of freeboard was observed in one of the tanks during the April 1987 VSI (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Prior to 1974 spent chromic acid was stored in these tanks. Facility representatives report that Oakite 33, a rust stripper, is presently contained in the tanks. The rust stripper is pH adjusted with soda ash in the units prior to discharge to Unit 69. Only one of the two tanks contained liquid during the April 1987 VSI. It is unclear if hazardous constituents have ever been stored in either tank (Ref. 5).

Release Controls: Tanks are constructed of steel with no secondary containment (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

69. UNIT NAME: Pond by Chromic Acid Treatment Plant Tanks

Unit Description: This unit was identified during the April 1987 VSI. The pond is down slope of the Chromic Acid Treatment Plant Tanks (Unit 68). Facility representatives are unclear of the exact nature of the unit, but suspect that the pond receives pH adjusted wastewater from Unit 68. The pond is unlined; unit dimensions and depth were not estimated (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Unknown.

Waste Managed: Facility representatives are unclear of the exact nature of the wastes managed in the unit, but suspect that the unit prior to 1974 received pH adjusted chromic acid and now receives pH adjusted "Oakite 33" rust stripper cleaning solution. It is unknown if hazardous constituents have ever been received by this pond (Ref. 5).

Release Controls: The unit is an unlined pond constructed with an overflow pipe which discharges to open ground down slope of the unit (Ref. 5).

Release History: No releases were observed during the VSI.

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70. UNIT NAME: Heavy Equipment Maintenance Shop Tractor Steam Cleaning Area

Unit Description: This unit was identified during the April 1987 VSI. A tractor steam cleaning unit consisting of a Steam Cleaning Pad and an Oil-Water Separator sump were are located outside of the heavy equipment shop. The Steam Cleaning Pad is constructed of cement with a drainage basin that collects waste and discharges the collected materials to a below ground Oil-Water Separator of unknown unit dimensions (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Waste oil is collected in the oil-water separator. Oil-contaminated dirt in the wash pad is shoveled by hand and collected in 30 and 15 gallon pails and stored adjacent to the unit on a gravel surface. It is unclear what happens to separated oil and water (Ref. 5).

Release Controls: The wash pad is sloped toward the drainage sump to collect contaminated wash waster. In addition, the pad is constructed with an approximate 6-inch curb to prevent run-off from the unit. However, several cracks were observed in the retainer wall (Ref. 5).

Release History: Discolored soil was observed around the outside of the wash pad (Ref. 5).

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71. UNIT NAME: Flash Burn Parts Area (Sanitary Landfill)

Unit Description: This unit was identified during the April 1987 VSI. The unit is an area of open ground just west of the Sanitary Landfill (Unit 40) used to flash burn metal process pipes. The exact dimensions of the unit could not be estimated (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Metal process pipes potentially contaminated with propellant (Ref. 5).

Release Controls: Flash burning operations are conducted on the open ground (Ref. 5).

Release History: During the VSI, straw ash and potentially contaminated debris were observed (Ref. 5).

72. UNIT NAME: Oleum Plant Acidic Wastewater Sump

Unit Description: This unit was identified during the April 1987 VSI of the RAAP Oleum Plant. The unit is a below grade acid-brick lined sump constructed with reinforced concrete. The sump is connected to drains throughout the Oleum Plant secondary containment areas that collect runoff and process acidic wastewater. The dimensions and volume of wastewater flow through the unit could not be determined during the April 1987 VSI (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Sulfuric acid wastewater from the Oleum Plant which is discharged to either the Sulfuric Acid Recovery Plant-Waste Acid Treatment (Unit 18) or C-line Acidic Wastewater Treatment Plant (Unit 20).

Release Controls: The unit is constructed of acid resistant brick with reinforced concrete. The unit is covered over top with a grate (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

73. UNIT NAME: Main Lab Waste Container Storage Area

Unit Description: This unit was identified during the April 1987 VSI. The unit is located outside of the main lab used to store 30 gallon metal and plastic trash cans which contain contaminated waste acid rags and paper. Nine of the containers were situated on a wooden rack, lifted 8" off the ground and three containers were on the ground during the VSI. The waste is taken to the Contaminated Waste Burning Area (Unit 17) for incineration.

Date of Start-Up: Unknown.

Date of Closure: Active (Ref. 5).

Waste Managed: Contaminated waste acid rags and paper are managed in 30 gallon metal and plastic garbage cans. It is unknown if hazardous constituents are contained in the wastes (Ref. 5).

Release Controls: The garbage cans are covered with lids (Ref. 5).

Release History: No releases were observed during the VSI (Ref. 5).

74. UNIT NAME: Inert Landfill No. 3

Unit Description:	This unit is permitted by the Virginia Department of Waste Management (Ref. 7). The unit is an unlined inert waste landfill located across the road northeast of Units 28 and 16. According to facility representatives this unit has not been previously identified. The dimensions of the landfill are unknown. Material is dumped on the side of a hill adjacent to the road. The slope of this fill area is greater than 20 percent to the roadway and drainage area below. Evidence of soil cover was apparent from previous disposal but no cover was observed on recently disposed material. No other release controls have been noted (Ref. 5).
Date of Start-Up:	According to facility personnel this unit began operation after the July 1986 VSI (Ref. 5).
Date of Closure:	This unit is currently active (Ref. 5).
Waste Managed:	During the April 1987 VSI material observed included: fluorescent light tubes, wet coal or asphalt, construction debris, laboratory chemical and reagent 5 gallon cans, and refuse. It is unclear whether these containers are RCRA empty (Ref. 5).
Release Controls:	No release controls were observed other than the previous soil cover (Ref. 5).
Release History:	No data indicating releases from this unit have been collected (Ref. 5).

75. UNIT NAME: Waste Oil Underground Storage Tank (A-421)

Unit Description: This unit located in the Inert Gas Plant operating area, west of the compressor house, due south of Unit 4. The unit is a below ground, waste oil collection tank. Facility representatives estimate that the tank is single shell of an approximate capacity of 600-700 gallons. Waste oil and hydraulic fluids are collected in a floor drain inside the compressor house and stored in this outside tank (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: This unit a presently active with no planned closure (Ref. 5).

Waste Managed: Wastes managed in this unit include waste oil and hydraulic fluids from the compressor house in the inert gas plant. Waste oil is removed from the tank, three times per week (approximately 550 gallons/removal) and used as fuel at the Waste Incinerator (Unit 14) (Ref. 5).

Release Controls: There are no known release controls for this unit.

Release History: Discolored soil around the tank access port was observed during the April 1987 VSI (Ref. 5).

76. UNIT NAME: Waste Oil Underground Storage Tank (South of Oleum Plant)

Unit Description: This unit is a below ground waste-oil collection tank, located in the south-central part of the main manufacturing area. The unit is located within the Contaminated Waste Stage and Burn Area (Unit 17a). Waste oil collected in the mobile Waste Carts (Unit 61) is deposited here and sold to an off-site waste oil reclamation firm. The size and materials of construction of the tank are unknown (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: This unit is presently active (Ref. 5).

Waste Managed: Waste oil from machinery and vehicle engines collected in the Mobile Waste Carts (Unit 61).

Release Controls: There are no known release controls for this unit (Ref. 5).

Release History: Discolored soil around the tank access port was observed during the April 1987 VSI (Ref. 5).

77. <u>UNIT NAME</u>: Garbage Incinerator

<u>Unit Description</u>: This unit is housed in building 7219, located in the south-central part of the main manufacturing area. The unit is located south of the Contaminated Waste Stage and Burn Area (Unit 17a). The unit is a garbage incinerator formally used for the incineration formerly used for the incineration of cardboard, wood, paper, and other unidentified trash from the facility. Building 7219 is presently used for the storage of pesticides. The building was not accessible during the April 1987 VSI (Ref. 5).

<u>Date of Start-Up</u>: Unknown.

<u>Date of Closure</u>: Unknown.

<u>Waste Managed</u>: The unit was formerly used for the incineration of garbage, including, cardboard, paper, wood, and other general trash from facility operations (Ref. 5).

<u>Release Controls</u>: Unknown.

<u>Release History</u>: Unknown.

78. UNIT NAME: Rubble Pile Southwest of Unit 51

Unit Description: This unit is located southwest of Unit 51 in the southeastern section of the "Horseshoe Area" of RAAP. The unit is approximately 4,000 square feet. The unit area consists of concrete, brick, sewer pipes, wood, and fresh asphalt on the open ground (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: Unknown.

Waste Managed: The unit consists of concrete, brick, sewer pipes, wood, and fresh asphalt on the open-ground (Ref. 5).

Release Controls: There are no known release controls.

Release History: Unknown.

79. UNIT NAME: Asbestos Disposal Trench No. 2

Unit Description: This unit believed to be permitted by the Virginia Department of Waste Management (Ref. 7). The unit is located adjacent to Units 51 and 81, in the southeastern section of the RAAP "Horseshoe Area." The unit is approximately 15 feet wide by 300 feet feet long. The unit is located adjacent to Asbestos Disposal Trench #1 (Unit 30) (Ref. 5).

Date of Start-Up: Unknown.

Date of Closure: The unit is presently active (Ref. 5).

Waste Managed: Double-bagged asbestos is disposed of in the unit (Ref. 5).

Release Controls: Daily soil cover in placed over the bags (Ref. 5).

Release History: No date indicating releases have been collected (Ref. 5).

30. UNIT NAME: "Drainage Ditch" for C-Line Wastewater Treatment and Plant Runoff

Unit Description: This unit was identified during the tour of Unit 20, C-Line Wastewater Treatment Plant. The unit is located in the northwestern section of the main manufacturing area. The unit is an earthen drainage basin/trench. The unit receives storm water run-off from the area in the vicinity of Unit 20. This water then drains into the discharge culvert for Unit 20 and ultimately is discharged to the New River via an NPDES regulated outfall.

Date of Start-Up: The date of the unit began operating is unknown, however, it is assumed to have coincided with the C-Line Acidic Wastewater Treatment Plant (Unit 9) (Ref. 5).

Date of Closure: The unit is presently active (Ref. 5).

Waste Managed: The unit receives surface water run-off (Ref. 5).

Release Controls: There are no known release controls for this unit.

Release History: Wastewater in the ditch discharges to the New River, NPDES outfall 004.

81. UNIT NAME: Redwater Treatment Plant

Unit Description: This inactive unit was identified during the VSI of April 1987. It is located immediately west of the "Red Water Storage Tank (Unit 1), approximately 30 feet, across the roadway. It consists of a below grade concrete basin with a series of open top stainless steel tanks contained within its confines; these components are explained below (Ref. 5).

The system apparently served the dual purpose of being able to pretreat "Redwater" prior to discharge to the TNT Wastewater Treatment Plant (Unit 3)and also to pretreat "Redwater" prior to shipment offsite to a papermill. Facility representatives were unclear as to the first scenario, however, the RAAP petition for delisting its "Red and Pink Water" (Ref. 4) clearly explains the system's use in the second scenario.

Redwater from the purification process at each Nitration/Purification Building flows by gravity through enclosed stainless steel gutters to the redwater Settling-Storage Area, where it is collected for off-plant shipment. The gutters are housed inside concrete trenches to prevent ground spillage, should the gutters overflow. The concrete trenches are directly interconnect to a concrete dike area which surrounds the redwater settling-storage tanks (Ref. 4).

At the redwater settling-storage area, the red water is collected in either a 50,000 or a 250,000 gallon stainless steel storage tank. These tanks are housed inside concrete dikes to protect against emergency spillage should a tank overfill or rupture. Pumping facilities exist to transfer tank spillage, rain water, and floor washdown back into the storage tanks (Ref. 4).

To ensure that the redwater is handled safely from generation through disposal, procedures and facilities previously used to dispose of over 225 million pounds of red water have been used. These are as follows: Red water is transferred from the storage tanks into two concrete diked 8,000 gallon stainless steel shipment tanks, and

81. <u>UNIT NAME</u>: Red Water Treatment Plant (Cont'd)

heated by low pressure steam heat coils to approximately 80°C to prevent solids drop-out. The heated red water is pumped into insulated commercial tank trucks and loaded to a normal truck capacity of 4,500 gallon (Ref. 4).

The system's components are as follows:

a. Concrete Basin
b. Tanks
   - T71
   - T72
   - T73
   - T74
   - T75
c. Drum staging area
d. Overflow basin
e. Soda ash mix tank

a. Concrete Basin

This unit is a below grade reinforced concrete basin with approximate dimensions of 50-60 feet long by 30-40 feet wide by 10 feet deep. It serves to provide secondary containment capacity for all the various tanks and appurtenant equipment for the system.

b. Tanks

- T71 & T72

These tanks are actually two separate vessels, arranged in a cascade system via two overflow pipes. Both tanks are open head, rectangular in shape and constructed of 316 Stainless Steel. The initial receiving tank has approximate dimensions of 5 feet wide by 8 feet long by 4-5 feet deep. It overflows by two three inch stainless steel pipes, located approximately 4-6 inches below the top lip of the tank, into the second, larger capacity tank, (T72) with approximate dimensions of 10-12 feet wide by 24-26 feet long by 6-8 feet deep. These tanks serve to equalize the flow of waste to the other units.

81. UNIT NAME: Red Water Treatment Plant (Cont'd)

- T73 and T74

These tanks are identical circular shaped, open head tanks, constructed of 316 stainless steel, with an approximate diameter of 10 feet, and 5-6 feet in depth and an estimated capacity of 5000 gallons. They are equipped with 4 steam coils for equalizing the temperature of "Redwater" prior to shipment offsite. Influent is pumped to these tanks via 3 inch stainless steel pipes from T72.

- T75

This tank is a closed head, circular shaped tank, with approximately a 3-5 foot diameter and an estimated height of 6 feet. It serves as the head tank and pumping station for the system. It is equipped with 2 pumps, mounted on the head plate of the tank.

c. Drum Staging Area

This area is a concrete pad located immediately adjacent to the basin (Unit 81a). Its approximate surface dimensions of were 40 feet long by 20-25 feet wide. It is used infrequently for drum storage; however during the April 1987 VSI, approximately 35 20-gallon containers of "Redwater" sludge mixed with sawdust were observed staged in this area. Facility representatives indicated that this material was from cleaning and maintenance activities on the system and would ultimately be burned at the Open Burning Ground (Unit 13).

e. Overflow Basin

This is a reinforced concrete below grade basin, located adjacent and immediately downgradient of Unit 81a. It is surrounded by 6 foot chain link fence. Its approximate dimensions are 20 feet long by 8-10 feet wide by 8 feet deep. It serves as secondary containment for a rectangular, 316

81. UNIT NAME: Red Water Treatment Plant (Cont'd)

stainless steel, open head tank with approximate dimensions of 15 feet long by 5-6 feet wide by 4-5 feet deep. It serves as an overflow containment basin for Unit 81 and also for emergency quench water from the TNT production lines. This quench water is utilized for emergency cooling of TNT intermediaries in the event of a production process upset. Unit 81a is connected to this unit via a flexible stainless steel braided hose. The quench tanks at the TNT production lines are connected via an open slot pipe. This unit would discharge to the TNT equalization basins (Unit 2) should it also overflow.

Date of Start-Up: 1974-1976 (estimated timeframe) (Ref. 5).

Date of Closure: This unit is currently inactive due to the currently inactive status of the TNT production lines (Ref. 5).

Waste Managed: Trinitrotoluene (TNT) is produced when toluene is mixed with a solution of nitric and sulfuric acids under proper temperature conditions. Nitrate groups are gradually added to the toluene until the product consists of trinitrotoluene isomers. The product is then washed free of residual acids, crystallized, and purified with sodium sulfite. The impure beta and gamma isomers are washed out of the alpha trinitrotoluene as soluble sulfonates, and the purified product is remelted, flaked, and packaged. The water that is used to wash the impure TNT (beta and gamma TNT) from pure TNT (alpha TNT) is intensely red in color and is referred to as "Red Water." "Red Water" contains numerous TNT by-products including alpha, beta, and gamma TNT isomers and TNT sodium disulfonates (Ref. 6).

Release Controls: The concrete basin (Unit 81a) serves as secondary containment for each of Units 81b and 81e.

81. UNIT NAME: Red Water Treatment Plant (Cont'd)

The overflow basin serves as secondary containment for Unit No. 81a. The drum staging area has no apparent secondary containment (Ref. 5).

Release History: No visible signs of release were observed during the April 1987 VSI (Ref. 5).

V. OTHER AREAS OF CONCERN

A. Nitrocellulose Line A Rainwater Ditch

This unit is located near Building 1558 in the Nitrocellulose Line-A production area. A low depression in the soil which appears to be an unlined rainwater ditch was identified during the April 1987 VSI. The culvert appears to receive any runoff from the A-Line. The area was void of vegetation and discolored soil was observed. The ditch is approximately one foot deep (Ref. 5).

B. Nitrocellulose Line A Activated Carbon Recovery Unit

This unit was identified during the tour of the Nitrocellulose Line-A area. The unit is located in Building 1555, which was locked and could not be observed. The unit is used to recover solvent from the production process. Facility representative reports that there is an occasional release of solvent vapor to the atmosphere. The facility reportedly has two other activated carbon recovery units located at Nitrocellulose Lines A and B.

C. C-Line Mix House

This building was identified during the tour of the C-Line production area. A white wet-looking powder was observed inside the open bay doors on the floor of the mix house (3509). The facility representative reports that this substance, however, is not explosive. The bay floors are periodically washed down into floor sumps which drain to the Biological Treatment Plant (Unit 10).

D. Drum Container Storage Area (Sanitary Landfill)

This area was identified during the inspection of the Sanitary Landfill (Unit 40). The area is used to store 55-gallon metal drums before they are sent off-site for resale. The area is an open field approximately 100 feet by 20 feet. An estimated 300 drums stacked four high on their side are reportedly rinsed out at one of the wastewater treatment plants prior to being stored here. Most of the drums were labeled diethyl phthalate or Dinormal Propyl Adipate (Ref. 5).

E. Drum Container Storage Area (266-2)

This area was identified during the inspection of the Ballistics Testing Firing Range. Eight 55-gallon metal drums are stored on a wooden platform with dimensions of 4 feet by 10 feet. All of the drums were empty, seven labeled methylene chloride and one waste oil. The platform is covered with a wooden roof. The unit is located adjacent to Building 266-2.

F. Drum Container Storage Area (9387-2)

This area is located by Warehouse No. 2 (9387-2) approximately 100 yards from the New River. The area is an open field where an estimated 500 55-gallon drums were stacked on their sides. The drums are reportedly empty and rinsed out at one of the wastewater treatment plants prior to being sold. Many of the drum lids were removed. Most of the drums were labeled bio-tech, and ethylene glycol. Some drums were labeled hydraulic and lubricating oil and several drums were unidentifiable. An odorous smell was prevalent around the drums and discolored soil was observed (Ref 5).

G. Refractory Rubble Pile

A refractory rubble pile was identified during the tour of the Waste Incinerator (Unit 14). This pile is several square feet in area located adjacent to the incinerator on the open ground (Ref. 5).

H. Former Site of TNT A-Line

This area was identified during the tour of the TNT manufacturing area. Facility representatives report that the TNT A-Line production building blew up in 1974 during nitration. Building rubble has been excavated from the site. There is a potential that residual waste from the production operations was left in place (Ref. 5).

I. Former Location of Red Water Incinerator Kilns

This area was identified during the tour of the TNT manufacturing area. The site is the former location of four redwater incinerator kilns. Pilings from the kilns remain in the area. No information is known on the incinerator process formerly used. There is potential that any tanks, pumps or pipes associated with this process may have leaked. In addition, the disposition of any redwater ash removed from the kilns is unknown (Ref. 5).

J. Roll-off Dumpster

RAAP uses numerous 30 cubic yard roll-off dumpsters at both the TNT B and C Lines for the collection of various materials. Facility representatives were unclear as to the types of materials managed in these units during the April 1987 VSI. It is suspected that waste propellants and contaminated debris maybe discarded in these units from time to time. The containers are open-top. The one viewed was situated on a concrete pad (Ref. 5).

K. Solvent Distillation Operations

RAAP operates a solvent recovery system for the redistillation of solvent recovered from the evaporative drying of propellant. This operation consists of evaporating and recovering solvent from fresh propellant in drying houses. The recovered solvent is then redistilled in distillation towers. Recovered solvent is stored in above ground, carbon steel storage tanks on-site. It is unclear as to the volume and disposition of still bottoms that could potentially accumulate at the distillation building. In addition, it is unclear as to whether the discharge of process equipment washdown goes to the Biological Treatment Plant (Unit 10) (Ref. 5).

L. Underground Storage Tanks

Numerous underground fuel and oil tanks are present at the RAAP. These tanks are used as auxiliary or main sources of fuel for various process operations. Operations of any of the various tanks and associated pumps may have potential for leakage to their surroundings (Ref. 5).

M. Subcontractors Equipment Storage Area

The Army Corps of Engineers operates a storage area at the central east end of the facility. The facility is several hundred square feet of fenced in ground. Field observations revealed several 55-gallon steel drums on the open ground. Facility representatives were unable to gain access to this area to determine the content of the drums (Ref. 5).

N. Product Storage Area

Several 55 gallon drums on metal cradles containing hydraulic fluid were identified during the VSI. This unit is located at the inest gas plant behind the compressor house. The cradles were constructed on a cement pad with no secondary curbing to prevent spill runoff. Stained areas outside of the cement pad were noted probably resulting from prior releases (Ref. 5).

O. Underground Fuel Oil Spill

This unit was identified just northeast of Unit 4 along the road. Facility representatives report that there was a fuel oil leak less than 10 years ago from an unknown source. Representatives are unaware of any clean-up activities at the site, however there is a groundwater monitoring well installed in the area. Oily waste materials were evident in surface water directly beneath the embankment from the suspected spill site (Ref. 5).

P. Scrap Metal Salvage Yard

This area is located along the New River, just west of the Biological Treatment Plan (Unit 10). The area is an open field several acres in size used for the storage of shredded scrap metal and old process tanks. Facility representatives were unclear during the VSI if any of the scrap metal or tanks had been decommissioned, torched or decontaminated. There is a high potential for any residual contamination to penetrate the soils to groundwater and/or runoff to the river (Ref. 5).

2. Alleged Abandoned Lagoon

This area is located adjacent to Unit 38 on the east embankment of the New River. The area is an earthen bermed depression with young trees growing in the basin. The area appears to be the site of a former lagoon. There is evidence of a former trench extending from Unit 38 to the basin. The bottom of the trench is approximately one foot above the present surface of Unit 38 (Ref. 5).

References

1. Draft Interim RFA Radford Army Ammunition Plant, August 29, 1986. REM III Program, EBASCO Services Incorporated.

2. Soil Survey of Montgomery County Virginia, United States Department of Agriculture Soil Conservation Service, September 1985.

3. RCRA Part B Permit Application, Volume 1 Text and Drawings, Radford Army Ammunition Plant, Radford, Virginia CH2M Hill, November 1984.

4. Savitsky, G.J. Ordnance Corps Commanding Officer RAAP letter to R. Ninesteel NUS Corporation, September 11, 1986.

5. Visual Inspection Field Notes, April 7, 8, and 9, 1987.

6. Final Interim RFA Radford Army Ammunition Plant, April 13, 1987. REM III Program, EBASCO Services Incorporated.

7. Phone Log May 12, 1987. Phebe Davol of A. T. Kearney, Inc. with Hasan Vakili of Virginia Department of Waste Management.

8. Savitsky, G.J. Ordnance Corps Commanding Officer RAAP letter to B. Rappaport A. T. Kearney, May 8, 1987.

APPENDIX A

VISUAL SITE INSPECTION PHOTO LOG

An opening meeting was held with RAAP officials at 8:15 a.m. on April 7, 1987 at the arsenal in Radford, Virginia to discuss the Visual Site Inspection (VSI) planned for the facility. This introductory meeting lasted approximately 2 1/2 hours. In this meeting RAAP representatives discussed with the Kearney Team the history, operational procedures, and waste management practices that have occurred at the site. The Kearney Team and EPA personnel explained the purpose of the site visit and the planned itinerary.

During the kick-off meeting the reviewers were requested by RAAP representatives to sign a liability waiver form to enter the production areas. The Kearney Team could not release their liability right in which RAAP and EPA agreed that the Team would not enter any active production buildings during the tour.

The VSI was performed on April 7, 8, and 9, 1987 at the RAAP. The following individuals were present for all or part of the three day site visit:

Name	Representative of
Phebe Davol	A. T. Kearney, Inc.
Shawn DeLorey	A. T. Kearney, Inc.
Chris Nelson	A. T. Kearney, Inc.
Bruce Rappaport	A. T. Kearney, Inc.
Mary Beck	U. S. EPA Region III
Maureen Essenthier	U. S. EPA Region III
George Savitsky	
John Horrath	COR Staff
Gary Nemeth	U. S. Army Environmental Hygiene Agency
Hasun Vakili	Virginia Department of Waste Management
Jim Morris	Hercules
Bob Richardson	COR Staff
Shelly Barker	COR Staff
Jeff Pack	Hercules
Bob Webb	Hercules

Following the morning meeting on April 7, the reviewers were taken on a tour of the facility, focusing on the previously identified SWMUs in the August 1986 RCRA Facility Assessment Report. The first day's site visit ended at approximately 4:30 p.m. The weather was cold and cloudy with temperatures in the high 30s to the low 40s (°F).

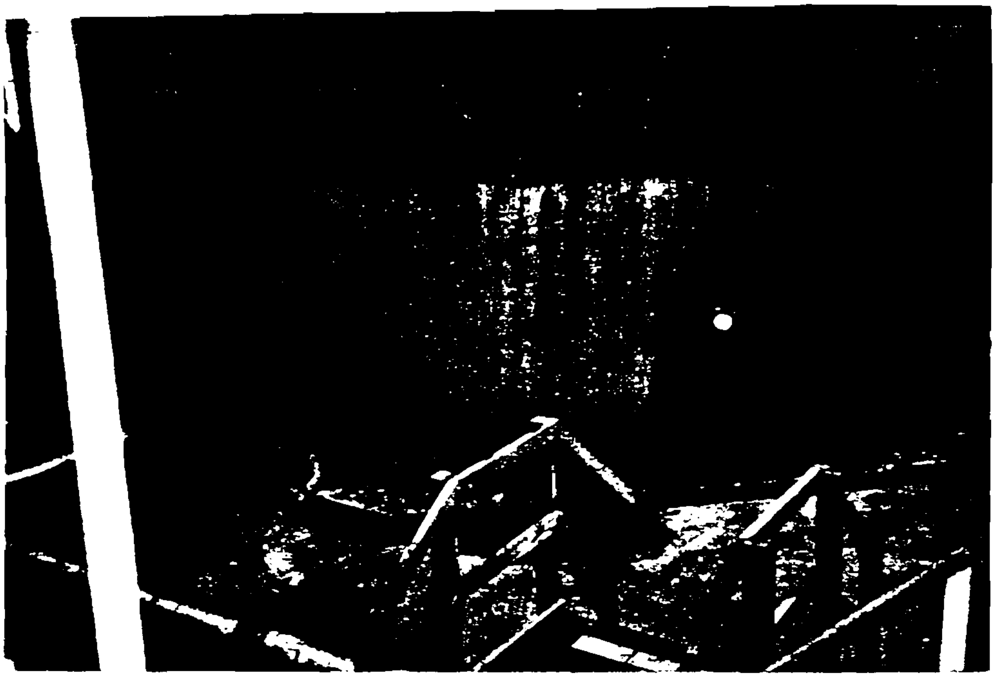
The second day's meeting of the Kearney Team with RAAP officials began at 8:00 a.m. lasting for approximately 15 minutes to discuss Team A and B's itinerary. The Kearney Teams spent the day touring the process areas and the SWMUs. The VSI proceeded from 8:15 a.m. to 6:00 p.m. The weather was warm and sunny with temperature in the 60s(°F).

On the third day, the Kearney Team arrived at approximately 8:00 a.m. and were taken on a tour to complete any SWMUs and production areas not covered on the first two days. The visit was completed at 11:00 a.m. and a brief meeting was held to summarize the tour and discuss any information gaps. The weather was warm and sunny with temperatures in the 60s (°F).

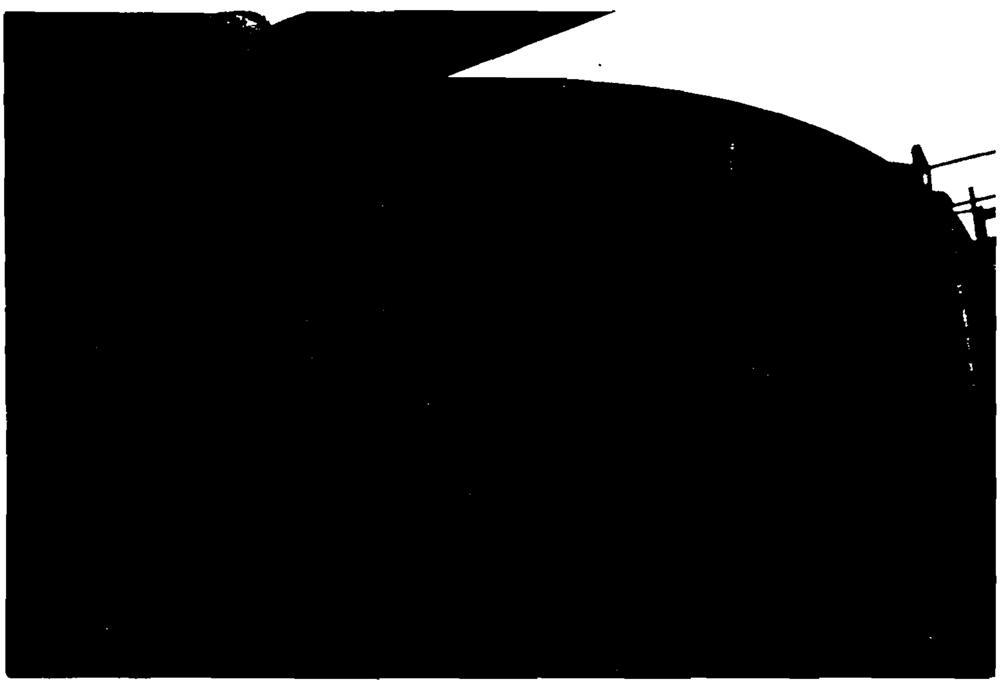
The photographs and comments on the following pages indicate some of the information obtained during the VSI.

PHOTO LOG

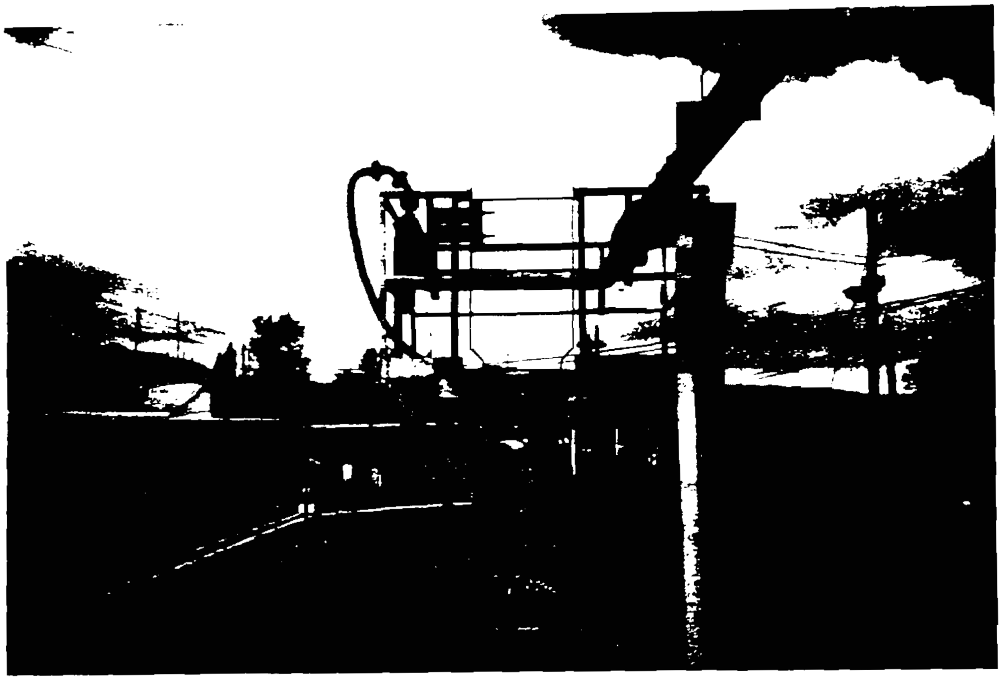
SOLID WASTE MANAGEMENT UNITS



1(i). Red Water Storage Tank (bottom). Note manway for removal of sludge.

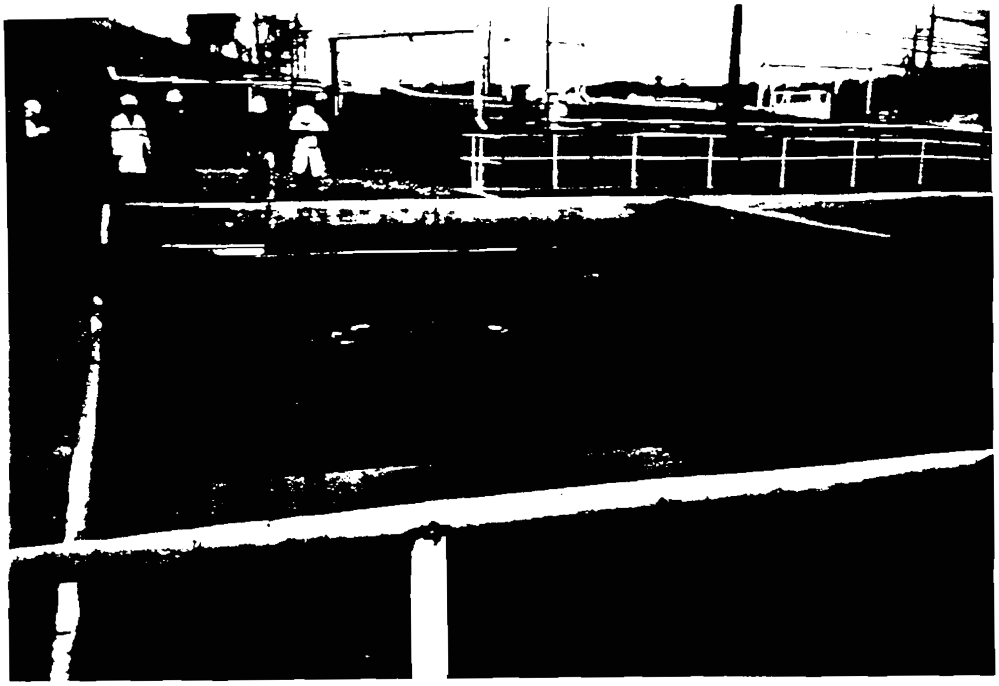


1(ii). Red Water Storage Tank (top). Note stains on seams.

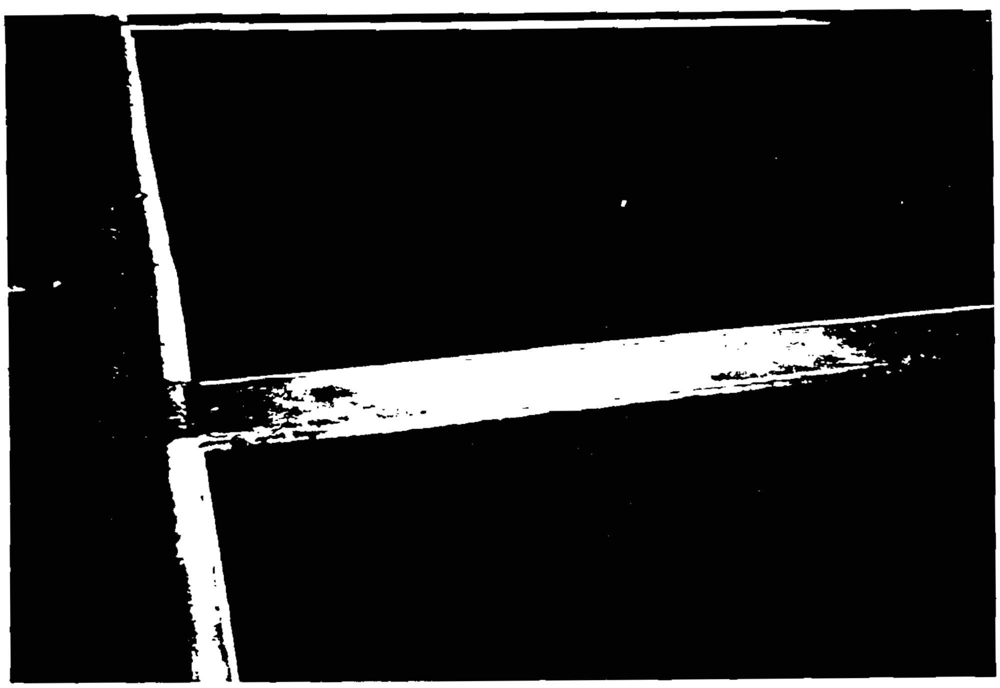


1(iii). Overview of the Red Water Storage Tank Transfer Station.

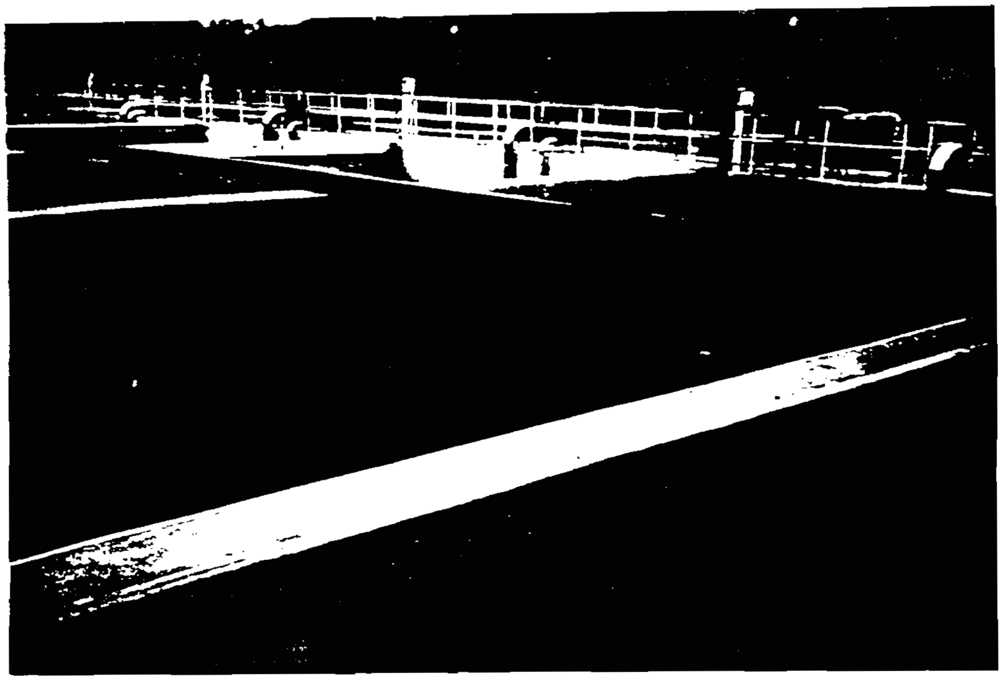
2. Overview of TNT Wastewater Equalization Basin (center). Note open trench in concrete flume (right).



2a(i). First TNT equalization basin. Content of 20 gallon containers is dilute red water sludge.

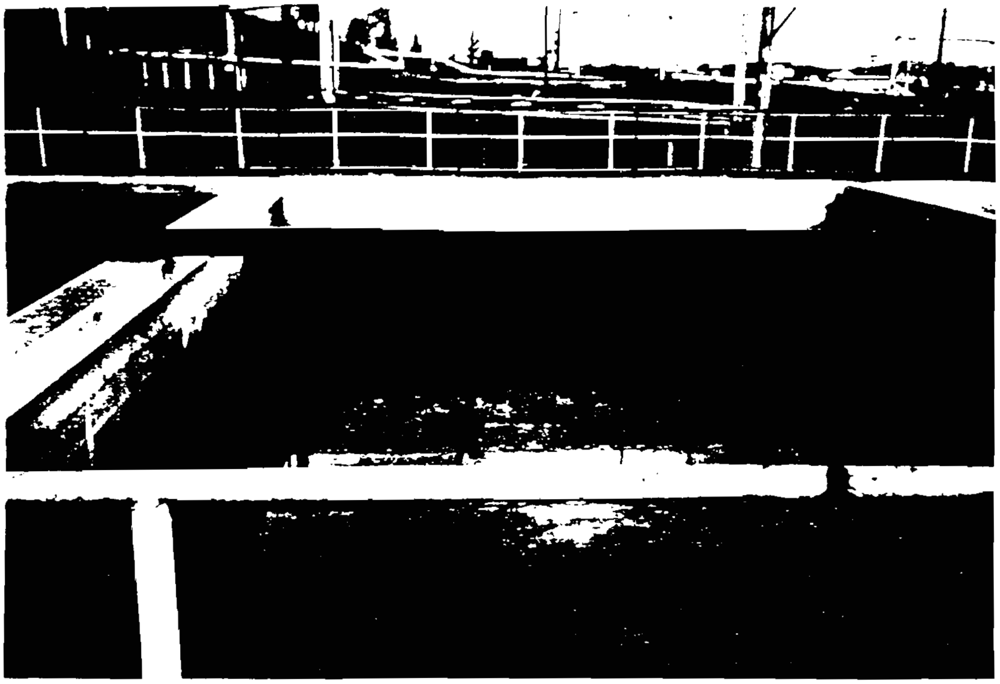


2a(ii). Second TNT equalization basin. Note depth of dilute red water sludge in reference to height of 20 gallon container.

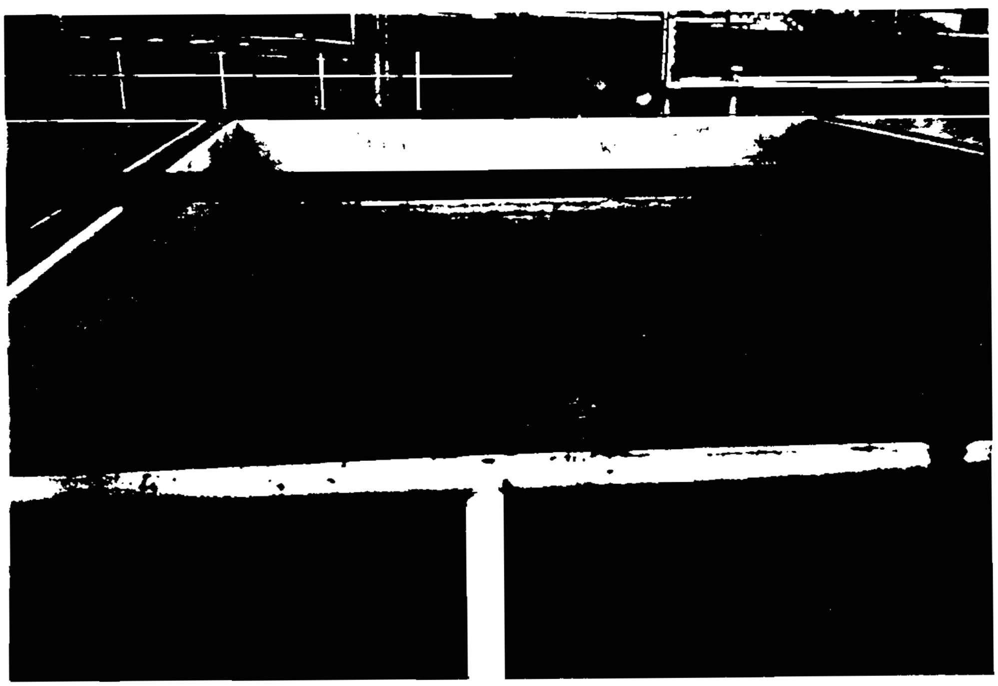


2a(iii). Looking towards west end of second TNT Equalization Basin. Note approximately 30 containers for sludge clean-up.

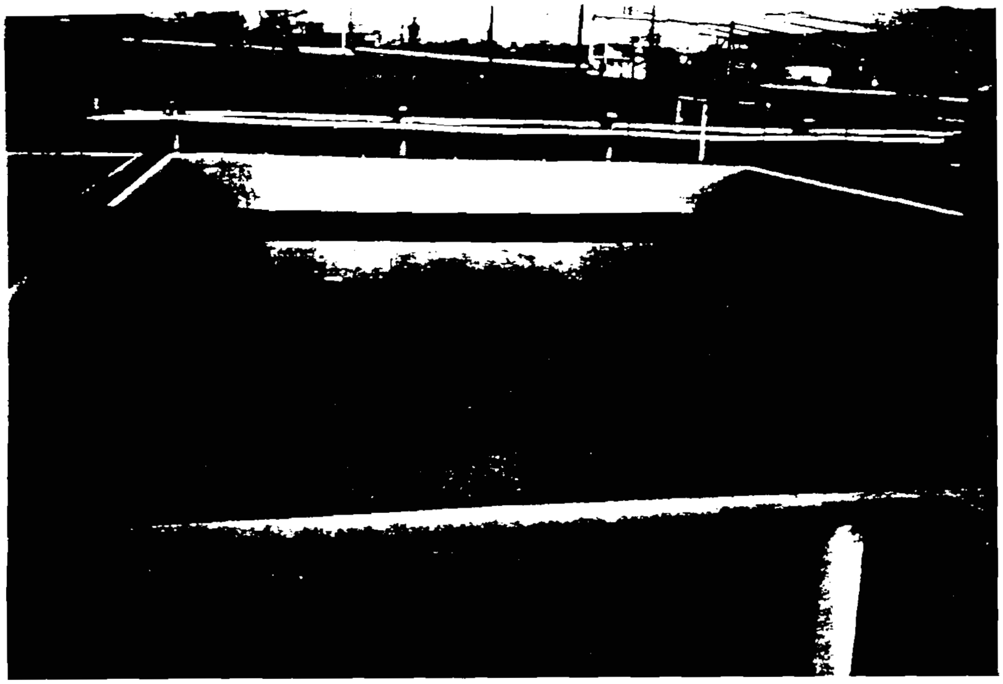
2a(iv). Outside of second TNT Equalization Basin. Note cracks in concrete.



2a(v). Third TNT Equalization Basin looking west.



2a(vi). Fourth TNT Equalization Basin looking west.

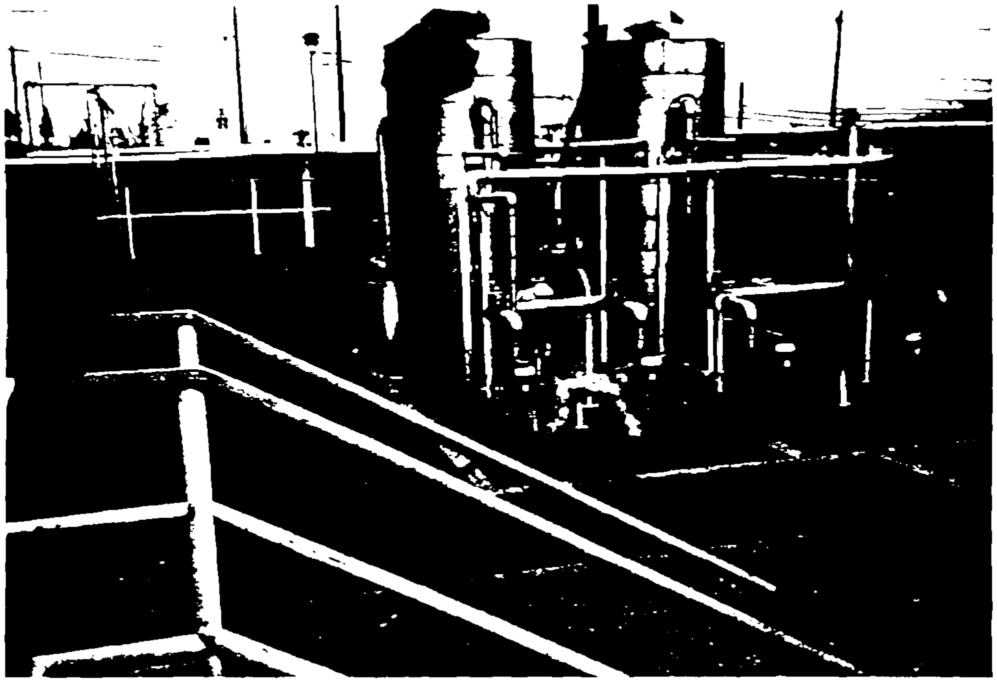


2a(vii). Fifth TNT Equalization Basin looking west.

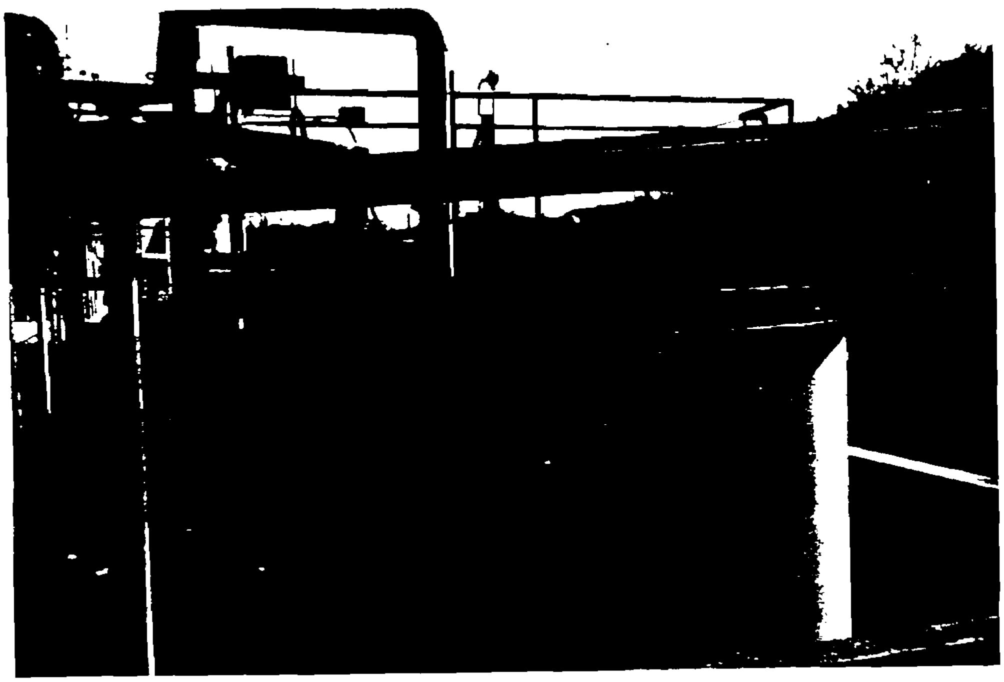
2a(viii). Ground area near Equalization Basin Sump. Note liquid on ground.

2b. Stainless Steel Flume and Concrete Secondary Containment Gutter (left).

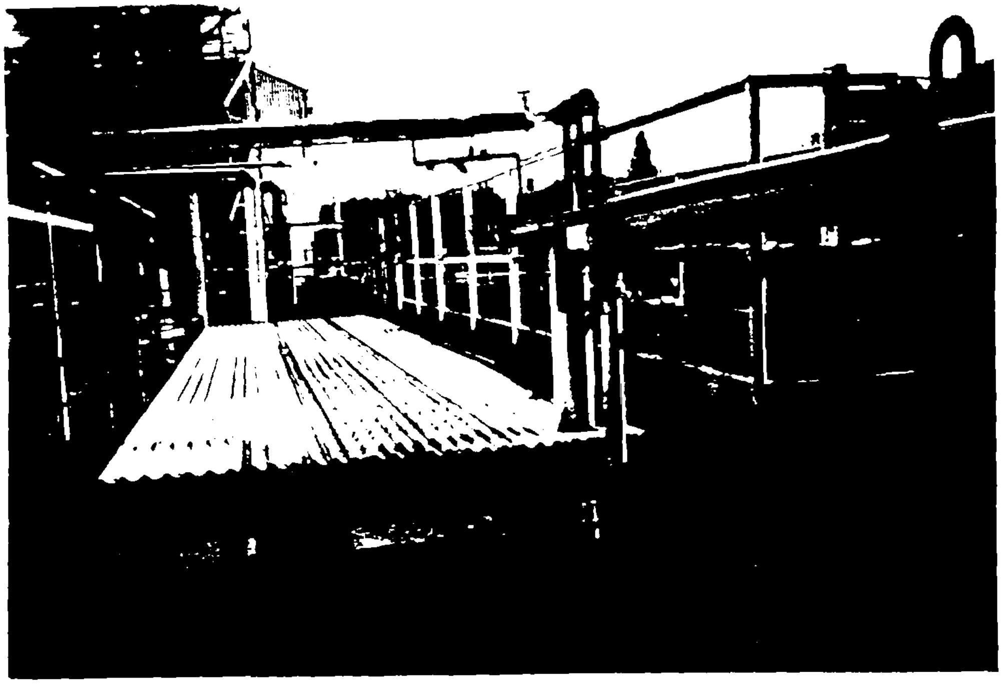
2c(i). Grate covered containment Sump Gallery for Equalization Basins looking south.



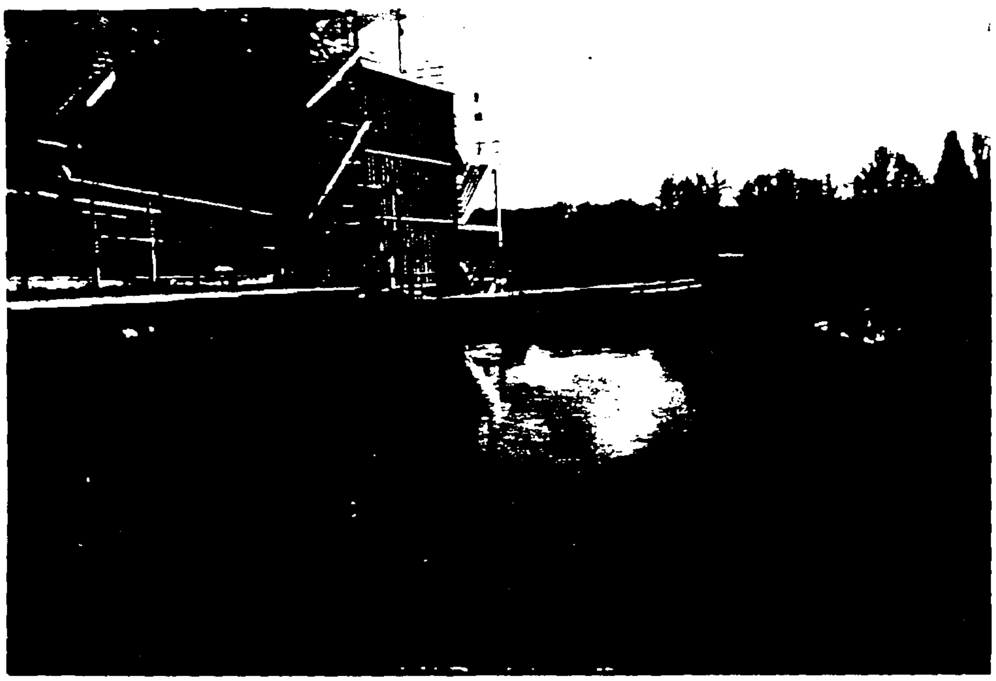
2c(ii) Sump for Equalization Basin overflow.



3a. View of the Primary Neutralization Tank



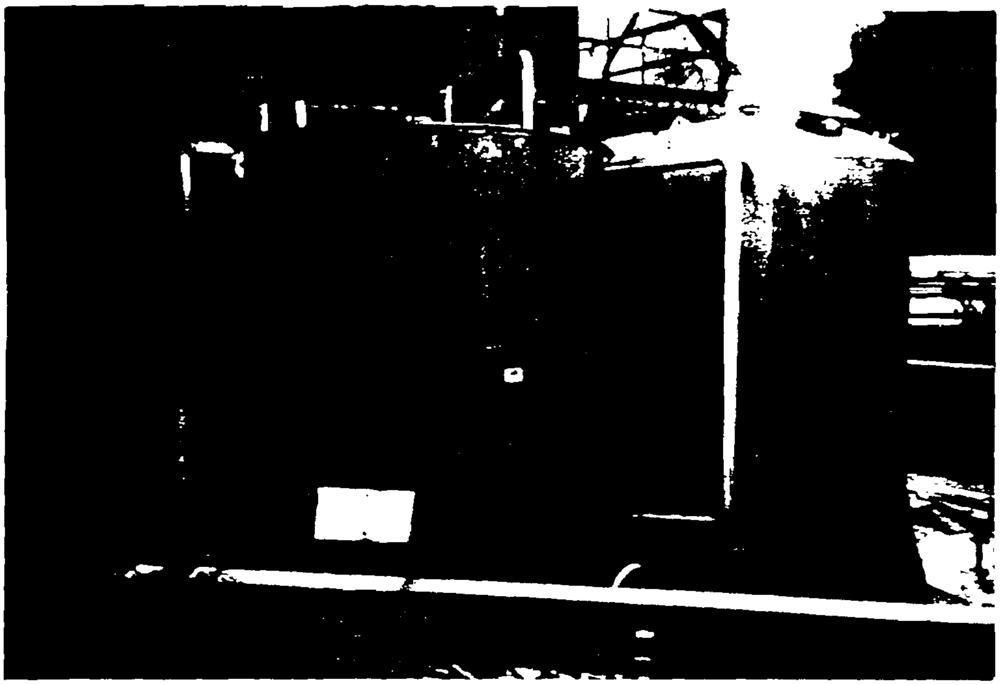
3b(i) Overview of the Sludge Settling Basin (left). Note to the right in the Equalization Basin.



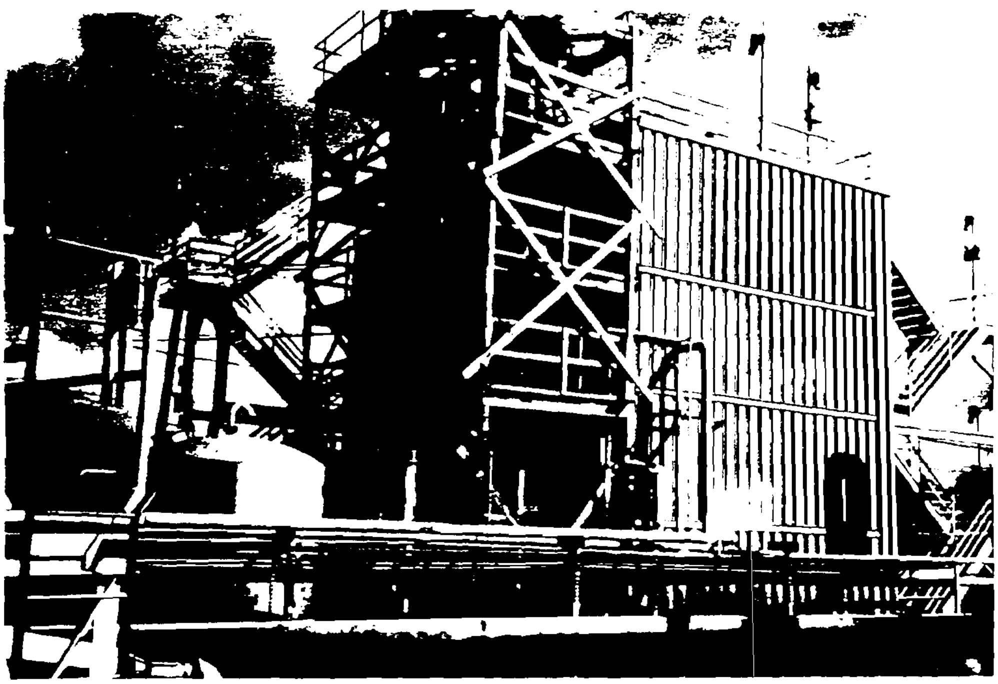
3b(ii) Overview of the Equalization Basin at the 1NT Wastewater Treatment Unit.

3c. View of the Neutralization Mix Tank.

3d. View of the Diatomaceous Earth Filter (background).

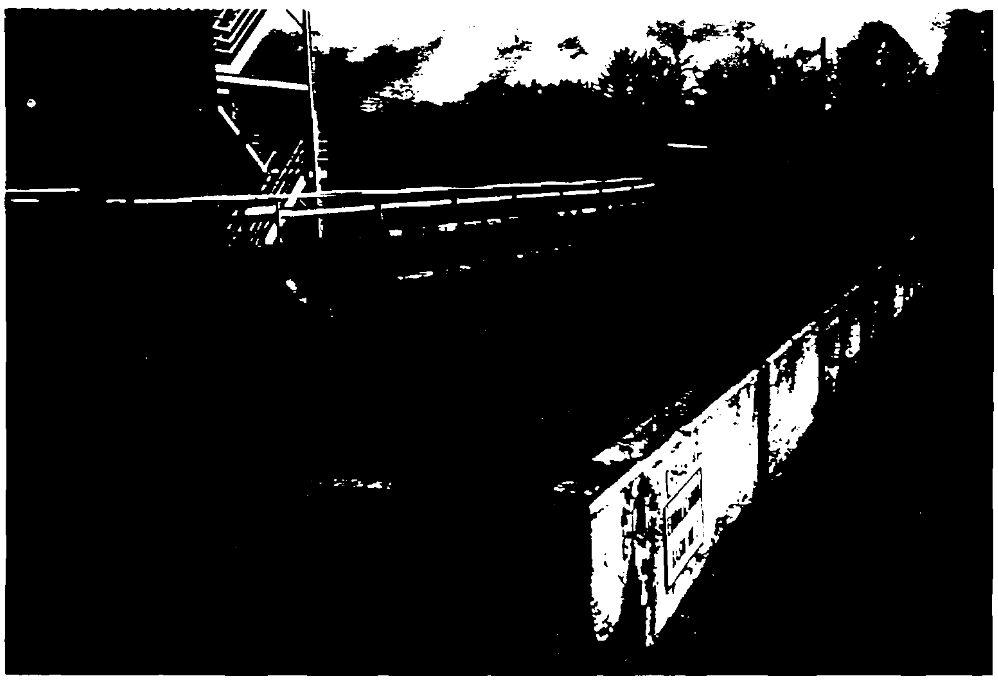


3e. Overview of the two Treated Water Surge Tanks.

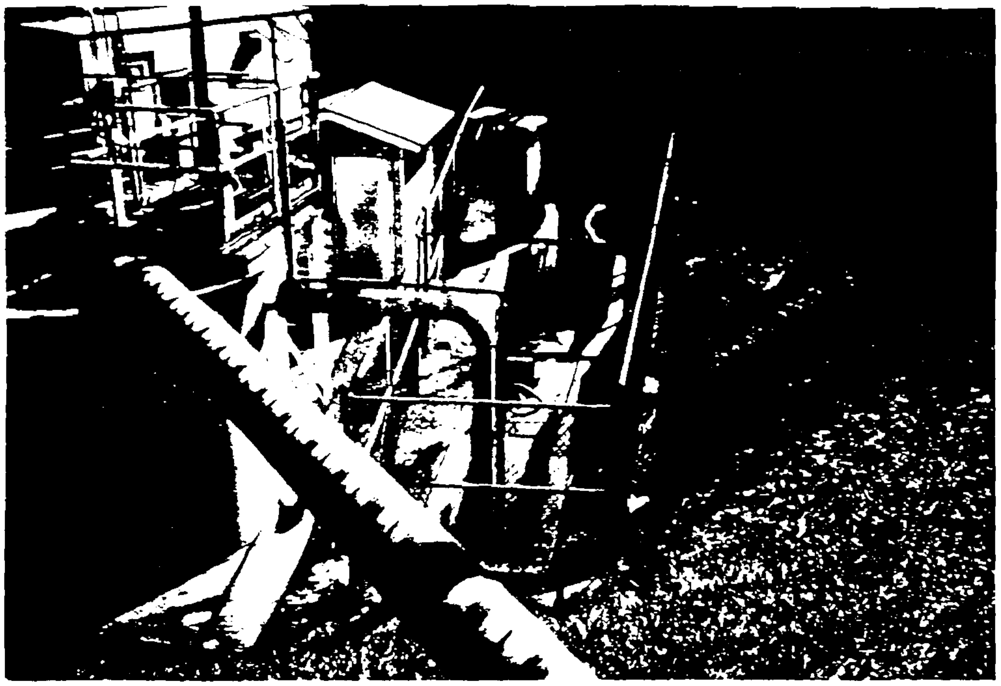


3f. View of the two Activated Carbon Columns (centers). Note the Surge Tanks to the left.

3g. View inside the Spent Carbon Storage Area.



3h. Overview of the Final Equalization Basin No. 2.



3i. View of the Final Neutralization Tank (left). Note the Parshall Flume to the right of the tank.

3j. Refer to photo 3i.

3k. View of the Activated Carbon Dust Collector.

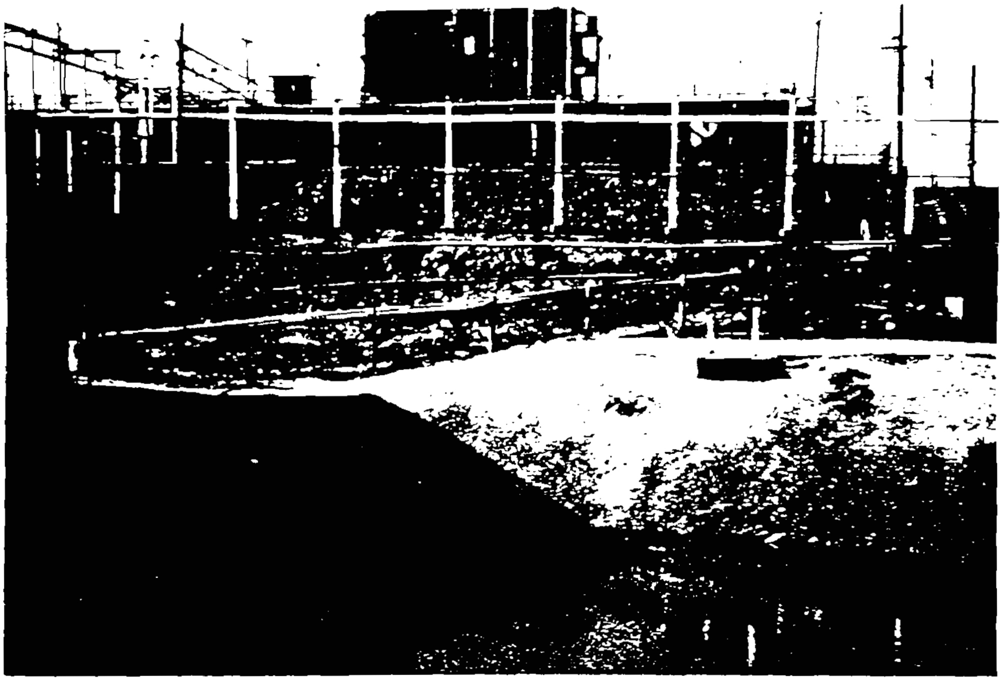
4(i). Acidic Wastewater Lagoon (southeast corner of RAAP), view of freeboard sign.

4(ii). Acidic Wastewater Lagoon influent pipe (center) looking west. Note sludge and discoloration at edge of lagoon.

4(iii). Panoramic Overview of Acidic Wastewater Lagoon looking north.

5(i). Close-up view of Acidic Wastewater Lagoon looking south.

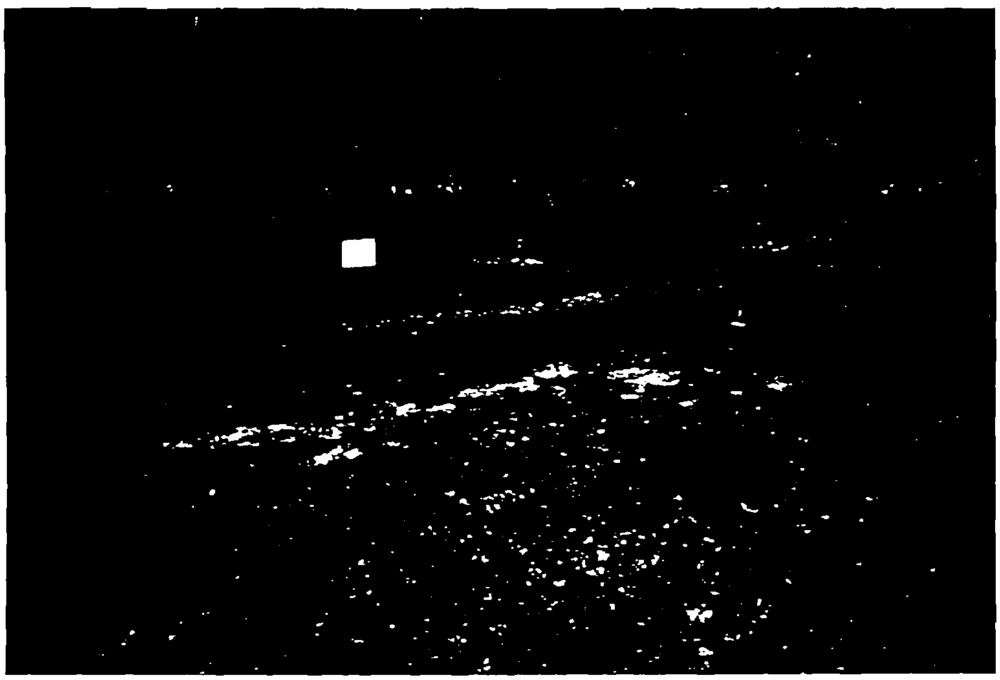
5(ii). Close-up view of freeboard sign for Acidic Wastewater Lagoon looking west.



6(i). View of the Acidic wastewater Lagoon in the Nitrocellulose C-Line Area.

6(ii). Close-up view of the acidic wastewater lagoon.

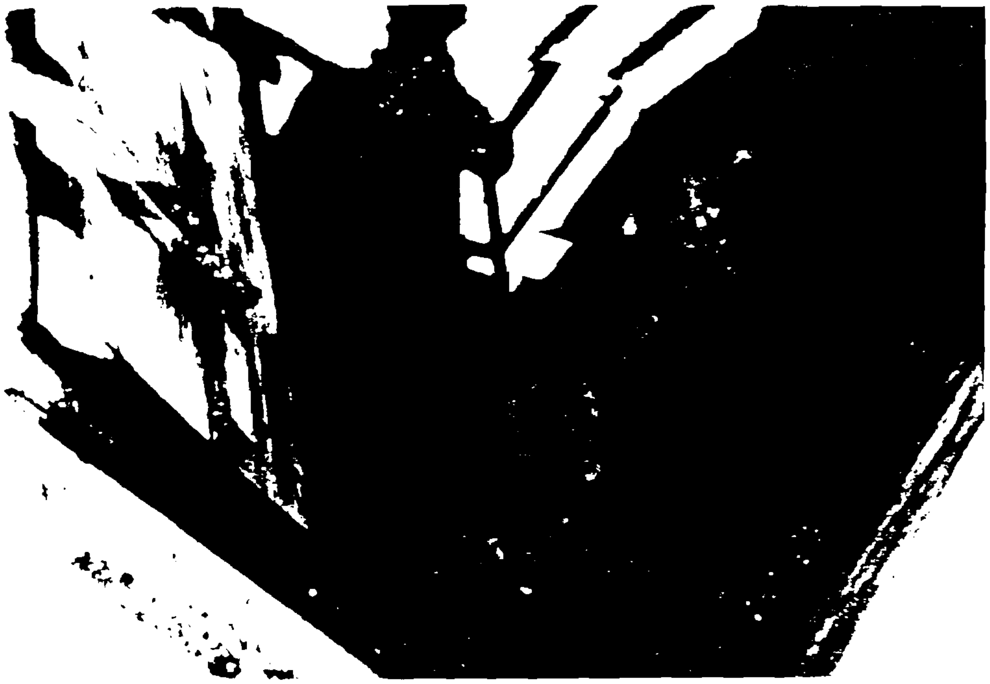
7(i). Acidic and Caustic Wastewater Lagoon looking south towards Sulfuric Acid Recovery Plant.



7(ii). View of downgradient monitoring wells for Aciaic and Caustic Wastewater Lagoon, adjacent to river, looking northeast.

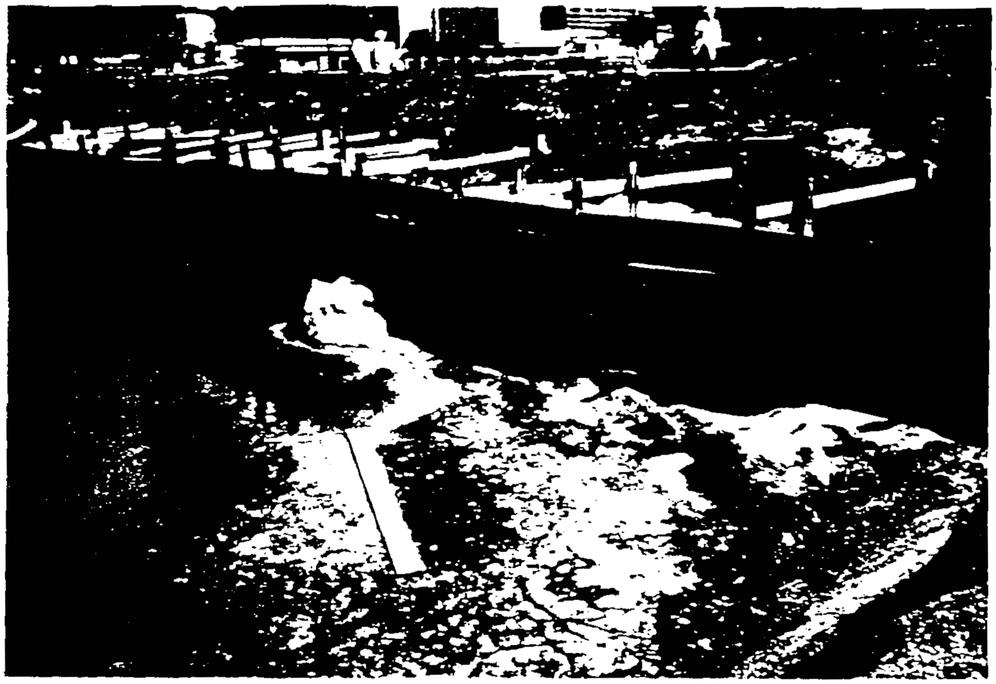
7(iii). Acidic and Caustic Wastewater Lagoon looking east. Note white material in foreground, and eroded embankment.

8a(i). A-B Line Acidic Wastewater (Nitrocellulose Lagoon #4032).



8a(ii). Influent sump for Calcium Sulfate Settling Lagoon.

8b(i). Second Calcium Sulfate Settling Lagoon for A-B Line Acidic Wastewater.



8b(ii). Bank of Calcium Sulfate Settling Lagoon. Note sludge residue on side.

9a(i). One of two C-Line Nitrocellulose Settling Ponds, looking soutwest towards main manufacturing area.

9a(ii). Edge of First C-Line Nitrocellulose Settling Pond. Note sludge material on bank.

9b. Second C-Line Nitrocellulose Settling Pond.

10a(i). Equalization Basin for Biological Treatment Plant adjacent to the New River looking North. Note oily sheen on water surface.

10a(ii). Equalization Basin for Biological Treatment Plant adjacent to the New River looking West.

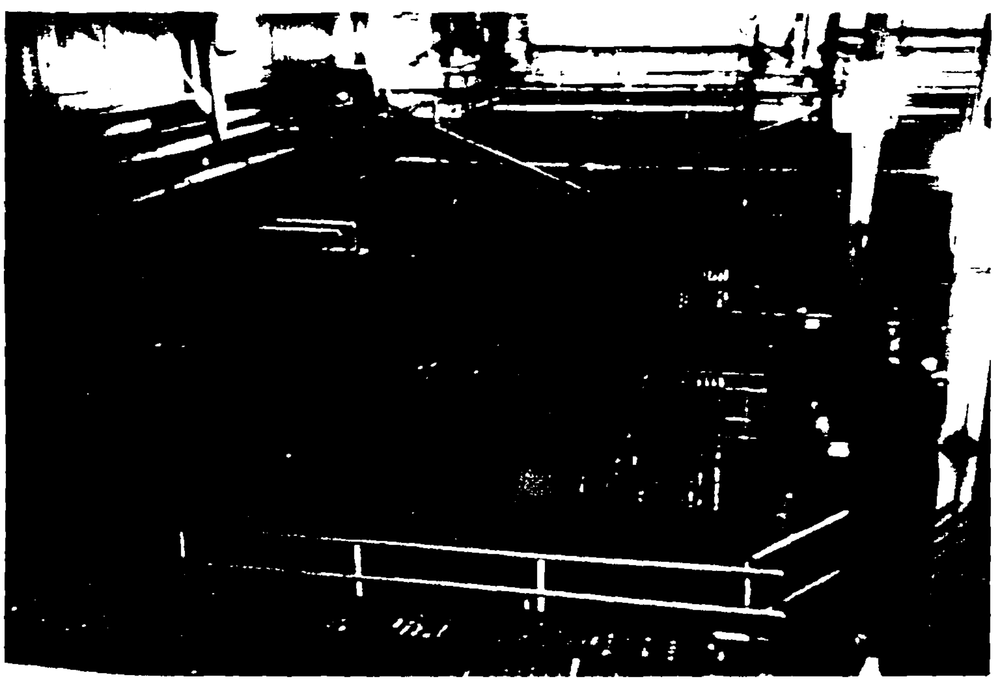
10a(iii). Soil/cement/clay liner for equalization basin for Biological Treatment Plant. Note cracks and discontinuity in liner (center).

10a(iv). Equalization basin adjacent to the Biological Treatment Plant and downgradient monitoring wells (center and left) adjacent to river looking east.

10a(v). Rip-rap and downgradient monitoring well for the Equalization Basin adjacent to the Biological Treatment Plant.

10b. Close-up view of surface aerators for the Equalization Basin at the Biological Treatment Plant, looking North towards river.

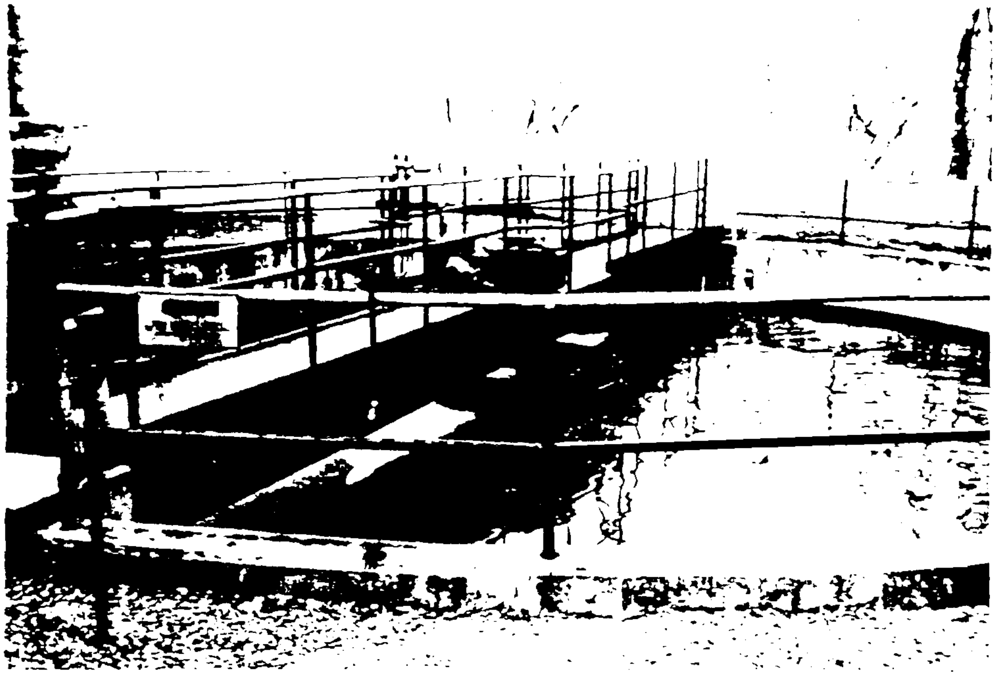
10c. Close-up view of jet injector type areators for the Biological Treatment Plant Equalization Basin.



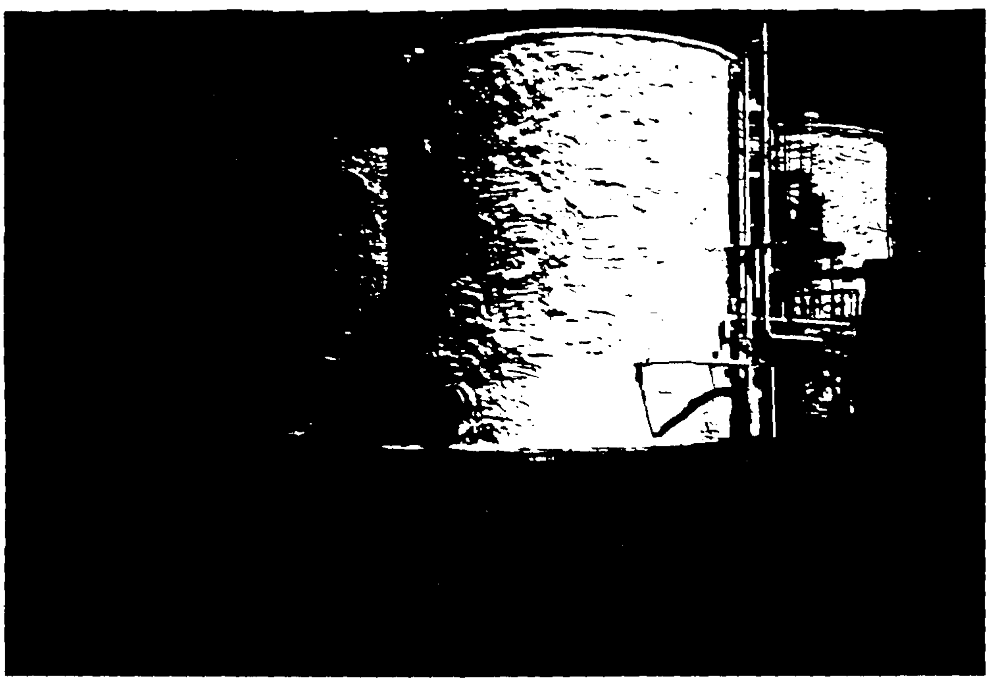
10d. Overview of Rotating Biological Contactors - Two Parallel trains.

10e. Distribution Tank to Rotary Biological Contactors.

10f(i). First Weir Clarifier for Biological Treatment Plant.

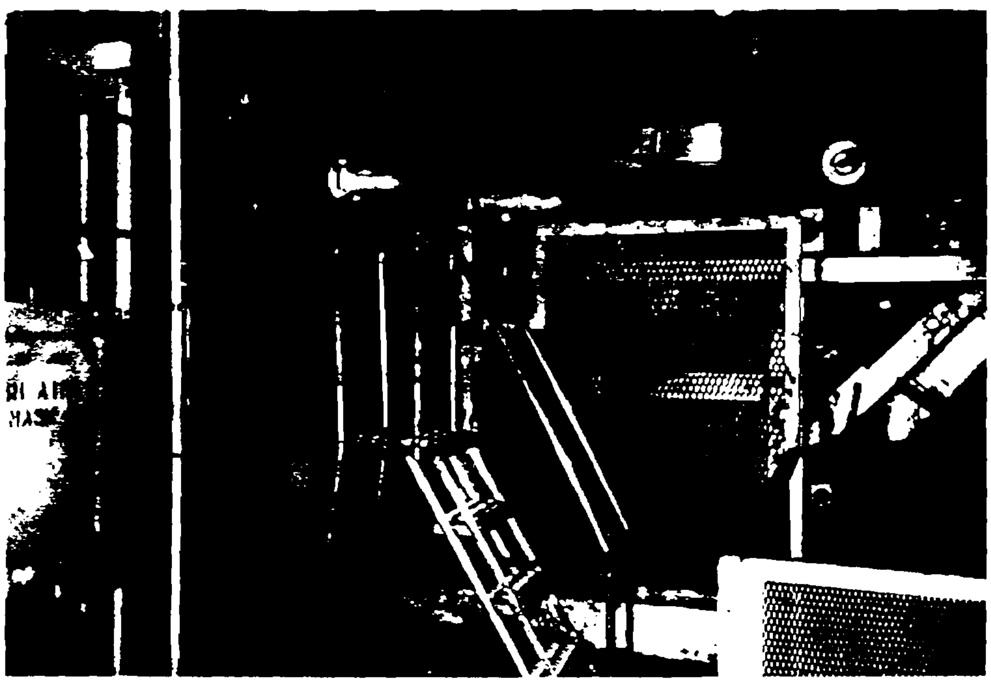


10f(ii). Second Weir clarifier for Biological Treatment Plant.

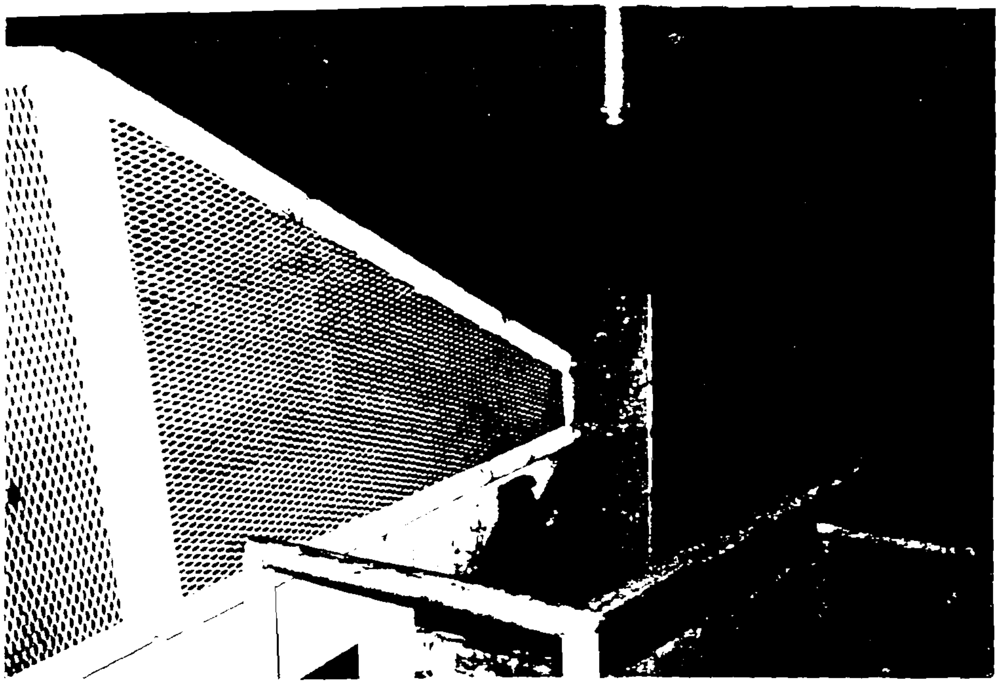


10g. Aerobic Sludge Digestors (3) east of the Biological Treatment Plant.

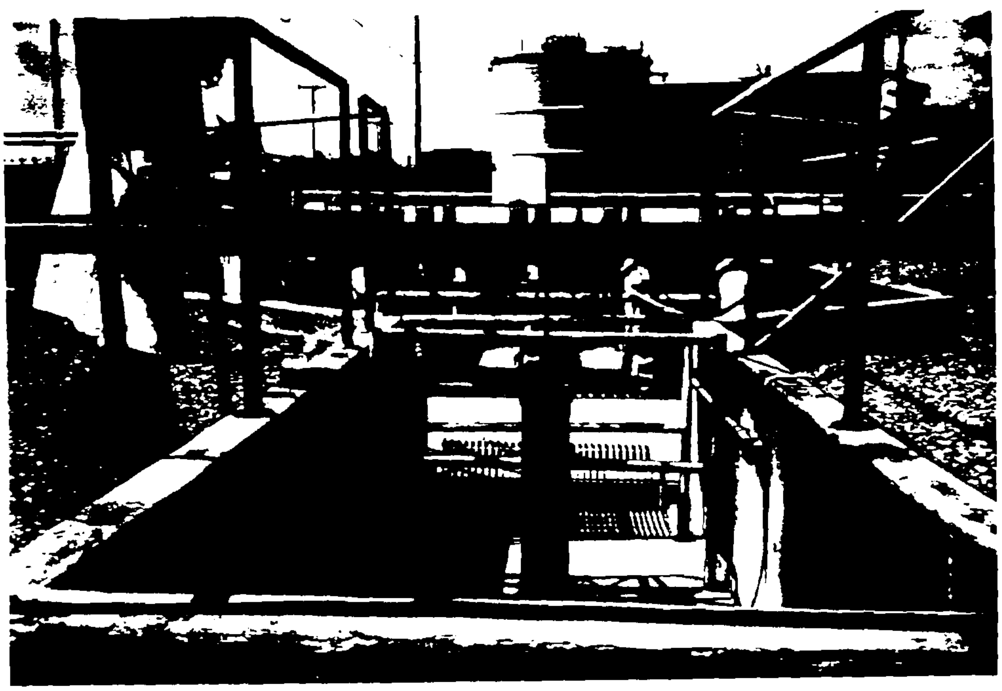
10h. Sludge Thickener Tank (center) adjacent to the Biological Treatment Plant.



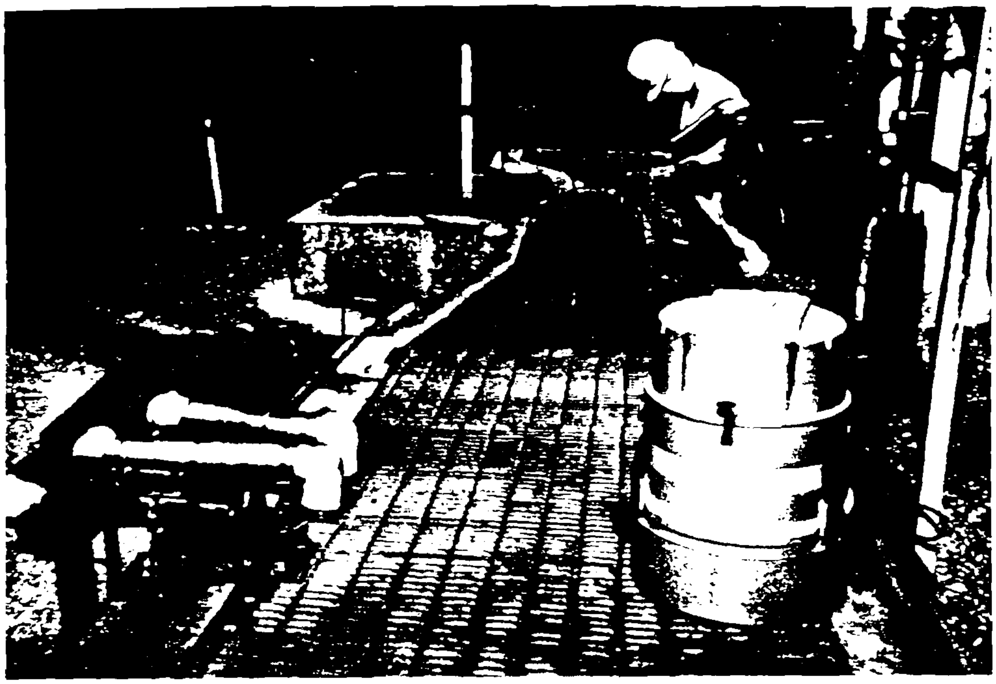
10i(i). Sludge Belt Filter Press Inside the Biological Treatment Plant.



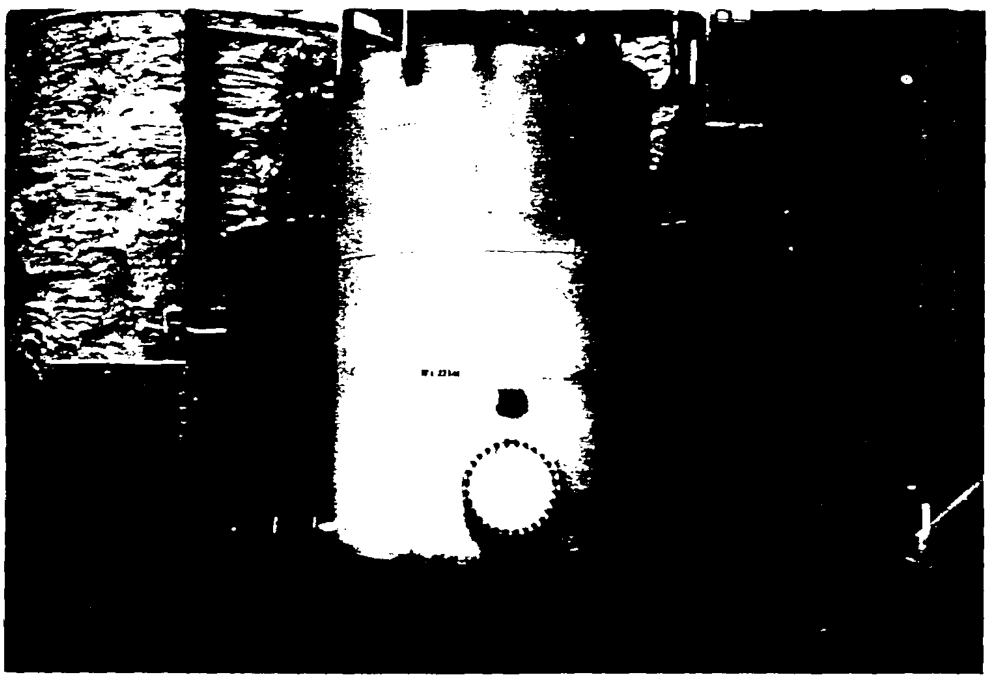
10i(ii). Exhaust vent from the sludge Belt Filter Press.



10j. Biological Treatment Plant Influent Station and Sampling Pit.



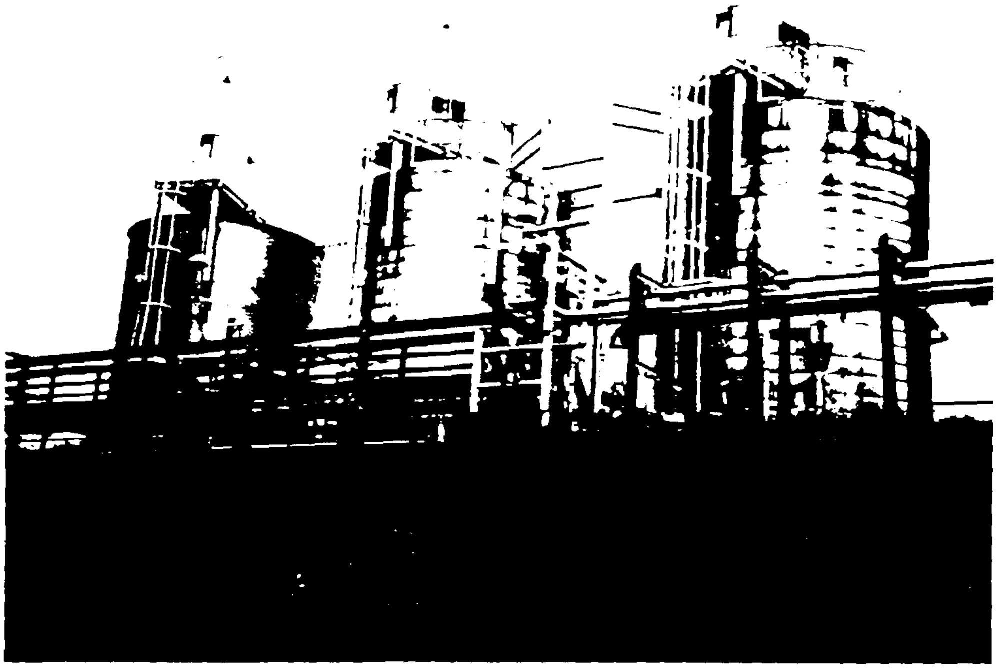
10k. Effluent Flume and sampling station for the Biological Treatment Plant.



101. Feed Stock Tank (Center) to the Belt Filter Press.

11a. Overview of the Sluice Waterway Gutter near Nitroglycerin 1 Pretreatment Plant. Note the lack of vegetation below the gutter is from herbicide spray not from spills.

11b. Lift Station Storage Tank. No picture available due to explosion hazard concerns with the camera flash.

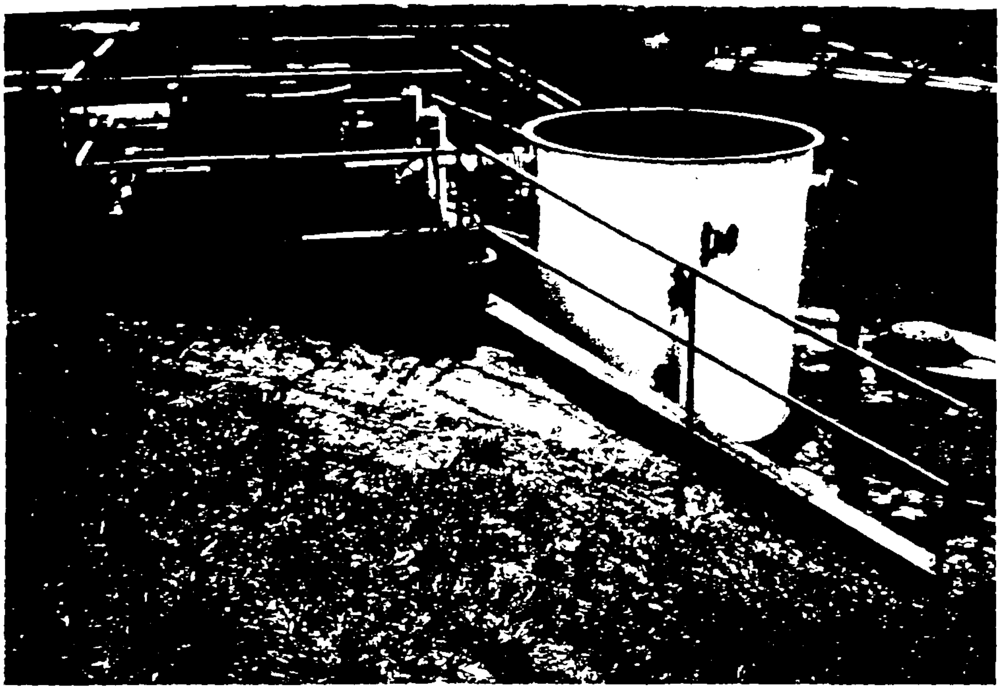


11c(i). Overview of the Nitroglycerin Acidic Water Storage Tanks near Nitroglycerin 1 Pretreatment Plant.

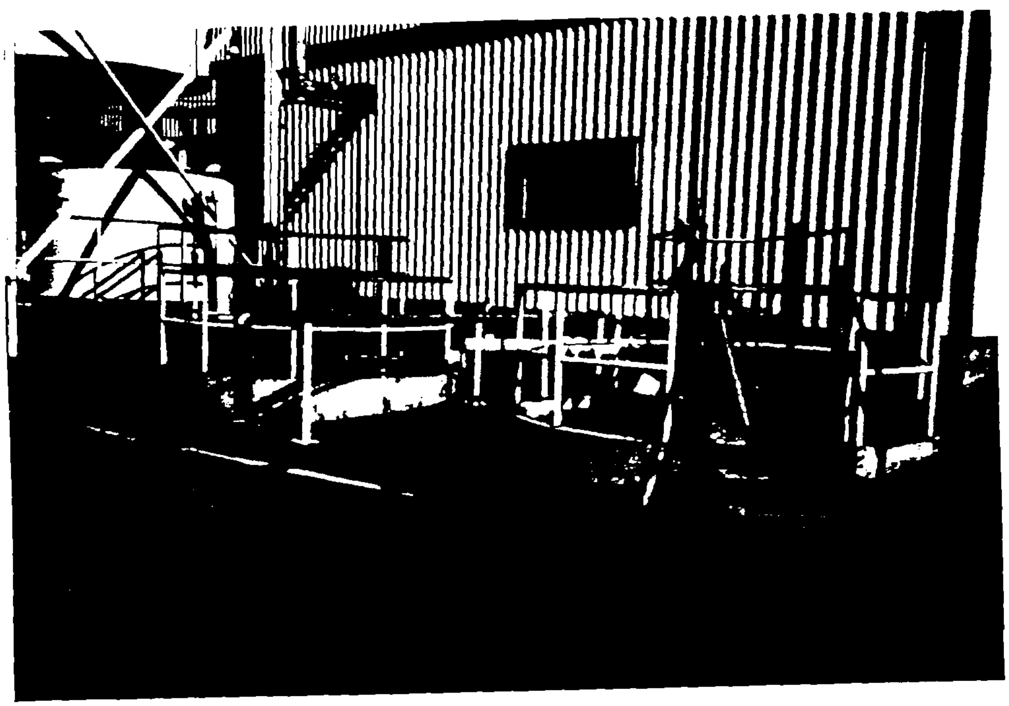
11c(ii). Close-up view of the Acidic Wastewater Storage Feed Tanks. Note lack of impervious secondary containment around the tanks.

11d. Batch Reaction Tanks. No picture available due to explosion hazard concerns with the camera flash.

11e. Lime Mix Tanks. No picture available due to explosion hazard concerns with the camera flash.

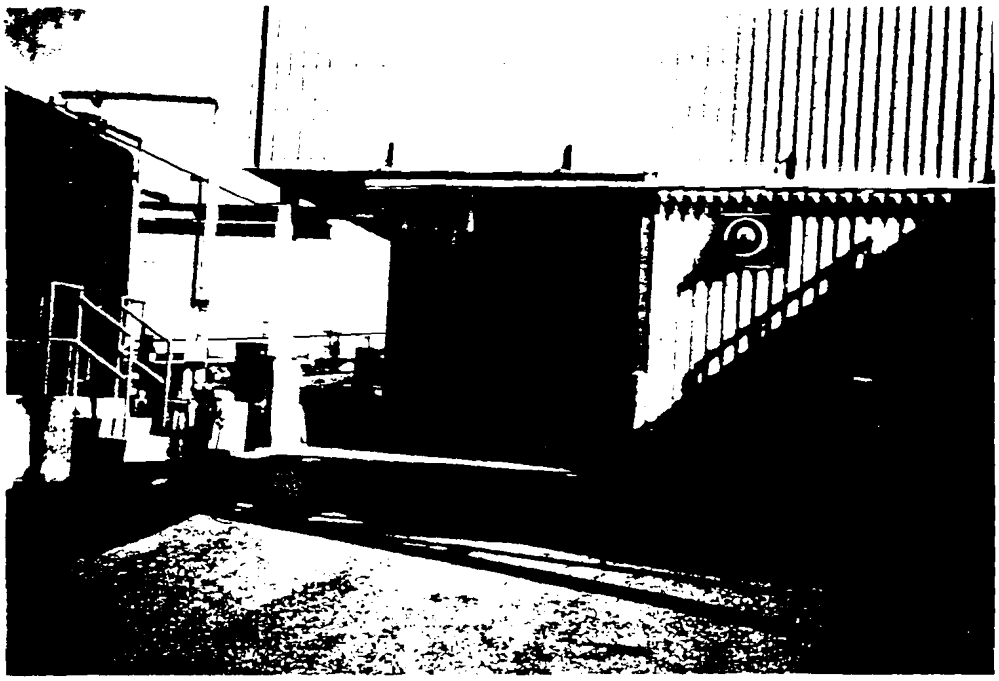


11f. Overview of the Nitroglycerin 1 Neutralization Tank (far right). Note the tank to the left of the unit is the concentrated sulfuric acid feed tank.

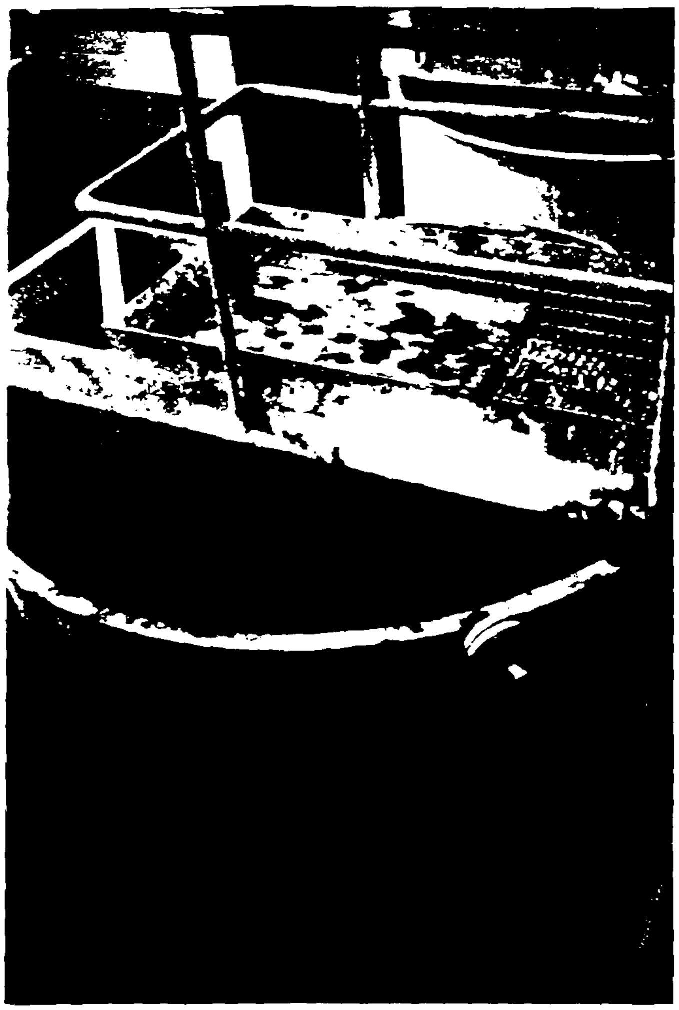


11g. Overview of Lime Clarifiers outside the Nitroglycerin 1 Pretreatment Plant (center and right).

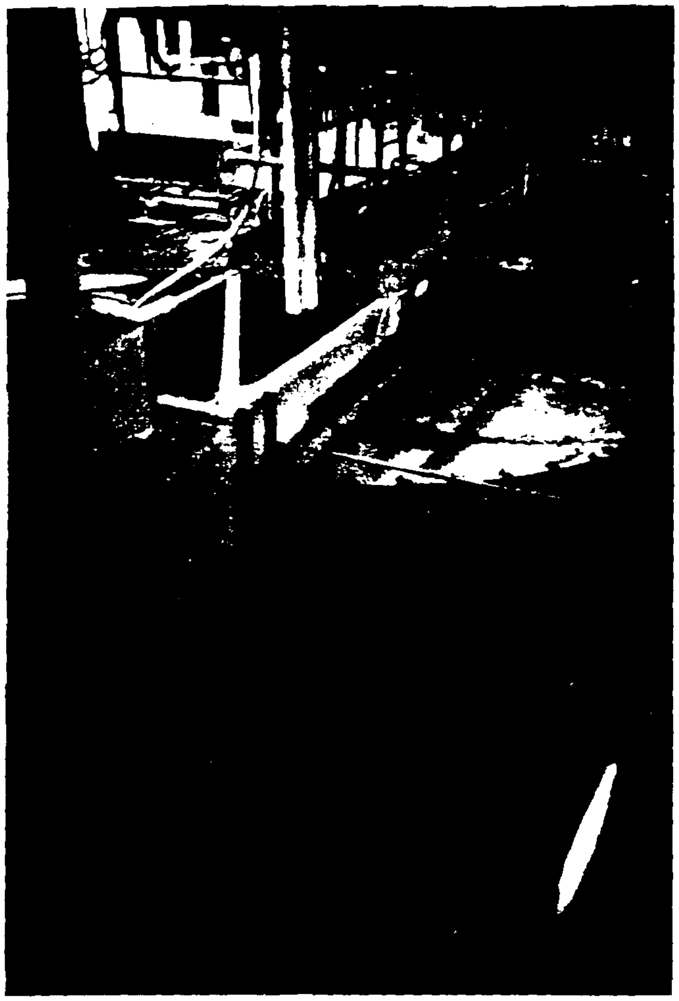
11h. Sludge Holding Tank outside the Nitroclycerin 1 Pretreatment Plant (bottom tank).



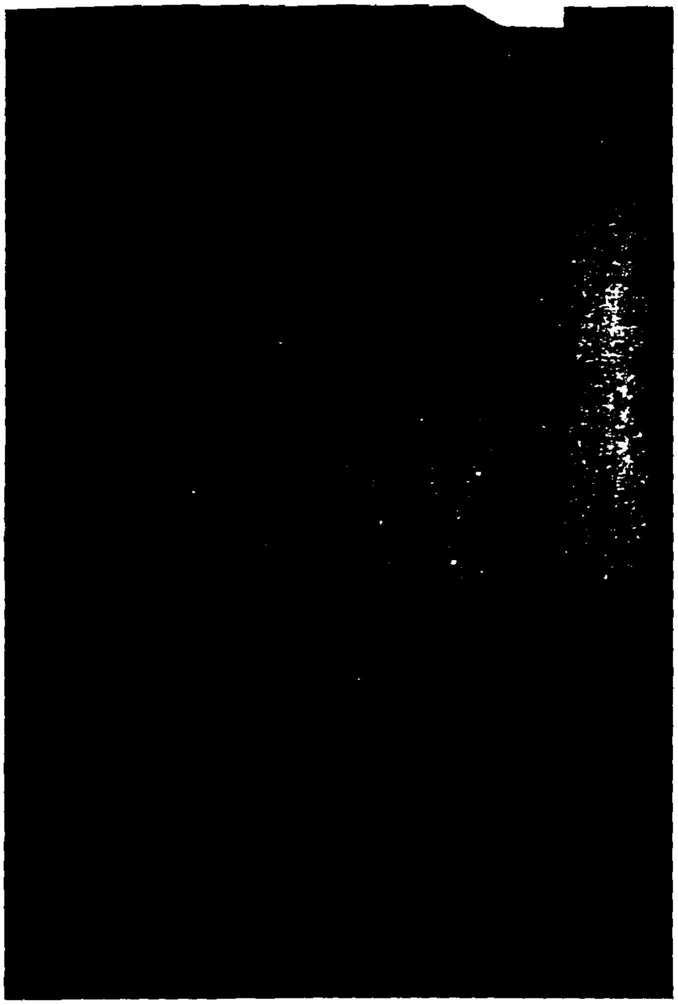
11i. Sludge Hopper at the Nitroglycerin 1 Pretreatment Plant (center).



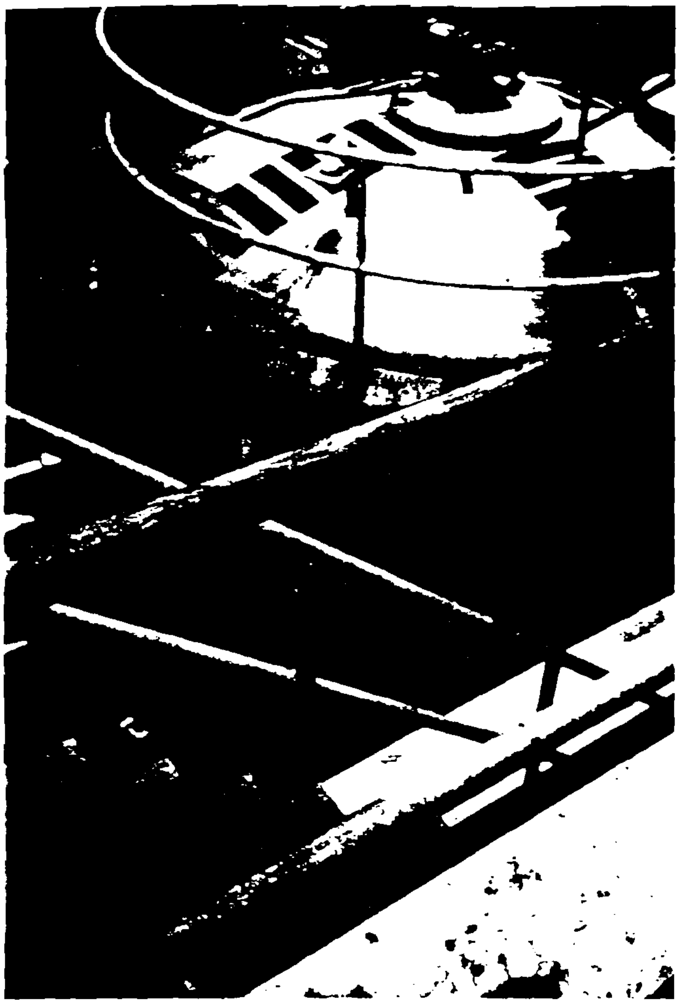
12a. Close-up view of one of the Lime Mix Tanks inside the Nitroglycerin Wastewater Pretreatment Plant.



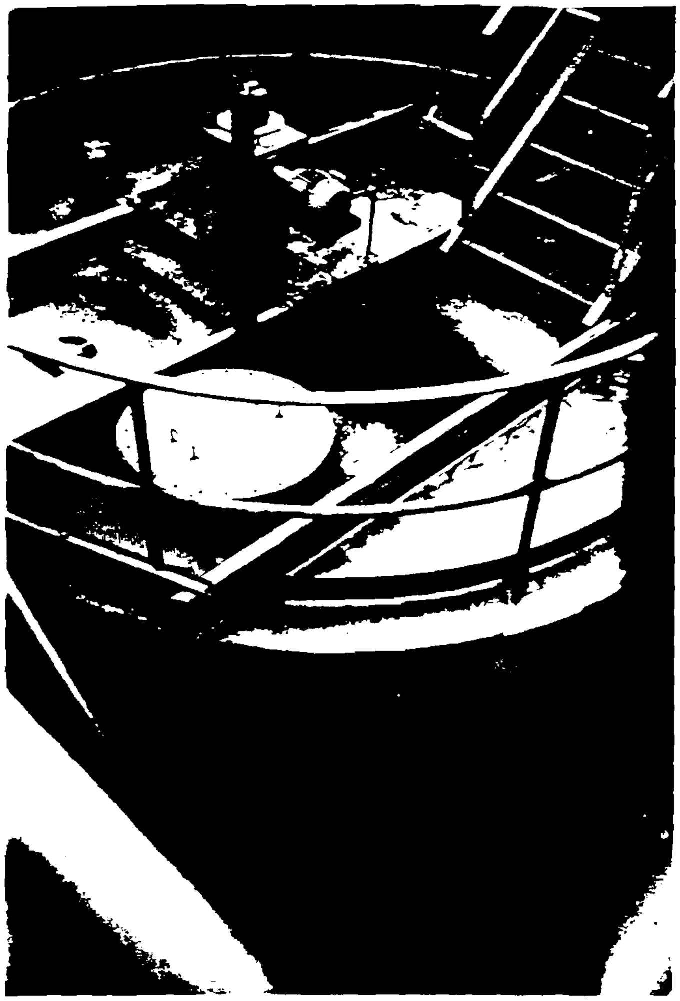
12b. Close-up view of one of the Batch Reaction Tanks inside the Nitroglycerin Wastewater Pretreatment Plant.



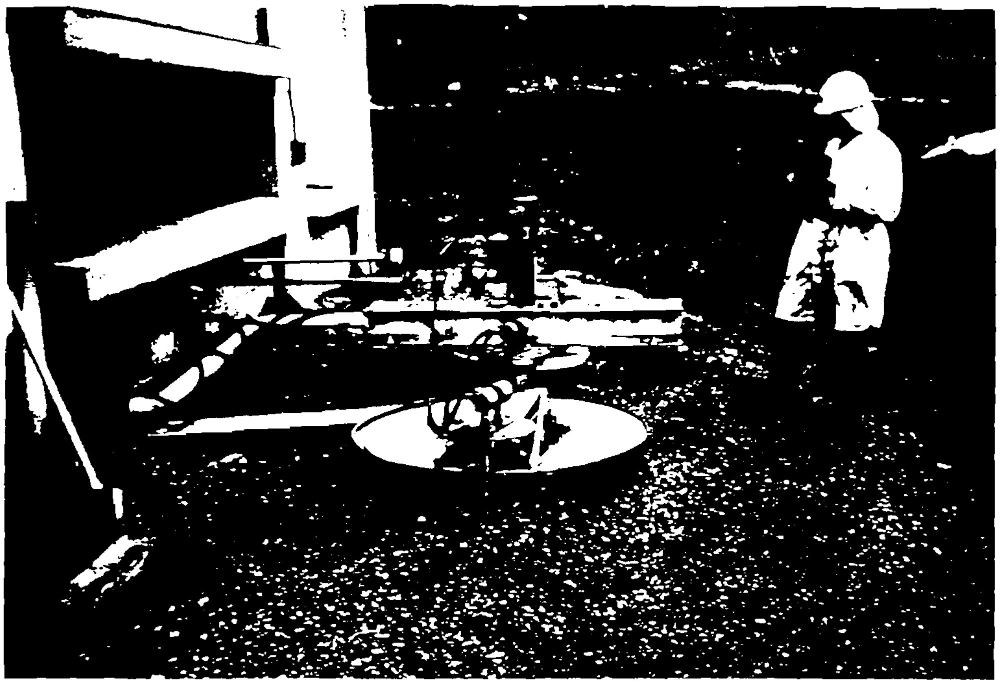
12c. Base view of one of the Flocculation Tanks inside the Nitroglycerin Wastewater Pretreatment Plant.



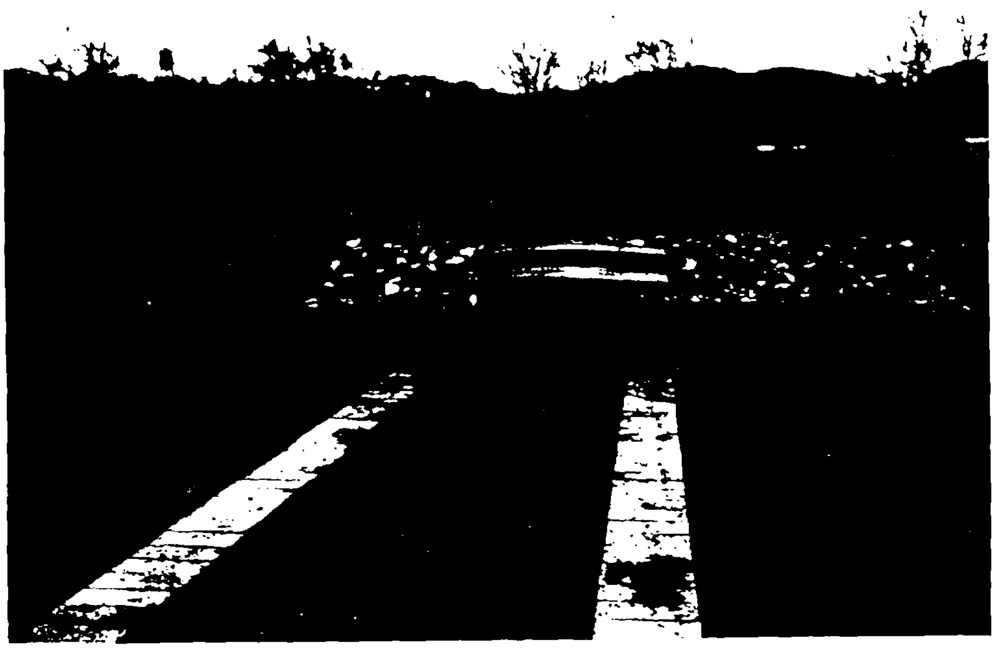
12d(i). View looking down into one of the secondary containment structures of one of the Outside Batch Reaction Tanks at the Nitroglycerin Wastewater Pretreatment Plant.



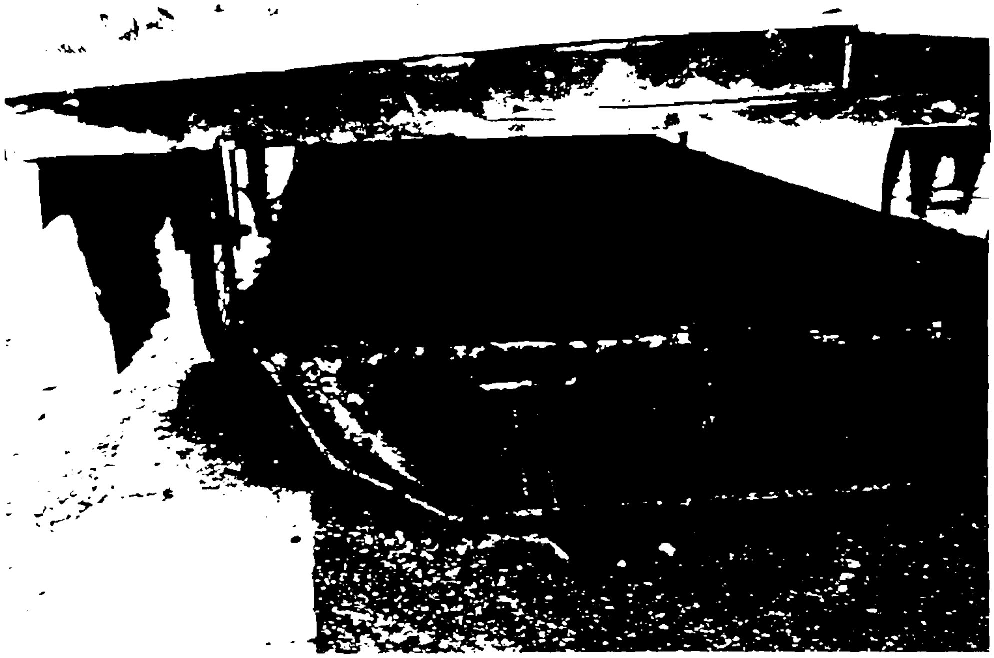
12d(ii). Top view of one of the Outside Batch Reaction Tanks.



12e. Overview of both of the In-Line mixers locatea outside of the Nitroglycerin Wastewater Pretreatment Plant.



13a(i). View of one of seven Burning Pans at the Waste Propellant Burning Ground, looking south towards the New River.

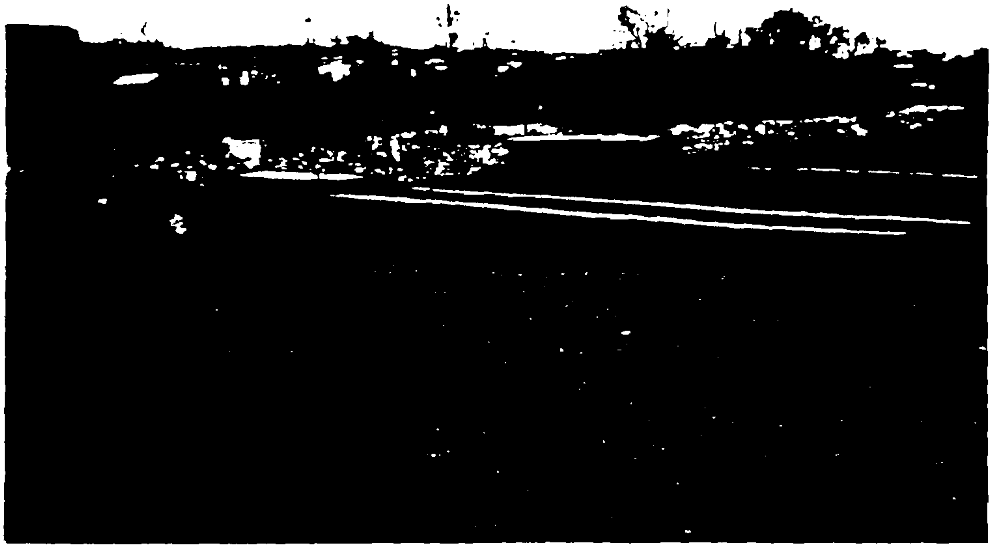


13a(ii). Close-up view of burned ash in a Burning Pan, looking south towards the New River.

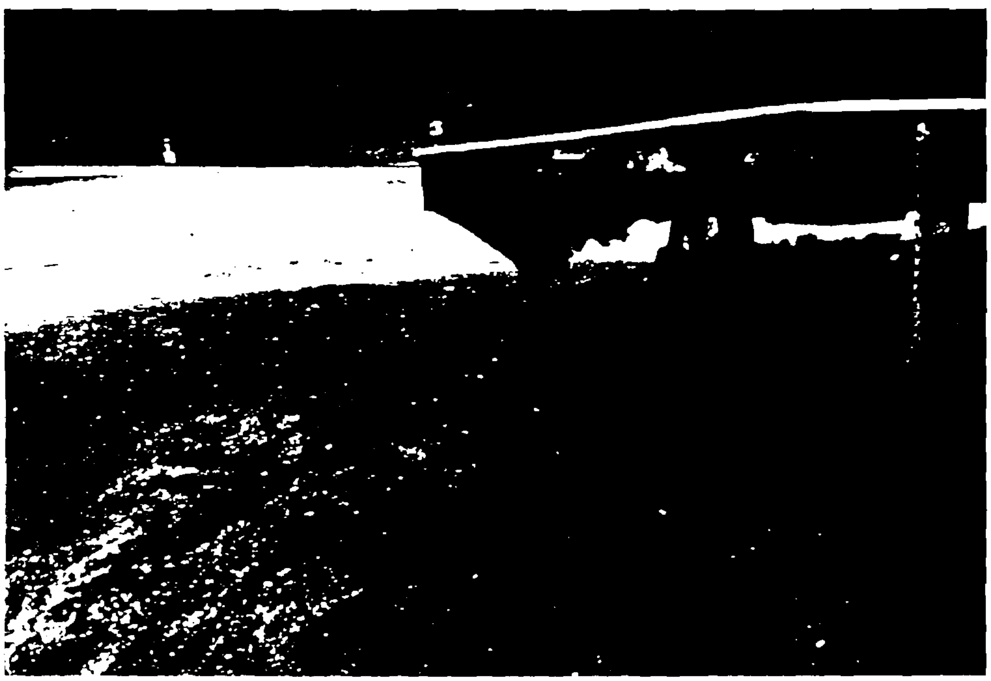
13a(iii). View of unburned propellant in a Burning Pan, looking south towards the New River.

13a(iv). Overall view of Burning Pans, looking east.

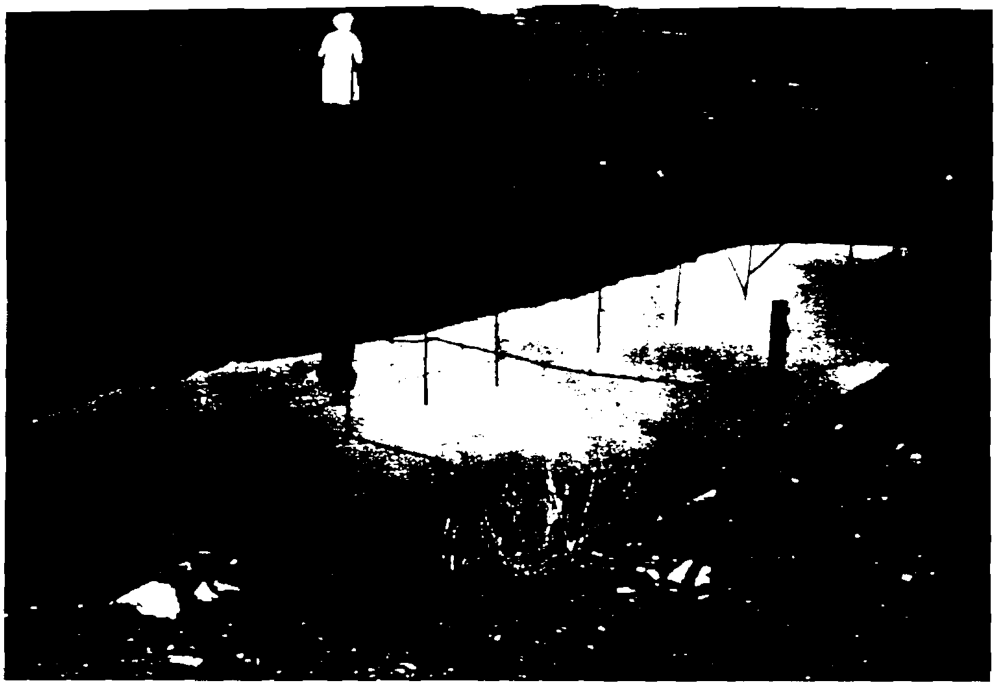
13a(v). Overall view of Burning Pans looking west.



13a(vi). View of an uncovered Burning Pan containing rainwater (left), looking southwest.



13a(vii). View of unburned propellant in a Burning Pan, looking northwest. Note windblown material and discoloration of ground.

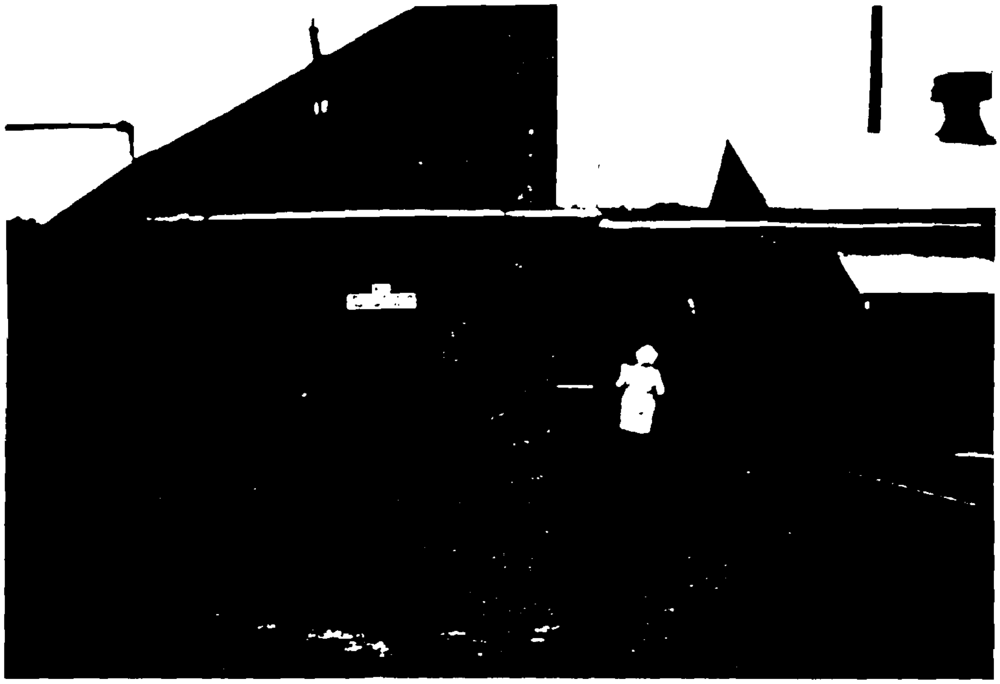


13c(i). Runoff Settling Basin for the Waste Propellant Burning Ground. Note corrugated pipe discharge culvert in lower left corner.

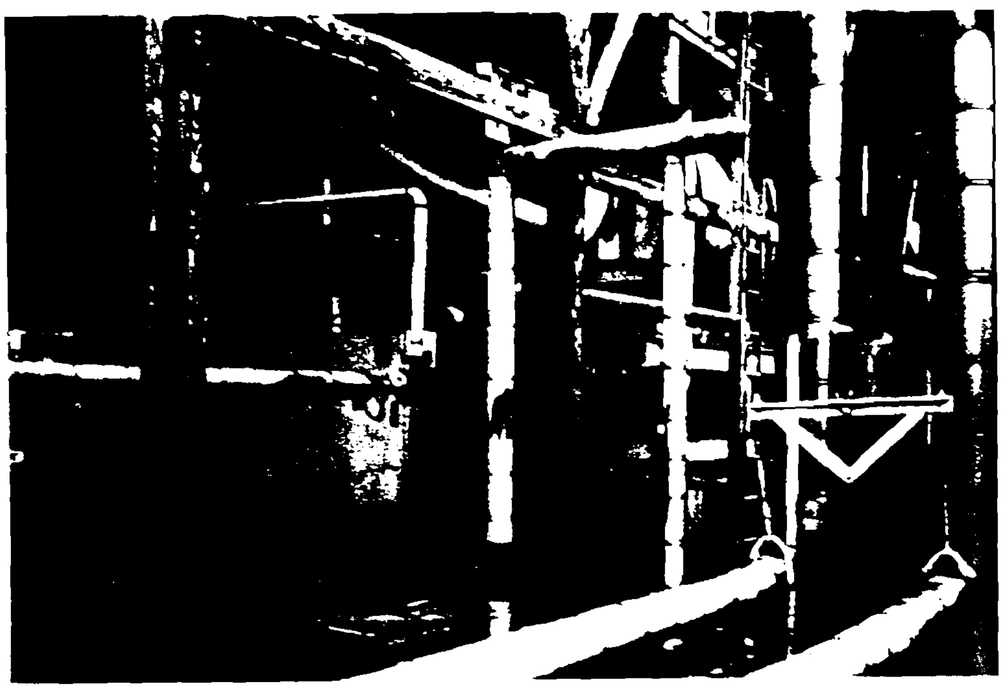
13c(ii). Influent pipe (center) from waste Propellant Burning Ground. Note pipe is filled with silt, scintillation vials and miscellaneous debris.

13d(i). Mobile and Temporary Storage Unit for waste propellant to be burned at the Waste Propellant Burning Ground.

13d(ii). Ground beneath Mobile and Temporary Storage Unit for Waste Propellant Burning Ground. Note orange propellant, dark discoloration of soil and dead vegetation.



14a. Storage building #430 for propellant at the incinerator.



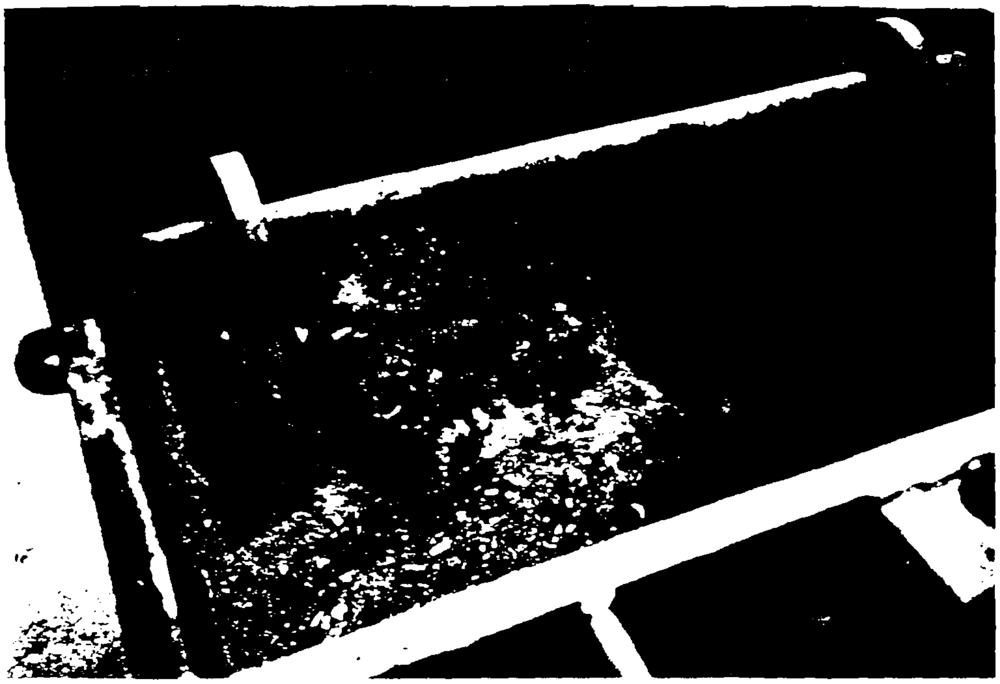
14b. Waste Propellant Incinerator behind building #430.

14c. Afterburners (no picture available due to location inside the contained incinerators).

14d. Precooler (no picture available due to location inside the contained incinerators).

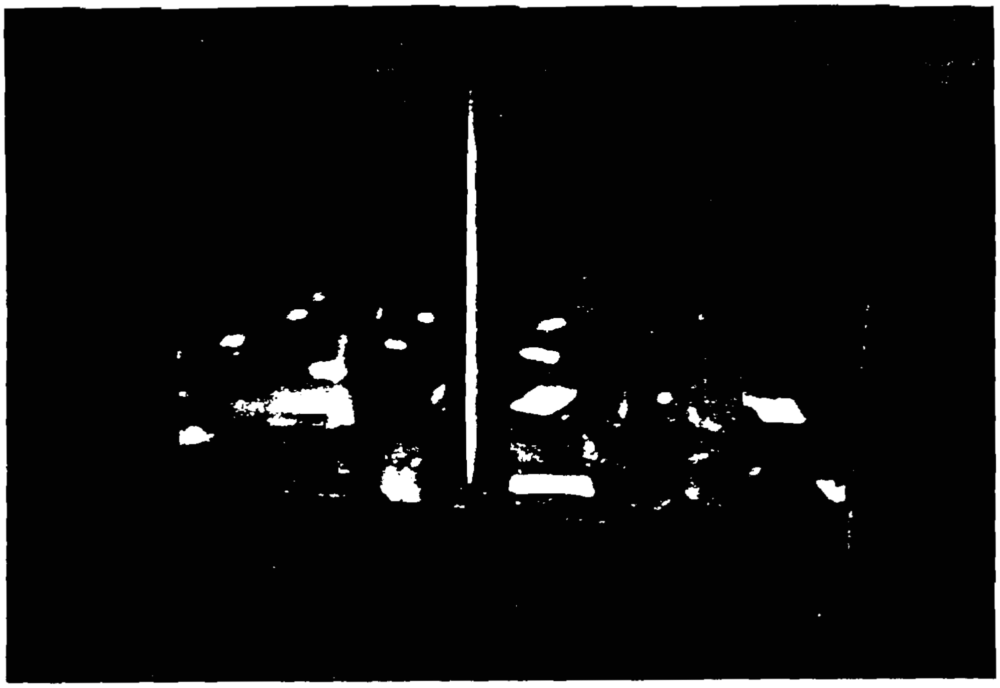
14e. Wet Scrubber (no picture available due to location inside the contained incinerators).

14f(i). Ash hoppers at the incinerator.

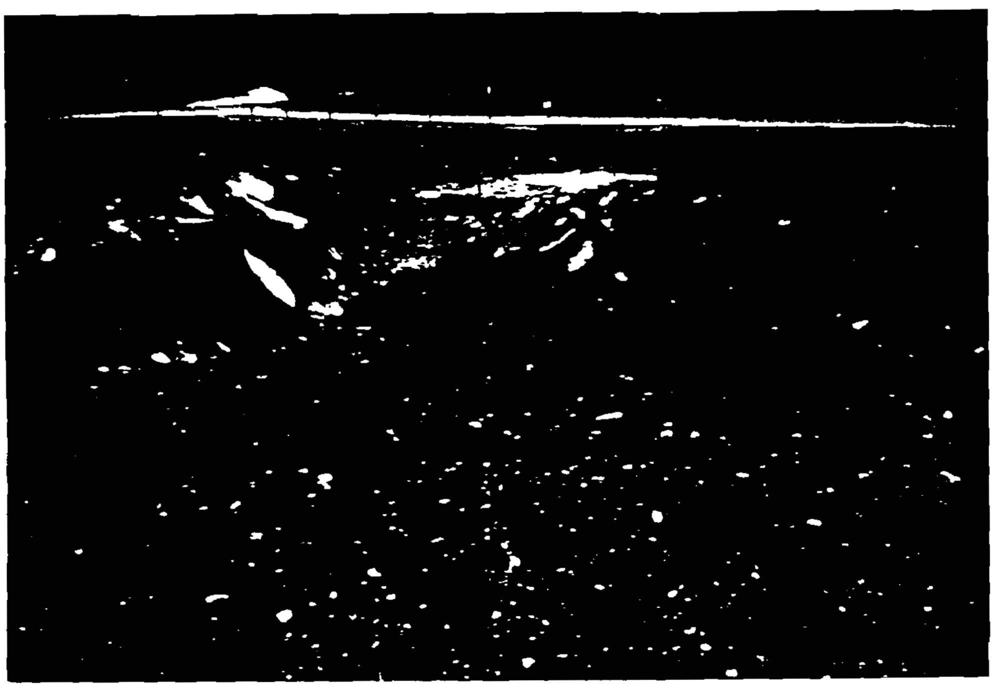


14f(ii). Close-up view looking down into ash hopper adjacent to the incinerator. Note orange residue that appears to be unburned propellant.

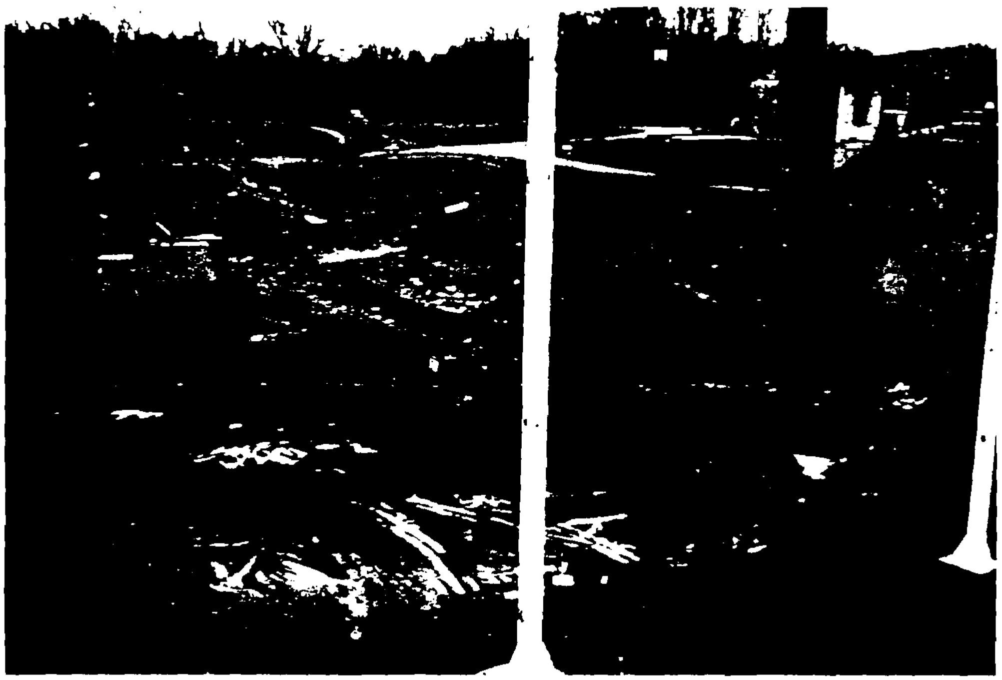
14g. Mobile and Temporary Storage unit for waste propellant and incinerator ash adjacent to incinerator.



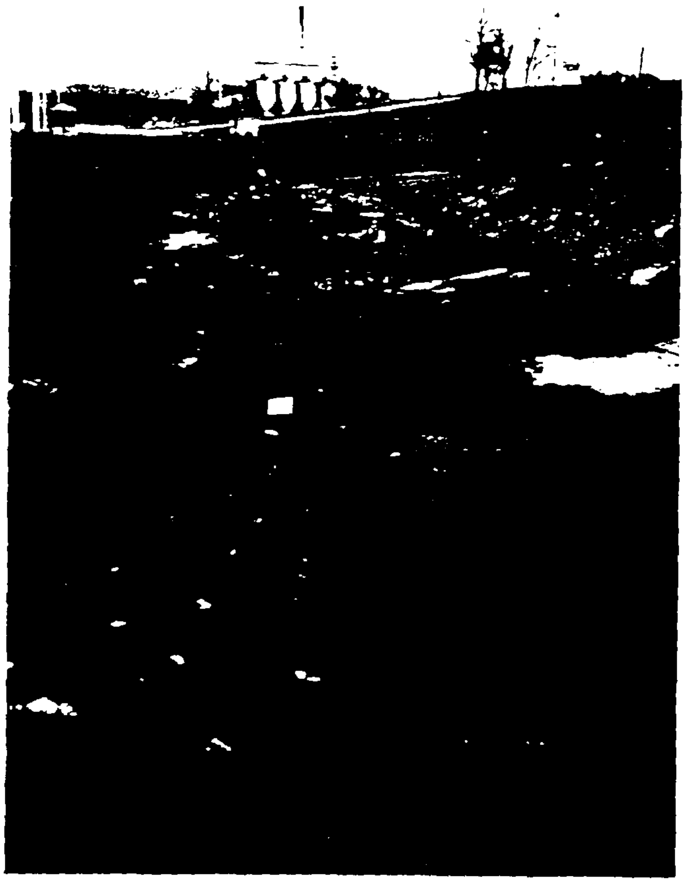
15. Waste Propellant Storage Facility at the Incinerator (Unit 14).



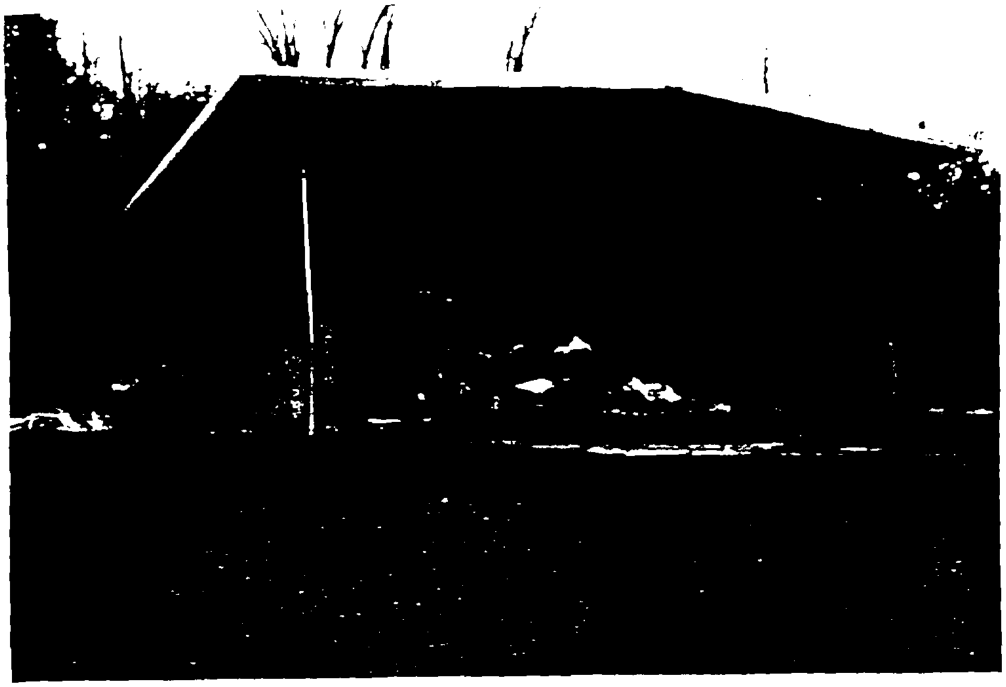
16. Former Active face of Hazardous Waste Landfill. Note soil erosion and standing water.



17a(i). Overview of the Stage and Burn Area looking north. Note the ponded water in a ditch to the far right.

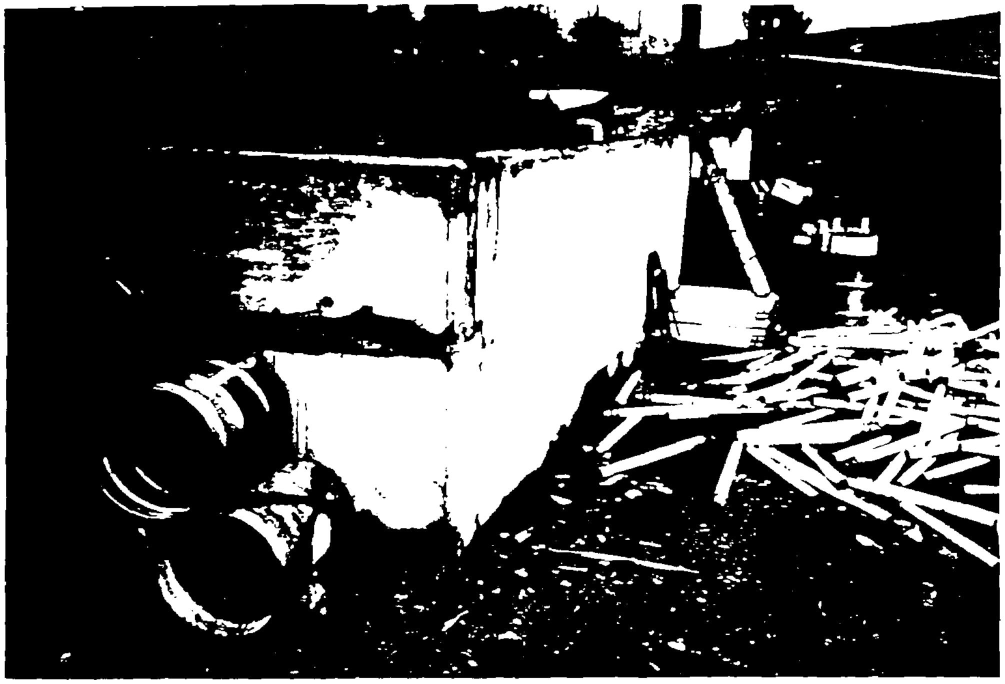


17a(ii). Second overview of the Stage and Burn Area looking east. Note propellant contaminated wood is often placed around metal pieces for burning (center).



17b(i). Overview of the Staging Pad at the Air Curtain Destructor. Note to the far right of the canopy is the uncovered staging pad.

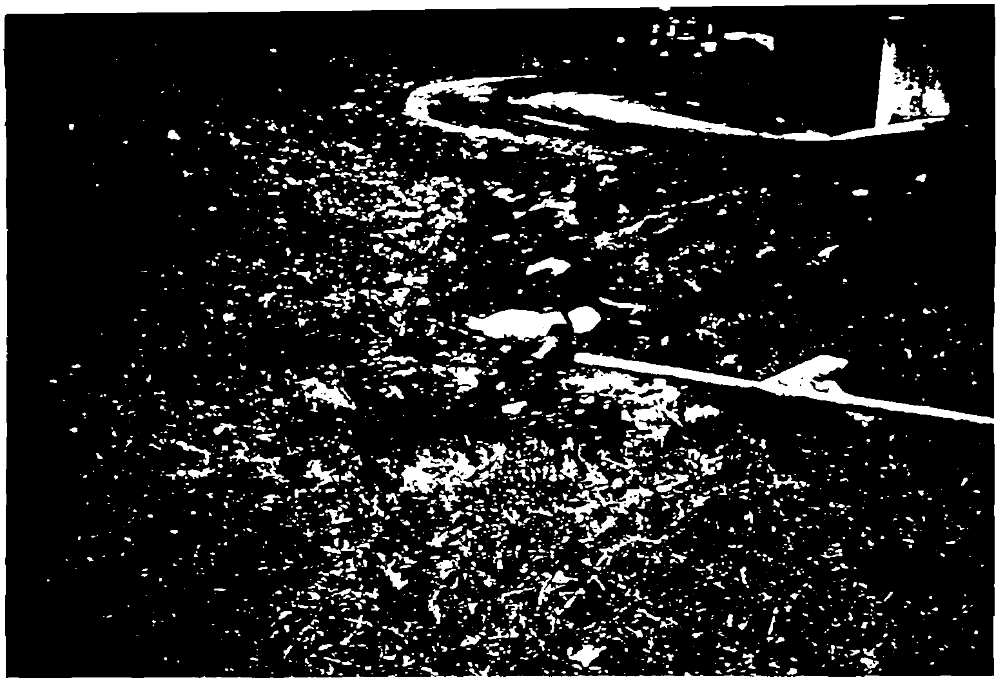
17b(ii). Drum storage containment pad (right) and propellant contaminated wood and paper containment pad (left). Note sloped front entrance to the pads and the soil in front of the storage bays.



17b(iii). Back and side wall of ACD Staging Pad.

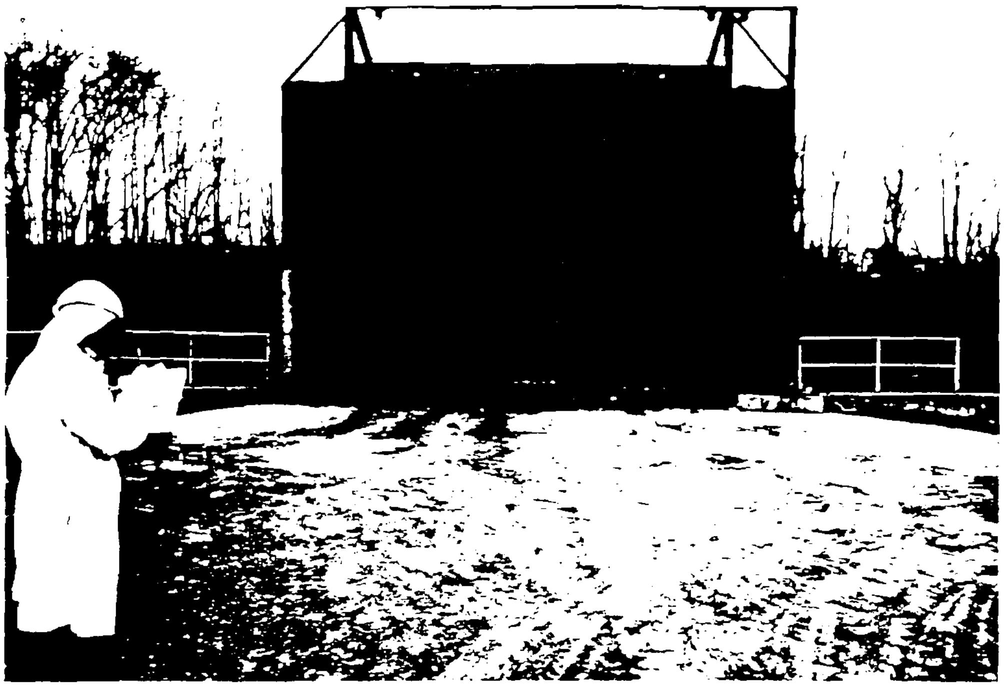
17b(iv). Spillway from ACD Staging Pad to ACD Collection Pit.

17b(v). ACD Collection Pit adjacent to ACD Staging Pad. Note potentially contaminated paper products in the sump.



17b(vi). Effluent pipe leading from the ACD Collection Pit. Note the drainage ditch in the background, soil discoloration, and lack of vegetation.

17c(i). Overview of the Air Curtain Destructor (center). Note the ACD Staging Pad and Pit (left) and burned material on the ground behind the incinerator.



17c(ii). Air Curtain Destructor (front view). Note discolored soil in front of the unit.

17c(iii). Rear view of the ACD (center) showing incinerated waste piles on the ground (right).

17c(iv). Stockpiles of segregated metals from bottom ash (right) collected from the ACD.

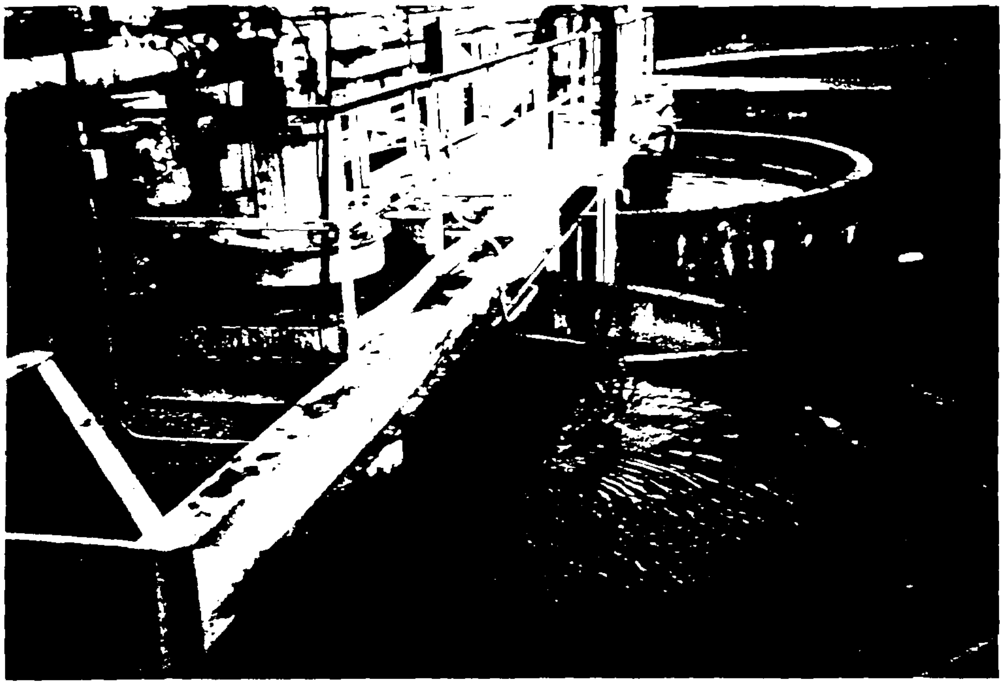
17d. Ash Staging Area located behind the ACD. Note the runoff drainage basin is located directly behind the ash hopper.

17e. Overview of the ACD Runoff Drainage Basin (background).

18a. Vacuum Filters located inside building (no picture available due the locked building).

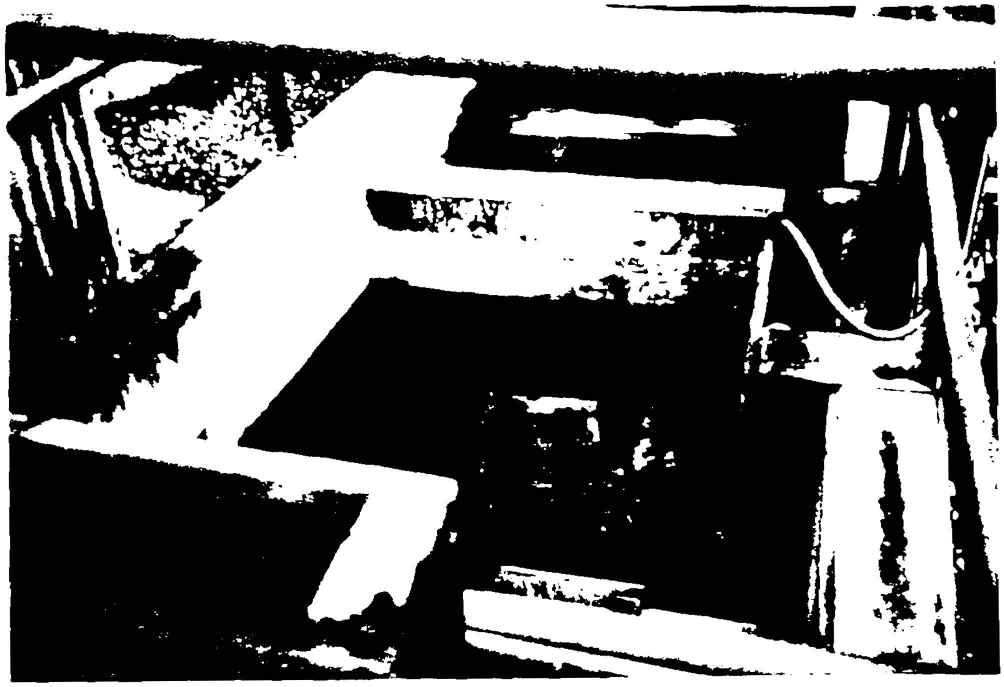
18b. Lime Silos located inside building (no picture available due to the locked building).

18c. Neutralization Tanks located inside building (no picture available due to the locked building).

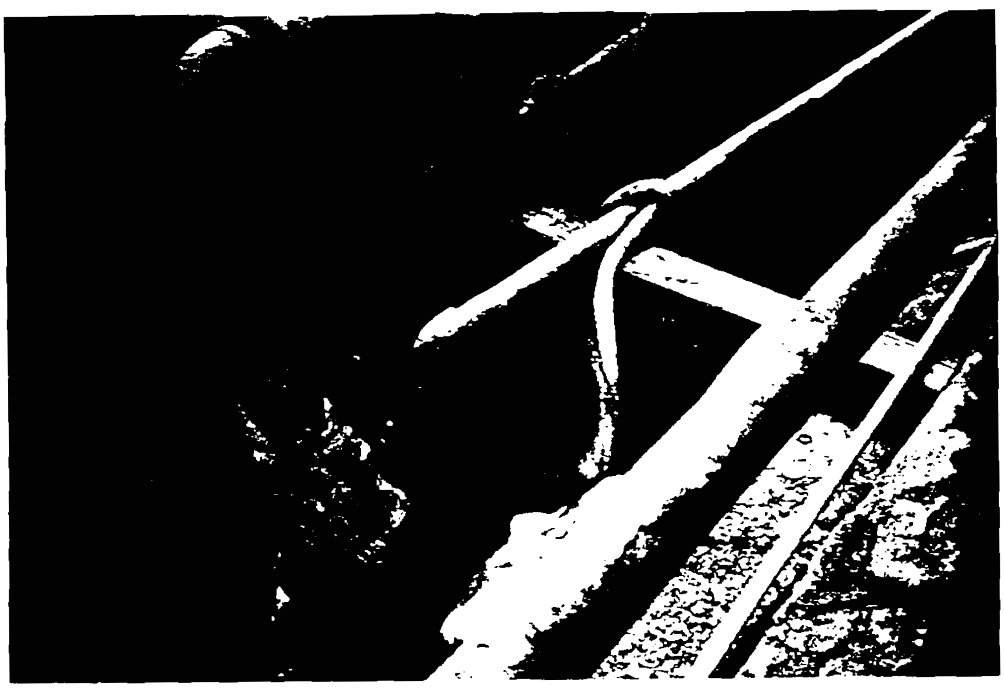


18d. Two clarifiers for Sulfuric Acid Recovery Plant-Waste Acid Treatment looking east.

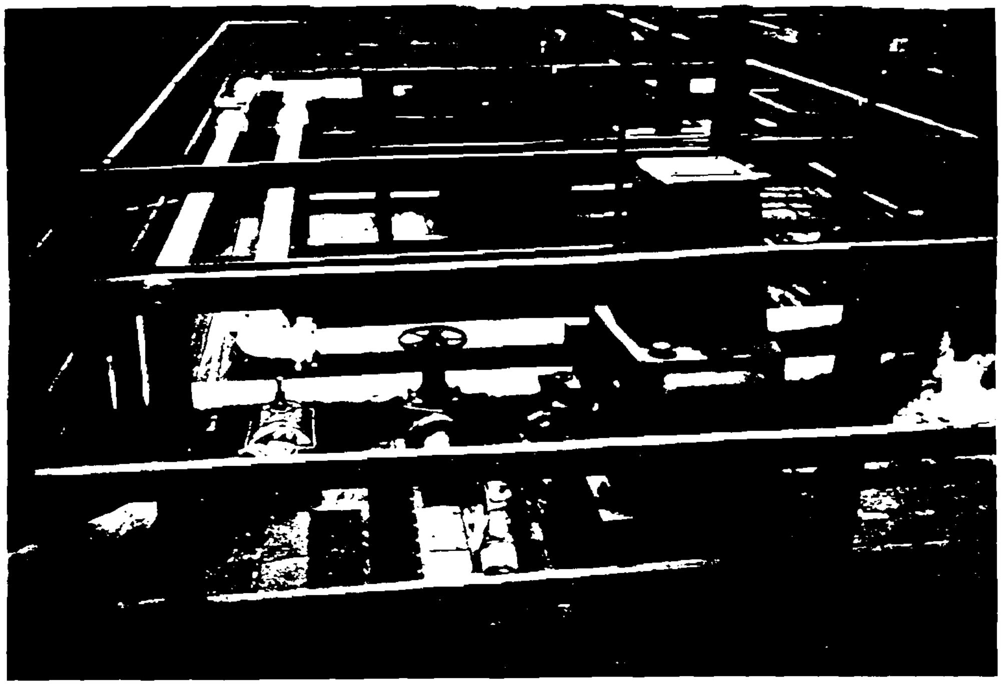
18e. Steel feed tank for Sulfuric Acid Recovery Plant-Waste Acid Treatment.



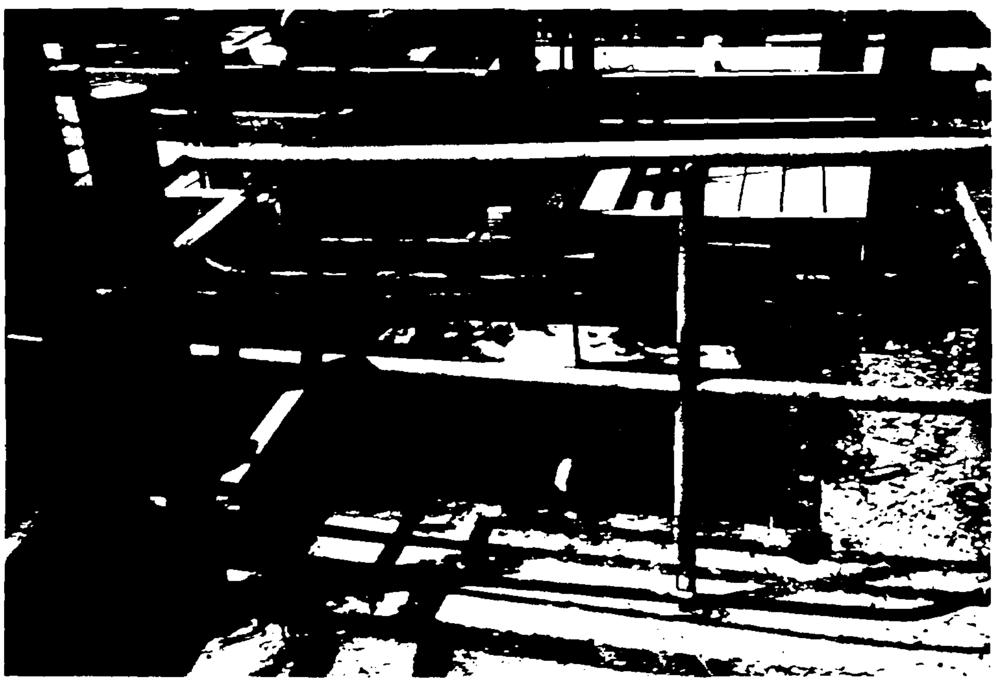
18f. Effluent sump from Sulfuric Acid Recovery Plant Waste Acid Treatment Clarifiers.



19a(i). A-B Line Acidic Wastewater Lime slurry and Wastewater Influent Mix Tank.



19a(ii). Influent pipes and Equalization Basin for A-B Line Acidic Wastewater Treatment Plant.



19b. Neutralization tank equipped with six rotary mixers for A-B Line Acidic Wastewater Treatment Plant.

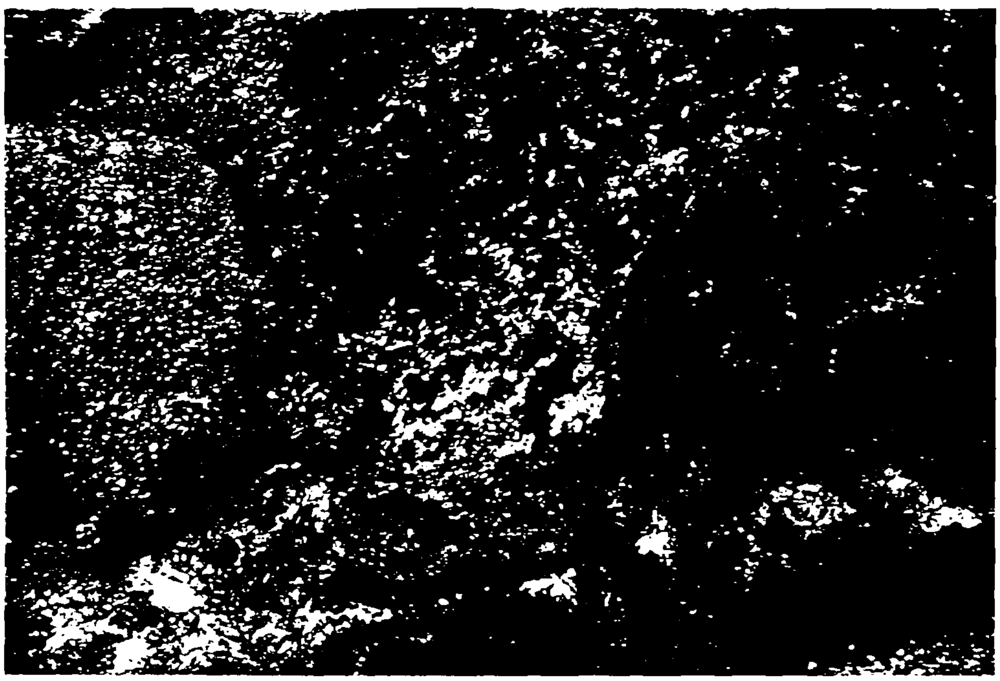
19c. Lime-Slurry Mix Pit (no pictures available due to location inside locked building).

19d(i). Lime Silo, above operaters building adjacent to A-B line Acidic Wastewater Treatment Plant.

19d(ii). Overview of the operators building which houses the Lime hopper and Slaker.

19e. Bucket Conveyor System, refer to photo 19d(i) (rectangular extension above silo).

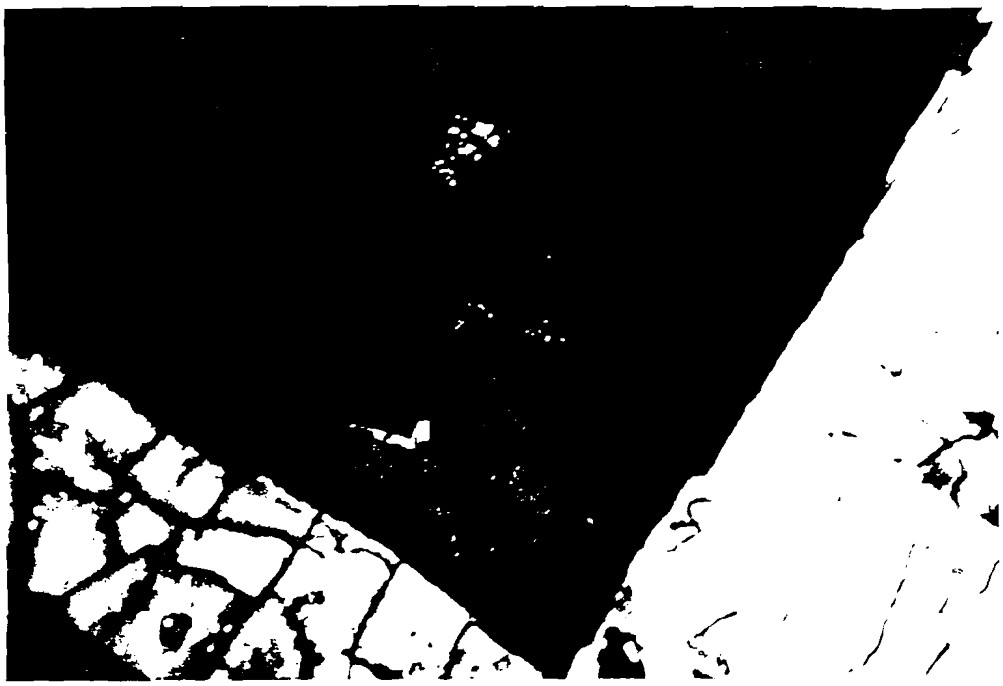
19f(i). Sludge Drying Bed for A-B Line Acidic Wastewater Treatment Plant, looking west.



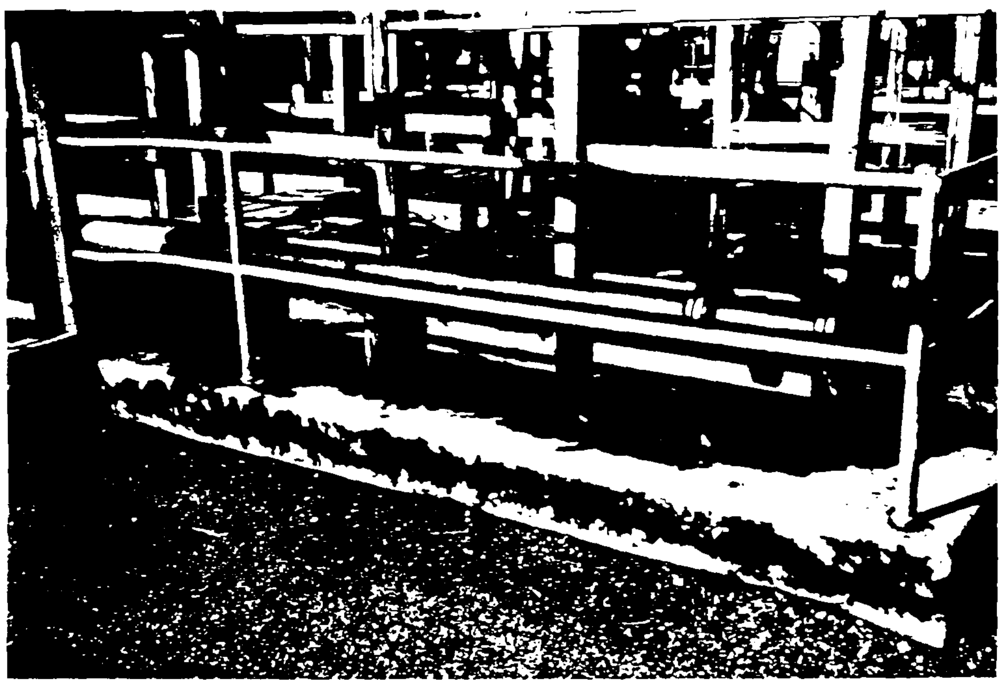
19f(ii). Close-up view of sludge in sludge drying bed. Note orange and dark oily discoloration.

19g. Parshall Flume for A-B Line Acidic Wastewater Treatment Plant.

20a(i). First Acid-Brick-Lined Influent Sump for C-Line Acidic Wastewater Treatment Plant.



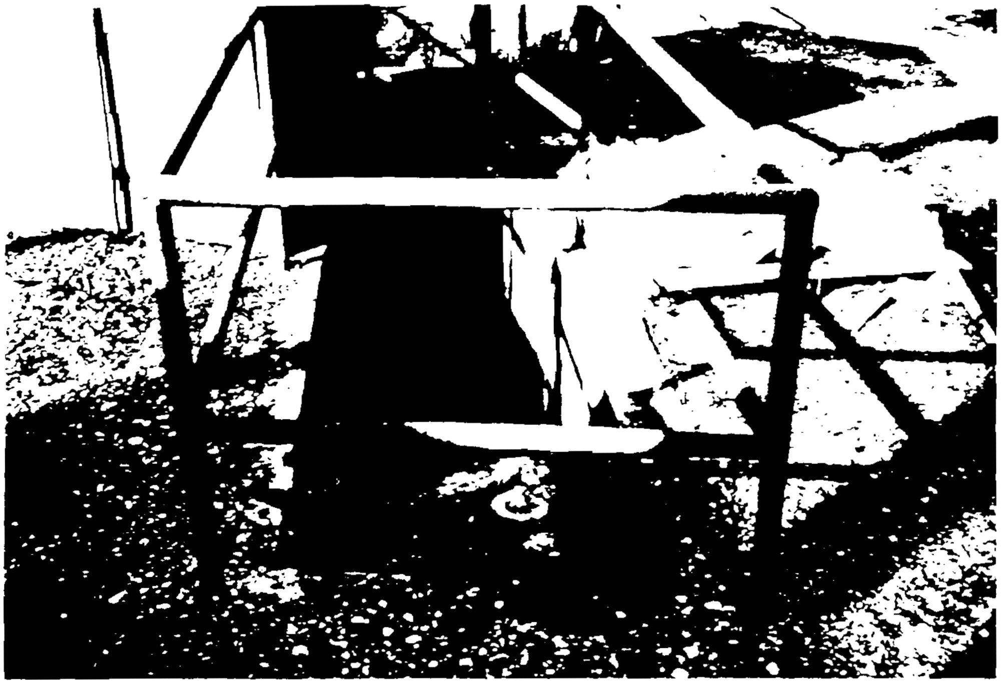
20a(ii). Second Acid-Brick-Lined Influent Sump for C-Line Acidic Wastewater Treatment Plant.



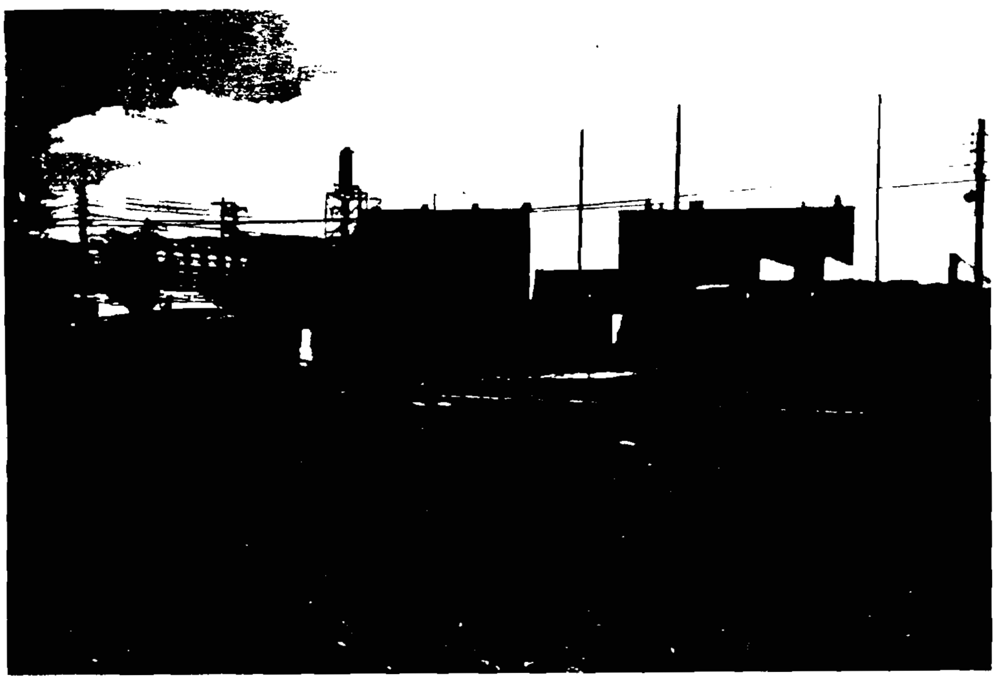
20b. Outside of Acid-Brick-Lined Mix/Neutralization Tank.

20c. Acid-Brick-Lined Effluent Sump for C-Line Acidic Wastewater Treatment Plant.

20d. Lime-Silo and Slaker contained in Cinder-Block Building adjacent to C-Line Acidic Wastewater Treatment Plant.



20e. Parshall Flume from Acid-Brick-Lined Effluent Sump (20c) of C-Line Acidic Wastewater Treatment Plant. Note stains and broken Lime Bag.



21. Continuous Automated Single Base Line Wastewater Treatment Plant (background), looking north from the New River.

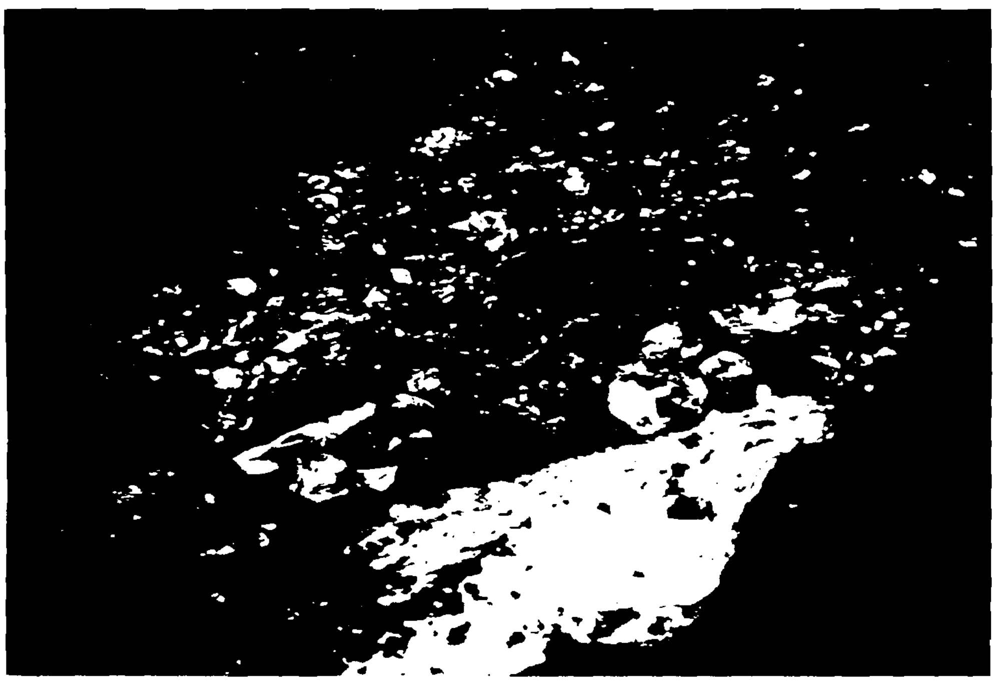
22, 23, 24, & 25 No picture was taken of the wastewater Holding Lagoon. Refer to the August 26, 1986 Draft Interim RFA photo log for photographs.

26. Fly Ash Landfill No. 1, looking northwest. Note slight subsidence in center of cover.

27. Calcium Sulfate Landfill located adjacent to Unit 29. Unit is located right of utility pole.

28(i). Sanitary Landfill near Asbestos and Hazardous Waste Landfills, looking north.

28(ii). Sanitary Landfill, looking North towards river. Note smoke in background is from Waste Propellant Burning Ground.



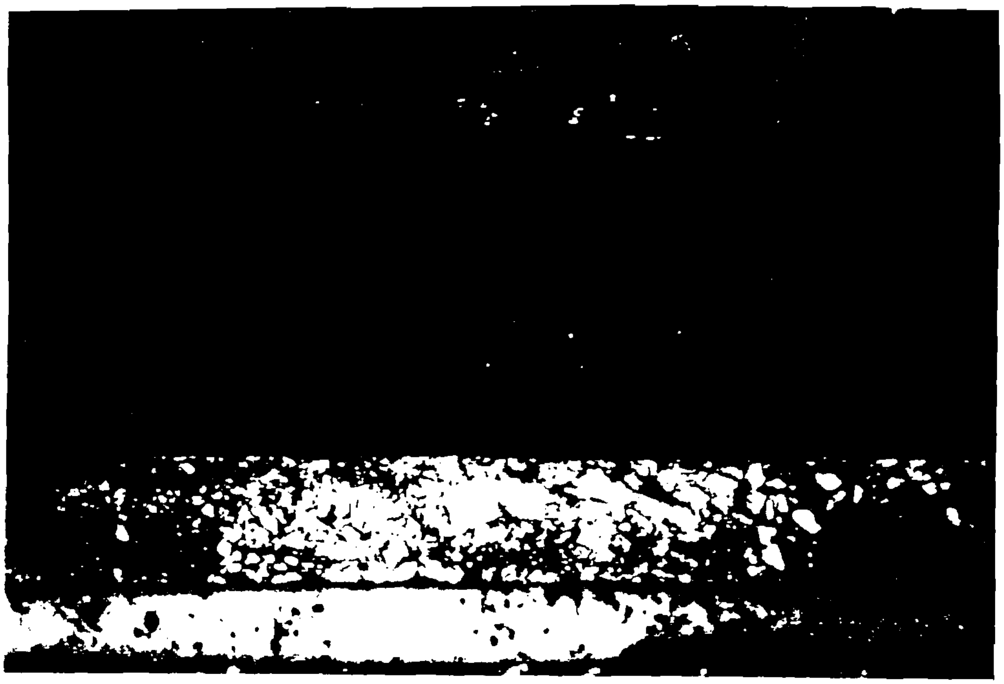
28(iii). Active face of Sanitary Landfill.

29(i). Fly Ash Landfill No. 2, looking south towards the New River.

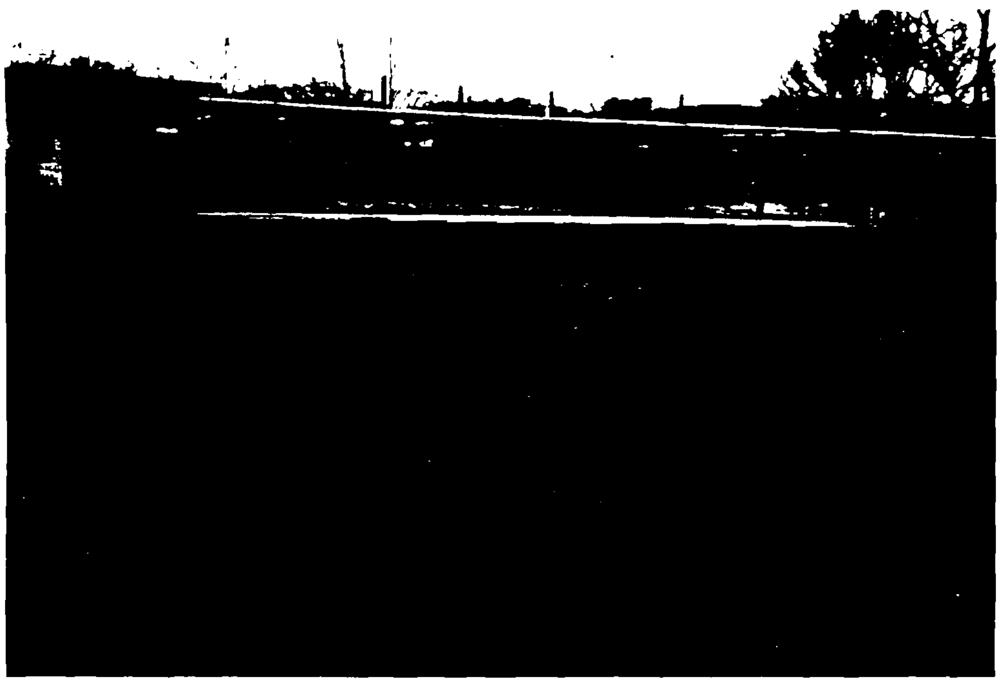
29(ii). Fly Ash Landfill No. 2 looking east. Note rainwater ponded in right h nd corner.

30. Closed Asbestos Disposal Trench No. 1. Note sign indicating Asbestos Waste Disposal Site.

31a(i). Overview of part of the Sluice Waterway leading to the Primary Bottom Ash Settling Lagoon (Unit 31b, background).

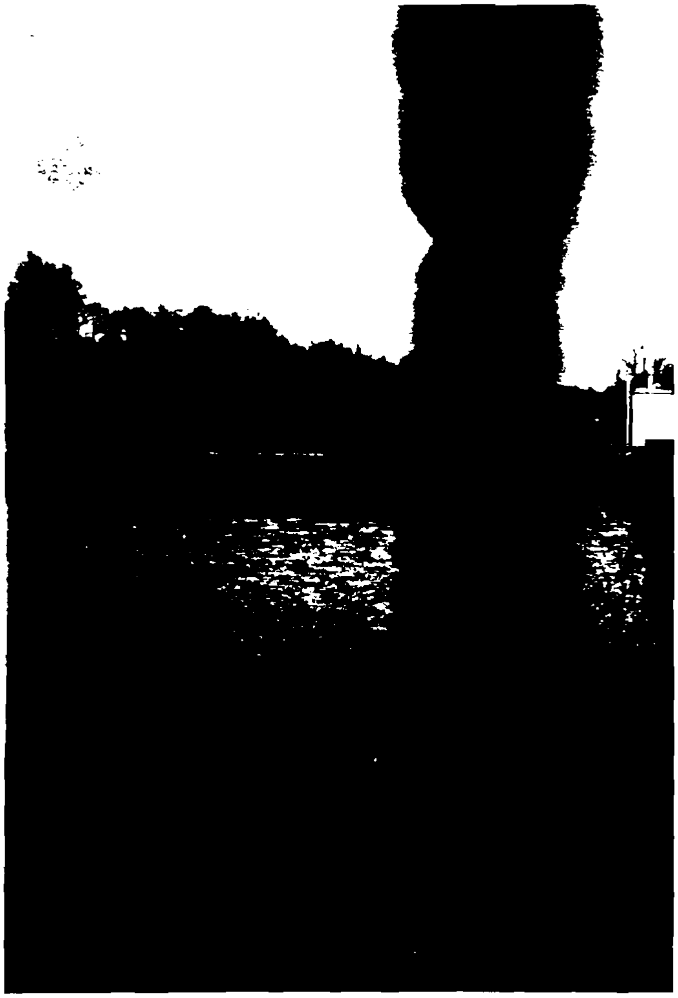


31a(ii). View peering down into the Bottom Ash Sluice Waterway at Power Plant No. 2.



31b(i). Bottom Ash Pile adjacent to Primary Bottom Ash Settling Lagoon.

31b(ii). Primary Bottom Ash Settling Lagoon. Note the sluice waterway influent point (left).



31c. Secondary Bottom Ash Settling Lagoon.

31d. Tertiary Bottom Ash Settling Lagoon.

31e. View looking down into the concrete sump through the top grating.

31f. View looking down into the Equalization Basin where effluent from the Bottom Ash Settling Lagoons is discharged. Note due to a lack of effluent volume in the basin, no neutralization has occurred.

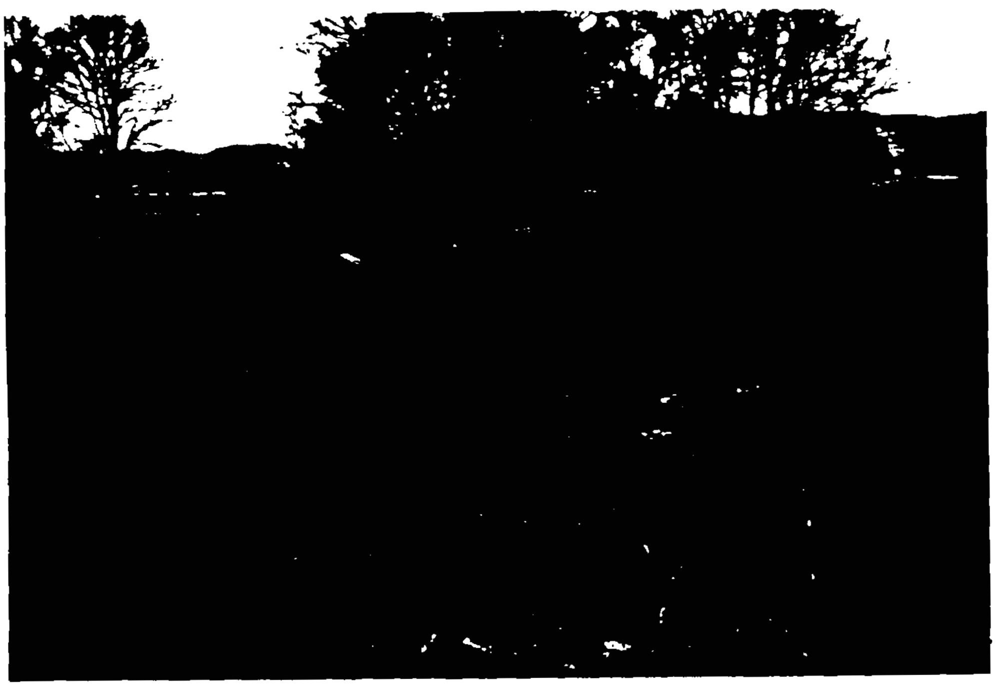
32. Inert Waste Landfill #1, no picture available due to development problems of the negative.

33 & 34. No pictures taken since these units were determined not to be SWMUs.

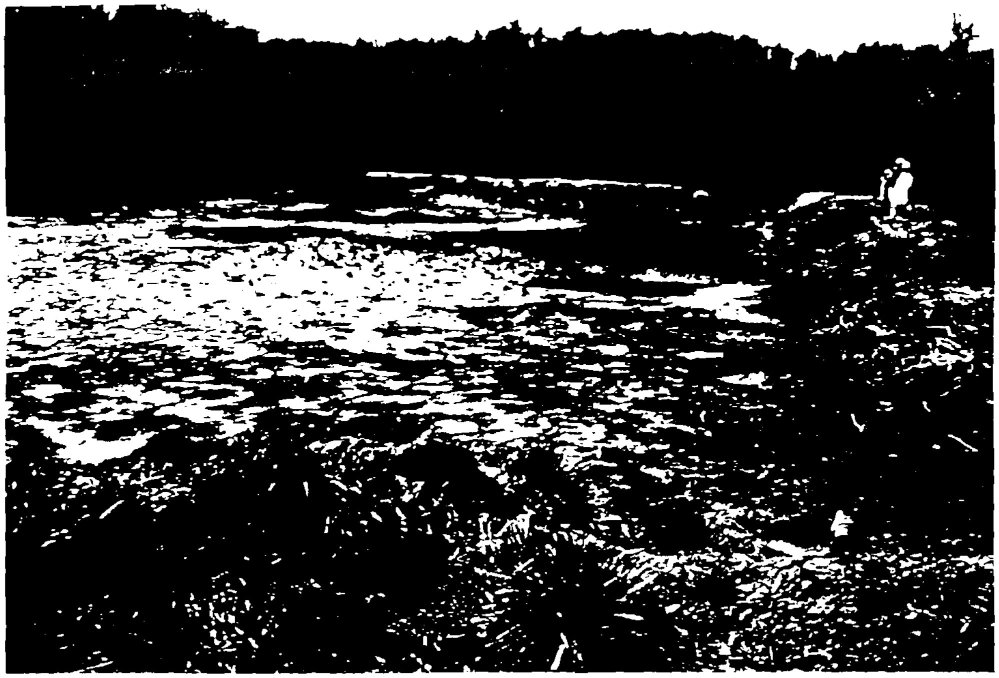
35a. Calcium Sulfate Drying Bed (northeast section). One of two Calcium Sulfate Drying beds adjacent to Unit 8.

35b. Second Calcium Sulfate Drying Bed adjacent to Unit 8.

36a. Calcium Sulfate Drying Bed (northeast section) located to east of the Calcium Sulfate Settling Lagoons.



36b. Second Calcium Sulfate Drying Bed.

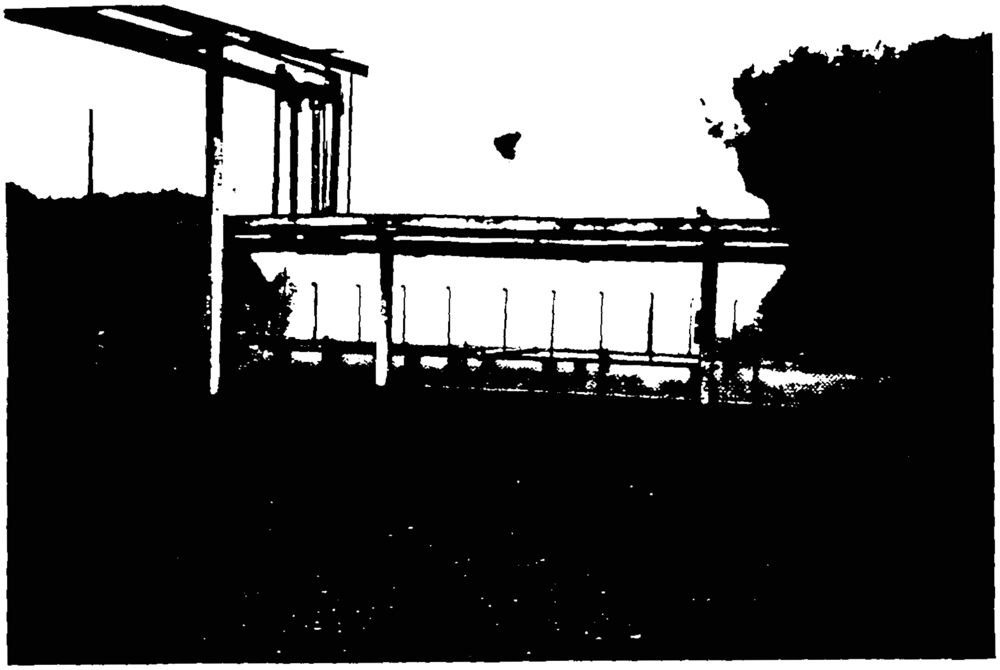


37. View of Calcium Sulfate Drying Bed (northwest section) looking northwest towards the New River. Note orange deposit on bank.

38. View of Calcium Sulfate Drying Bed (northwest section) looking south.

39a(i). Incinerator (Unit 14) Wastewater Pond #1, looking south.

39a(ii). Incinerator (Unit 14) Wastewater Pond #2, looking south



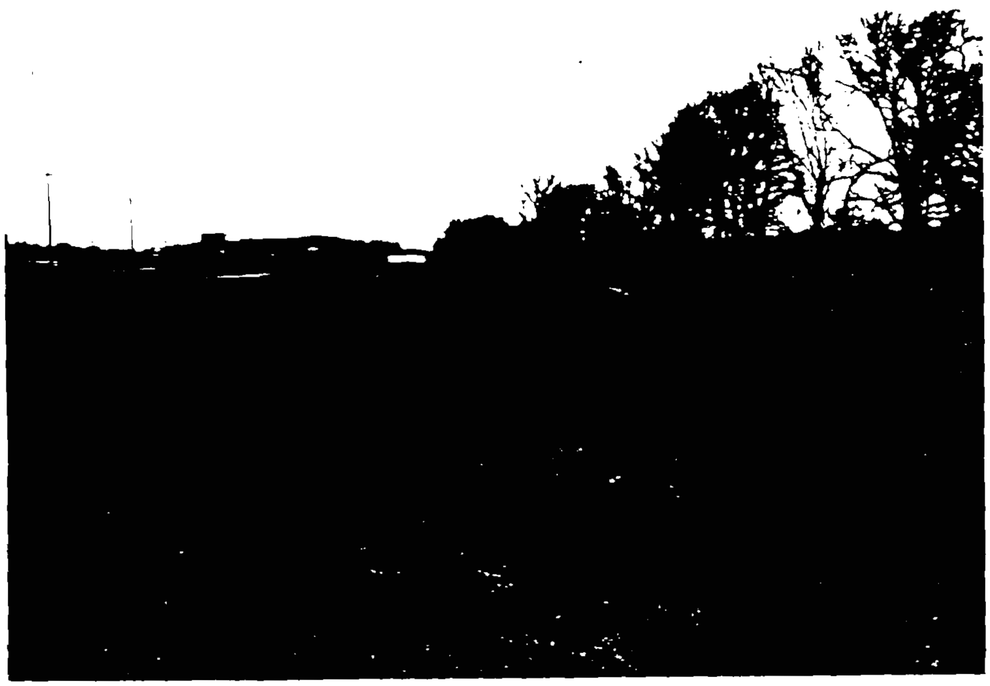
39b. Spray pond adjacent to Incinerator (Unit 14) and Wastewater Pond #1 (Unit 39a). Observe spray stand pipes in center.

40. Overview of the Sanitary Landfill (background). Note earthen mounds.

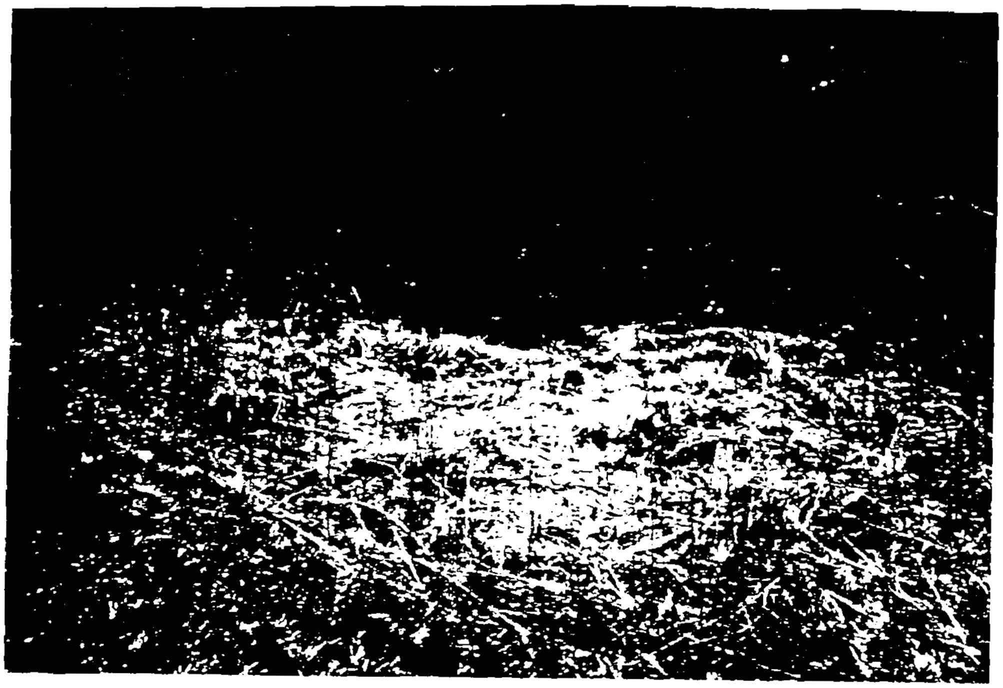
41. Red Water Ash Landfill (Southeast of Barracks) adjacent to TNT Wastewater Treatment Unit (background).

42. Red Water Ash landfill (Eastern Edge of Main Manufacturing area. (No picture, area has been sold and is no longer within facility boundary).

43(i). View of Sanitary Landfill looking west. Note subsidence and stressed vegetation.



43(ii). Sanitary Landfill adjacent to New River. Note ravine in center of photograph.



44. Alleged site of Toluene Spill north of railroad tracks.

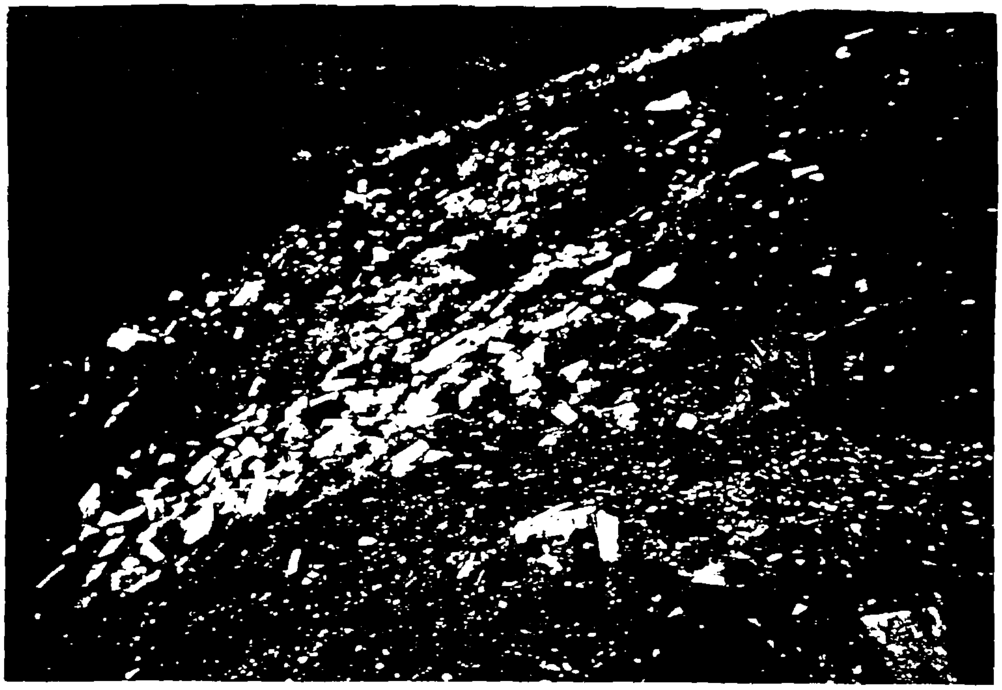
45(i). Abandoned trench in area of Sanitary Landfill (adjacent to New River).

45(ii). Mound of excavated soil adjacent to Sanitary Landfill area.

46(i). Former Waste Propellent Disposal Area.

46(ii). View showing the proximity of the Former Waste propellant Disposal Area to the New River.

47(i). Overview of Inert Waste Landfill #2, looking east.



47(ii). Edge of Inert Waste Landfill, looking North. Note erosion on embankment.

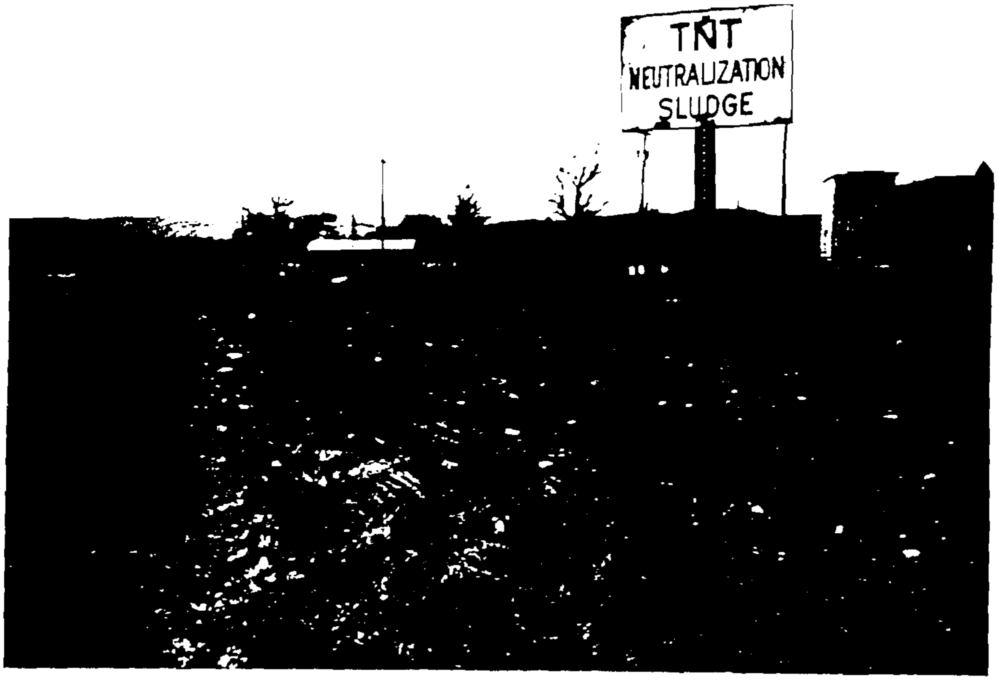
48, 49, & 50(i). Overview of Oily Wastewater, Red Water Ash, and Calcium Sulfate Disposal Areas, looking southwest.

48, 49, & 50(ii). Looking east over Oily Wastewater, Red Water Ash, and Calcium Sulfate Disposal Areas. Note Bottom Ash used for cover.

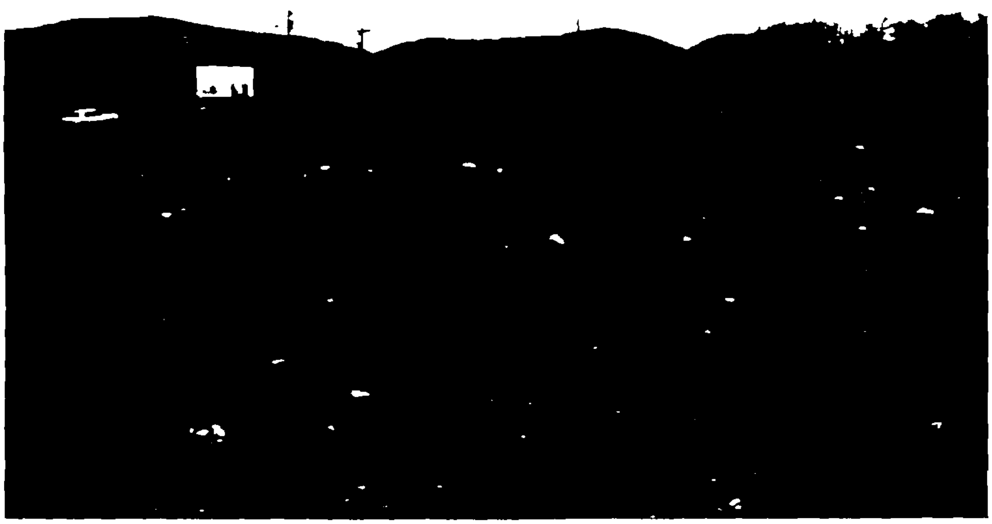
48, 49, & 50(iii). Southern edge of Oily Wastewater, Red Water Ash, and Calcium Sulfate Disposal Areas.

48. 49, & 50(iv). Burned grass from Propellant Burning Ground (Unit 13) on Oily Wastewater, Red Water Ash, and Calcium Sulfate Disposal Areas.

48, 49, & 50(v). Close-up view of Calcium Sulfate residue on edge of disposal area.



51. TNT Neutralization Sludge Disposal Trench.

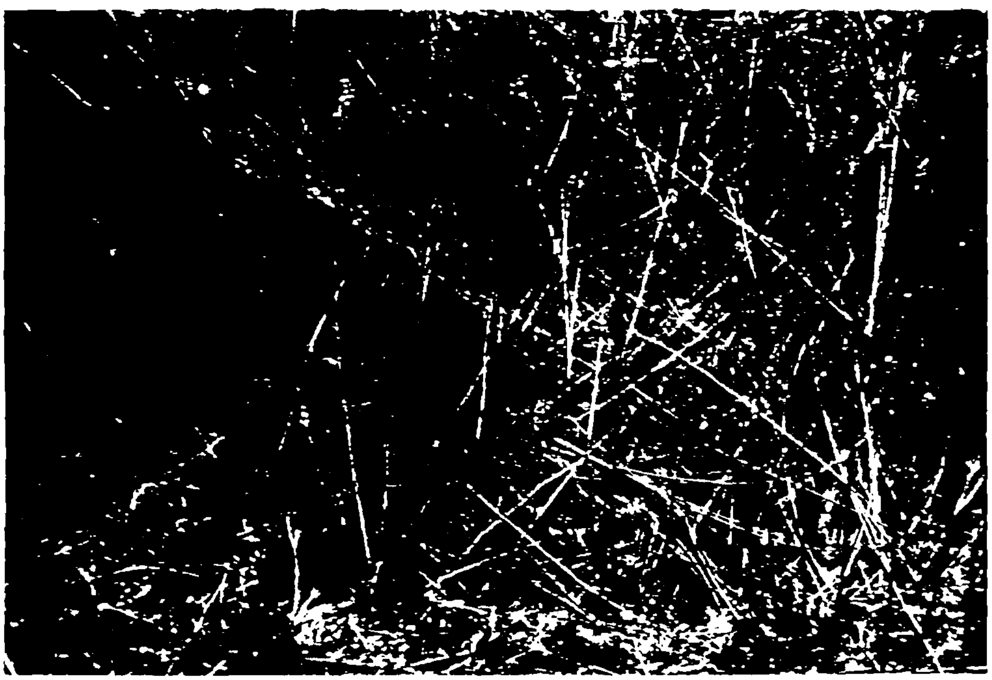


52. Closed Sanitary Landfill looking north toward New River.

53. Activated Carbon Disposal Area (center) within Fly Ash Landfill No. 2. Plateau in center of Fly Ash Landfill No. 2 is location of activated carbon disposal area.

54(i). Ash from Burning of Waste Propellants.

54(ii). Suspected disposal area for waste propellant ash. Note subsidence of soil or trench south of area.



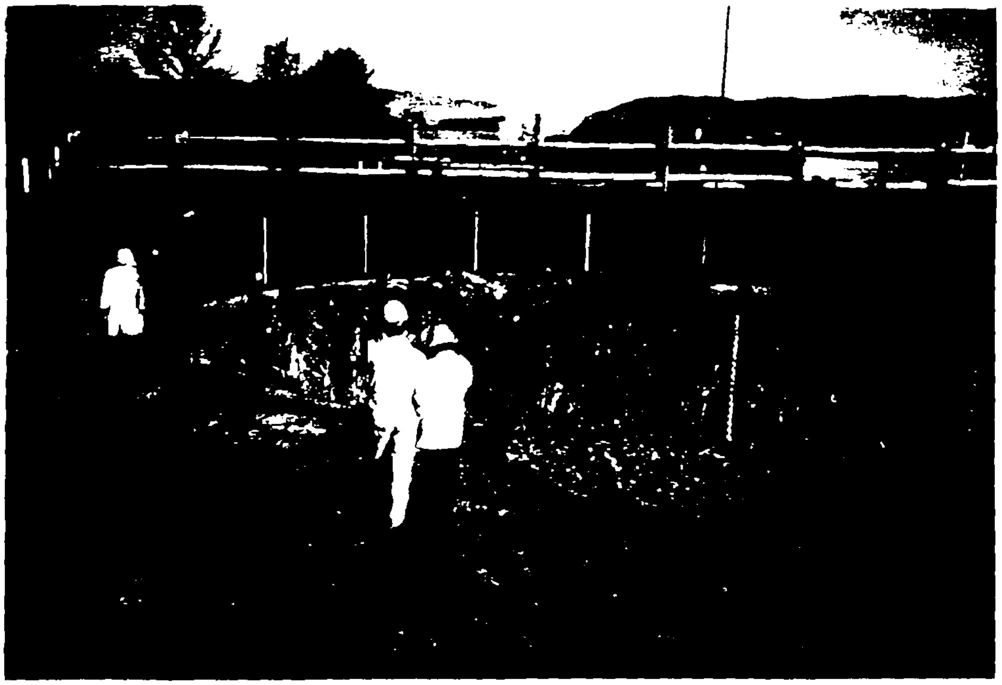
54(iii). Larger of two trenches in area suspected to be ash from burning of waste propellants.

54(iv). Overview of area designated as Ash from Burning of Propellants.

54(v). Overview of small excavated area designated as Disposal area for Burning of Propellants

55. No picture available since this unit was determined not to be a SWMU.

56. No picture available since this unit was determined not to be a SWMU.



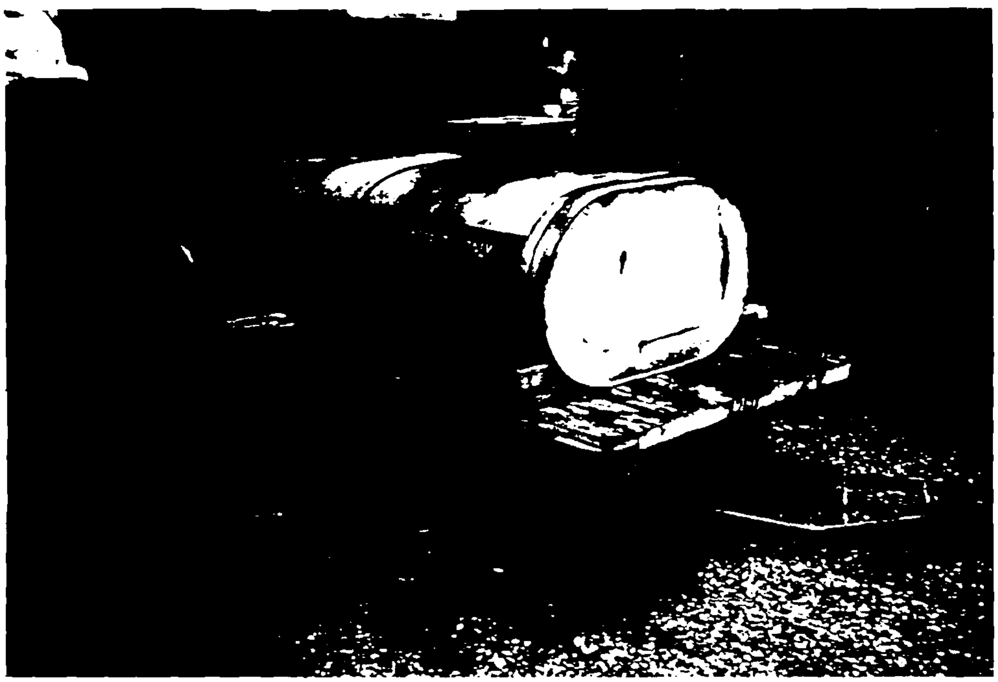
57. Overview of the Pond by Building 4931.

58. Rubble Pile adjacent to Inert Waste Landfill looking west.

59. Bottom Ash Pile located east of Units 48, 49, and 50 adjacent to roadway.

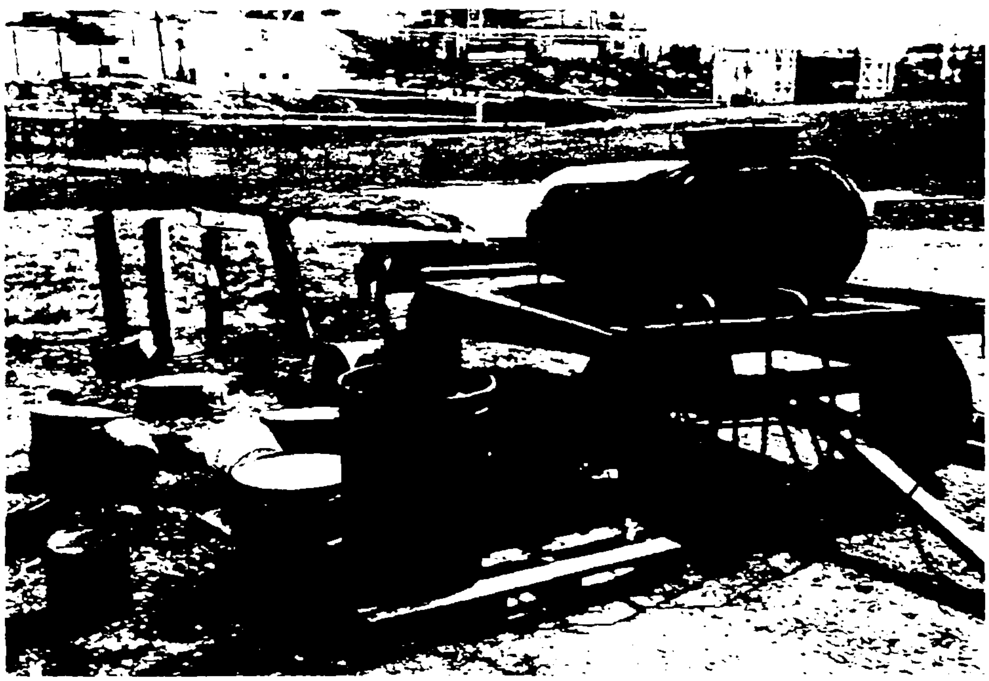
60. Rubble Pile east of Administration Building consisting of demolition debris.

61(i). Overview of a Mobile Waste Oil Cart stored by Building 266-2.

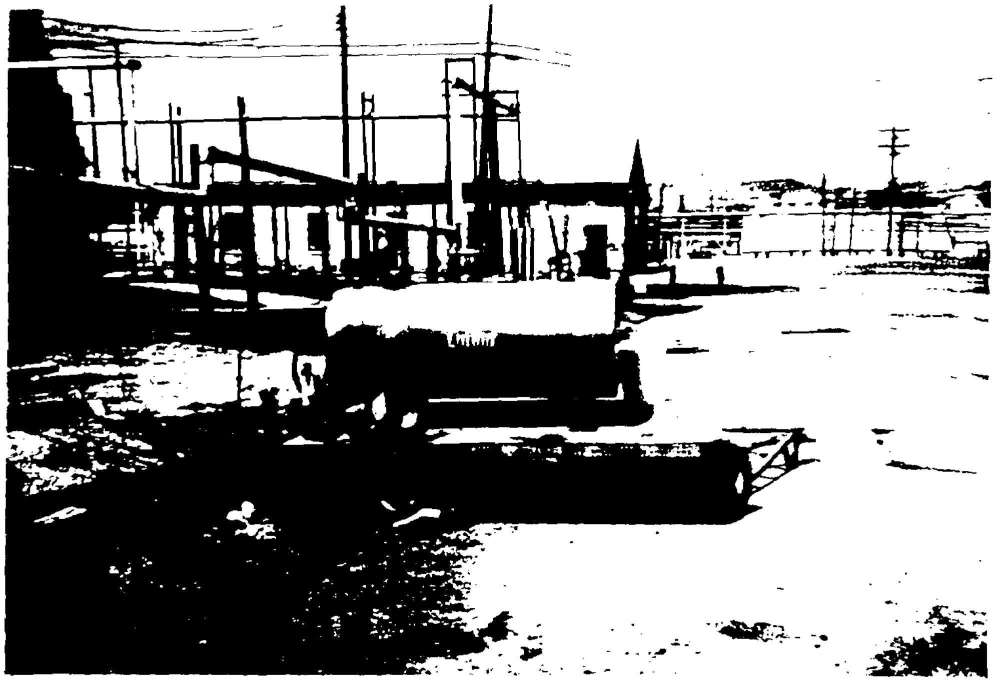


61(ii). Close-up view of stained gravel beneath the Mobile Waste Oil Cart stored at Building 266-2.

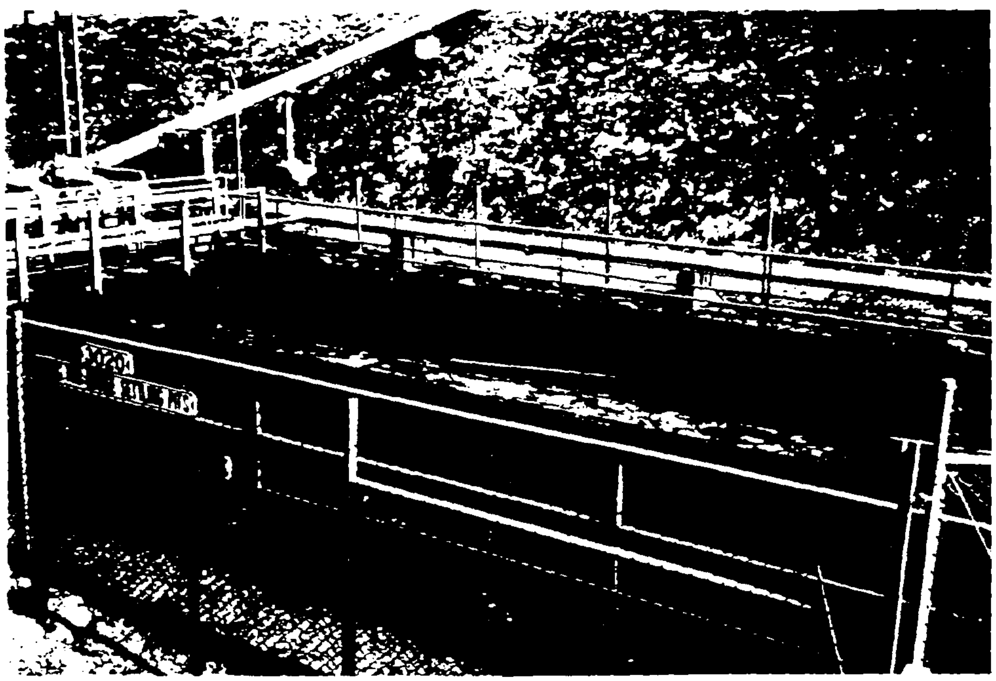
61(iii). View of another Mobile Waste Oil Cart being used at the facility.



61(iv). Mobile Waste Oil Cart in use at the Heavy Equipment Maintenance Shop.

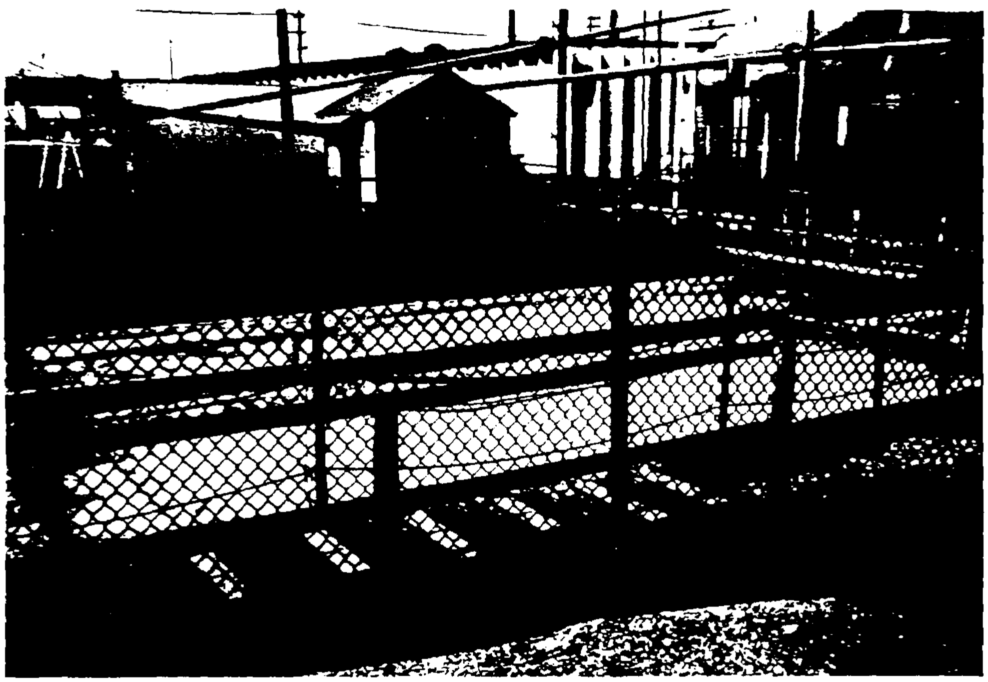


62. Contaminated Flammable Liquid Mobile Cart.

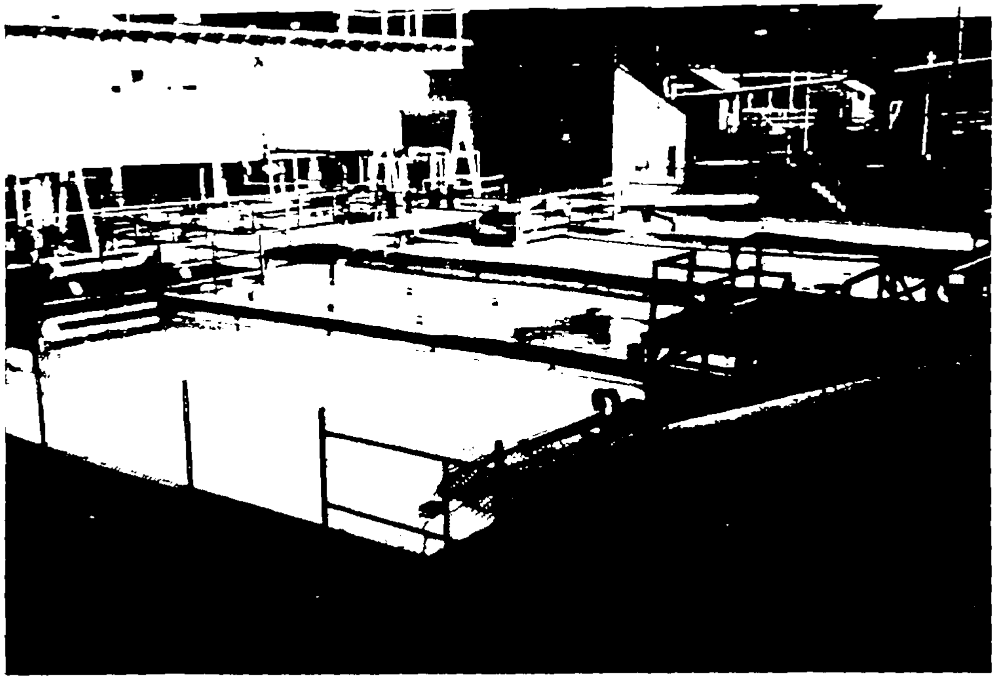


63. Nitrocellulose C-Line Settling Pits.

64. No picture available.

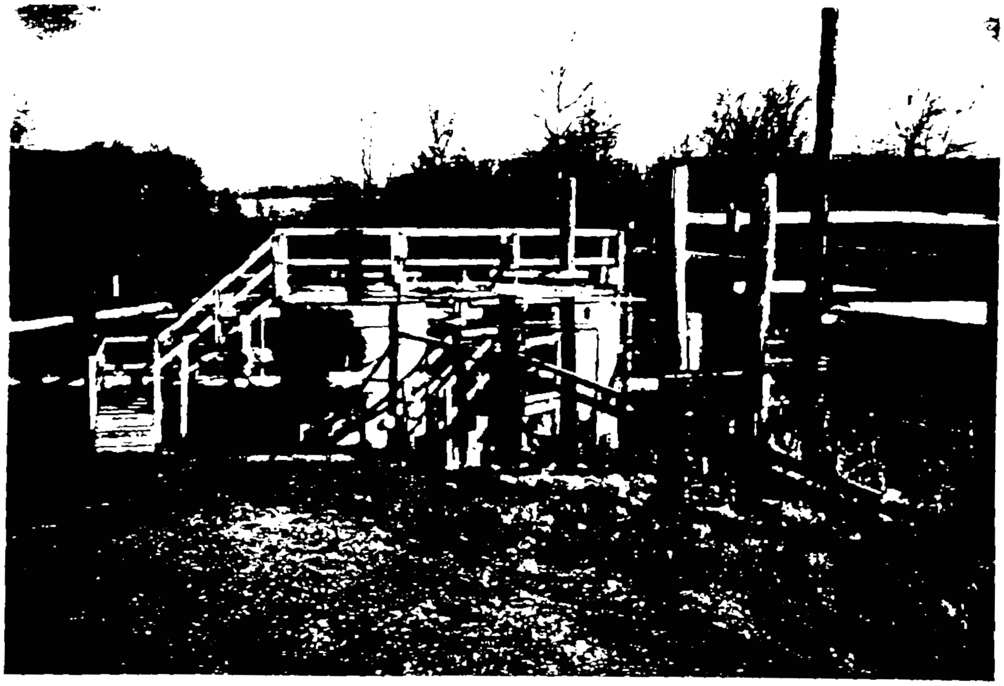


65. Nitrocellulose A-B Line Acidic Settling Pits.



66. Nitrocellulose A-B Line Neutral Settling Pit.

67. View looking down into the Main Acid Sewer Line.



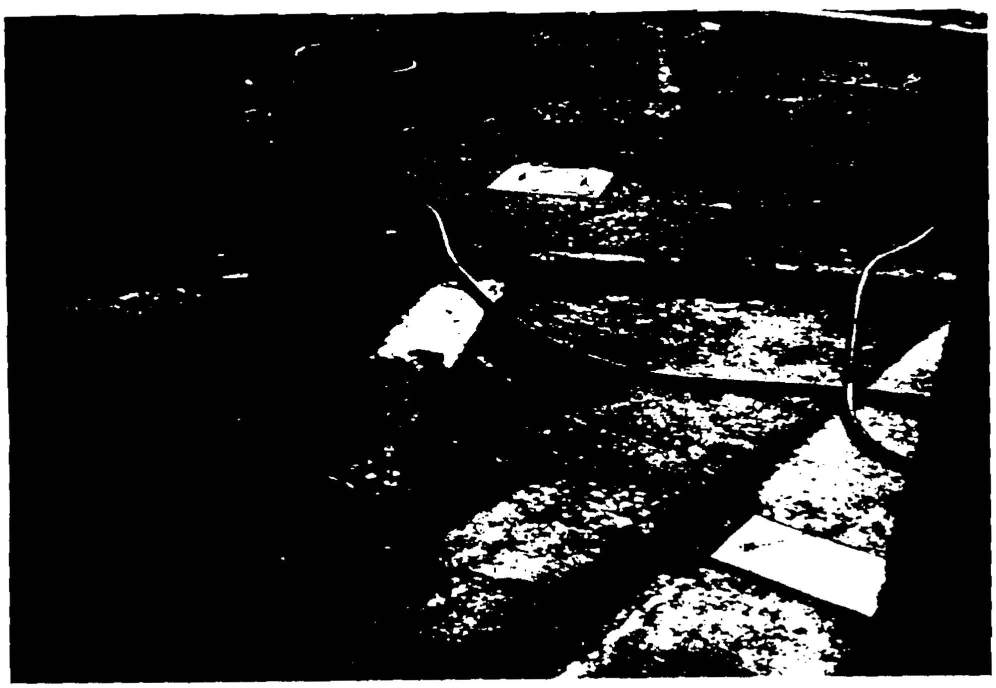
68. View of both Chromic Acid Treatment Tanks (center).

69(i). View of the pond by the Chromic Acid Treatment Plant Tanks. Note the pond located behind the Chromic Acid Treatment Tanks (Unit 68).

69(ii). View of the Pond by Chromic Acid Treatment Plant Tanks. Note the discharge pipe (center) leading from the pond to the grounds outside the unit.

69(iii). View of an eroded surface embankment of the pond by the Chromic Acid Treatment Plant Tanks.

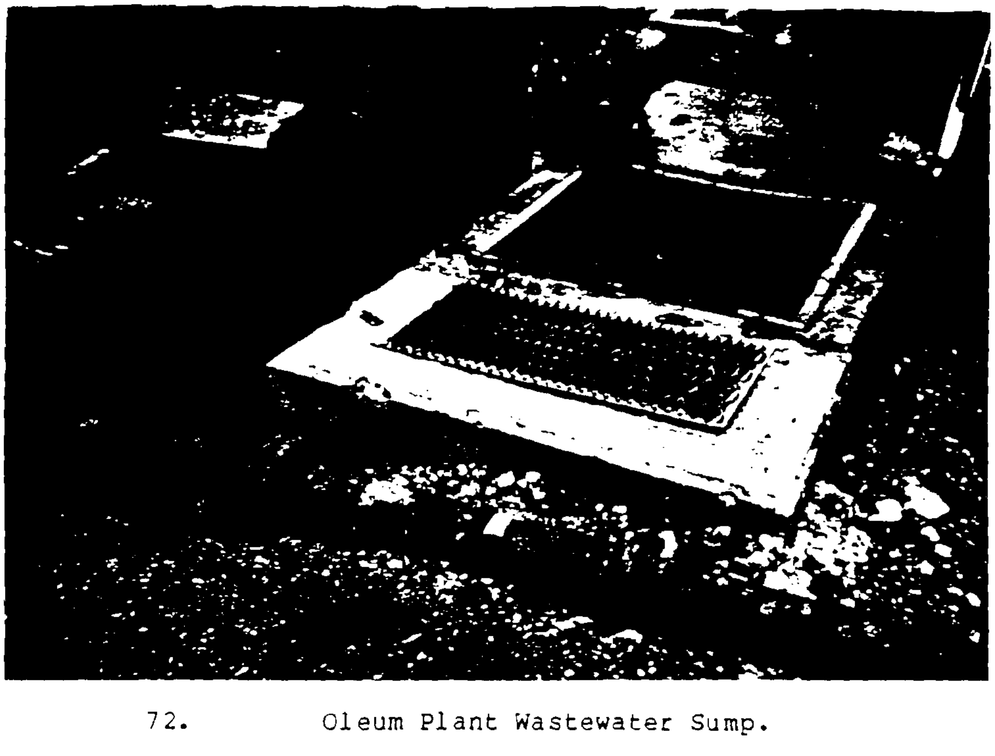
70(i). Heavy Equipment Maintenance Shop Steam Cleaning Area. Note the cracked curbing. Sump in the lower background of the pad discharges to the oil-water seperator.



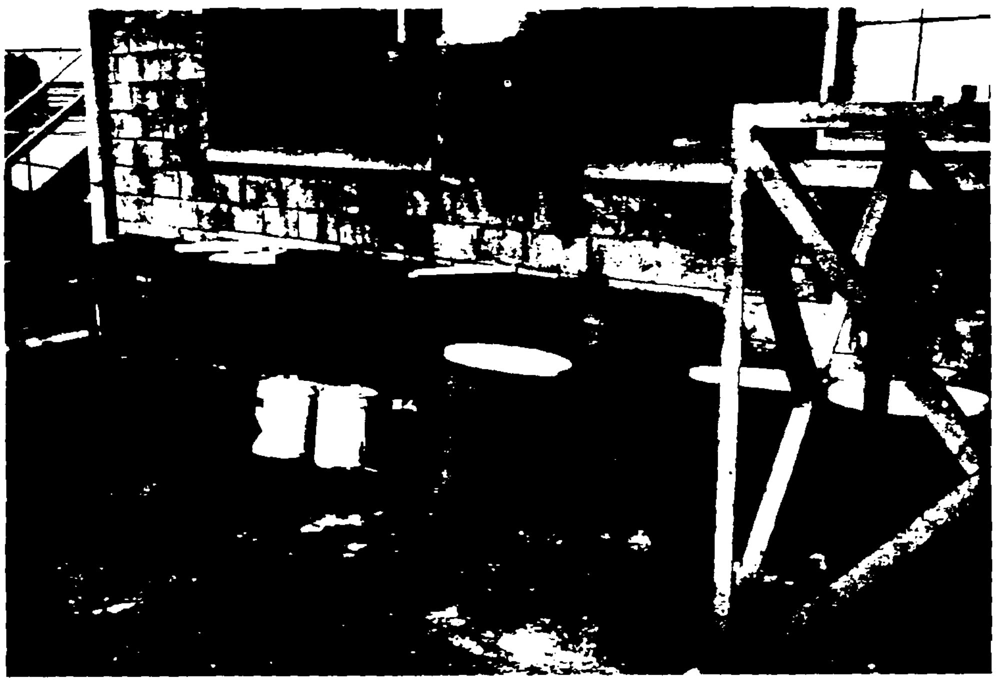
70(ii). Heavy Equipment Maintenance Cleaning Area Sump. Note the oil-water seperator is located in the background. Observe trash pails on the soil and stained areas.

71(i). Overview of process pipes at the Flash Burn Parts Area located adjacent to the Sanitary Landfill (right, Unit 40).

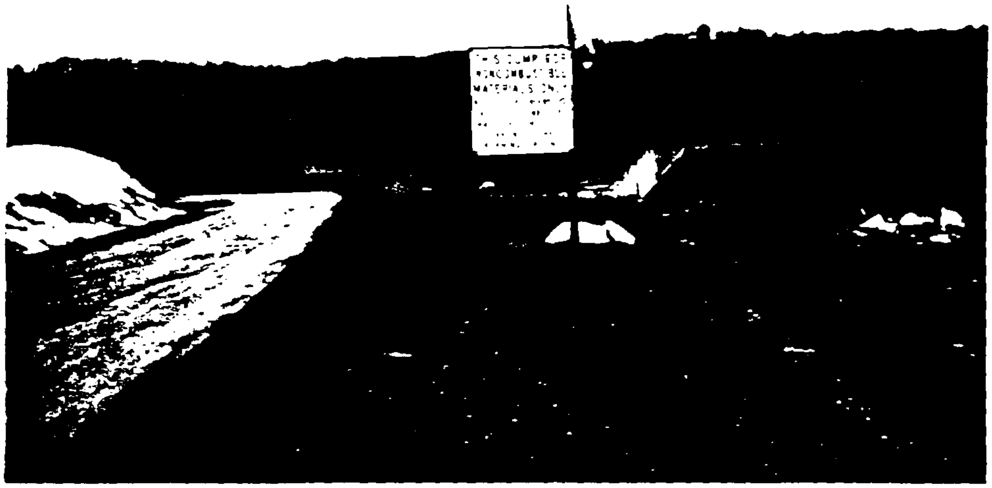
71(ii). Close-up view of discolored soil at the Flash Burn Parts Area.



72. Oleum Plant Wastewater Sump.

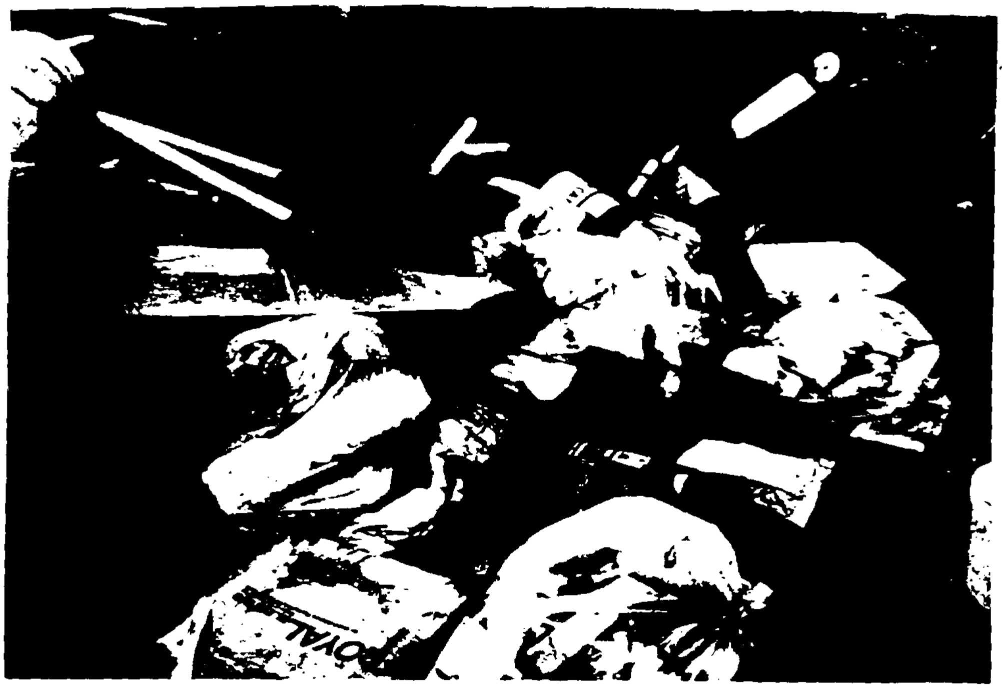


73. Waste Container Storage Area near Main Lab.



74(i). Inert Waste Landfill No. 3, sign indicates area is for noncombustible materials only.

74(ii). Base of inert waste landfill No. 3. Note five gallon chemical or reagent cans and discolored soil.



74(iii). Close-up view of material disposed in inert waste landfill No. 3. Note fluorescent tubes and 5 gallon solvent cans.

75(i). Waste Oil Underground Storage Tank (A-421). Note waste oil on ground surface.

75(ii). Waste oil underground storage tank (A-421). Operator removing hose from inlet. Note oil stains and spillage on ground.

76(i). Waste Oil Underground Storage Tank (foreground) located adjacent to Flash Burn Parts Area (South of Oleum Plant). Note oil stains on gravel.

76(ii). Suspected old Waste Oil Incinerater (center) located adjacent to the Waste Oil Underground Storage Tank.

77(i). View of Garbage Incinerater building located south of the Flash Burn Parts Area.

77(ii). Close-up of door to Garbage Incinerater looking west.

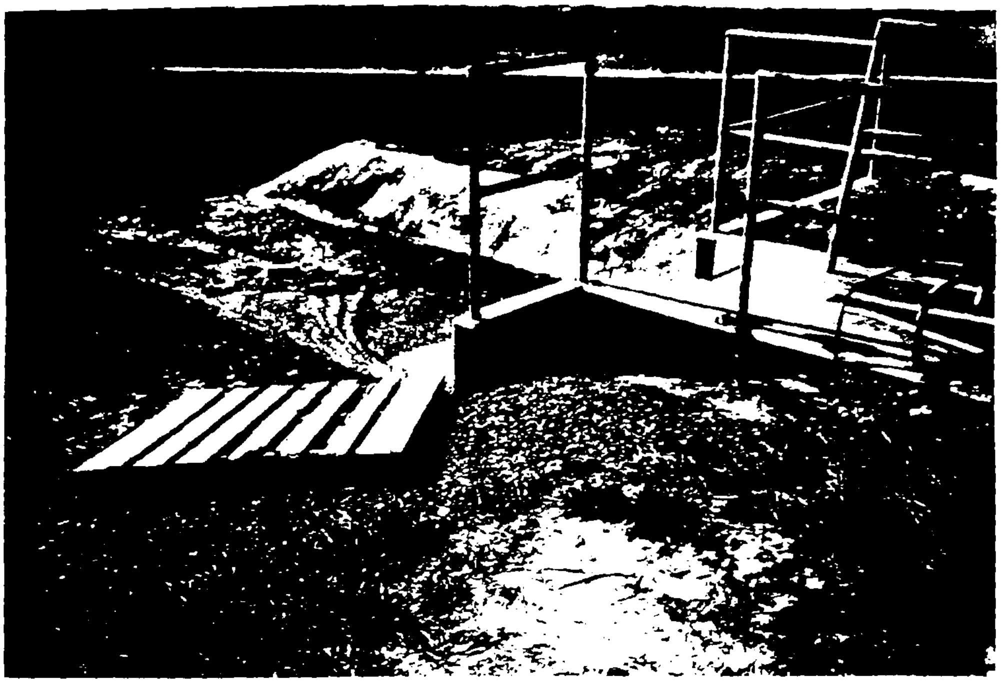
78(i). Concrete Rubble Pile located southwest of Unit No. 51.

78(ii). Concrete Rubble Pile looking northwest.

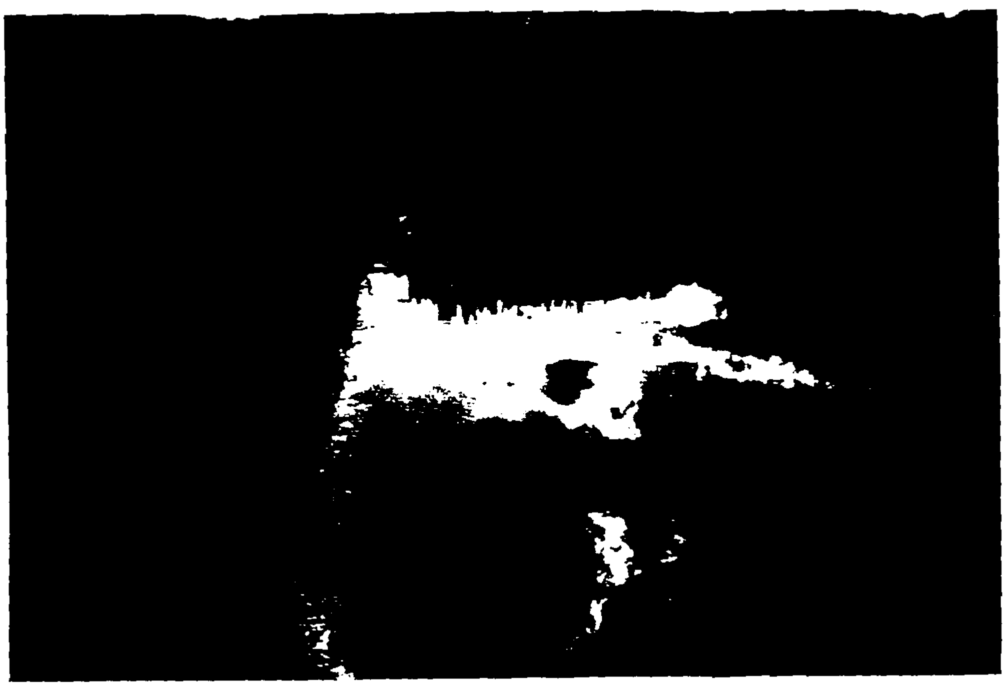
79(i). Close-up of torn asbestos bags in Asbestos Disposal Trench No. 2.

79(ii). Asbestos Disposal Trench No. 2, looking north. Note snow and standing water on left side of trench.

79(iii). Additional Asbestos Disposal Trench, looking south towards the New River.

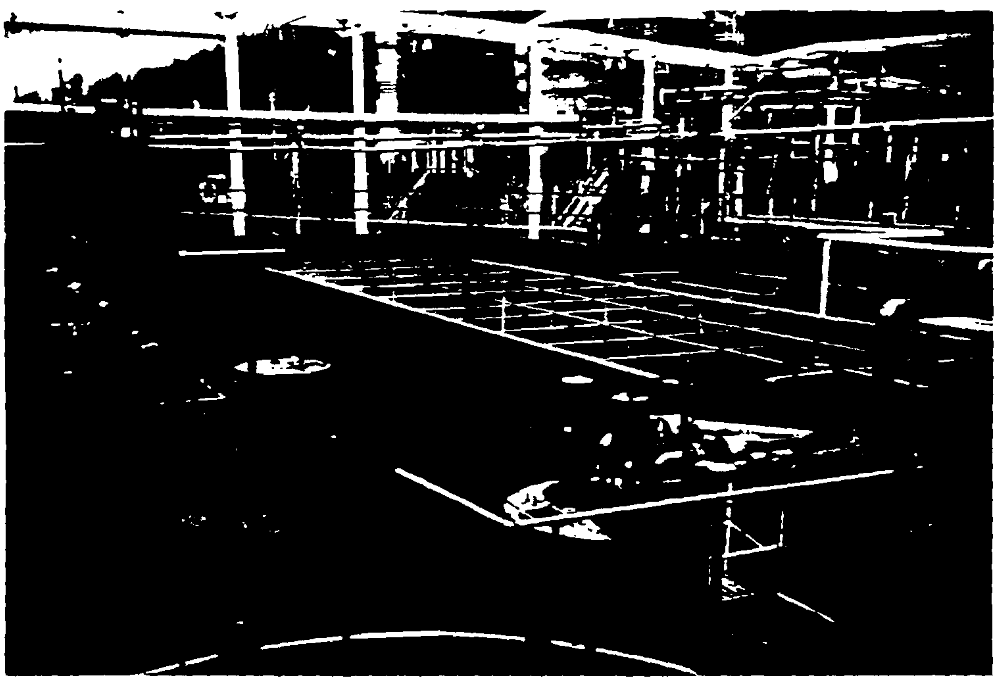


80(i). Parshall Flume and outlet from C-line Wastewater Treatment to "drainage ditch".

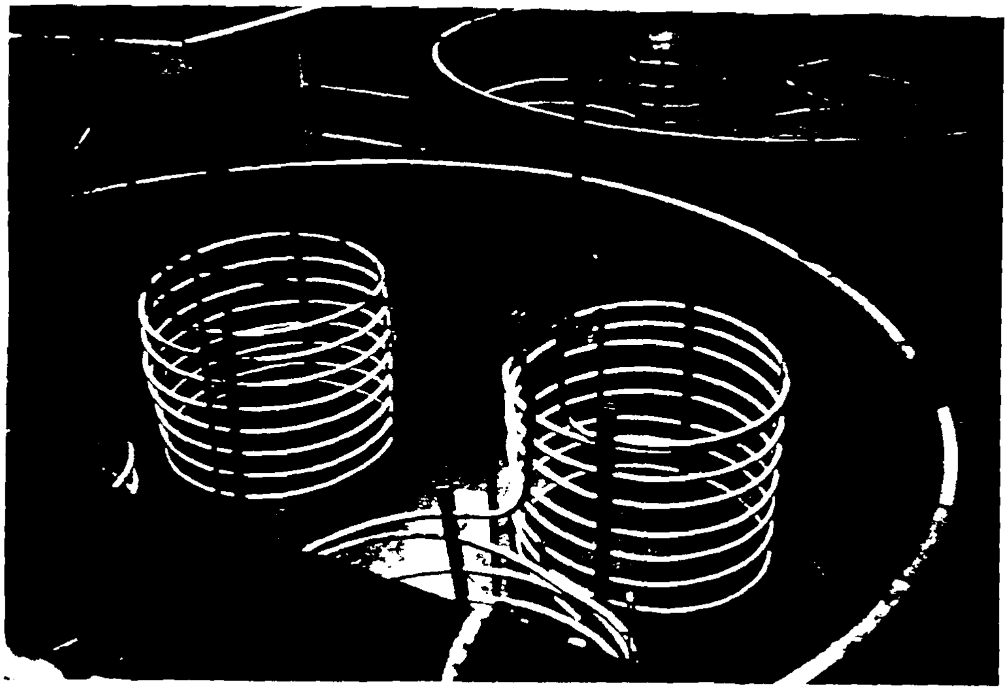


80(ii). "Drainage Ditch" for C-line Wastewater Treatment and Facility runoff water.

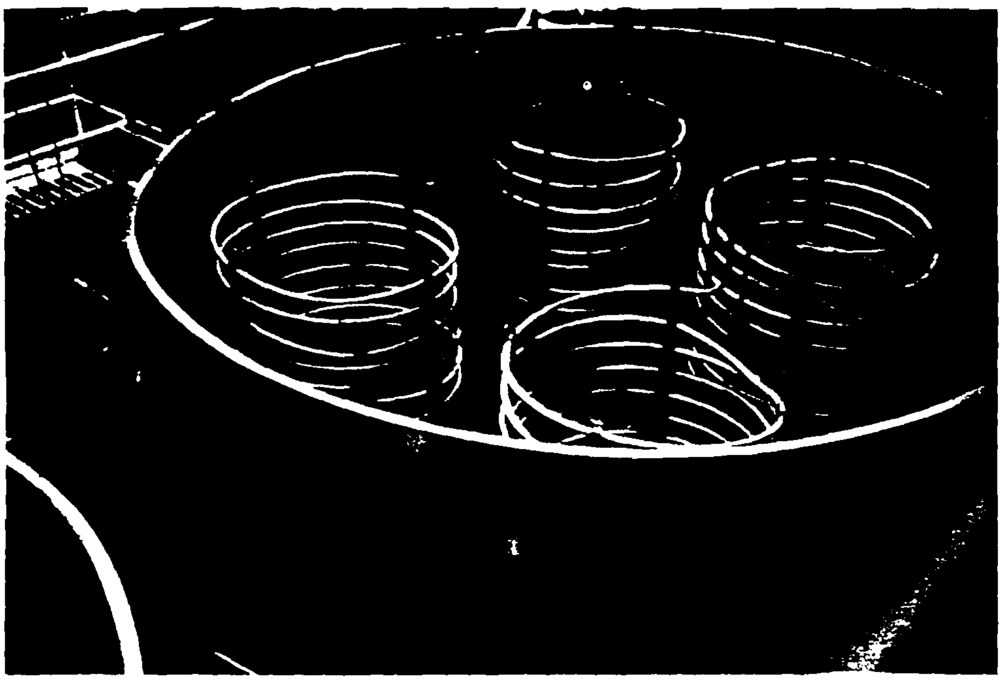
81a. Concrete Basin, refers to photo 81b(i).



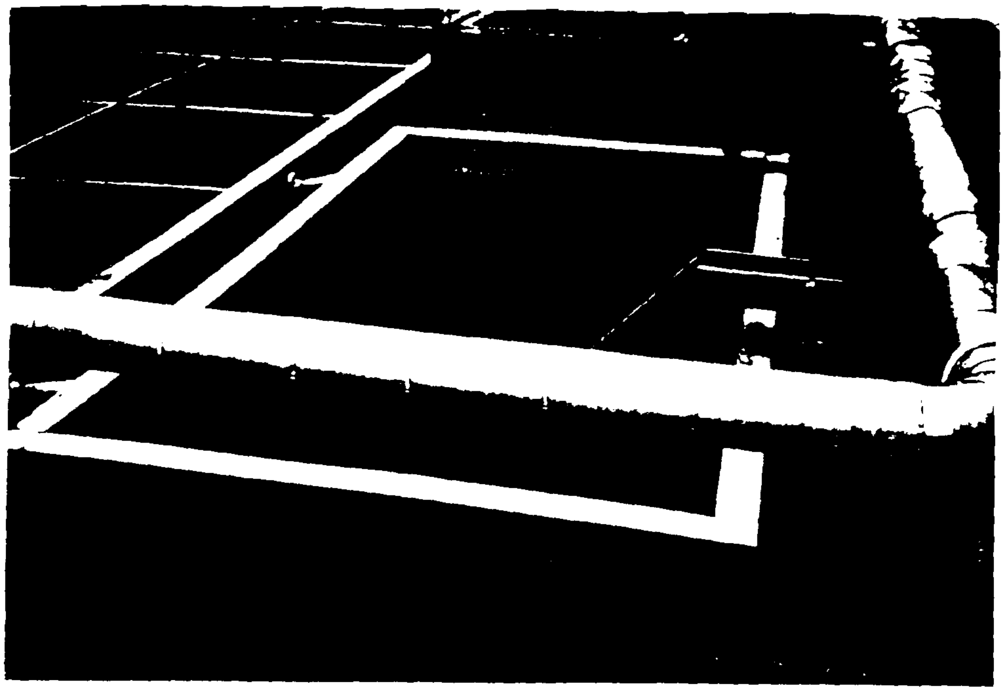
81b(i). Red Water Treatment Plant Stainless Steel Storage Tank (center).



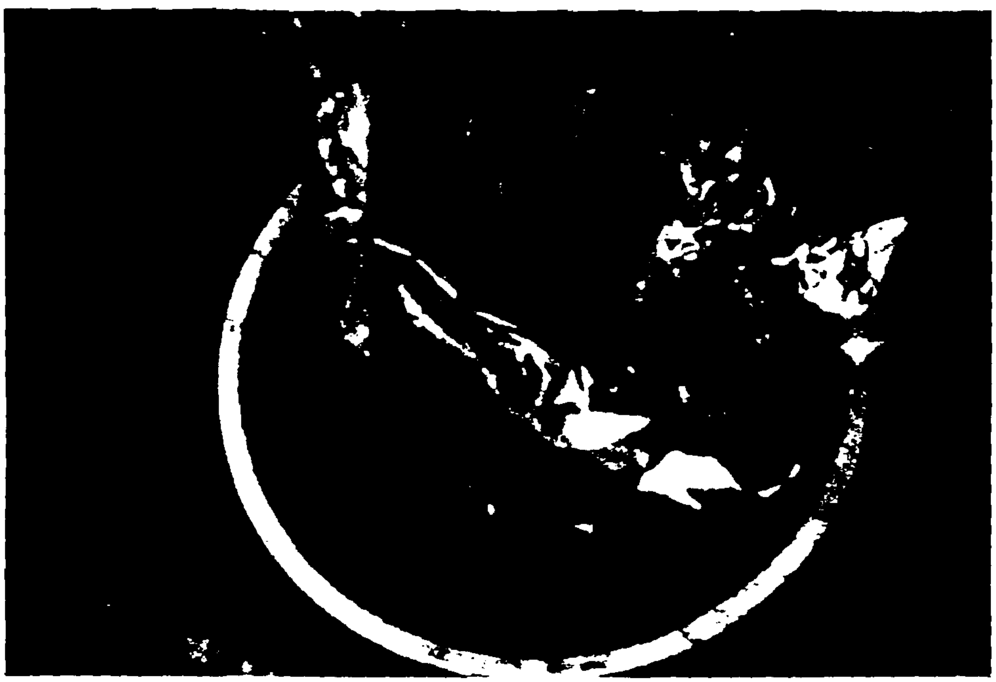
81b(ii). Red Water Treatment Plant 5000 gallon stainless steel tank #T-74 (foreground).



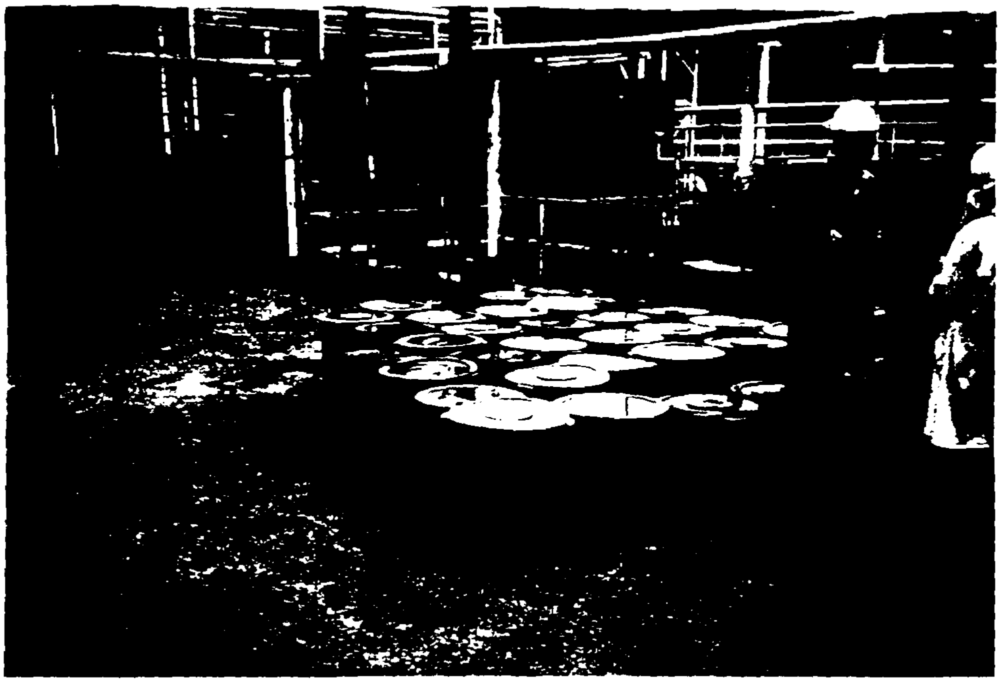
81b(iii). Red Water Treatment Plant 5000 gallon stainless steel tank #T-73.



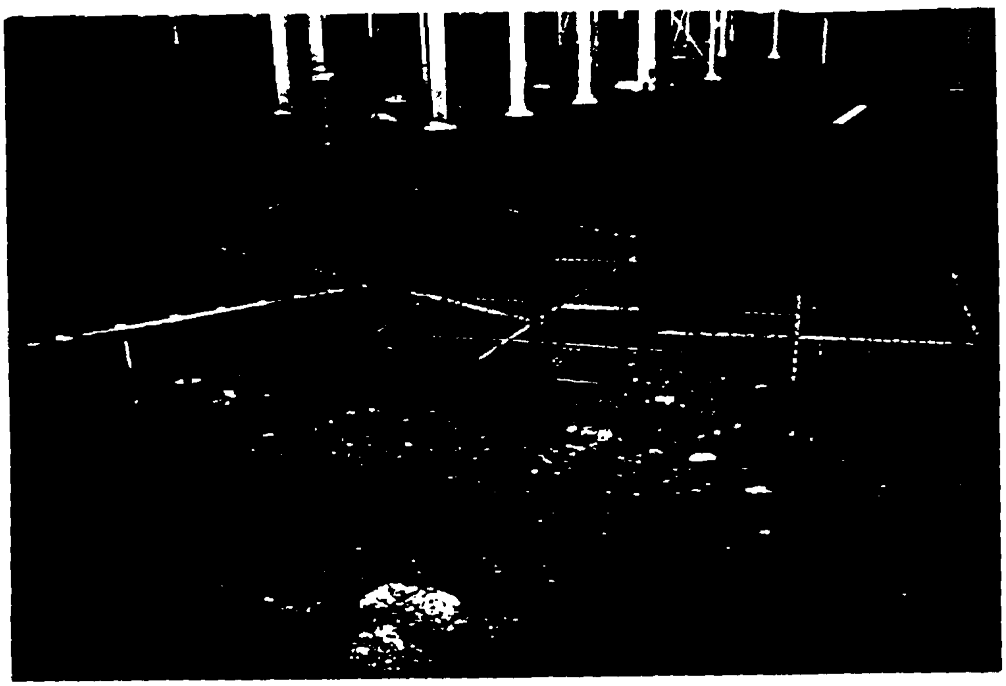
81b(iv). Red Water Treatment Plant Influent Tank #T-71.



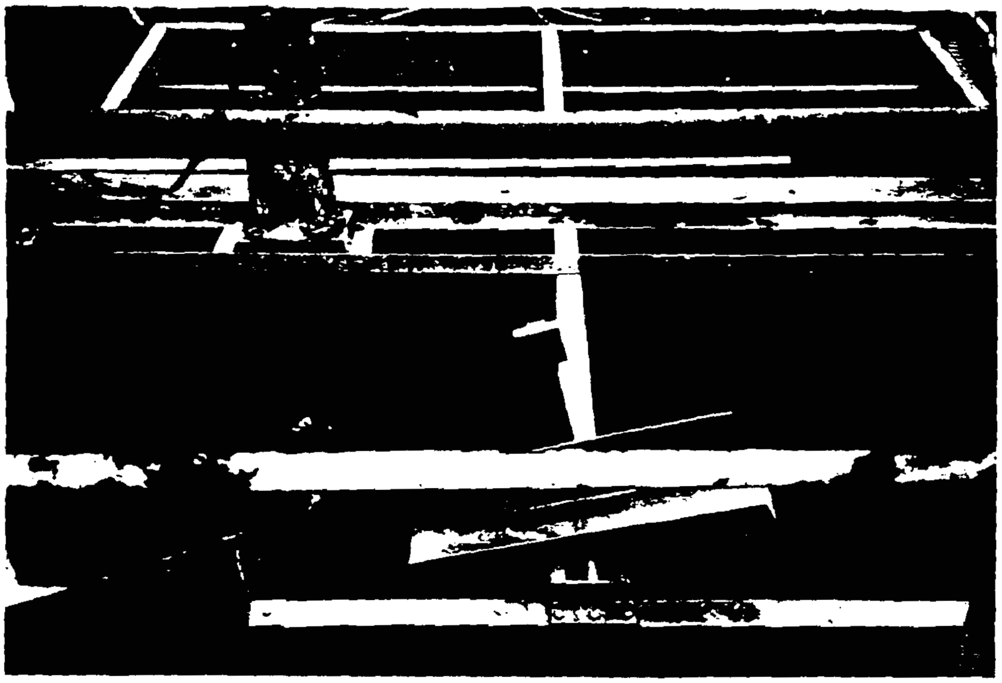
81c(i). Red water mixed with sawdust in 20 gallon plastic containers with lids.



81c(ii). Close-up view of contents of 20 gallon containers. Note plastic liner.



81d. Red Water Treatment Plant Overflow Basin for routing to TNT Wastewater Treatment Plant.



81e. Red Water Treatment Plant stainless steel Soda Ash Mix Tank.

OTHER AREAS OF CONCERN

A. Overview of the Nitrocellulose A-Line Rainwater Ditch. Note soil discoloration and the vegetation in the ditch.

B. Overview of building 1555 which houses the A-line Activated Carbon Recovery Unit.

C. Overview of the Nitrocellulose C-Line Mix House. Note the white substance on the floor and the drain outside the building.

D1. Overview of the Drum Storage Area located adjacent to the Sanitary Landfill. Note green tags on the drums indicating rinsing of containers.

D2. Refer to Photo D1.

D3. Close-up view of the Drum Storage Area located adjacent to the Sanitary Landfill.

D4. Refer to photo D3.

E. Overview of the Drum Storage Area located near Building 266-2.

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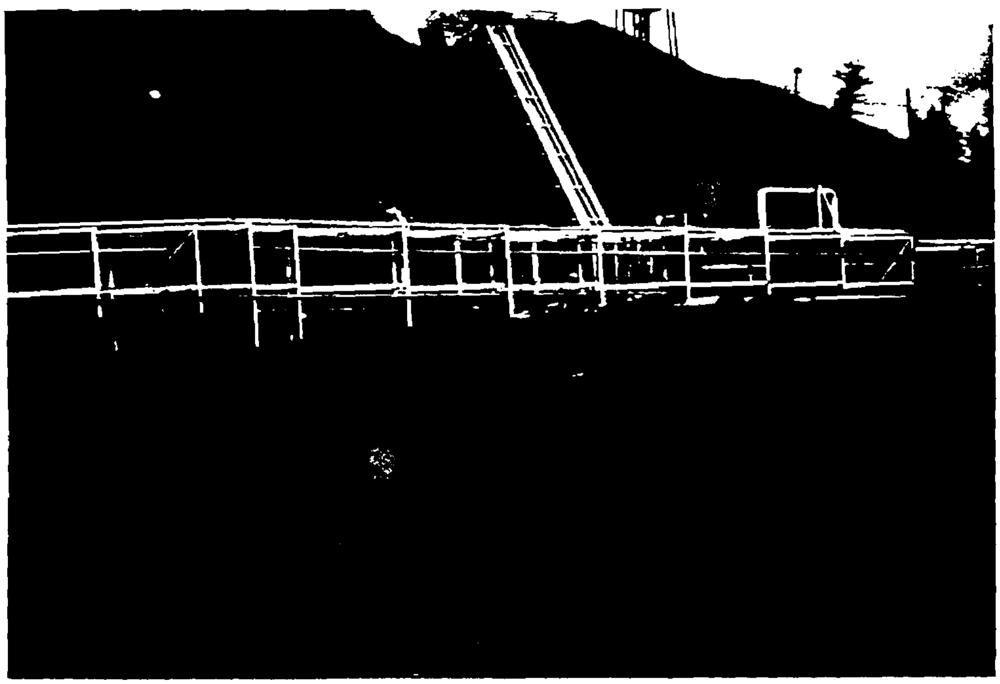
F1. Overview of the Drum Storage Area near Building 9387-2.

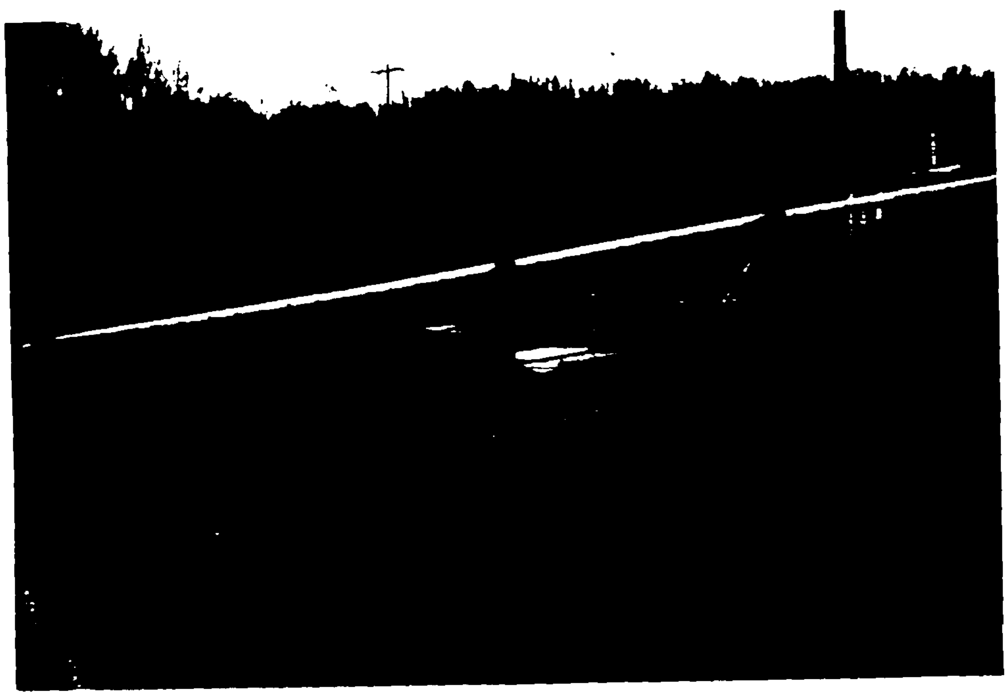
F2. Close-up view of discolored soil beneath drums stored by building 9387-2.

G. Refractory Rubble Pile adjacent to Waste Incinerator.

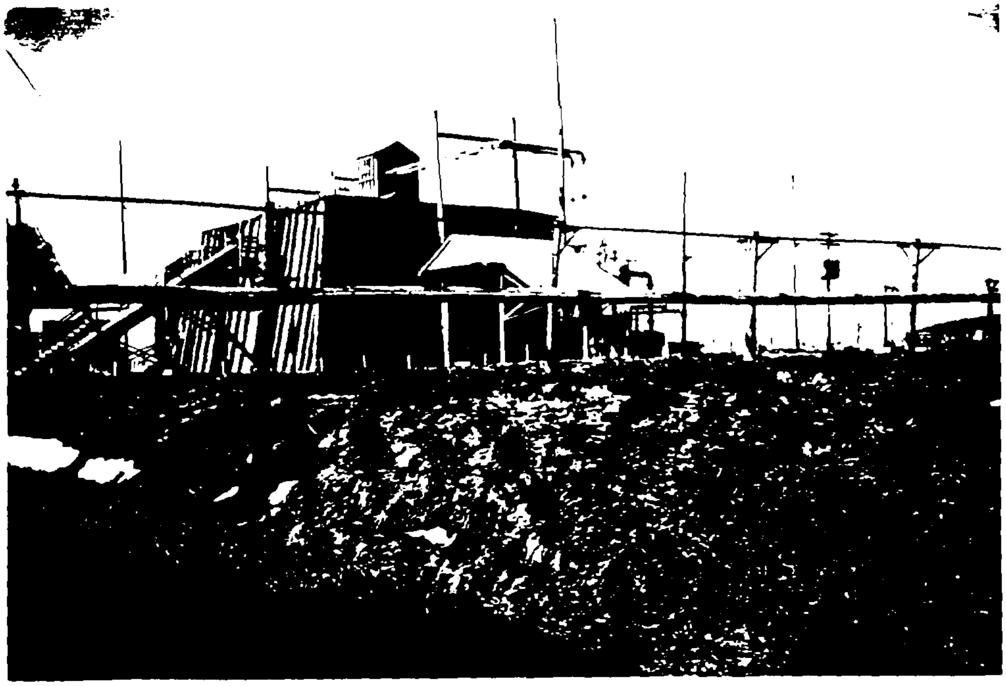


H. Former Site of TNT A-Line (Line blew up in 1974).

I. Former location of Red Water Incineration Kilns.



J. Roll-off Catch Tank near finishing building used as a catch basin.

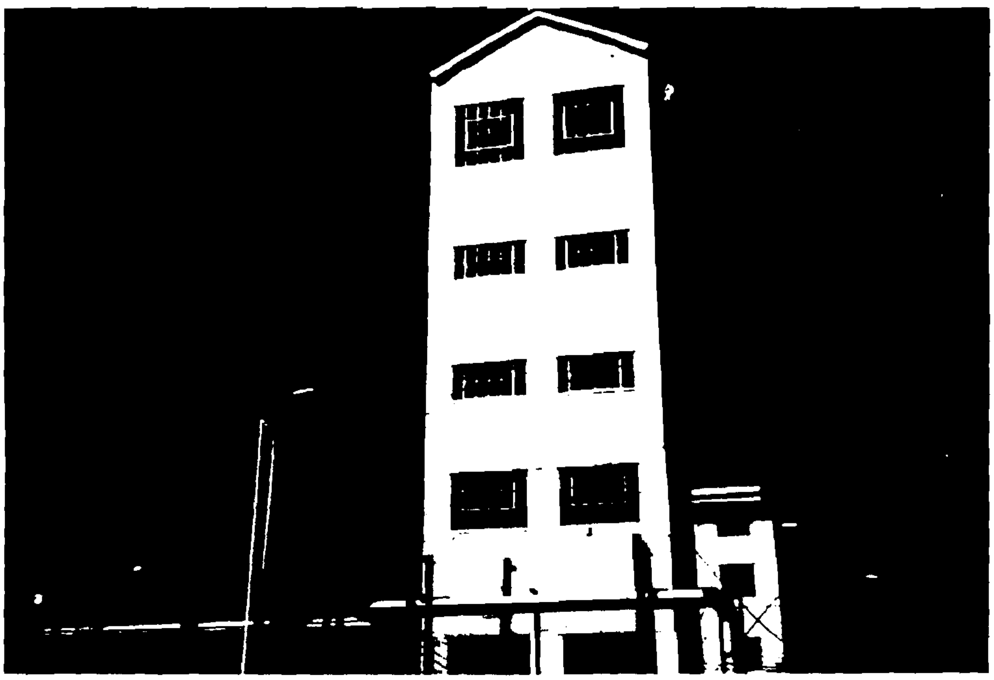


K1. Solvent Recovery Building with propellant/solvent separator on north side (typical).

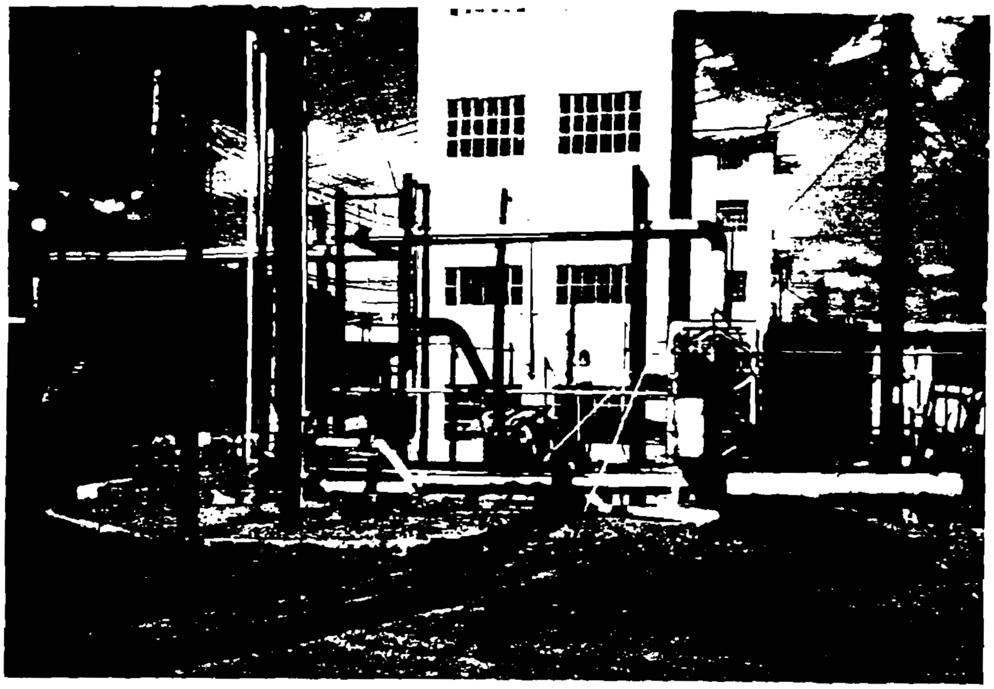
K2. Above ground product tank located adjacent to one of several recovery buildings (typical).

i6

K3. Wastewater catch basin located adjacent to a solvent recovery building (typical).



K4. Solvent Distillation Building, looking north.



K5. Solvent Distillation Building, looking West.

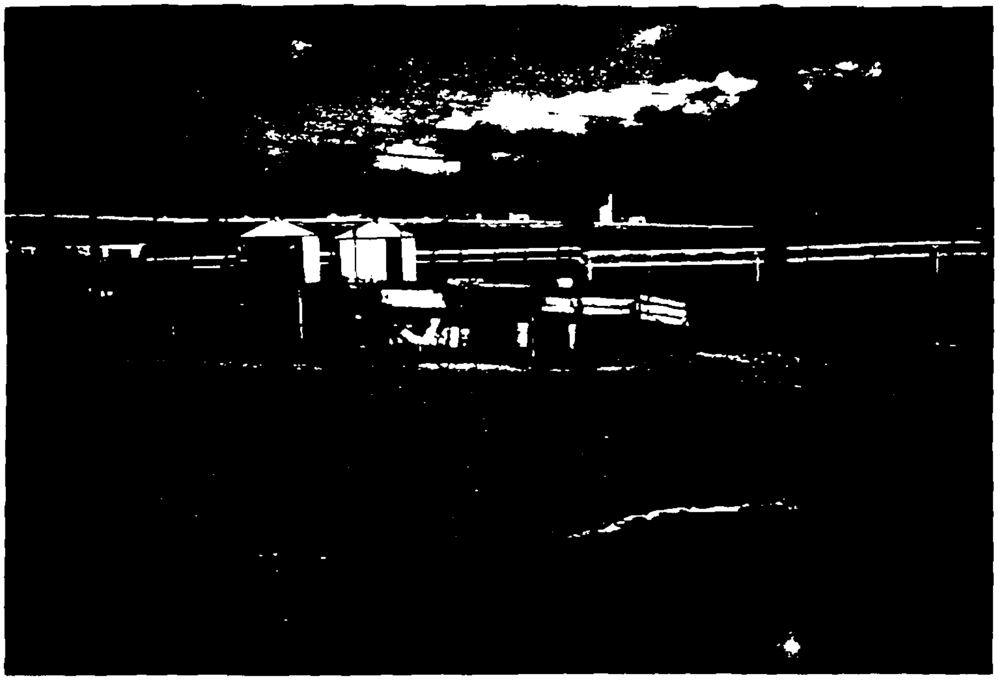
K6. Solvent Tank Farm located adjacent to Solvent Stills.

K7. Ether Still House and Alcohol Rectification Building, located adjacent to Solvent Tanks.

L1. Fuel Oil for Building No. 432 Underground Storage Tank adjacent to incinerator.

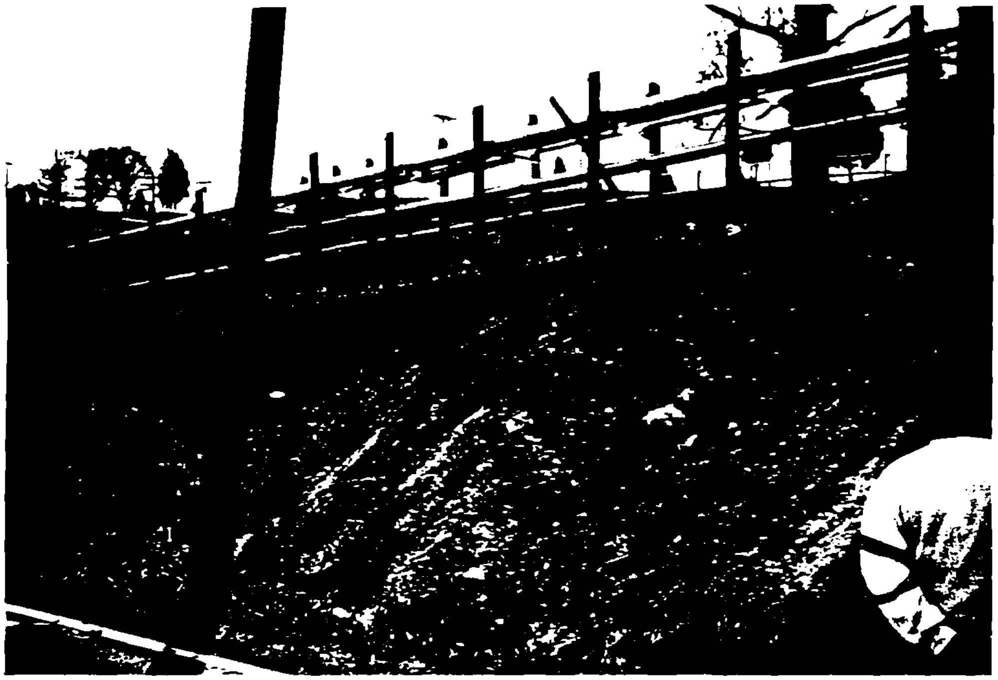
L2. Close-up view of oil stained gravel above underground storage tank.

L3. Kiln Fuel underground Storage Tank.



M. Subcontractors storage area. Note 55 gallon drums and plastic five gallon paint buckets.

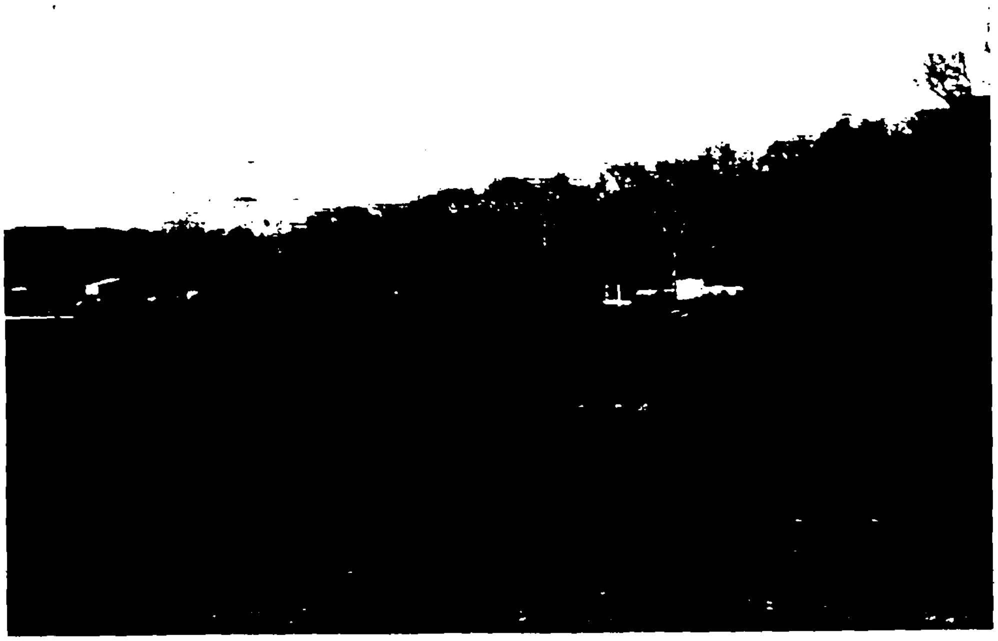
N. Product Storage Area located outside a Compressor House (Bldg. 421). Note spills on ground and concrete.



01. Groundwater monitoring well downgradient of the Underground Fuel Oil Spill.

02. Storm Water Drainage Ditch, near alleged underground fuel oil release. Note oily sheen on surface.

O3. Storm Water Drainage Ditch and culvert adjacent to area of prior underground fuel oil release.



P1. Looking West of the Biological Treatment Plant at the Scrap Metal Salvage Yard.

P2. Close-up view a scrap metal salvage yard.

Q. Abandoned suspected Lagoon adjacent to Calcium Sulfate drying bed Unit 38.

APPENDIX D

WASTE FEED COMPOSITIONS/DATA

ANNEX B-1

SINGLE-BASE PROPELLANTS

Waste Feed: Benite

Commercial Use: Single-base propellant

Physical Form: Solid pellets at > 0°F

Mixture Composition: (% by weight)

Nitrocellulose[1,4]	40 ± 1.0
Potassium Nitrate[1]	44.3 ± 1.0
Sulfur[1]	6.3 ± 0.3
Charcoal[1]	9.4 ± 0.3
Ethyl Centralite[2,4]	0.5 added
Total Volatiles[3]	2.23 max.
Moisture[3]	1.00 max.
Specific Gravity	1.65 gm/cc

Notes:

1 - Percent on ethyl centralite, volatiles, and moisture - free basis
2 - Added to propellant
3 - Byproducts of manufacture; volatiles are diethyl ether and ethyl alcohol; percent based on propellant weight
4 - See Appendix D

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: BS - NACO

Commercial Use: Single-base propellant.

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	93.55 nominal
n - Butyl Stearate[3]	3.0 ± 0.3
Ethyl Centralite	1.2 ± 0.2
Basic Lead Carbonate	1.0 ± 0.2
Potassium Sulfate	1.25 ± 0.3
Graphite[1]	0.1 (added)
Moisture[2]	1.0 to 3.0 (residual)
Total Volatiles[2]	5.0 (residual)
Specific Gravity	0.85 gm/cc

Notes:

1 - Added to propellant
2 - Byproducts of manufacturer; volatiles are diethyl ether and ethyl alcohol
3 - See Appendix D

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: CBI Powder

Commercial Use: Single-base propellent

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	98.0 %(remainder, minimum)
Diphenylamine[1,4]	1.5 $\pm$ 0.2
Potassium Nitrate[2]	0.1 max (added)
Graphite[2]	0.2 max (added)
Total Volatiles[3]	1.3 (residual)
Specific Gravity[3]	32.0 lb/ft^3

Notes:

1 - Based on graphite, potassium nitrate, and total volatiles - free basis
2 - Added to propellant
3 - Byproducts of manufacture; volatiles are diethyl ether and ethyl alcohol
4 - See Appendix D

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: HES 6706.1

Commercial Use: Flash suppressant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	69.0 nominal
Ethyl Centralite[1]	0.8 (minimum)
Potassium Sulfate[1]	30.0 nominal
Graphite[1]	0.03 added
Total Volatiles[2]	0.40 (residual)
Specific Gravity	1.70 g/cc

Notes:

1 - Based on total volatiles - free basis
2 - Byproducts of manufacture; volatiles are diethyl ether and ethyl alcohol

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: IMR 5010

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	Remainder
Diphenylamine	0.50- 1.25
Graphite	0.4 max
Potassium Sulfate	0.1-1.00
Total Volatiles[1]	2.35 max
Residual Solvents[1]	1.10 max
Moisture and Volatiles[1]	1.00 ± .25
Specific Gravity	0.910-1.025 gm/cc

Notes:

1- Total volatiles are sum of moisture and solvents from production process (diethyl ether and ethyl alcohol)

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: M1

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	85.00 ± 2.00
Dinitrotoluene[1]	10.00 ± 2.00
Diphenylamine[2]	0.90 ± 1.20 (added)
Dibutylphthalate[1,4]	5.00 ± 1.00
Potassium Sulfate[2]	1.00 ± .3 (added)
Total Moisture[3]	0.60 ± 0.2
Residual Solvent[3]	0.8 max

Notes:

1 - Based on total volatiles, diphenylamine, and potassium sulfate - free basis
2 - Added to propellant
3 - Byproducts of manufacture; diethyl ether and ethyl alcohol
4 - See Appendix D

Waste Feed: M6

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	87.00 ± 2.00
Dinitrotoluene[1]	10.00 ± 2.00
Dibutylphthalate[1,2]	3.00 ± 1.00
Diphenylamine[3]	0.90 - 1.20
Potassium Sulfate[3]	1.00 ± 0.3
Total Volatiles	
Moisture[4]	0.6 ± 0.2
Volatile Solvents[4]	

<u>Notes</u>:

1 - Based on total volatiles, diphenylamine, and potassium sulfate - free basis
2 - See Appendix D
3 - Added to propellant
4 - Byproducts of manufacture; diethyl ether and ethyl alcohol

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: M10 Flake/All M10 formulations

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	98.00 ± 1.00
Potassium Sulfate[1]	1.00 ± 0.30
Diphenylamine[1]	1.00 ± 0.30
Graphite[2]	0.25 max
Total Volatiles[3]	2.00 max
Moisture[3]	0.50-1.20

Notes:

1 - Total volatiles and graphite - free basis
2 - Added to propellant
3 - Byproducts of manufacture; volatiles include diethyl ether and ethyl alcohol

Waste Feed: M6 + 2

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose[1]	87.00 ± 2.00
Dinitrotoluene[1]	10.00 ± 2.00
Dibutylphthalate[1]	3.00 ± 1.00
Diphenylamine[2]	0.90 - 1.20
Potassium Sulfate[2]	2.00 ± 0.30
Total Volatiles[3]	1.62 Max
Moisture[3]	0.60 ± 0.20

Notes:

1 - Calculated on total volatiles, potassium sulfate and diphenylamine - free basis
2 - Added to propellant
3 - Byproducts of manufacture; volatiles include diethyl ether and ethyl alcohol

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: IMR 4895

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	Remainder
Diphenylamine	0.50 to 1.25
Graphite	0.4 max
Dinitrotoluene	5.0-9.0
Potassium Sulfate	0.10-1.00
Total Volatiles[1]	2.35 max
Moisture and Volatiles	1.00 ± 0.25
Residual Solvents[1]	1.10 max
Specific Gravity	0.905-0.950 gm/cc

Notes:

1 - Total volatiles is sum of moisture and volatile solvents (diethyl ether and ethyl alcohol)

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: IMR 7383

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	Remainder
Diphenylamine	0.50-1.25
Graphite	0.40 max
Dinitrotoluene	9.5-13.5
Dibutylphthalate	2.00-4.00
Potassium Sulfate	0.10-1.00
Total Volatiles	1.90 max
Moisture and Volatiles	0.50 ± 0.20
Residual Solvents	1.10 max
Specific Gravity	0.790-0.875 gm/cc

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: IMR 8097

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	Remainder
Diphenylamine	0.50-1.25
Graphite	0.40 max
Dinitrotoluene	0.0-5.0
Potassium Sulfate	0.10-1.00
Total Volatiles	2.35 max
Moisture and Volatiles	1.00 ± 0.25
Residual Solvents	1.10 max
Specific Gravity	0.870-0.920 gm/cc

Waste Feed: M14 MP

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition (% by weight)

Nitrocellulose[1]	90.00 ± 2.00
Dinitrotoluene[1]	8.00 ± 2.00
Dibutylphthalate[1]	2.00 ± 1.00
Diphenylamine[2]	1.00 ± 0.10
Total Volatiles[3]	1.25 maximum
Moisture[3]	0.60 ± 0.20
Volatile Solvents[3]	0.55, nominal

Notes:

1 - Calculated on total volatiles and diphenylamine - free basis
2 - Added to propellant
3 - Byproducts of manufacture; volatiles include diethyl ether and ethyl alcohol

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: 25 mm Bushmaster

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	Remainder
Diphenylamine	0.5-1.3
Potassium Nitrate	1.0 (min)
Dinitrotoluene	3.1 (nominal)
Graphite	0.4 (max)
Total Volatiles	2.9 max
Moisture	1.1 ± 0.4
Residual Solvent	1.7 max
Specific Gravity	0.99 gm/cc (min)

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: IMR 8208 M[3]

Commercial Use: Single-base propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	100.00
Potassium Sulfate[1]	1.00
Diphenylamine[1]	1.00
Total Volatiles[2]	2.35 max
Moisture[2]	0.75-1.25
Residual Solvent[2]	1.10

Notes:

1 - Added to propellant
2 - Byproducts of manufacture; volatiles include diethyl ether and ethyl alcohol
3 - Data same for IMR 8138 M and IMR 4475

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Waste Feed: DIGL-RP

Commercial Use: Propellant

Physical Form: Solid

Mixture Composition: (% by weight)

Nitrocellulose	62.5 ± 2.00
Diethylene Glycol Dinitrate[1]	36.70 ± 1.50
Ethyl Centralite	0.25 ± 0.05
Akardit II[1]	0.45 ± 0.15
Magnesium Oxide	0.05 max
Graphite	0.05 max

Notes:

1 - See Appendix D

ANNEX B-2

DOUBLE-BASE PROPELLANTS

Parameter	M7 TOW Launch Motor	M7 LAW Unit
Physical Form	Solid	Solid
Chemical Composition:		
Nitrocellulose	54.60, nominal	58.70
Nitroglycerin	35.50, nominal	32.00
Potassium perchlorate	8.05, max	7.80-8.05
Carbon black	1.20, nominal	0.60
Ethyl centralite	0.80, min	0.8-0.9
Total volatiles[1]	0.80	0.8, max
Specific gravity (gm/cc)		1.60-1.70

Notes:

1 - Byproducts of manufacture; volatiles include acetone and ethyl alcohol;
- based on weight of propellant; free basis

Parameter	AHH Casting Powder	ARP Casting Powder	M26
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	5	1
Nitrocellulose	83.0 ± 1.3	75.00 ± 1.20	67.25 ± 1.00
Nitroglycerin[2]	11.4, nominal	17.00 ± 1.00	25.00 ± 1.00
Lead salicylate	2.3, nominal[2]	3.00 ± 0.25	---
Lead 2-ethylhexoate	2.3, nominal[2]	---	---
2-nitrodiphenylamine[2]	1.0 ± 0.15	2.00 ± 0.15	---
Graphite	0.03-0.06[3]	0.04 ± .01[3]	0.30 ± 0.1[3]
Lead beta resorcylate	----	3.00 ± 0.25[2]	---
Carbolac I (carbon black)	----	0.30 ± 0.10[2]	---
Total volatiles	1.50, max[4]	1.75, max[4]	2.00, max[4]
Barium nitrate	----	---	0.75 ± 0.20
Potassium nitrate	----	---	0.70 ± 0.20
Ethyl centralite	----	---	6.00 ± 0.50
Total moisture	----	---	0.70, max
Specific gravity (gm/cc)	0.95	1.638-1.701	

Notes:

1 - Graphite and volatiles - free basis; percent by weight
2 - See Appendix D
3 - Added to propellant
4 - Byproducts of manufacture; percent based on propellant weight; volatiles include acetone and ethyl alcohol
5 - Carbolac, graphite and volatiles - free basis; percent by weight

Parameter	M26 E1	PNJ Casting Powder (TOW)[2]	M9
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	2	1
Nitrocellulose	68.70 ± 1.80	74.84	57.75 ± 1.50
Nitroglycerin	25.00 ± 1.00	16.58	40.00 ± 1.50
Ethyl centralite	6.00 ± 0.50	0.02	0.75 ± 0.10
Graphite	0.30 ± 0.10	0.17	0.40 max[4]
Total volatiles	0.50, max[3]	---	0.50, max[3]
Potassium sulfate	----	0.75 ± 0.10	----
2-nitrodiphenylamine	----	1.95	----
Carbolac I	----	0.17	----
Lead 2,4 dihydroxybenzoate	----	2.93[5]	----
Lead salicylate	----	2.93	----
Potassium nitrate	----	---	1.50 ± 0.50
Density (lb/cu ft)			46.0, min

Notes:

1 - Graphite and volatiles - free basis; percent by weight
2 - All percentages nominal, except potassium sulfate
3 - Byproducts of manufacture; based on propellant weight; volatiles include acetone and ethyl alcohol
4 - Added to propellant
5 - See Appendix D

Trial Burn Test Plan, Waste Propellant Incinerators, Radford AAP

Parameter	M7 Subscriber LAW Unit	M2	M5
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	3	1
Nitrocellulose	58.70	77.45 ± 2.00	81.95 ± 2.00
Nitroglycerin	32.00	19.50 ± 1.00	15.00 ± 1.00
Potassium perchlorate	7.80[4,2]	----	----
Carbon black	0.60	----	----
Ethyl centralite	0.80 - 0.90	0.60 ± 0.15	0.60 ± 0.15
Total volatiles	0.80, max	2.10, max	1.25, max
Barium nitrate	----	1.40 ± 0.25	0.50 - 1.60
Potassium nitrate	----	0.75 ± 0.25	0.25 ± 1.00
Graphite[1]	----	0.30 ± 0.10	0.30 ± 0.10
Total moisture	----	0.70, max	0.70, max
Specific gravity (gm/cc)	1.60 - 1.70	----	0.42, min

Notes:

1 - Volatiles - free basis; percent by weight
2 - Blended with 0.5% by weight magnesium oxide and 0.5% magnesium stearate
3 - Graphite and volatiles - free basis
4 - See Appendix D

Parameter	M 16	JA-2	M-21
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	1	1
Nitrocellulose	55.12	59.50 ± 2.00	53.00
Nitroglycerin	27.68	14.90 ± 1.00	31.00
Diethylene glycol dinitrate	---	24.80 ± 1.50[2]	---
Akardit II	---	0.70 ± 0.20[2]	---
Magnesium oxide	---	0.05, max	---
Graphite	---	0.05, max	---
Dinitrotoluene	10.66	---	---
Ethyl centralite	3.97	---	2.00
Potassium sulfate	1.56	---	---
Carbon black	0.50	---	0.03
Lead stearate	0.50	---	0.50[2]
Triacetin	---	---	11.00[2]
Lead salicylate	---	---	2.50

Notes:

1 - Percent by weight
2 - See Appendix D

Parameter	2680 DQ	ABL 2776 Casting Powder Type II	N-4
Physical Form	Solid	Solid	Solid
Chemical Composition:	1,4	1	1
Nitrocellulose	25.00, nominal	27.56	51.02
Nitroglycerin	12.50 ± 1.00	10.03	34.63
Resorcinal	1.50 ± 0.30[2]	1.68	---
Ammonium perchlorate	50.00 ± 2.00[2]	49.78	---
2-nitrodiphenylamine	1.00 ± 0.20	1.00	2.09
Aluminum	10.00 ± 0.50	9.95	---
Total volatiles	0.5, max[3]	0.5, max	---
Diethylphthalate	---	---	10.90[2]
Potassium sulfate	---	---	0.75
Lead stearate	---	---	0.51[2]
Carbon black	---	---	0.10
Specific gravity, (gm/cc)	---	1.78	---

Notes:

1 - Percent by weight
2 - See Appendix D
3 - Byproducts of manufacture; volatiles include acetone and ethyl alcohol
4 - ABL 2901 DQ/D propellant has same composition

Parameter	N-8	N-12 Standardrd	HEN-12 High Energy
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	1	1
Nitrocellulose	49.55	50.0 ± 1.5	48.8
Nitroglycerin	37.69	38.0 nominal	40.6
Diethylphthalate	6.65	---	---
2-Nitrodiphenylamine	1.98	2.00 ± 0.5	2.0
Wax	0.10	0.15	0.1
Carbon black	0.05	---	---
Lead 2,4 dihydroxybenzoate	1.99	2.0 nominal	2.5[2]
Lead salicylate	1.99	---	---
Di-normal-propyl adipate	---	5.85 nominal	3.5[1]
Cupric salicylate	---	2.0, nominal	2.5[2]

Notes:

1 - Percent by weight
2 - See Appendix D

Parameter	M8	N-5	N-[illegible]
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	1	1
Nitrocellulose	52.15 ± 1.50	48.5-52.0	48.0 ± 1.[illegible]
Nitroglycerin	43.00 ± 1.50	34.9, nominal	44.5
Diethylphthalate	3.00 ± 0.50	10.5, nominal	---
Potassium nitrate	1.25 ± 0.25	---	---
Ethyl centralite	0.60 ± 0.20	---	---
Total volatiles	0.40, max[2]	---	---
Wax	---	0.2, nominal	0.1, [illegible]
2-Nitrodiphenylamine	---	1.5-2.0	2.0 ± [illegible]
Moisture	---	0.60, max	0.50, ma[illegible]
Lead 2-ethylhexoate[3]	---	1.2, nominal	---
Lead salicylate	---	1.2, nominal	---
Di-n-propyl adipate	---	---	0.4, no[illegible]
Lead betaresorcylate, mono-basic	---	---	2.5, no[illegible]
Cupric salicylate	---	---	2.5, no[illegible]

Notes:

1 - Percent by weight; volatiles - free basis
2 - Byproducts of manufacture based on propellant weight; volatiles include acetone a[illegible] ethyl alcohol
3 - See Appendix D

Parameter	NOSIH-AA-2	NOSIH-AA-6	M36
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	1	1,2
Nitrocellulose	51.0 ± 1.5	49.0-50.5	48.0-51.0
Nitroglycerin	38.6	38.8, nominal	40.0
2-Nitrodiphenylamine	2.0 ± 0.5	1.8-2.0	1.5-2.5
Di-n-proply adipate	1.6	2.0, nominal	3.0
Triacetin	2.7	3.25, nominal	---
LC-12-15	4.0	----	---
Wax	0.10	0.1, nominal	0.1
Moisture	0.60, max	0.60, max	0.60, max
Cupric salicylate, monobasic	---	1.50, nominal	---
Lead salicylate	---	3.30, nominal	---
R-303 Type II	---	0.30, nominal	---
Aluminum	---	1.50, nominal	---
Carbon black	---	0.05, nominal	---
LC-12-6	---	----	5.4

Notes:

1 - Percent by weight; nominal unless noted
2 - Moisture-free basis

Parameter	NOSIH-AM-2	N-12	NOSOL-13
Physical Form	Solid	Solid	Solid
Chemical Composition:	1	1,2	1,4
Nitrocellulose	45.0 ± 1.5	50.0 ± 1.5	46.0 ± 1.25
Nitroglycerin/Metriotrinitrate	NG 44.2	NG 38.0	MTN 38.5 ± 1.00[3]
Aluminum	2.5	---	---
Di-n-proply adipate	1.2	5.85	---
2-Nitrodiphenylamine	2.0 ± 0.5	2.0 ± 0.5	---
Cupric salicylate, monobasic	2.5	---	---
Lead betaresorcylate[3]	0.3	---	---
Lead betaresorcylate, monobasic	2.2	---	---
Wax	0.1	0.15	0.1 ± 0.05
Moisture	0.60, max	0.6, max	0.5, max
Cupric salicylate	---	2.0	---
Triethylene glycol dinitrate	---	---	3.0 ± 0.3[3]
Dibutylphthlate	---	---	8.1 ± 0.5
Lead carbonate	---	---	1.0 ± 0.2
Ethyl centralite	---	---	2.0 ± 0.3
Potassium sulfate	---	---	1.3 ± 0.2

Notes:

1 - Percent by weight; nominal unless noted
2 - Moisture - free basis
3 - See Appendix D
4 - Volatile - free basis

Parameter	Roland II Booster	HDDR-A
Physical Form	Solid	Solid
<u>Chemical Composition</u>	1	1
Nitrocellulose	54.65	30.0
Nitroglycerin	33.50	10.0
2-Nitrodiphenylamine	1.35-1.96	1.0
Diethylphthalate	5.88	---
Copper chromite	0.98	---
Potassium cryolite	0.58[2]	---
Lead stearate, dibasic	2.45	---
Total volatiles	0.8, max	---
Acetylene black	1.00 ± 0.5	---
HMX	---	15.0[2]
Ammonium perchlorate	---	15.0
Aluminum	---	27.5
Resorcinal	---	1.7[2]

<u>Notes</u>:

1 - Percent by weight; nominal unless noted
2 - See Appendix D

ANNEX B-3

TRIPLE-BASE PROPELLANTS

Parameters	M30[1]	M30A1[1]	M30A2[1]
Physical Form	Solid	Solid	Solid
Chemical Composition:	1,2	1,2	1,2
Nitrocellulose	28.00 ± 1.30	28.00 ± 1.30	27.00 ± 1.30
Nitroglycerin	22.50 ± 1.00	22.50 ± 1.00	22.50 ± 1.00
Nitroguanidine	47.70 ± 1.00[3]	47.00 ± 1.00	46.25 ± 1.00
Ethyl centralite	1.50 ± 0.10	1.50 ± 0.10	1.50 ± 0.10
Cryolite	0.30 ± 0.10[3]	----	----
Graphite	0.2, max	0.15, max	0.15, max
Total volatiles	0.50, max[4]	0.50, max[4]	0.5, max[4]
Potassium sulfate	----	1.00 ± 0.30	----
Potassium nitrate	----	----	2.75 ± 0.25
Specific gravity	63.0 lb/ft^3	----	----

Notes:

1 - Percent by weight; nominal unless noted
2 - Graphite and volatiles - free basis; volatiles include pentane and methylene chloride
3 - See Appendix D
4 - Volatiles include methylene chloride and pentane

Parameters	M31A1
Physical Form	Solid
Chemical Composition:	1
Nitrocellulose	20.00 ± 1.30
Nitroglycerin	19.00 ± 1.00
Nitroguanidine	54.00 ± 1.00
Dibutylphthalate	4.50 ± 0.30
2-Nitrodiphenylamine	1.50 ± 0.30
Potassium sulfate	1.00 ± 0.30
Graphite	0.15, max
Total volatiles	0.30, max[2]

Notes:

1 - Percent by weight on graphite and volatile - free basis
2 - Volatiles include methylene chloride and pentane