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ENVIRONMENTAL SURVEY AND ASSESSMENT OF GATEWAY ARMY AMMUNITION PLANT

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ABSTRACT

An environmental survey and assessment of Gateway Army Ammunition Plant (GAAP) showed that the installation will require decontamination prior to release. Leaking PCB transformers and leaking, potentially PCB-contaminated hydraulic metal-forming equipment, in the process of being removed from GAAP prior to release of the property, have contaminated the sumps, process sewers, and basements of the Main Manufacturing Building. This material must be prevented from entering the River Des Peres storm channel or the solid waste system of St. Louis, Missouri.

Other contaminants of GAAP which must be removed prior to release include spilled oil; peeling paint with excessive lead content; friable asbestos insulation; oil and sludge which are likely to be toxic under the definition of the Resources Conservation and Recovery Act of 1976; and a biologigal health hazard, which can cause histoplasmosis.

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SUMMARY

This report presents the findings of an environmental survey and assessment of Gateway Army Ammunition Plant (GAAP). GAAP was operated as a steel foundry during World War II and the Korean Conflict and as a projectile manufacturing works from 1967 to 1970. GAAP has been recommended for excess based on U.S. Army requirements. The objective of the survey was to determine if the installation contained evidence of contamination by toxic or hazardous materials as a result of past operations or current activities.

The survey included a thorough building inspection, inventory, and records search. Sampling and analysis included air, peeling paint, and insulation from each of the buildings comprising GAAP, as well as leaking transformer oil; and sludge, water, and oil present in the underlying sumps, basements, and process waste system of the Main Manufacturing Building. Seventy-seven samples were analyzed.

The survey showed that GAAP will require decontamination before release as a result of PCB contamination; oil contamination; the presence of peeling paint with excessive lead content; friable asbestos insulation; oil and sludge which are likely to be toxic under the definition of the Resource Conservation and Recovery Act of 1976; and the presence of a biological health hazard, which can cause histoplasmosis.

Spills and leaks of hydraulic fluid and oil from hydraulic metal-forming equipment located in the Main Manufacturing Building have resulted in collection of these materials in the underlying basements, sumps, and the process sewers. Several leaking PCB transformers were located in

the Main Manufacturing Building. The leaked and spilled materials should be prevented from entering the River Des Peres storm channel or the solid waste collection system of the City of St. Louis, Missouri. PCB contamination also exists in the bermed Former Oil Tank Farm; however, the potential for movement of PCB from this area is low.

It is recommended that corrective action be taken to eliminate the hazards posed by the leaked hydraulic oil and transformer fluid. Other contaminants should also be disposed properly prior to release.

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1.0 INTRODUCTION

The Gateway Army Ammunition Plant (GAAP), located in St. Louis, Missouri, was built as a steel foundry in 1942 by Scullin Steel Company under Government financing for the purposes of producing armor casting for the Maritime Commission. Materiel for the war effort was produced on site from late 1943 to 1945. After World War II, the plant was placed in the National Reserve until December 1950, when it was reactivated, designated as the St. Louis Army Steel Foundry, and given the mission to produce armor for medium tanks. The armor production continued from 1950 to 1954 when the installation was again inactivated. The total period of foundry production was approximately 6 years.

In 1967, the installation was reactivated, and the Main Manufacturing Building was extensively modified to produce 175-millimeter (mm), M106, and 8-inch (in) projectiles. At that time the installation was renamed Gateway Army Ammunition Plant. Chrysler Corporation operated GAAP as a government-owned, contractor-operated facility and produced 175-mm projectiles from 1968 through 1970. Subsequent to this period, the facility was again inactivated and laid away in long-term storage, but at a high state of readiness. Metal working operations at GAAP have therefore only been active for a total of 9 years during the existance of the installation.

After the plant was made inactive and laid away by Chrysler Corporation in 1970, Voss Machinery Company, of Pittsburgh, Pennsylvania, became the maintenance and surveillance contractor. Vulcan Manufacturing Company currently leases two buildings at GAAP for light-metal machining work and for storage and sale of construction supplies and hardware.

U.S. Army Armament Materiel Readiness Command (ARRCOM) has recommended that GAAP be released as excess property. Currently, salvageable and removable equipment is being packed and prepared for removal by Voss Machinery Company for eventual release of installation property by the Government.

During 1979, the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) conducted an installation assessment (IIA). The conclusion of the assessment (Report No. 152, December 1979) was that no evidence of contamination of the installation by toxic or hazardous materials or contaminant migration potential existed as a result of past operations. A further conclusion was that a final investigation be performed prior to release of the property to provide a current clearance.

1.1 PURPOSE OF ENVIRONMENTAL SURVEY

1.1.1 Objective

The objective of the environmental survey of GAAP was to determine whether the installation contained any contaminants which constitute a hazard to human health as a result of exposure in future use or which would cause significant environmental degradation during either plant renovation or waste disposal. A second objective was to provide recommendations of alternative methods for proper management and disposal of hazards for identified contaminated areas. These objectives support the USATHAMA (1979) recommendation for final assessment and clearance.

During February and March 1982, ESE conducted the environmental survey which consisted of the components described in the statement of work outlined in Section 1.1.2. The results of sampling and analysis, review of plant records, and facility inspection are presented in this report along with an assessment of the contamination status of each GAAP building and the grounds. Alternatives assessment and recommendations for proper management and disposal have been presented for the identified contaminated areas.

1.1.2 Statement of Work

The scope of the environmental survey included:

1. Examination and review of the Initial Installation Assessment (IIA) (USATHAMA 1979) and the installation records;

2. A detailed inspection of all installation buildings, grounds, and underlying areas (sumps, the industrial sewer system, basements, and the chip conveyer system);
3. Documentation of the location and evidence of leakage of any transformers and oil-cooled electrical equipment; location of peeling paint and insulation which was in poor repair; location of all areas in the Main Manufacturing Building where liquid sludge was present; and the location and evidence of leakage or spills at present and past storage areas of petroleum, oil, or lubricants (POL), solvents, and other industrial chemicals; and
4. Sampling and analysis of the air within the buildings, paint chipped from areas of peeling paint, insulation, water and sludge from sumps and sewers, spilled oil, oil from leaking transformers, and spilled material from the Former Oil Tanks Farm.

Seventy-seven samples were collected and analyzed for the presence of contaminants. A detailed matrix of the samples collected and analyzed is presented in Section 2.0. Contaminants chemically or physically quantitated included heavy metals (cadmium, chromium, lead, mercury, and zinc) asbestos, polychlorinated biphenyls (PCBs) (PCB-1016 and PCB-1260), and total trichlorobenzenes (TCB). These data were entered into the USATHAMA computerized data management system.

This report presents a description of the technical approach used in sampling and analysis in Section 2.0, and a summary of the results of the inspection and chemical analysis, and comparison of the results to relevant environmental and regulatory criteria in Section 3.0. An assessment of each building and installation area is presented in Section 4.0. Significant findings and conclusions are summarized in Section 5.0. Recommended alternatives and actions are presented in Section 6.0. A copy of the complete chemical data base and sampling location coordinates is presented in the appendices.

1.2 LOCATION AND ENVIRONMENTAL SETTING

GAAP is located in the southern section of St. Louis, Missouri, along Southwest Avenue, east of the intersection of Southwest Avenue and Ecoff Avenue near Scullin Steel Corporation. The installation covers approximately 6 hectares and is divided into two parcels by the River Des Peres, which is a man-made stormwater channel right-of-way. The general location of GAAP is shown in Figure 1-1.

The environmental setting of GAAP has been described in the IIA (USATHAMA 1979) and may be summarized as being located in an urbanized industrial area. GAAP is comprised entirely of man-made structures, buildings, roadways, or parking lots. Surface runoff and the industrial process sewers are routed to the River Des Peres.

Figure 1-2 is an installation map for GAAP which shows the location of the installation in the Universal Transverse Mercator System (UTM) and identifies each of the buildings included in the survey. These buildings are identified by number on the map. Only Building 17, the Guardhouse, was not included in the environmental survey. In Table 1-1, the identification key for each building included in the survey is supplemented by a brief summary of past and current activities. As shown in Figure 1-2, the Main Manufacturing Building is the principal feature of GAAP and encompasses the majority of the 5-hectare southern part of the installation. This building was the foundry prior to rennovation and later housed the projectile production facility. The Main Manufacturing Building covers approximately 3.1 hectares.

1.3 SUMMARY OF PAST OPERATIONS AND CURRENT ACTIVITY

1.3.1 Past Operations

The IIA performed by USATHAMA described the history of industrial operations at GAAP, which included 6 years as a steel foundry and 3 years as a heavy machining works to turn steel billets to projectiles. Details of the industrial process wastes generated and waste disposal operations are presented in USATHAMA (1979). Laboratory operations, pest control,

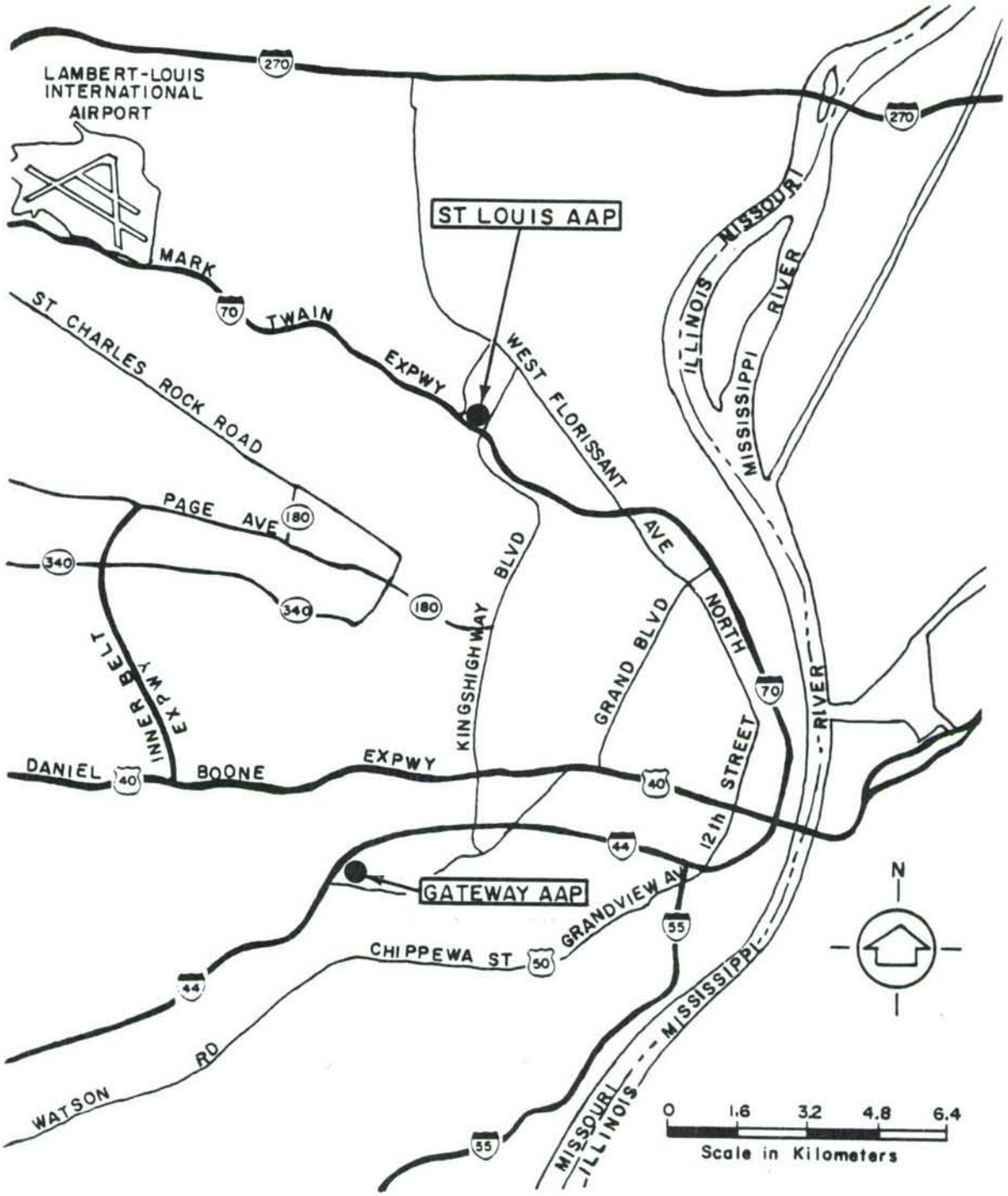


Figure 1-1
LOCATION MAP, GATEWAY ARMY AMMUNITION PLANT

SOURCE: MODIFIED FROM USATHAMA, 1979.

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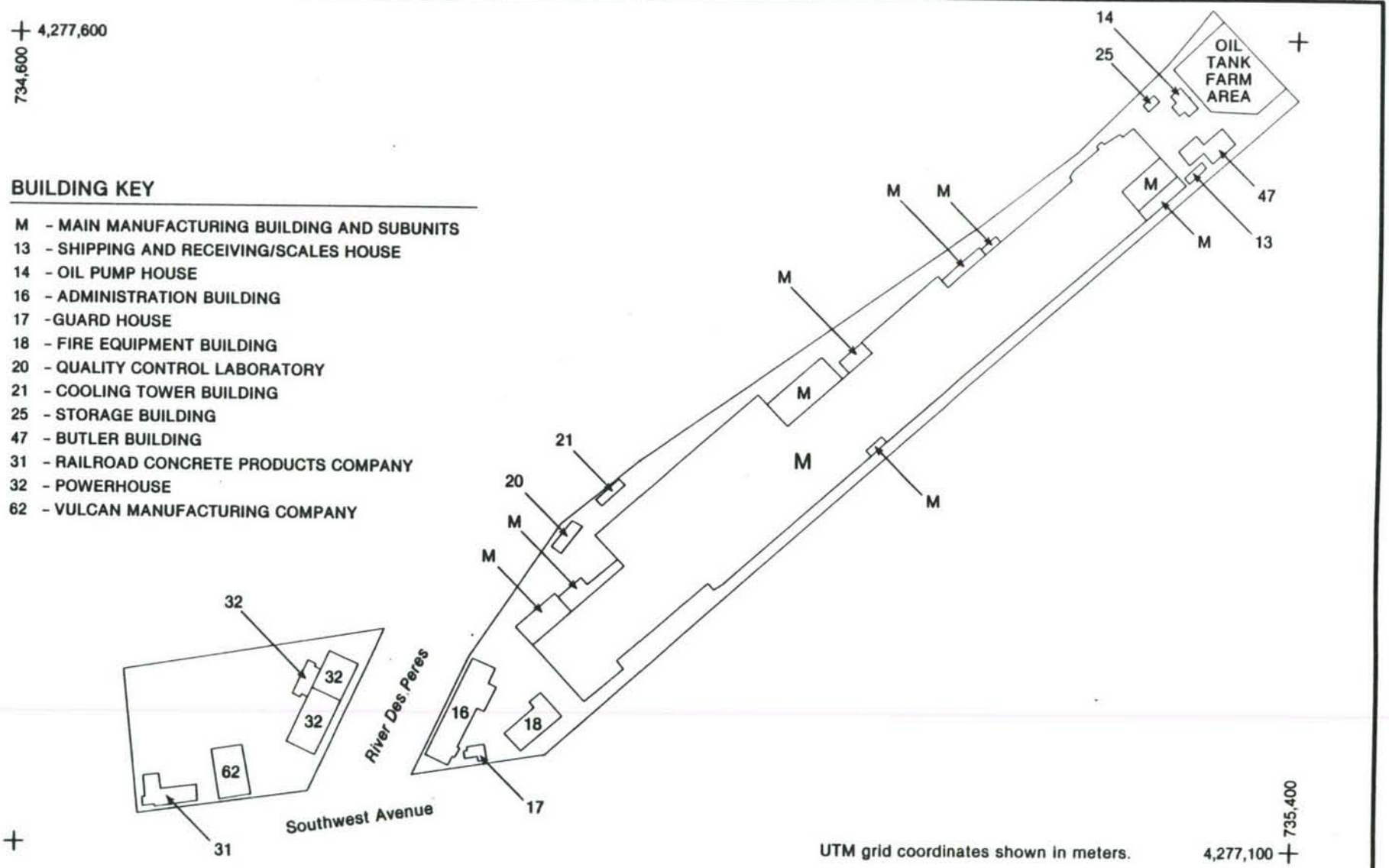


Figure 1-2
BUILDING LOCATION MAP, GATEWAY ARMY AMMUNITION PLANT

SOURCES: USATHAMA, 1982; ESE, 1982.

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Table 1-1. Key to Building Locations and Summary of Activities

Building Number	Designation or Name	Foundry and Casting Operations 1943-1954	Activity or Operation During: Projectile Manufacture 1967-1970	Current Activity
M	Main Manufacturing Building	Open Hearth Furnace Operations and Ancillary Activities, X-ray for Quality Control, Machining and Scale Removal Operations	Storage of Billets, Cutting, Drilling, Heat Treatment, Quenching, Support/ Maintence Facilities, and Waste Treatment Plant	Removal of Projectile Manufacturing Equipment
13	Shipping and Receiving/Scales House	Unknown, not a Manufacturing Area	Shipping and Receiving, Weighing of Rail Cars	Not in Use
14	Oil Pump House	Unknown, Possibly Oil Supply to Foundry	Oil Supply to Factory	Not in Use--Chemical Storage
16	Administration Building	Works Office & Dispensary	Works Office and Administration Building	Administration
18	Fire Equipment Building	Storage, Laundry	Fire Department	Storage of Fire Fighting Equipment
20	Quality Control Laboratory	Unknown	Metalurgical Laboratory	Not in Use
21	Cooling Tower Building	Cooling Tower for Foundry	Unknown	Not in Use
25	Storage Building	Foamite Building	Unknown; Possibly Paint Storage, Shipping and Receiving	Not in Use

Table 1-1. Key to Building Locations and Summary of Activities (Continued, Page 2 of 2)

Building Number	Designation or Name	Foundry and Casting Operations 1943-1954	Activity or Operation During: Projectile Manufacture 1967-1970	Activity or Operation During: Current Activity
47	Butler Building	Shipping & Receiving	Shipping and Receiving	Not in Use
31	Leased to Vulcan Manufacturing Co.; Subleased to Railroad Concrete Products (Subsidiary of Vulcan) Since 1975	Main Office Building	Perpetual Development Corp. Leased Building Prepared Training Aids, Graphics, and Processed Infra-Red Film	Railroad Concrete Products Co., Storage and Sales of Power Tools and Building/Roofing Supplies
32	Powerhouse	Supplied Power to Foundry	Not in Use	Not in Use
62	Leased to Vulcan Manufacturing Co.	Pattern house	Leased. Unknown tenants	Light metal working operations, stamping and machining. Also Vulcan Manufacturing Co. offices
--	Oil Tank Farm	Supply Oil to Furnaces	Not in Use	Not in Use, Tanks Removed

Sources: USATHAMA, 1979.
ESE, 1982.

radiological activities, and disposal of solid and liquid wastes were addressed. The conclusions of the IIA (USATHAMA 1979) were that there was no evidence of contamination or contaminant migration at GAAP.

1.3.2 Current Activities

Operations ongoing at GAAP at the time of this environmental survey were the following:

1. Installation management by ARRCOM, Building 16;
2. Dismantling, packing, and shipment of equipment by Voss Machinery Company, in the Main Manufacturing Building;
3. Light metal machining and stamping by Vulcan Manufacturing Company in Building 62; and
4. Storage and sales of small quantities of power tools and certain building supplies, adhesives, epoxy, muriatic acid, asphalt roofing compound, etc., by Railroads Concrete Product Company, a subsidiary of Vulcan Manufacturing Company, Building 31.

Handling and/or disposal activities related to toxic or hazardous materials as determined by records search and interview of installation personnel during the building inspection and/or sampling and analysis are described in the assessment of each building in Sections 3.0 and 4.0. All other buildings at GAAP which are no longer in use and are locked and abandoned with equipment or material stored inside are also described.

2.0 TECHNICAL APPROACH

The purpose of this section is to describe the technical approach to the final installation inspection, sampling, and analysis which supports the assessment of the contamination status of each building and area at Gateway Army Ammunition Plant (GAAP). Data used for the assessment were obtained through interviews with installation personnel, inspection of all available installation records and drawings, thorough walk-through inspection of the installation buildings and grounds, and sampling and analysis.

2.1 ACTIVITY AND RECORDS REVIEW

During the December 22, 1981 project initiation meeting and field investigations (February 15 to February 26, 1982), available plans and drawings were reviewed to determine the locations of sumps and underground structures, transformers and other electrical equipment, insulated piping and the structure and location of production and support activities. Records of chemical analysis of transformers and electrical equipment were reviewed to determine the polychlorinated biphenyl (PCB) content of these items. Results of these analyses are presented in Appendix A.

The following installation personnel were interviewed:

Mr. Meryl Humphries--Intallation Manager

Mr. Elmer Jones--Voss Machinery Company, Site Manager

Mr. George Hillman--President, Vulcan Manufacturing Company

Prior to the on-site visits, the previous Installation Assessment (USATHAMA, 1979) was reviewed in detail.

2.2 BUILDING INSPECTION

Each building at the facility was inspected to determine any potentially hazardous materials which might be present in specific areas. The locations of frayed, friable asbestos and peeling paint were documented, and quantities of this material were inventoried. All transformers were located, and all leaks of transformer fluid or apparent spill areas were documented.

All underlying areas, as well as the waste treatment plant in the Main Manufacturing Building, were inspected and the presence of liquids and sludge documented. Locations and approximate amounts of petroleum, oil and lubricants (POL), solvents, and other hazardous materials were documented as well as evidence of past spillage of such materials. During the initial phases of the building inspection, sampling sites were selected and approved by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) project officer.

2.3 SAMPLE COLLECTION AND ANALYTICAL METHODS

The environmental survey and assessment at GAAP included sampling and analysis of metals and asbestos in air samples; metals in sludge and in water; lead in paints; PCBs; total trichlorobenzenes (TCB) in sludge, soil, and filter swabs; and confirmation of the presence of asbestos in pipe insulation. The numbers of samples of each type and the sampling and analytical methods employed are summarized in Table 2-1. Seventy-seven samples were collected; 34 air samples, 13 insulation samples, 8 paint samples, 7 PCB/TCB samples, and a total of 15 from water, sediment, and sludge samples. Certain of these samples were collected in duplicate to assess sampling variability. The purpose of this section is to outline the specific collection, preparation, and analysis procedures. The focus of method selection was the defensibility of the procedure in terms of the USATHAMA Quality Assurance Program (USATHAMA, 1980) and/or National Institute for Occupational Safety and Health (NIOSH) certified sampling and analytical procedures.

2.3.1 Lead In Paint

Paint coating the baseboards, walls, and ceilings of many unimproved areas within the Main Manufacturing Building and the other buildings is badly cracked and peeling. Samples of paint from selected surfaces were collected and analyzed for lead content as described in this section.

Paint samples were collected by filling a clean 50-cubic centimeter (cm^3) Nalgene® bottle with pieces of paint pried from the surface.

Table 2-1. Summary of Samples Collected and Chemical Analyses Performed for Assessment of Contamination of GAAP

Type of Sample and Matrix	Number of Samples	Analytical Parameters	Sampling Method	Analytical Method and Reference	
Air					
Metals	34	Cadmium	NIOSH Method P&CAM 173*	ESE	CD 7S†
	34	Chromium	NIOSH Method P&CAM 173*	ESE	CR 7S
	34	Lead	NIOSH Method P&CAM 173*	ESE	PB 7S
	34	Zinc	NIOSH Method P&CAM 173*	ESE	ZN IN
Mercury	34	Mercury	Impregnated Charcoal	ESE	HG 2D
Asbestos	34	Asbestos Fibers	NIOSH Method P&CAM 239*	UBTL**	NIOSH Method P&CAM 239
Pipe Insulation	13	Asbestos Fibers	NIOSH Method P&CAM 245	UBTL	NIOSH Approved Method after McCrone††
Paint	8	Lead	Collection of 50 cm^3 of paint chips by scraping	ESE	PB 7S
Soil/Sludge/Filter Swabs					
PCB	7	PCBs	Grab	ESE	PCB 016 2M
				ESE	PCB 260 2M
TCB	7	TCB	Grab	ESE	TRIBZ 2M
Sludge/Water					
Metals	15	Cadmium	Grab	ESE	Water: CD 3T; Sludge: CD 7S
	15	Chromium	Grab	ESE	CR 3T CR 7S

Table 2-1. Summary of Samples Collected and Chemical Analyses Performed for Assessment of Contamination of GAAP (Continued, Page 2 of 2)

Type of Sample and Matrix	Number of Samples	Analytical Parameters	Sampling Method	Analytical Method and Reference		
Sludge/Water Metals	15	Lead	Grab	ESE	PB 3T	PB 7S
	15	Mercury	Grab	ESE	HG 1D	HG 2D

* From NIOSH Manual of Analytical Methods, Second Edition, Permanent and Certified Analytical Method Numbers, P&CAM Number 173 from Volume 5, 1979, P&CAM Numbers 239 and 245 from Volume 1, 1977.
† USATHAMA Test Name and Number.
** UBTL—Utah Biomedical Testing Laboratory.
†† UBTL—See text for references.

Source: ESE, 1982.

Bottles were cleaned in accordance with the schedule shown in Table 2-2. A stainless steel spatula was used to scrape the wall. This implement was cleaned between each sampling by wiping with a clean paper tissue (Kim-Wipe®), rinsing with deionized water, then by drying with a second tissue. The sampler wore a clean pair of disposable latex, surgical gloves to make each collection. One collection was made in duplicate in order to assess the sampling variability.

The procedure used to prepare the paint chips for analysis involved the digestion of the sample with concentrated nitric acid, a process which destroys all organic matter contained in the sample. This procedure has been designed and certified for releasing metals from the more complex and refractory matrix of soil or sediment and therefore is assumed to release lead contained in the paint matrix. Formal documentation of this method required the preparation of paint of known levels of lead content, weathering of the paint, and collection for analysis. To perform formal documentation was beyond the scope necessary to determine any potential hazard from peeling paint at GAAP. The achievable detection limit represented a sensitivity more than 10 times greater than the detection limit required to determine whether the paint was contaminated by lead at concentrations of 0.06 percent or greater. This concentration represents the maximum safe level for lead in paint for unrestricted use according to the Consumer Product Safety Commission (USATHAMA 1981b).

Quality control samples were prepared and analyzed in accordance with the USATHAMA Quality Assurance Program by spiking a paint sample with lead prior to digestion. This spiking was performed by adding 100, 600, and 1,200 ug of lead per gram of reference paint.

An additional reference sample (Standard Reference Material 1579, Powdered Lead Base Paint) obtained from the National Bureau of

Standards (NBS) was analyzed to confirm the ability of the digestion/analytical procedure to quantitatively recover lead from paint. This standard material contains 11.87 percent lead by weight. No powdered paint at a lower lead content was available from NBS as a reference material. The NBS reference paint was diluted by mixing at a ratio of 1 part in 200 parts with dried, chipped, nonleaded oil-based paint. The diluted mixture was designed to contain 0.06 percent lead (11.87%/200 = 0.59%), the required detection limit to provide a realistic test of the recovery of lead from paint at this level. This procedure provided a matrix which approximated the tested paints from the installation. The nonleaded paint was commercially purchased with assurances that it was lead-free. As analyzed, this paint contained 0.05 percent lead. The spiking and recovery of the reference were calculated to account for this factor.

2.3.2 Asbestos In Pipe Insulation

Numerous locations were observed where the insulation covering pipes was in a poor state of repair. This insulation often consisted of what appeared to be asbestos-containing material. Thirteen samples of this insulation material were collected for analysis. Approximately 20 grams of insulation were collected and placed in a labeled Nalgene® bottle. Each bottle was cleaned in accordance with procedures described in Table 2-2. Two sample sites were duplicated by collecting independent, separate samples from the same location as a test of variability. These were analyzed as separate samples. As a safety precaution during the sampling, the sampler wore a particle mask and disposable rubber gloves. A fresh pair of gloves was used for each collection.

Samples were shipped to Utah Biomedical Testing Laboratories (UBTL) for analysis of bulk asbestos by NIOSH-approved polarized light microscopical procedures referenced as follows:

Table 2-2. Sample Container Cleaning Procedures

Analysis/ Parameter	Container Type	Matrix	Cleaning Procedure
PCB and TCB	Glass Mason Jar	Soil/Sediment	1
Metals	Plastic Cubitainer	Water	2
	Glass Mason Jar	Soil/Sediment	3
Filters for Metals and Asbestos	Plastic Filter	Air	4
Mercury Tubes	Sealed Glass Tubes Containing Impregnated Charcoal	Air	4
Bulk Asbestos	Nalgene® Bottles	Pipe Insulation	5
Paint Chips--Lead	Nalgene® Bottles	Paint Chips	3

Procedures

1. Container is thoroughly washed with hot detergent and water. Triple rinse with tap water. Triple rinse with deionized water. Rinse with acetone. Rinse with hexane.
2. Rinse with 2 to 3 milliliters (ml) of Ultrex® grade concentrated nitric acid. Drain thoroughly. Triple rinse with deionized water.
3. Container is thoroughly washed with hot detergent and water. Triple rinse with tap water. Rinse with 2 to 3 ml of Ultrex® grade concentrated nitric acid. Triple rinse with deionized water.
4. No cleaning procedure required. Use new container.
5. Container is thoroughly washed with hot detergent and water. Triple rinse with tap water. Air dry.

Source: ESE, 1982.

McCrone, W.C. 1974. Detection and Identification of Asbestos by Microscopical Dispersion Staining. Environmental Health Prospective, 9:57-61.

Dixon, W.C. 1978. Occupational Safety and Health Administration (OSHA) METHODS (Internal Training Publication of the OSHA National Lab, Salt Lake City, Utah).

Particle Atlas, Ann Arbor Science Publishers. n.d.

United States Environmental Protection Agency. Office of Toxic Substances. 1979a. Asbestos-Containing Materials in School Buildings, a Guidance Document: Part 1. Office of Chemical Control, EPA, Washington, D.C.

UBTL is accredited by the American Industrial Hygiene Association (AIHA) to perform asbestos analysis in air and in bulk samples and is the NIOSH contractor for reference asbestos analysis. In addition, UBTL performs asbestos analysis in the NIOSH interlaboratory quality control [Proficiency Analytical Testing (PAT)] as a component of its AIHA accreditation.

Quality control samples described as follows were included as blind reference samples to accompany the 13 samples plus 2 field duplicates collected at GAAP. Also, one of the samples collected at GAAP was split and sent as a blind duplicate for analysis.

UBTL provided to ESE three known bulk asbestos samples which were derived from the PAT program. ESE selected one of the three samples, introduced it into the analytical batch as an unknown sample, and submitted it to UBTL for analysis. All samples were run by UBTL in accordance with the referenced procedure and the required quality control requirements for NIOSH reference analysis. Results were reported in terms of percent composition of various asbestos minerals in the sample of weight.

2.3.3 PCBs and Total Trichlorobenzenes

Samples of soil and other substrates were collected from areas where transformer or hydraulic fluid appears to be leaking or to have leaked to determine whether PCB or total trichlorobenzenes (TCB) contamination has occurred. Samples were collected by directly scooping substrate material into a glass jar which had been cleaned in accordance with the procedures outlined in Table 2-2. As necessary, substrate was loosened using a steel trowel which was triple-rinsed with hexane and dried with a Kim-Wipe® between samplings. The grab sample consisted of a full bottle of material from the area of the leaked material most likely to contain the highest PCB or TCB concentration. Samples of soil and oil sorbent were collected in this manner. Several transformers were leaking onto bare concrete. To collect these samples, a clean 37-millimeter (mm) membrane filter was used to swab the spill area. The filter was then analyzed for PCB and TCB. One sample was selected and sampled as a field duplicate. Samples were chilled to 4°C, returned to the laboratory, and extracted within 14 days.

PCBs were analyzed semiquantitatively in terms of ARCLOR 1016 and ARCLOR 1260 in accordance with USATHAMA method number 2M for organochlorine pesticides and PCBs in soil samples.

A modification of this PCB method was documented for semiquantitative analysis of TCBs, as specified in the USATHAMA Quality Assurance Program (USATHAMA 1980). The total concentration of TCB is reported; this consists of three isomers of TCB: 1,2,3-TCB; 1,2,4-TCB; and 1,2,5-TCB. The method has been approved as Method TRIBZ 2M.

2.3.4 Sampling and Analysis of Sludge and Water in Sumps, Tanks, and Underlying Areas

All underlying areas within the Main Manufacturing Building (such as sumps, quench tanks, and the chip conveyer system) as well as each of

the industrial waste system manholes, and the waste treatment area were inspected to document the locations where liquid or sludge was present. Selected samples were taken for analysis of cadmium (Cd), chromium (Cr), and lead (Pb), using the USATHAMA certified inductively-coupled, argon plasma (ICAP) methods, and mercury (Hg) content using the USATHAMA certified atomic absorption methods, identified in Table 2-1, for either water or soil/sediment.

2.3.5 Air Sampling and Analysis

NIOSH-approved equipment and procedures were employed for sampling and analysis of asbestos fibers, cadmium, chromium, lead, zinc, and mercury in 34 samples of air from GAAP. Concentrations observed were compared to OSHA Standards 29 CFR 1910.1000 and 29 CFR 1910.1001. The methods for sample collection and analysis have been summarized in Table 2-1. The following paragraphs describe the procedures which were used for calibration, quality control, and analysis, and rationale for selection of each method.

Cadmium, chromium, lead, and zinc were analyzed on filters collected from each of the locations in accordance with P&CAM 173 and analyzed by atomic absorption spectrophotometry or ICAP procedures. The quantitative soil analysis methods for each metal (see Table 2-1) were used to digest and analyze the filter and trapped material. Mercury was analyzed by the certified soil method by flameless atomic absorption after trapping particulate mercury and mercury vapor on and in an impregnated charcoal absorbent. Mercury collection is separate from that of the other metals.

A third collection was made for asbestos in air in accordance with P&CAM 239. This required a separate collection from either of the metals. Collected air filters along with quality control samples were shipped to UBTL for analysis.

Sampling Procedure--Ten sampling pumps, either Thomas-type (powered by 110 volts) or battery-powered personnel monitoring pumps [Mine Safety Appliances (MSA), Model S or G], were individually calibrated to known flow rates set between a value of 1 and 2 liters per minute (lpm) to collect the metals (except mercury) and asbestos samples in accordance with NIOSH protocol. Calibrated flow rates of 0.1 to 0.2 lpm were set for mercury collection as recommended by NIOSH. Thomas Pumps were fitted with fixed orifices, and the flow rate measured and recorded with each separate sample train in place (3-Stage Asbestos Collector, 2-Stage Metals Collector, and Charcoal Mercury Tube). The pump calibrations were checked on a daily basis for each sampling system. Four of these pumps were used to sample areas where an electric power source was convenient.

The personnel monitoring pumps have adjustable settings. Each personnel monitor was calibrated with the appropriate filter train in place and set immediately prior to and following each filter run to verify the air flow. Both pump types were checked at least every 20 minutes during each filter run to verify proper operation. The length of the filtering was recorded to the nearest minute. A total of 3 runs at each location was required to collect samples for each of the three tests. Based on the analytical sensitivity, a 2-hour filter run was judged sufficient to attain a sensitivity one-tenth or less of the required criteria for each of the three analytes. Since activity in all buildings except the tenant machining operations is light or nonexistent, a 2-hour sample was adequate to project a time-weighted average (TWA). In the tenant-operated machine shop, an approximate 6-hour sample was required to adequately establish the TWA.

The above procedures ensured that a known volume of air was sampled for each test performed. At a flow rate of 2 lpm, 240 l or 0.24 cubic meters (m^3) were collected during the 2-hour sampling period. At a flow rate of 2 lpm, 720 l or 0.72 m^3 were collected during a 6-hour test of the full working day. The volume sampled is related to flow

rate by the following equation:

$$\text{Volume sample } (m^3) = \frac{\text{Flow rate (lpm) x time sampled (minutes)}}{1000 \text{ liters}/m^3}$$

A Teledyne-Hastings-Raydist® Model NALL-10K mass flowmeter and Model H-10KMS transducer was used to measure total dilution air flow rates in standard cubic centimeters per minute (cm^3/min) to perform all calibrations of air sampling pump systems. This instrument is traceable to NBS.

Analysis of Cadmium, Chromium, Lead, and Zinc on Air Filters--Quantitative atomic absorption or ICAP methods for each of these metals in soils were used to quantify the metals collected on the 37-mm cellulose acetate filters. ESE is certified to perform analysis of chromium, cadmium, and lead by ICAP methods, and zinc by atomic absorption, as shown in Table 2-1. Metals spiked in standard soil were used as quality control test samples. The rationale for using the soils methods without further documentation is that the matrix of airborne particulates plus the cellulose acetate filter approximates a soil environment.

In addition to USATHAMA certification for analysis of all four metals, ESE is accredited by AIHA to perform analysis of three of the metals (cadmium, lead, and zinc) on filters by either ICAP or atomic absorption and has collaborated successfully in the NIOSH PAT program for 4 years. ESE holds AIHA laboratory accreditation number 110.

Analysis of Mercury in Impregnated Activated Charcoal Tubes--Prepared tubes (commercially available from MSA, Pittsburgh, Pennsylvania) were analyzed after digestion using the USATHAMA-certified method for analyzing mercury in soil by Flameless Atomic Absorption. Rationale for use of this method without further documentation was that the digestion is quantitative and will liberate mercury from the charcoal as well or

better than from the soil matrix. Use of the charcoal tube for mercury collection has been approved by NIOSH as a method for collection of mercury from atmospheres and is reported by Crable (1982) to be superior to the sniffer procedure specified in the Scope of Work. Use of the colorimetric sniffer test would require complete documentation, including generation of known concentrations of mercury in air.

Analysis of Asbestos Fibers on Air Filters--Air filters collected in accordance with P&CAM Method 239 were sent along with quality control filters to UBTL. The credentials of this laboratory have been presented in a previous paragraph. Quality control samples sent included the filters from colocated monitoring pumps and four 37-mm filters which were components of previous PAT programs and for which ESE knows the true asbestos fiber density. These were introduced into the analytical batch to be indistinguishable from the filters which were obtained from GAAP.

Reporting of Air Sampling and Analysis Data--Results of the analyses of metals on filters and mercury in the charcoal, as well as the asbestos on filters, were reported in terms of concentration (or number of fibers) per cubic meter of air. For metals collected on filters, the filter was digested as described in P&CAM Method 173 and the extract analyzed. The result in terms of ug metal/milliliter (ml) extract were converted to milligrams per cubic meter (mg/m^3) exactly as described in Section 10, page 173-10 of the procedure. For mercury collected in the charcoal tube, a similar calculation was made. (The only difference was the weight of charcoal in the tube was determined gravimetrically.) Mercury was analyzed by cold vapor atomic absorption, the result obtained in ug per gram of charcoal, then converted to ug/m^3 by the calculations referenced in the previous paragraph.

Air filters on which asbestos was collected were submitted to UBTL for analysis. The total fiber count per filter was obtained for fibers longer than 5 microns or nannometers (nm). This count was converted to

concentration in fibers/m^3 air as described in P&CAM Method 239 Section 10.

2.4 DATA MANAGEMENT

The sampling and analysis data were entered into the USATHAMA Installation Restoration Management System (IR-DMS) into map location and chemical sampling and analysis files. The map location file was developed for each sampling point from an existing map of GAAP in the IR-DMS files. Sample locations were plotted on copies of the map and entered into the IR-DMS by digitizing the points. The resultant map file was checked and validated in accordance with MIL-STD 105 as specified in the USATHAMA Quality Assurance Program, (USATHAMA, 1980). This file is appended as Appendix B to this report. The figures which show the location of samples collected in the survey are derived from the digitized map. Samples from GAAP consist of two site types: building interiors and building exteriors. Site identifications (ID) were developed in accordance with the Installation-Restoration Data Management System Users Guide (USATHAMA 1981). The 10-character format of the site ID for building interior samples are as follows:

* * * * * † @ x x x

*--corresponds to building number, up to five characters. (At GAAP the last two or three characters are usually blanks.)

†--corresponds to location, possible entries; F-floor; C-ceiling; W-wall; V-vent; B-baseboard; S-window sill; P-pipe; H-bench; K-sinks; T-cabinet; D-drinking faucet; E-exhaust hood; O-drying oven; Z-composite sample; Q-equipment; I-intersection; A-air sample.

@--corresponds to floor level, 0, 1, ...9

0 = basement

1 = first floor

x--corresponds to sample site number 001 - 999 (three numbers)

The format for building exteriors is similar and is as follows:

* * * * * d y y x x

*--corresponds to building number as for building interior.

d--corresponds to direction from building; N-north; S-south; E-east; W-west; R-roof; and W-wall.

yy--corresponds to distance from the building in meters.

xx--corresponds to sample number 01...99 (two numbers).

The following conventions were used for building nomenclature adapted from the building name or number as presented in Table 1-1. Buildings which were identified by number (13, 16, 25, etc.) were identified in the sampling site ID by the designation B number, for example B13, corresponding to the building designations Table 2-1 and Figure 1-2.

The Main Manufacturing Building, designated as M on the installation map, is a large and complex building that has numerous areas located within it. The building is constructed on a grid system with longitudinal supports designated by letters with A being the northwest wall and H being the southeast. Major longitudinal supporting columns or walls are designated as A, B, C, D, E, F, and H. The lateral supports are designated by number and run from 1 at the southwest wall to 79 at the northeast wall. The lateral and horizontal components of the grid system are carried in the site ID's as a letter designating the column, followed by a number designating the distance along the long axis of the building beginning at the southwest wall (e.g., M79, M18, M57, etc.).

The identity and integrity of all samples received from the field were verified by the quality control coordinator by inspection and comparison of the sample labels with the chain-of-custody record and copies of the field notes and the samples were logged into the data management system. At this point, unknown reference samples were entered into each analytical batch as a quality control check. Performance records for

all these were maintained to verify analytical accuracy. At least one of these types of reference samples was analyzed in each analytical batch.

All laboratory analytical data were reviewed and entered into ESE's computerized data management sytem. After all quality control checks were passed, a computer program was run to reformat the data to conform to USATHAMA chemical sampling and analysis data files. These files were taped and data sent to the USATHAMA Installation Restoration--Data Management Systems (IR-DMS) at the Tier-1 level of a 3-tiered system.

The Tier-1 files were upgraded to Tier-2 by USATHAMA after the ESE Data Management Coordinator checked the data using USATHAMA's data format checking program and after the ESE Quality Assurance Supervisor had validated the data. Tier-2 files are structured according to the formats outlined in the IR Data Management User's Guide (1981a). All Tier-2 files contain only validated data records. The Tier-3 level consists of a Data Base Management System loaded from validated Tier-2 files.

Validation of the data to upgrade from Tier-1 to Tier-2 was accomplished by testing the accuracy and control of randomly selected data entries. For a specified percentage of the entries, the results were traced through the entire system and verified. The acceptable error level (MIL Standard 105) is 0.25 percent. The number of errors expected for this accuracy level was compared with errors for sets of data entries of varying sizes. Comparison of the number of errors found with the number of errors expected is the basis of acceptance or rejection of a set of data. All data quality control results, sample chain-of-custody procedures, and the transcription processes were validated before data were entered to the Tier-2 level. The complete chemical data file are appended as Appendix C.

3.0 TECHNICAL RESULTS--ANALYSIS OF CONTAMINANTS

The purpose of this section is to summarize the results of chemical analysis of the:

1. Lead content in peeling paint;
2. Asbestos content of pipe insulation materials;
3. Metals content of water and sludges in the sumps, process sewer systems, and basement areas of the Main Manufacturing Building;
4. Polychlorinated biphenyl (PCB) and total trichlorobenzenes (TCB) content of leaking transformer oil, swabs of areas where spills have or are likely to have occurred, and solid samples believed contaminated with PCB; and
5. Asbestos and metal content of the air in various buildings.

Also summarized is the location of leaking transformers; storage locations and spills of petroleum, oil, and lubricants (POL); solvents; and other hazardous materials; and the location of peeling paint and asbestos insulation. Sampling locations, site identification (ID), and Universal Transverse Mercator (UTM) coordinates for all samples collected are appended as Appendix B. The complete chemical data base is appended as Appendix C.

For each type of contaminant examined, the applicable regulations governing the disposition and disposal are cited. Those materials which violate criteria, regulations, or which cause either environmental degradation or human health hazard are identified and alternative corrective actions described which would mitigate the degradation and/or bring GAAP into compliance with applicable regulations. Where different levels of effort would be required to release GAAP for unrestricted use when compared to industrial use, the effort to achieve both types of release are identified.

3.1 PAINT LEAD CONTENT

Following a detailed visual inspection of the facility, samples of paint chips collected from eight areas of peeling paint representative of the overall installation, were analyzed for total lead content. Four of these sites were located in the Main Manufacturing Building. At one site in the Main Manufacturing Building (M79), two samples were collected from the same area to assess the variability in paint lead content. Two samples were collected in Building 31, and one each was collected in Buildings 32 and 16. These buildings were selected because they contained relatively large areas of painted surface and large amounts of peeling paint. The following list describes the samples collected.

Site ID	Description of Samples
M57 W1001	Beige to off-white paint taken from wall of old office area
M58 W1001	Gray paint from doorway of office
M65 W1001	Orange paint from metal column in phosphate area
M79 W1001	Green paint from door to paint room
M79 W1002	Duplicate of M79 W1001
B31 W0001	From wall in basement of Building 31
B31 W1001	From wall on first floor of Building 31
B32 Q1001	From boiler cover in Powerhouse
B16 W1001	From wall on first floor of Building 16

Many of the buildings contain significant areas of peeling paint. Exceptions are Buildings 21, 25, 18, and 47. In the occupied buildings (Buildings 16, 31, and 62), the areas which are in use are relatively free of peeling paint and in good repair. Unused portions of these buildings contain numerous areas of peeling paint. Section 4.0 presents a detailed inventory of the location of peeling paint in each building. The amount of peeling paint was estimated to constitute less than one percent of the painted areas of the installation overall.

All of the samples of paint collected at Gateway Army Ammunition Plant (GAAP) contained lead in excess of 0.06 percent. This percentage is the maximum safe level for lead in paint for unrestricted use according to the Consumer Product Safety Commission (USATHAMA, 1981b). The test results for lead content in the paint samples are tabulated in Table 3-1. The locations of the samples collected are shown in Figure 3-1.

Except for the samples collected in duplicate at the north end of the Main Manufacturing Building, all the samples contained less than 1.00 percent of lead. The samples collected from the same location were different by approximately 150 percent. The lead content is apparently quite variable and is probably a function of the number of coats or thickness of the application of different paints, each containing different concentrations of lead and the amount which has already flaked off.

The paint samples contained 0.09 to 2.75 percent lead; therefore, it is probable that all or nearly all peeling paint at GAAP exceeds the Consumer Product Safety Commission criterion for unrestricted use. No such criterion exists for paint used in industrial applications. Areas of GAAP where paint is not peeling are suitable for industrial use with no action with respect to existing painted surfaces. Areas where peeling paint occurs could present an exposure hazard in terms of airborne lead which is regulated to a maximum concentration in air of 0.15 milligrams per cubic meter (mg/m^3) as a time-weighted average (TWA) in the working environment, according to the American Conference of Governmental Industrial Hygienists (USATHAMA, 1981b). If not removed, lead dust exceeding this limit could be generated during removal of peeling paint, renovation, or during future industrial activity. Undisturbed, the peeling paint does not release significant lead; no detectable lead was observed during the air monitoring phase at GAAP (see Section 3.6). Areas where paint containing lead is peeling are suitable for industrial use as long as an airborne lead hazard is

Table 3-1. Paint Lead Content at GAAP

Sample ID	Building	Total Lead Content ug/g	Total Lead Content Percent
M57 W1001	M	930	0.09
M58 W1001	M	4,750	0.48
M65 W1001	M	2,030	0.20
M79 W1001	M	12,300	1.23
M79 W1002	M	27,500	2.75
B16 W1001	16	1,350	0.14
B31 W0001	31	3,390	0.34
B31 W1001	31	1,580	0.16
B32 Q1001	32	6,530	0.65

Source: ESE, 1982.

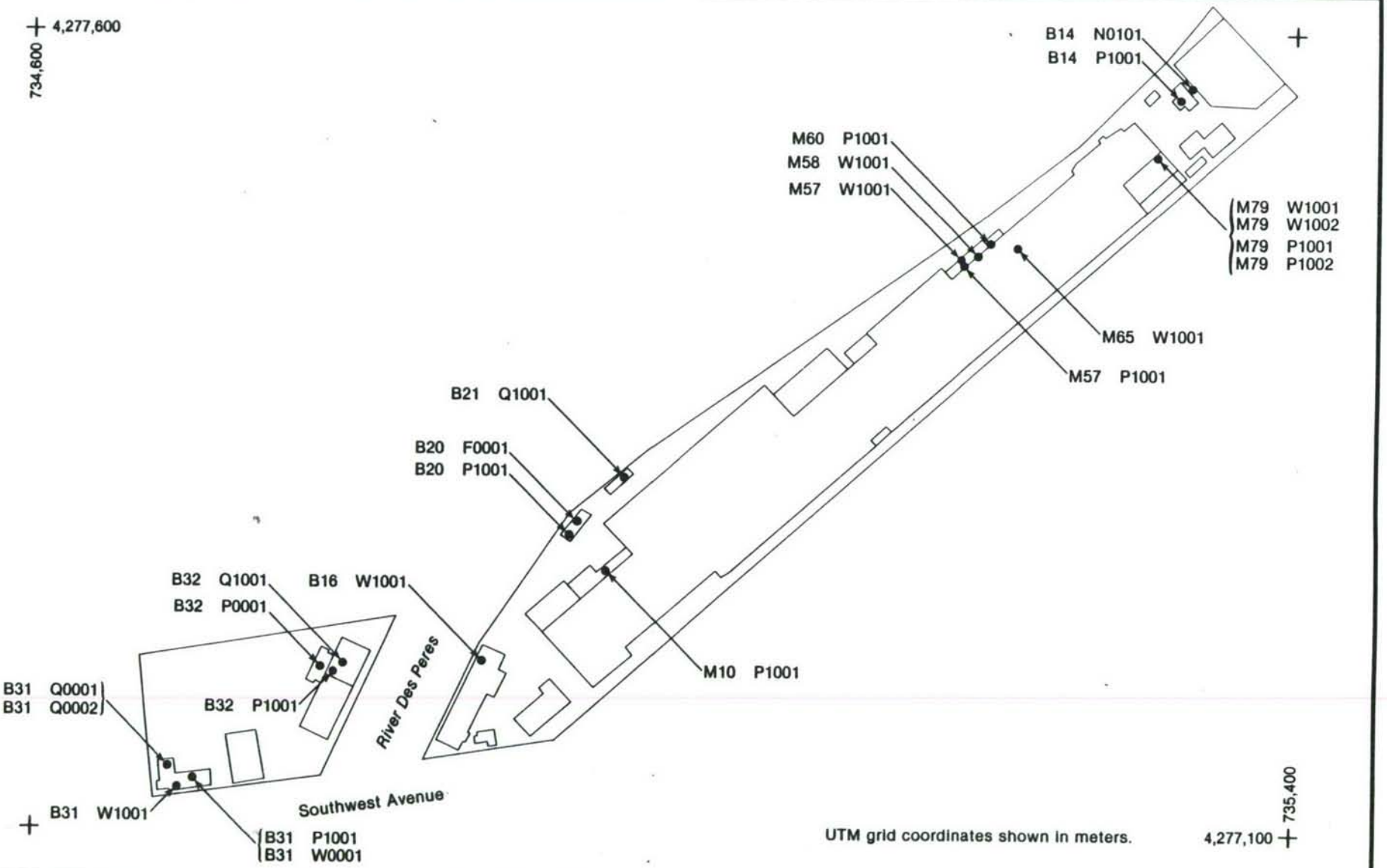


Figure 3-1
SAMPLING LOCATIONS FOR LEAD IN PAINT AND ASBESTOS IN INSULATION

SOURCES: USATHAMA, 1982; ESE, 1982.

Prepared for:

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

Aberdeen Proving Ground, Maryland

not present. All peeling paint containing lead posing an ingestion hazard must be removed prior to release for unrestricted use. However, paint that is not peeling is suitable for either industrial or unrestricted use.

In order to release GAAP for use restricted to industrial operations or activities, all peeling paint which must removed, should be removed in accordance with sound Occupational Health and Safety Agency (OHSA) practices and disposed into a hazardous waste landfill. Such removal practice includes monitoring the airborne lead content and worker protection measures of wearing respirators, coveralls, and caps. OSHA regulations applicable to permissible airborne lead concentrations and worker protection are contained in 29 CFR 1910.1025. Paragraph (c) of the regulation specifies permissible lead levels; worker protection requirements are described in paragraphs (f) (respiratory protection) and (g) (protective work clothes and procedures).

The removed lead paint chips would probably constitute a volume of less than 10 cubic feet, assuming a total area of peeling paint of no greater than 10,000 square feet at GAAP. The costs to test the removed paint for EP toxicity and ignitability in accordance with Resource Conservation and Recovery Act (RCRA) regulations [Federal Register, 45(98):33140-33150; U.S. Environmental Protection Agency (EPA), 1980] would exceed $100.00. Costs to dispose of the paint as hazardous material would be approximately $60.00 [the cost for disposal of two drums of hazardous waste according to Bob's House Service, a licensed hazardous waste service in St. Louis (Bob's House Service, 1982)]. Cost of transport would be equal for both types of disposal.

To release GAAP for unrestricted use, all present paint posing an ingestion hazard would have to be removed. Since the results indicate that most, if not all, of the paint exceeds 0.06 percent lead, it would not be economically feasible to determine whether any small areas would be salvagable without paint removal. Labor costs to remove all

lead-containing paint at GAAP would greatly exceed the cost for removing only the peeling paint. Removal of the large areas of paint could be effected by sand blasting or stripping. The paint chips and sand or solvent solutions would have to be tested but might be hazardous materials by definition of toxicity and/or ignitability (for solvent). Costs for removal of paint to clear GAAP for unrestricted use would be 10 to 100 times greater than to clear the installation for industrial use.

3.2 INSULATION ASBESTOS CONTENT

Each of the buildings at GAAP was inspected in order to determine the presence of asbestos insulation which is in a poor state of repair. This determination was made by visual inspection of frayed insulating materials and confirmed by analysis of samples of the insulation from 13 sites. Four sites were located in areas of the Main Manufacturing Building; the remaining samples were located in other buildings at GAAP. Sampling sites are shown in Figure 3-1. These samples were examined for the presence and composition of asbestos minerals by polarized light microscopy by Utah Biomedical Testing Laboratory (UBTL). The laboratory report from UBTL is appended as Appendix D. Two sites were sampled in duplicate, one in the Main Manufacturing Building and the other in Building 31. In addition, a blind reference asbestos mineral standard was included in the sample set.

Asbestos is a well known health hazard since it may cause fibrosis of the lung or malignancy of the lungs, stomach, and colon. The potential for exposure of persons at GAAP either by inhalation of airborne particulates or a result of ingestion of fibers which might reach the mouth exists whenever asbestos insulating materials are in a poor state of repair. Asbestos was commonly used as an insulating material when GAAP was constructed. Asbestos which is friable (in a poor state of repair) may easily become airborne, and therefore constitutes a potential health hazard (29CFR 1910.1001).

It was reported that during renovation in 1967, asbestos insulation in the renovated areas was replaced by fiberglass materials. The inspection of the buildings showed that insulation was present primarily as a pipe wrapping and as a coating on boilers and other equipment. The only buildings which contained no insulation were Buildings 25 and 47. In areas renovated in 1967 or currently in use, insulation generally was in good repair, and most appeared to be fiberglass rather than asbestos. In these areas, only small amounts of frayed material were present. In areas which were not renovated in 1967 or are currently not in use, insulation was generally in poor repair and looked like asbestos. Details of the location and condition of insulation in each building are inventoried in Section 4.0.

Table 3-2 presents a description of the insulation samples collected to test for asbestos content. Table 3-3 summarizes the asbestos content of each sample. Only two samples did not contain asbestos: B21 Q1001, insulation above a light in the Cooling Tower Building, Building 21, and B20 F0001, scraps from the basement of Building 20, the Quality Control Laboratory. These samples were visually distinct from the asbestos containing samples. The computerized data base accepts the insulation data on a positive or negative basis (PP or NN) only. Qualitatively, the samples were determined to be chrysotile or mixtures of chrysotile and amosite. These were both asbestos minerals; therefore the asbestos insulation sampled has been confirmed to be asbestos-containing. Fiberglass insulation is visually distinct in character. Insulation in the buildings that is listed as asbestos (see Section 4.0) must therefore be considered to be asbestos.

At GAAP, only Buildings 21, 25, and 47 were free from friable asbestos insulation.

Frayed asbestos insulation may cause a violation of OSHA regulations for asbestos content in air (29 CFR 1910.1001) if it is disturbed during industrial or other activity. The extent of exposure is a function of the asbestos content, air movement, and friability of the asbestos.

Table 3-2. Description of Insulation Samples Collected at GAAP

Sample ID	Building	Description of Sample
M10 P1001	Main Manufacturing Building	Pipe insulation, office area along north wall at E-10*
M57 P1001	Main Manufacturing Building	Pipe insulation in north foundry at E-57*
M60 P1001	Main Manufacturing Building	Pipe insulation in north foundry at E-60*
M79 P1001	Main Manufacturing Building	Pipe insulation at east end of building at G-79*
M79 P1002	Main Manufacturing Building	Duplicate of M79 P1001
B14 P1001	Building 14, Oil Pump House	Pipe insulation on first floor; pipe insulation on pipes
B14 N1001	Building 14, Outside	Outside, north of Building 14; scraps of insulation
B20 F0001	Building 20, Laboratory	On basement floor; pipe insulation from first floor
B20 P1001	Building 20, Laboratory	On basement floor; pipe insulation from first floor
B21 Q1001	Building 21, Cooling Tower Building	Asbestos insulation above light
B31 Q0001	Building 31, Railroad Concrete Products Building	Insulation from boiler in basement
B31 Q0002	Building 31, Railroad Concrete Products Building	Duplicate of B31 Q0001
B31 P1001	Building 31, Railroad Concrete Products Building	Pipe insulation from first floor

Table 3-2. Description of Insulation Samples Collected at GAAP (Continued, Page 2 of 2)

Sample ID	Building	Description of Sample
B32 P0001	Building 32, Power-house	Pipe insulation from large diameter pipe in basement; pipe insulation from first floor
B32 P1001	Building 32, Power-house	Pipe insulation from large diameter pipe in basement; pipe insulation from first floor

* In Main Manufacturing Building, E-10, etc., indicate nearest support column.

Source: ESE, 1982.

Table 3-3. Results of Analysis of Insulation Samples Collected at GAAP

Sample ID	Asbestos	Minerals and % Content
M10 P1001	PP*	50-60% Chrysotile**
M57 P1001	PP	~ 50% Chrysotile
M60 P1001	PP	~50% Chrysotile
M79 P1001	PP	10-20% Chrysotile, 10-20% Amosite**
M79 P1002	PP	30-40% Chrysotile, 10% Amosite
B14 P1001	PP	50-60% Chrysotile
B14 N0101	PP	~ 20% Chrysotile, 50-60% Amosite
B20 F0001	NN†	No Asbestos Detected
B20 P1001	PP	40-50% Chrysotile
B21 Q1001	NN	No Asbestos Detected
B31 Q0001	PP	~ 10% Chrysotyile, 40-50% Amosite
B31 Q0002	PP	5-10% Chrysotile, 50% Amosite
B31 P1001	PP	60-70% Chrysotile
B32 P0001	PP	1-2% Chrysotile
B32 P1001	PP	50-60% Chrysotile

Note: In Main Manufacturing Building E-10, etc., indicate nearest support column.

* PP = Positive--contains asbestos.
† NN = Negative--does not contain asbestos.
** Amosite and Chrysotile are asbestos minerals.

Source: ESE, 1982.

Removal or encapsulation of all torn or frayed insulation which appears to be asbestos would be required before GAAP could be cleared for release for industrial use. Undisturbed, however, the frayed material does not appear to cause detectable airborne asbestos (see Section 3.6). To release GAAP for unrestricted use, all asbestos-containing material including that in good repair would have to be removed or permanently encapsulated. Encapsulation would require periodic inspection to ensure the integrity of the capsules. The amount of asbestos insulations which is in poor repair is less than 5 percent of the total amount of asbestos insulation. Costs to remove all the asbestos to allow unrestricted use would be 20 to 100 times that for cleaning up GAAP for industrial use.

Cleanup procedures and personnel protection for asbestos removal are described by OSHA in 29 CFR 1910:1001. These may be summarized as follows.

Personnel working with asbestos-containing materials must be provided with respirators, coveralls, gloves, foot coverings, and head coverings. Nonwoven disposable coveralls should be available for use in heat stress situations. Where feasible, personnel working with asbestos containing materials should moisten these materials with a water mist prior to removal and handling. This practice will reduce the generation of airborne materials. Air monitoring for airborne asbestos concentrations is required during removal operations. Personnel working with asbestos-containing materials should be informed of the potential hazard and receive training on the health hazards of asbestos exposure.

Removed asbestos must be encapsulated in two layers of protection and then may be disposed into a state-approved landfill.

3.3 TRANSFORMER INVENTORY AND SURVEY OF PCBs AND TOTAL TRICHLOROBENZENES

An inventory and inspection of all transformer locations at GAAP was made as a part of the survey in order to determine whether any of the in-service equipment was leaking. At present, there is no out-of-service electrical equipment at GAAP. A total of 12 transformers at the installation are U.S. Government property. At present 17 transformers, all located outside of the GAAP buildings, are the property of Union Electric Company (UEC). The locations and designations of this equipment are shown in Figure 3-2.

The regulations which control the uses and disposal of PCBs have been promulgated by the EPA in Federal Register, 44(106):31514-31568 (EPA, 1979b). This regulation defines the transformer PCB nomenclature with reference to the PCB content of the contained fluids and has regulatory implications. Specific definitions are given for other PCB-containing or contaminated items. For the purposes of this report these regulatory definitions are used in describing transformer contamination status and the status of other material which may contain or be contaminated with PCBs. The following definitions, as used in the cited EPA regulation (EPA 1979b), will be adhered to when describing transformers and other materials at GAAP.

1. "PCB Item" is defined as any PCB article, container, or equipment which contains or has as a part of it any PCB(s) at a concentration of 50 parts per million (ppm) or greater.
2. "PCB Transformer" is any transformer that contains 500 ppm of PCB or greater.
3. "PCB-Contaminated" is any transformer that contains 50 ppm or greater of PCB but less than 500 ppm of PCB.
4. "Non-PCB Transformer" is any transformer that contains less than 50 ppm of PCB.

Records of testing of transformers were available; however, no PCB

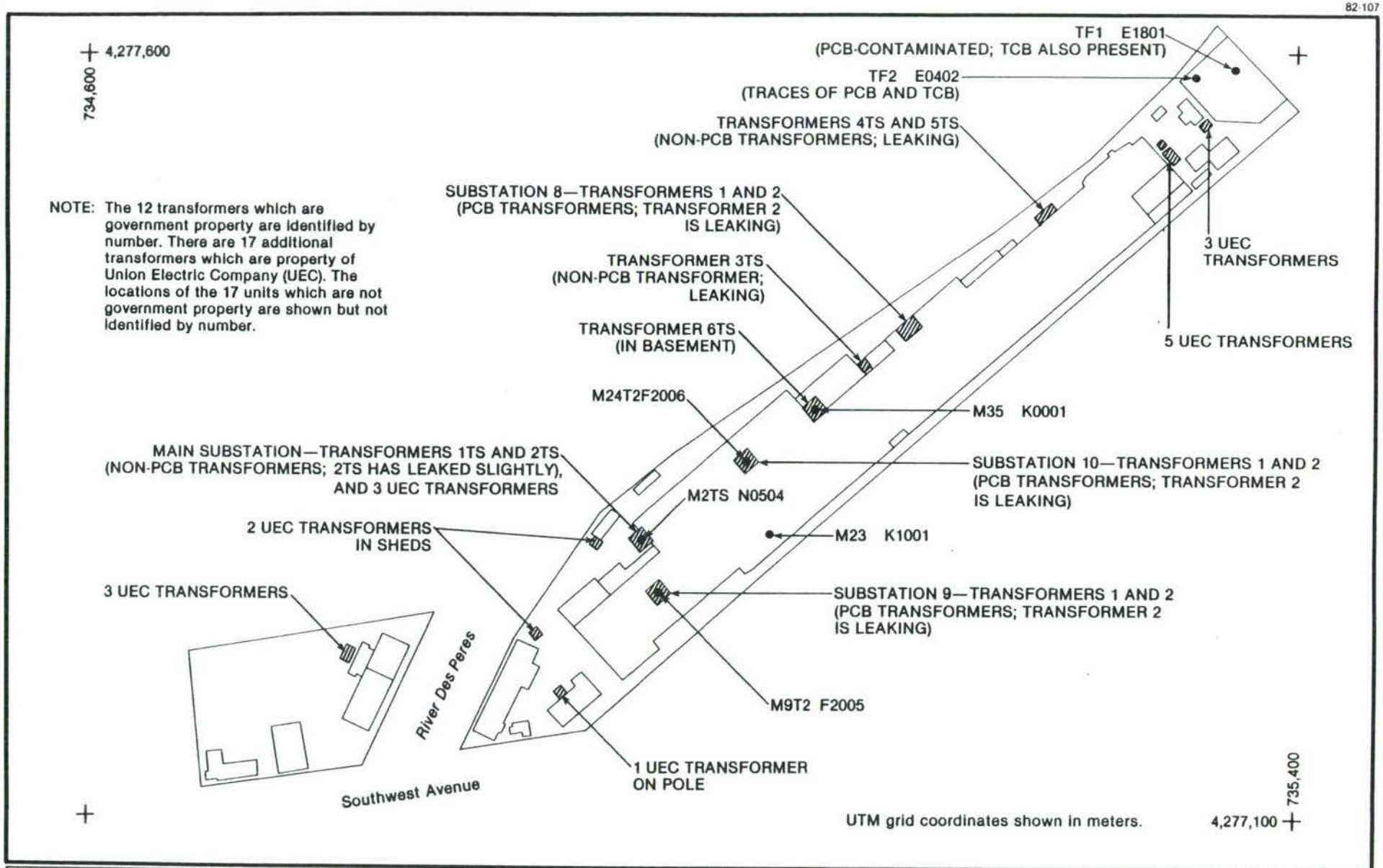


Figure 3-2
LOCATION OF ELECTRICAL TRANSFORMERS AND PCB AND TCB SAMPLING LOCATIONS

SOURCES: USATHAMA, 1982; ESE, 1982.

Prepared for:

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Aberdeen Proving Ground, Maryland

analyses had been conducted prior to 1981. Present installation management was reported to have been assured by past management that no PCB transformers remained at GAAP. Analysis of the 12 transformers which were government property were performed in late 1981 and early 1982 and showed that seven were PCB transformers. Table 3-4 describes the U.S. Government transformers and summarizes the results of PCB analyses which were performed by CHEMO-SERVICES Associates, Inc. (2948 South Brentwood Boulevard; St. Louis, Missouri; 63144). The analytical reports are appended as Appendix A. Transformers which were leaking at the time of the survey are also noted in Table 3-4. Samples of oil leaking from transformers were analyzed for PCB-1016, PCB-1260, and TCB. The analytical results for the samples of leaking fluid are presented in Table 3-5.

It was reported that spills and leaks have occurred from storage of fuel oils at the Former Oil Tank Farm. In addition, hydraulic metal-forming equipment removed from the Main Manufacturing Building was stored within the bermed areas of the tank farm while awaiting shipment. Two samples of oil-soaked material were collected from the tank farm area and analyzed for metals (see Section 3.4), PCB-1016, PCB-1260, and TCB. These sampling locations, TF1 E1801 and TF2 E0402, are shown on Figure 3-2 and the results tabulated in Table 3-5. Sample TF2 E0402 was collected at the southwest corner of the bermed area near Building 14. This sample was composed primarily of a gravelly soil matrix which was black as a result of saturation with oily material. The other sample, TF1 E801, was a soil matrix which was cemented together by an asphaltic, oily substance.

One additional GAAP sample, M23 K1001, was analyzed for PCB and TCB oil from the Nosing Press Pit.

3.3.1 Transformer Status

The analytical data in Table 3-5 confirm the results of Chemo-Services (Appendix A) which indicate those leaking transformers which are

Table 3-4. Inventory of Transformers which are U.S. Government Property at GAAP

Transformer Designation	Description (Locations shown in Figure 4)	PCB Status as analyzed by CHEMO-SERVICES (Appendix A)*	Approximate Leaking Area†	Sample ID
1TS (Main Substation)	Westinghouse, 400 gallons oil, three UEC transformers are located here also	Non-PCB transformer	Not Leaking	—
2TS (Main Substation)	Westinghouse, 400 gallons oil, are located here also	Non-PCB transformer	0.9 m^2	M2TS N0504
3TS (Main Substation)	Westinghouse, 400 gallons oil, Serial No. 3162131	Non-PCB transformer	9.2 m^2	—
4TS (Main Substation)	Westinghouse, 400 gallons oil, Serial No. 3162126	Non-PCB transformer	<0.9 m^2	—
5TS (Main Substation)	No identification plate	Non-PCB transformer	0.9 m^2	—
6TS (Main Substation)	Niagara Transformer Corp. Serial No. 37189, Contains 454 gallons, ASKAREL	PCB transformer	Gross leakage, absorbed in vermiculite	M35 K0001
Substation 8				
Transformer 1	Westinghouse, contains INERTEEN 300 gallons Serial No. YCR-94582	PCB transformer	Not leaking	—
Transformer 2	Westinghouse, contains INERTEEN 425 gallons Serial No. YCR-94613	PCB transformer	10 cm^2	

Table 3-4. Inventory of Transformers which are U.S. Government Property at GAAP (Continued Page 2 of 2)

Transformer Designation	Description (Locations shown in Figure 4)	PCB Status as analyzed by CHEMO-SERVICES (Appendix A)*	Approximate Leaking Area†	Sample ID
Substation 9				
Transformer 1	Westinghouse, contains INERTEEN 425 gallons Serial No. YCR-94611	PCB transformer	Not Leaking	
Transformer 2	Westinghouse, contains INERTEEN 300 gallons Serial No. YCR-94583	PCB transformer	0.18 m^2	M9T2 F2005
Substation 10				
Transformer 1	Westinghouse, contains INERTEEN 425 gallons Serial No. YCR-94612	PCB/Oil mixture may be either PCB transformer or PCB-contaminated transformer	Not Leaking	
Transformer 2	Westinghouse, contains INERTEEN 300 gallons Serial No. YCR-94581	PCB transformer	60 cm^2	M24T2 F2006

* Assessment of PCB status was based on results of CHEMO-SERVICES PCB analyses for oil from each transformer. Results are appended as Appendix A.

† This is the estimated area which either was covered by oil or where the floor was stained by oil in the immediate vicinity of the transformer.

Source: ESE, 1982.

Table 3-5. Results of PCB-1016, PCB 1260, and TCB Analysis

Sample ID	Sample Description	Concentration of: PCB-1016	PCB 1260	Total PCB	Total TCB
Transformer Samples:					
M2TS N0504	Transformer filter swab of spill area, transformer 2TS	<0.07 ug/cm^2	<0.07 ug/cm^2	<0.14 ug/cm^2	<0.004 ug/cm^2
M9T2 F2005	Filter swab of spill area, Transformer 2, Substation 9	800 ug/cm^2	2,000 ug/cm^2	2,800 ug/cm^2	90 ug/cm^2
M124T2 FZ006	Filter swab of spill area, Transformer 2, Substation 10	1,000 ug/cm^2	5,000 ug/cm^2	6,000 ug/cm^2	1,000 ug/cm^2
M35 K0001	Vermiculite absorbant soaked with fluid, Transformer 6TS	8,000 ug/cm^2	60,000 ug/cm^2	68,000 ug/cm^2	10,000 ug/cm^2
Nosing Press Pit:					
M23 K1001	Oil from pit	0.05 ug/g	0.03 ug/g	0.08 ug/g	9 ug/g
Former Oil Tank Farm:					
TF1 E1801	Oily, asphaltic waste plus soil	50 ug/g	400 ug/g	450 ug/g	50 ug/g
TF2 E0402	Gravel/soil soaked by oil	0.5 ug/g	2 ug/g	2.5 ug/g	<10 ug/g

Note: 1) Analysis of filter swabs or vermiculite absorbent confirms the PCB status of the leaking transformer as reported by CHEMO-SERVICES, Table 3-4. The oil as analyzed by CHEMO-SERVICES was either mineral oil, nearly pure PCB, or a mixture of PCB and mineral oil.

2) Regulatory standards for PCB and TCB applying to the spilled material are those cited in the text from EPA 1979b.
   - < 50ppm - Non-PCB or not contaminated in a solid matrix such as soil
   - > 50ppm < 500ppm - PCB-contaminated
   - > 500ppm - PCB material

Source: ESE, 1982.

PCB-transformers, since the leaking area swabbed contained large quantities of PCB compared to the leaked area under Transformer 2TS in which the swab contained no PCB. The exact concentration of PCB in the oil spread on the floor cannot be accurately assessed because of the nature of the sampling technique.

The results of analysis and inventory therefore show that in-service (but de-energized) transformers at GAAP contain PCBs and TCB and that these compounds are leaking in the Main Manufacturing Building. The leaking transformers constitute improper use of PCB-containing equipment (EPA, 1979b) (44 Federal Register, 31514-31568) because the PCBs are not being used in a totally enclosed manner. Leakage also constitutes improper disposal of PCB. Results of the survey indicated that none of the UEC transformers are leaking, their PCB status is unknown; however, they do not need to be analyzed as long as they are in-service. Up-keep and removal are the responsibility of UEC. Leaking transformers which are the property of the U.S. Government must be repaired and the leaked material cleaned-up, containerized, labeled, and disposed of in accordance with regulations in Federal Register, 45(98):31530-31532 and 31543-31548 (EPA, 1980). In-service PCB transformers must be labeled in accordance with EPA regulations and inspected monthly for leakage.

Removal of PCB transformers or PCB-contaminated transformers when GAAP is excessed does not constitute disposal as long as the items are intended for other use. Inspection, labeling, and storage requirements are similar to those for actual in-place transformers.

Cleanup requirements for the U.S. Government transformers at GAAP, therefore, are to label and properly transport PCB and PCB-contaminated transformers in accordance with EPA regulations after repairing all leaking items. These items must be transported in accordance with Department of Transportation (DOT) requirements which call for packing the items in absorbant, inspection every three months, and labeling the container with EPA-approved PCB labels and as DOT classifications ORM-E.

The rules and containers specifications are published in 40CFR761(c)(6). Leaked PCB and TCB should be cleaned and disposed in accordance with the cited regulations. Appendix E also summarizes the regulations governing storage, labeling and transport of PCB-transformers (Supp. E-8 through E-15).

3.3.2 Contamination of the Former Oil Tank Farm

The bermed area of the Former Oil Tank Farm has been contaminated by PCBs and TCB as a result of past disposal and storage practices. The area inside the berm is a concrete pad with numerous spills of asphaltic material, 2 to 4 centimeters (cm) thick. Some gravel and soil are present in the spills. Sample TF1 E1801 contained a total of 450 micrograms per gram (ug/g) of PCB and 50 ug/g of TCB. Contamination migration is prevented by the berm; however, prior to release, the PCB-contaminated materials must be removed, containerized, labeled, and disposed in accordance with EPA regulations (EPA, 1979b). Testing of the floor of the area after removal would be required to assure the effectiveness of decontamination. There are 10 to 20 spills evident in the area. The total area covered by spilled material was estimated to be approximately 250 square feet (5.8 m^2).

The overall quantity of PCB-contaminated material cannot be estimated from the present data, since some spills may involve fuel oil rather than PCB-contaminated or PCB oil. The high (approximately 500ppm) concentrations found in sample TF1 E1801 suggest that leaking PCB equipment had been stored in the bermed area.

The spilled asphaltic, oily material should be removed. There are two alternative strategies for clean up.

1. Clean all apparent spills and test residual and background pad areas within the berm.
2. Test to determine the spills which are contaminated, remove the required material, decontaminate the surface, and retest.

Engineering Systems Company (ENSCO), Eldorado, Arkansas, is the closest incinerator which will accept PCBs; PCB-contaminated soil material can

be disposed of at $150.00 per drum (ENSCO, 1982). Three drums would probably remove all of the apparent contamination. The cost of this would be $450.00. Testing 30 areas for residual contamination (the 20 spills plus 10 background samples) would cost $6,000.00 for a total of $6,450.00. Routine PCB analyses on soil or sludge cost approximately $200.00 per sample. To perform sufficient tests to define which of the 20 areas are contaminated would require at a minimum $2,000 in analytical effort. If ten background samples were analyzed the analyses would then total $3,000 prior to clean up. The total cost for the second alternative would be $9,450.000 ($3,000.00 pretesting plus $6,450.00 for clean up and confirmation testing). The asphaltic material analyzed in the environmental survey required extensive sample pretreatment to prepare it for analysis. Costs to pretreat the material would be expected to exceed $200.00 per sample.

3.3.3 Contamination of the Spaces of the Main Manufacturing Building

The sample of oil from the Nosing Press Pit was found to contain traces of PCBs and 9 ug/g of TCB. Since it contains less than 50 ug/g PCB and TCB, the oil alone would not render the pit waste PCB-contaminated; however, the presence of PCB and TCB in this area has broader implications. Other oil-containing sumps and sewer areas (see Table 3-6, Section 3.4; and Section 3.5), may be similarly contaminated, therefore the oils in these areas should be removed and tested to determine whether they contain PCBs.

A major oil spill area exists under the hydraulic press reservoirs in an area approximately bounded by supports E-7 to E-10 and F-7 to F-10. Oil from this spill has migrated into the press pit sump. Other past spills and migration have resulted in oil contamination of most of the sump areas in the Main Manufacturing Area (see Section 3.4). Trace levels of PCB and TCB [<50 parts per million (ppm)] were present in the oil in the Nosing Press Pit, Sample M23 K1001. Because of this, the oil spills in the Main Manufacturing Area may contain PCBs.

According to National Academy of Sciences (1979), PCBs were used in hydraulic fluids until 1971 and until that time comprised 13 percent of the total use. Since 1971 PCBs have no longer been used as hydraulic fluid. Because of the age of the hydraulic equipment in the production lines at GAAP, hydraulic fluid may contain PCB. In addition, guidance for Department of the Army, Headquarters U.S. Army Materiel Development and Readiness Command (1980), as well as the May 31, 1979 EPA rules (EPA 1979b) indicate that the oil in the hydraulic metal production and forming equipment require special testing for PCB and may contain PCB. Waste oil such as that spilled on the floor and sumps at GAAP must be considered contaminated unless proven otherwise, according to these rules. The U.S. Army guidance is appended as Appendix E and describes the requirements for testing, removal, and disposal. As related to the hydraulic equipment at GAAP the U.S. Army (1980) guidance in Appendix E is quoted as follows:

> d. Disposal.
>
> (1) PCB and PCB items stored for disposal prior to January 1, 1983, must be removed from storage and disposed of prior to January 1, 1984. PCB and PCB items stored for disposal after January 1, 1983, must be removed from storage and disposed of within 1 year.
>
> (2) Disposal options depend on PCB concentration and material to be disposed of (Inclosure 1) (SIC). Alternative methods may be used upon demonstration to EPA that the alternative method provides equivalent destruction and control of PCB. Local Defense Property Disposal Offices (DPDO) will accept liquid-cooled transformers for disposal provided: (a) the transformer is factory-sealed, without access ports, and shows no trace of leakage; or (b) the transformers contain less than 50 ppm PCB; or (c) the transformer is completely drained and did not contain more than 500 ppm PCB. Incinerators have not yet been approved by EPA; a listing of EPA-approved landfills was provided in reference 1f. Dilution to reduce PCB concentration and processing into non-liquid forms to circumvent high-temperature incineration requirements is prohibited.

(3) Packaging and transport for disposal is subject to DOT shipping regulations, PCB marking regulations, and EPA hazardous waste manifesting regulations, when effective in the fall of 1980.

(4) Waste oil must be considered to be contaminated by PCB unless laboratory test proves otherwise. All waste oil will be subject to EPA hazardous waste regulations; waste oil containing concentrations greater than or equal to 50 ppm PCB is subject to PCB disposal regulations. Use of waste oil as a sealant, coating or dust control agent is prohibited by Army Regulations (AR 200-1; AR 420-47).

e. Hydraulic Systems. Hydraulic metal production and forming equipment (e.g., die-casting, metal forging, foundry, etrusion) (SIC) where high temperature stable PCB hydraulic fluids were likely to have been used, and hydraulic equipment (e.g., forklift trucks, elevator lifts, loading dock levelers) where PCB fluids may have been used for convenience, require special testing for PCB. Where fluids contain greater than 50 ppm PCB, draining and proper disposal of the fluid is required. Once refilled, retesting is required for PCB not sooner (SIC) than 3 months nor later than 1 year.

In summary, major contamination and potential contamination migration problems at GAAP are PCB and TCB contamination of the Main Manufacturing Building and, secondarily, contamination of the Former Oil Tank Farm.

3.4 ANALYSIS OF METALS CONTENT IN SLUDGES, SOIL, AND WATER

The underlying areas, basement, sumps, quench tanks, industrial sewers, waste treatment process area, and the chip conveyer system of the Main Manufacturing Building were inspected to document the presence of sludge, sediment, or water. Since it was reported that liquids and oil had been disposed onto the surface of the bermed area, which formerly was the Oil Tank Farm, this area was also inspected. Table 3-6

Table 3-6. Inventory of Sumps and Other Underlying Areas in the Main Manufacturing Building at GAAP

Identification of Area	Location in Building (In Terms of Support Columns)	Description Contents	Sample Collected	Description of Sample
Draw and Pierce Press Pit	E-1 to E-6 F-1 to E-7	Thick (2 cm) oil layer over water	M06 K001	From press pit sump--sample is oil layer over water
Water Draw Pits	E-11 to E-12 and F-11 to F-12	Dry	No	—
Descaler Sludge Pit	E/F-14	Solid sludge—brown, rust-colored, granular	M14 F1001	Sludge sample brown granular material
West Chip Conveyor Trench	E/F-15 to E/F-30	Metal chips, shavings, concrete, and other debris	M17 Q1001	Solid granular sample--metal chips, dirt, and concrete
Industrial Sewer System	E-13 to E-66	Oily water and water accessed at three points	M31 K1001	Oil/water mixture with debris (metal shavings, rocks)
			M43 K1001 M43 K1002	Water—yellow in color which clarified upon acidification (sampled in duplicate)
			M57 K1001	Oil water
Phosphate Area Surface Drain	E/F-66	Fine gravel and metal scraps	M66 K1001	Surface treatment drain area, sediment, fine gravel and metal scraps
Nosing Press Pit	E-23 to H-23	Oil, 4 cm deep, covering whole pit	M23 K1001	Oil
Quench Pit	E-28 to E-31 F-28 to F-31	Empty	No	—

Table 3-6. Inventory of Sumps and Other Underlying Areas in the Main Manufacturing Building at GAAP (Continued, Page 2 of 2)

Identification of Area	Location in Building (In Terms of Support Columns)	Description Contents	Sample Collected	Description of Sample
Oil Pump Room and Well	B-28 to B-31 E-28 to E-31	Small quantities of oily water—water collected from sump in northeast corner	M31 K0001	Oil mixed with water
Conveyor Belt Pit	E-29	Water	M29 F0001	Water with oil sheen
Compressor Room Basement	B-34 to B-41 E-34 to E-41	Sump contained oil layer over water	M35 K0001	Oil layer sampled
Pump Room Pit	F-35/36	Oil spills on floor	No	—
East Chip Conveyor Trench	E/F-38 to 55	Similar to west conveyor trench	No	—
Process Waste System	B-42 to 44	Clean except for peeling paint	No	—
Grinder Filter Pit	E/F-57	Solid material: (1) blackish brown claylike material, (2) loose soil	M57 F1001 M57 F1002	As described in area descriptions (column 3)
Crusher Pad Oil Well	B/E-53	Oil spills	No	—
Pump Room Basement	B/E-64	Oil spills on floor	No	—
Rail Line Loading Trench (between rails leading into east end of building)	E/F-66-75	Oil spills	No	—

Source: ESE, 1982.

catalogs all the underlying structures in the Main Manufacturing Building. In this table, the location of each structure is described with respect to the column supports and building features. The materials, if any, which were observed, the sample location, and description of the samples collected are also presented in Table 3-6. The locations of the 14 samples collected in the Main Manufacturing Building and the two collected from the Former Oil Tank Farm are shown in Figure 3-3. The two samples collected at the Former Oil Tank Farm were selected to represent the two different types of apparent spills. Sample TF1 E1801 was selected as representative of the 10 to 20 areas of oily or asphaltic material scattered throughout the bermed area. Sample TF2 E0402 was collected from blackened, gravelly material located at the corner of the tank farm nearest to Building 14. The results of analysis of cadmium, chromium, lead, and mercury are presented in Table 3-7. A total of 5 of the liquid matrix samples were analyzed and reported as metal content in oil in ug/g rather than micrograms per liter (ug/l). In these samples the aqueous digestion procedure could not be used due to the ignitable nature of the oily matrix. Samples TF1 E1801, TF2 E0402 and M23 K1001 were also tested for PCB and TCB content (see Section 3.3).

The criteria for identification of hazardous concentrations in the sludge or water samples was based on the EP Toxicity Criteria as defined in Identification and Listing of Hazardous Waste 40 CFR 261.24 (45 Federal Register 33122, May 19, 1980). The following criteria apply to water samples collected in this task. The maximum allowable concentrations in the liquid, after filtering, where the sample contains less than 0.5 percent solids would be:

Cadmium	1.0 mg/l,
Chromium	5.0 mg/l,
Lead	5.0 mg/l, and
Mercury	0.2 mg/l.

The discussion of the criteria which will be used for identification of

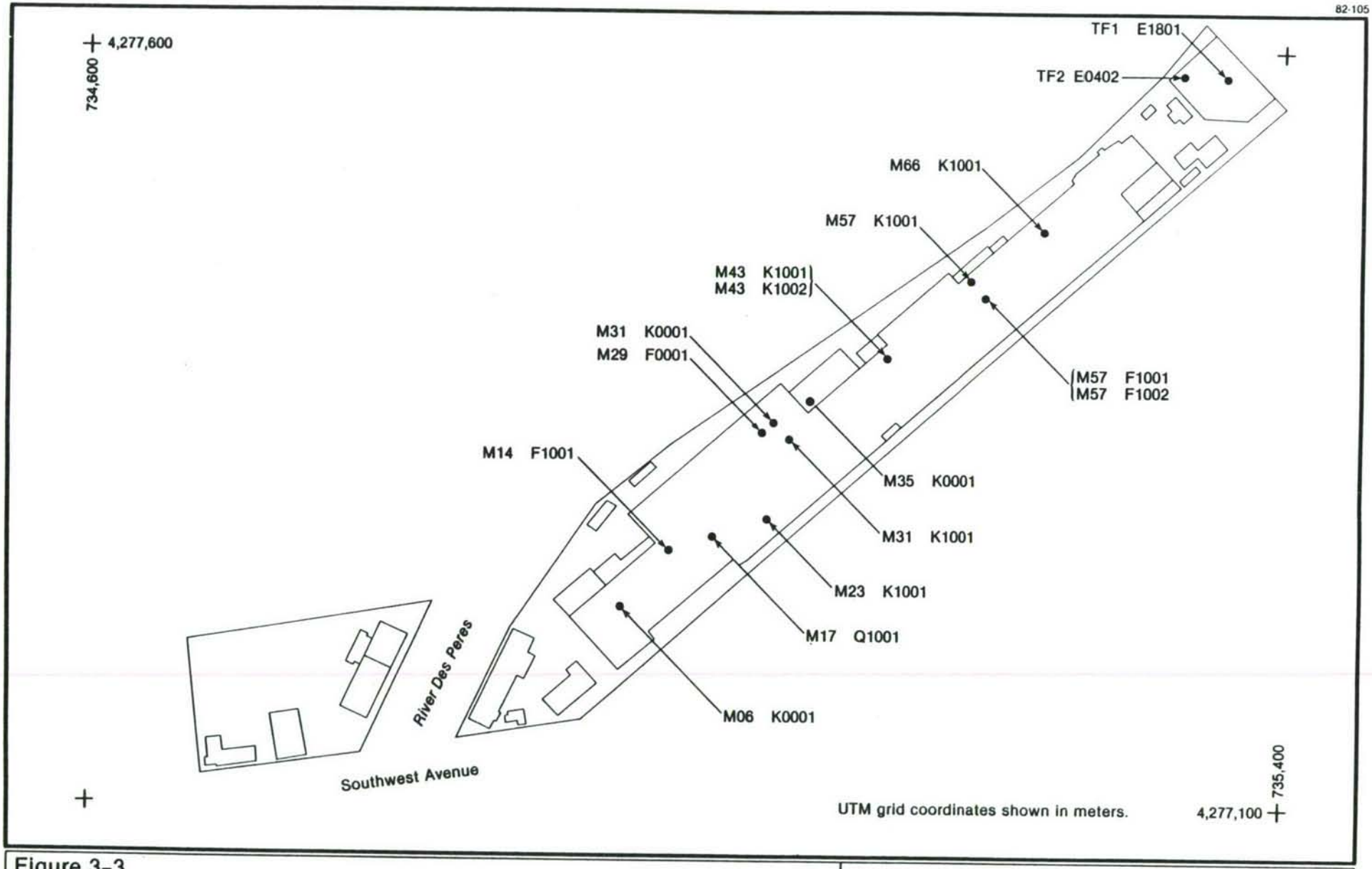


Figure 3-3
SAMPLING LOCATIONS FOR METALS IN WATERS, SEDIMENTS, AND SLUDGES

SOURCES: USATHAMA, 1982; ESE, 1982.

Prepared for:

U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY

Aberdeen Proving Ground, Maryland

Table 3-7. Concentration of Selected Metals in Water, Sediment, Sludge, and Soil at GAAP

Sampling Site ID	Cadmium	Chromium	Lead	Mercury
Aqueous, ug/l				
M29 F0001	8.2	8.6	107	<0.5
M43 K1001*a	<3.7	<5.0	<18.8	<0.5
M43 K1002*a	<3.7	<5.0	<18.8	<0.5
M57 K1001	<3.7	<5.0	<18.8	<0.5
Sediment, Sludge, and Soil ug/g				
M14 F1001	<5	194	19	<0.1
M17 Q1001	<5	147	41	<0.1
M57 F1001*b	33	13	27	<0.1
M57 F1002*b	<5	151	38	<0.1
M66 K1001	155	363	322	<0.1
TF1 E1801	<5	<8	18	<0.1
TF2 E0402	<5	13	120	<0.1
Oil ug/g of oil				
M06 K0001	<5	410	<8	<0.1
M23 K1001	<5	28	1,190	<0.1
M31 K0001	<5	<8	<8	<0.1
M31 K1001	<5	<8	<8	<0.1
M35 K0001	<5	<8	67	<0.1

* Colocated samples: a = duplicated samples at M43; b = colocated samples at M57; the M57 samples were separate, each one representing a distinctly different matrix.

Source: ESE, 1982.

catalogs all the underlying structures in the Main Manufacturing Building. In this table, the location of each structure is described with respect to the column supports and building features. The materials, if any, which were observed, the sample location, and description of the samples collected are also presented in Table 3-6. The locations of the 14 samples collected in the Main Manufacturing Building and the two collected from the Former Oil Tank Farm are shown in Figure 3-3. The two samples collected at the Former Oil Tank Farm were selected to represent the two different types of apparent spills. Sample TF1 E1801 was selected as representative of the 10 to 20 areas of oily or asphaltic material scattered throughout the bermed area. Sample TF2 E0402 was collected from blackened, gravelly material located at the corner of the tank farm nearest to Building 14. The results of analysis of cadmium, chromium, lead, and mercury are presented in Table 3-7. A total of 5 of the liquid matrix samples were analyzed and reported as metal content in oil in ug/g rather than micrograms per liter (ug/l). In these samples the aqueous digestion procedure could not be used due to the ignitable nature of the oily matrix. Samples TF1 E1801, TF2 E0402 and M23 K1001 were also tested for PCB and TCB content (see Section 3.3).

The criteria for identification of hazardous concentrations in the sludge or water samples was based on the EP Toxicity Criteria as defined in Identification and Listing of Hazardous Waste 40 CFR 261.24 (45 Federal Register 33122, May 19, 1980). The following criteria apply to water samples collected in this task. The maximum allowable concentrations in the liquid, after filtering, where the sample contains less than 0.5 percent solids would be:

Cadmium	1.0 mg/l,
Chromium	5.0 mg/l,
Lead	5.0 mg/l, and
Mercury	0.2 mg/l.

The discussion of the criteria which will be used for identification of

hazardous concentrations of cadmium, chromium, lead, and mercury in the sludge and/or water samples requires amplification.

The discussion does not pertain directly to either the sampling or analysis of the samples from the installation. These samples were collected, preserved as applicable, and analyzed using the identified USATHAMA certified methods. Results were reported for each sample in either ug/l or ug/g (dry weight) as appropriate for liquid, solid, or semisolid samples. Oil samples, although liquid, were reported in ug/g of oil or ppm.

Amplification is required in connection with the manner in which the data are to be interpreted in the report, and in the conclusions or recommendations to be drawn from the data.

A waste exhibits the characteristic of EP toxicity and is regulated under the Resource Conservation and Recovery Act if, using the test methods described in Appendix II of the EPA (1980) Federal Register article, the extract from a representative sample of the waste contains any of the regulated contaminants at a concentration equal to or greater than the respective value given by EPA (1980). Where the waste contains less than 0.5 percent filterable solids, the waste itself, after filtering, is considered to be the extract.

Liquid wastes from the sumps and sewers would be subject to the regulation. For liquid samples (<0.5 percent filterable solids), the EP-toxicity criteria listed above were applied directly to the measured levels of cadmium, chromium, lead, and mercury. If any of these metals exceeded their specified criterion, the liquid was considered hazardous. The oil material, since it potentially is comingled with unknown wastes, is subject to the EP toxicity criteria.

In solid samples, the EP toxicity criteria apply, however, to the concentrations in the liquid fraction prepared by extracting at least

100 g of the solid material (as is; i.e., without drying) using the procedure described in Appendix II of the 1980 EPA ruling on hazardous waste contained in the Federal Register. The final total volume of this extract is 2,000 milliliters (ml).

The extraction procedure essentially consists of separation of solid and liquid components and extraction of 100 grams or more of solid material (wet weight) at pH 5 in a total volume of 2,000 ml. The sample is acidified with 0.5 N acetic acid. After extraction, the extract and any liquid fraction are combined and analyzed to determine whether the concentrations of any of the constituents exceed the listed maximum concentrations.

The scope of work for this environmental survey did not include any EP toxicity testing; therefore, the direct assessment of whether sludge or sediment is hazardous cannot be made. This is because it is impossible to determine without testing what fraction of any of the metals contained would be mobilized to the aqueous phase during the test. If, however, there were insufficient metal (e.g., cadmium) in the 100-g sample of sludge to produce a concentration in the 2,000-ml extract exceeding the 1.0-mg/l extract concentration criterion if 100 percent of the metal were leached, the sludge would be considered nonhazardous in terms of cadmium. If the sludge cadmium concentration were high enough that if all of the metal were extracted into the 2,000-ml extract volume, the resulting concentration in the extract would be greater than 1.0 mg/l cadmium, the sludge could be hazardous. The sludge would not necessarily be hazardous, but further testing (application of the EP toxicity test) would be required to resolve the status of the sludge. The following three examples illustrate the possible interpretations, using cadmium as the metal for testing.

1. The sludge contains 25 percent moisture and was found to contain 13.33 ug/g cadmium on a dry weight basis.
   a. The wet weight concentration of the sludge is:
      13.33 ug/g x 75 percent solids = 10 ug/g.

b. Extracting a 100-g portion of wet sludge. 10 ug/g x 100 g = 1,000 ug total cadmium in the sample which is available to be extracted.

c. The total volume of extract is 2,000 mg; therefore: 1,000 ug cadmium/2,000 ml = 0.5 ug/ml = 0.5 mg/l 0.5 mg/l <1.0 mg/l criterion.

The sludge could not violate the toxicity criterion even if all the cadmium were extracted.

2. The sludge contains 25 percent moisture, 26.66 ug/g cadmium dry weight.

   a. 26.6 ug/g x 0.75 = 20 ug/g wet weight.

   b. 20 ug/g x 100 g = 2,000 ug total cadmium.

   c. 2,000 ug/2,000 ml extract = 1 mg/l cadmium = criterion.

   The sludge equals the criterion if 100 percent is extracted.

3. The sludge contains 40 ug/g cadmium dry weight and 25 percent moisture.

   a. 40 ug/g x 0.75 = 30 ug/g wet weight.

   b. 30 ug/g x 100 g = 3,000 ug total cadmium.

   c. 3,000 Cd/2,000 ml = 1.5 ug/ml = 1.5 mg/l.

   The sludge could exceed the cadmium criterion if 100 percent were extracted.

Based on these three cases, Case 1 would be considered as nonhazardous (if no other criteria were exceeded) and Cases 2 and 3 as potentially hazardous. For Cases 2 and 3, further testing (EP) would be recommended in order to determine the status and required disposal procedures(s).

For the four metals being tested in this task, the criteria for judging solid samples (> 0.5 percent solids) as hazardous are the following

concentrations (based on a 1/20 dilution of the wet weight concentration as analyzed):

Parameter	EPA Extract Maximum Allowable Concentration (mg/1) (40 CFR 261.24)	Maximum Allowable Sludge Concentration (ug/g wet weight)
Cadmium	1.0	20
Chromium	5.0	100
Lead	5.0	100
Mercury	0.2	4

The aqueous samples (see Table 3-7) did not contain metals concentrations which violate the EP toxicity criteria. The waters in the underlying areas are not contaminated from the standpoint of metals and present no contaminant migration threat.

Five oil samples were tested for metals content and compared to the liquid EP toxicity criteria in terms of ppm. The ug/g concentrations or ppm would approximate mg/1, considering that the oil density was probably in the range of 0.7 to 0.9. Only two of the samples, M31 K0001 and M31 K1001, contained no detectable metals. The remaining oil samples had concentrations of at least one of the metals tested which exceeded the relevant criterion by at least one order of magnitude (see Table 3-7). These oily wastes would therefore be considered hazardous by virtue of toxicity according to the EPA regulations. Disposal of the oily wastes from the sumps will have to be in accordance with regulations in Federal Register, 45(98):33063-33285 (EPA, 1980, Parts V, VI, and VII). Further consideration of the oily materials is presented in Section 3.3 which describes the PCB contamination status of these materials. In almost all of the sumps, several of the process sewer line access points, and several pits contained oil. This oil presents a contamination problem if the lines are flushed to the River Des Peres, or if the oily waste is improperly disposed as nonhazardous solid waste.

Two of the solid samples exceeded the projected maximum allowable cadmium concentration, four exceeded the chromium maximum, and two exceeded the lead maximum. No mercury was detected. None of the solid

samples would pass the EP toxicity test if all of the metal were leachable under the test conditions. This does not necessarily mean that the sludge would actually fail the EP toxicity test. The nature of the samples is that they contain metal shavings, etc. Under complete digestion, metals in the steel, the shot, etc., are solubilized. Under EP toxicity test conditions, the shot and shavings would not be solubilized to an appreciable degree. The source of the chromium, cadmium, and lead may not be the solid metal, however. If the sources of these metals are corrosion products, they could be leachable and cause the solid to fail the test.

In order to release GAAP for industrial or unrestricted use, the sludges and soil from the underlying areas must be removed. Considering the small volume of waste and the cost of analysis for EP toxicity testing (approximately $150 per sample) compared to the cost of disposal as a hazardous waste (approximately $50/drum according to Bob's Home Service, 1982), the most cost effective disposal option is to dispose the material as a hazardous waste.

The results of analysis of the two samples from the Former Oil Tank Farm are presented in Table 3-7. TF1 E1801 did not contain significant metals concentrations in terms of the EP toxicity criteria. The lead content of TF2 E0402 was 120 ug/g on a dry weight basis. Adjusting this value for the sample moisture content (5 percent), the wet weight lead concentration was 114 ug/g. This would barely exceed the criterion for lead if all metal were extracted under test conditions. Typically, soils and solids do not release all of the total metals content under conditions of the EP toxicity test. In all probability the soils of the Former Oil Tank Farm would not be considered as hazardous by virtue of toxicity.

In summary, analysis of the materials in the underlying spaces of the Main Manufacturing Building indicates the following conclusions and cleanup requirements:

1. The waters in the sumps, sewers, etc., are not hazardous; however, the oily fraction would be considered hazardous according to EP toxicity criteria. The contamination status of the oil material is further discussed in Sections 3.3 and 3.5. As described in these sections, the oil presents a contamination problem in terms of its hydrocarbon (POL) and potential PCB content and should not be flushed into the River Des Peres. In order to release GAAP, the oil and water in the sumps must be properly disposed.

2. The solid sludges and soils, shavings, and metal debris of the underlying systems potentially could be toxic based on total metals content. These materials should either be tested for EP toxicity, removed, and properly disposed, or disposed as if they were hazardous waste. The latter alternative is the most economically feasible because of the cost of analysis for EP toxicity considering the small amounts of solid material present.

3. The soils of the Former Oil Tank Farm would not be considered hazardous with respect to EP toxicity for metals. Section 3.3 discusses the PCB contamination status cleanup and disposal options for these soils, waters, sludges, and oil.

3.5 INVENTORY OF PETROLEUM, OIL, AND LUBRICANTS, SOLVENTS, INDUSTRIAL CHEMICALS, AND OTHER TOXIC AND HAZARDOUS MATERIALS

3.5.1 Storage Areas

Small amounts of petroleum, oil, and lubricants (POL), solvents, and other chemicals are stored at various designated locations at GAAP. Table 3-8 presents a building-by-building summary of the stored materials. The locations within buildings are shown in Figure 3-4. Prior to release of GAAP, all stored POL, waste oil, and other chemicals should be disposed through DPDO or used either by the lessee operations or by the salvage contractor. There was no evidence of significant spills in the listed storage areas B, C, D, F, G, and H. The empty

Table 3-8. Inventory of POL, Solvent, and Chemical Storage Areas at GAAP

Building Number	Map Location (Fig. 3-6)	Description of Area	Materials Stored
Main Manufacturing Building	A	Hydraulic reservoirs for presses	Hydraulic fluid 1,000 to 3,000 gallons in machinery reservoirs
	B	At Columns E-7 and H-7	2 55-gallon drums solvent possibly kerosene in use by salvage contractor
	C	Brick structure at Columns H-52 and H-53	2 55-gallon drums of rust preventative 2 55-gallon drums motor oil 1 55-gallon drum lubricating oil
	D	Tool storage area (old Area 6) bounded by Columns B35 to B40 and E35 to E40	Empty drums approximately 20, 50 gallons of petroleum based hydraulic fluid 1 55-gallon drum of waste oil
Building 14	E	Pumphouse--first floor	20, 5-gallon cans of lubricants
Building 62	F	Vulcan Manufacturing Co. machine shop	1 55-gallon drum of trichloroethane degreaser (in use) 1 55-gallon drum of cutting oil
Building 31	G	Behind building	1 55-gallon drum of trichloroethane 1 55-gallon drum of cutting oil One empty can (1 gallon) of promethon herbicide (contains 2,4-D and 2,4-bis-isopropyl-amino, 6-methoxy triazine)
	H	On first floor in the safe which was used to store documents during 1940's	148 gallons epoxy adhesive 3 gallons muriatic acid (HCl) 15 gallons asphalt roofing compound 10 gallons concrete additives

Source: ESE, 1982.

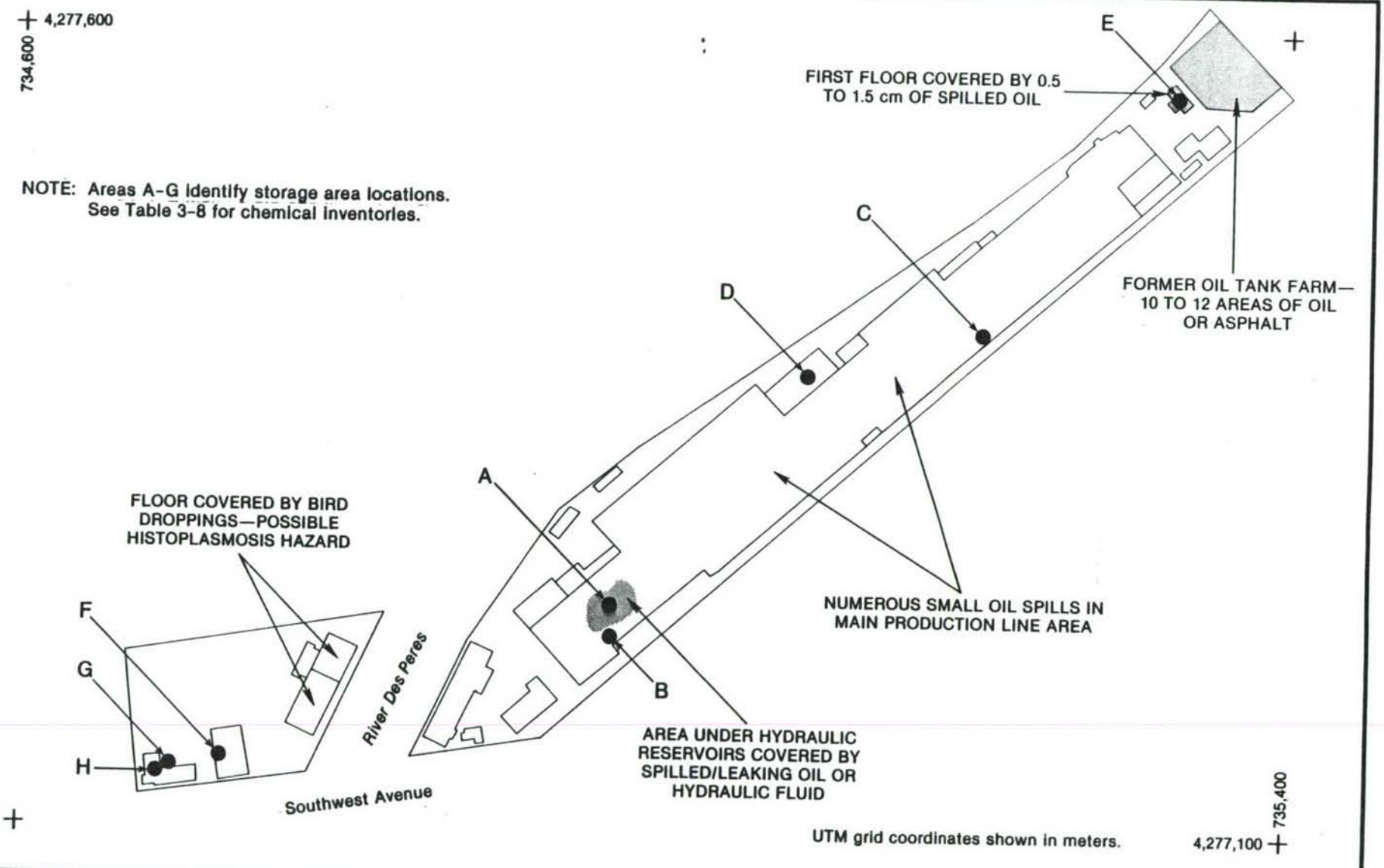


Figure 3-4
LOCATIONS OF POL AND CHEMICAL STORAGE AREAS AND SIGNIFICANT SPILLS

SOURCES: USATHAMA, 1982; ESE, 1982.

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herbicide container at location G should be triple rinsed, crushed or punctured, and disposed of into the solid waste in accordance with AR-200 (U.S. Army, 1978).

3.5.2 Spills

POL spills have occurred and are still occurring as a result of equipment removal, and numerous (up to 100) small spills are present on the floor of the Main Manufacturing Building.

A major spill area exists under the hydraulic press reservoirs as shown in Figure 3-4 in an area approximately enclosed by supports E-7 to E-10 and F-7 to F-10 (location A). Oil from this spill has migrated into the press pit sump. Other past spills and migration have resulted in oil contamination of the sump areas in the Main Manufacturing Building (see Sections 3.3 and 3.4). Trace levels of PCB and TCB (<50 ppm) were present in the oil in the Nosing Press Pit, location M23 K1001 (see Figure 3-3). Therefore, the oil spills in the area of the Main Manufacturing Building are potentially contaminated by PCB. Because of the age and period of use of the hydraulic equipment in the production lines at GAAP, the presence of PCB-contaminated hydraulic fluid is likely. Rationale for this has been presented in Section 3.3.

Ten to 20 patches of oily or asphaltic material constituting approximately 250 square feet (5.8 m^2) of area were also found in the Former Oil Tank Farm. The results of analysis of two of these spills and PCB contamination status were described in Section 3.3. It was reported by installation personnel that oil had been disposed of into these bermed areas in the past.

Clean up of all of the oil spills at GAAP testing for PCB and proper disposal will be required prior to release of the property for either industrial or unrestricted use. Waste oil and oil in the hydraulic equipment should be treated as contaminated by PCB until tested as described in Section 3.3. Oil which is PCB-contaminated (50 to 500 ppm

PCB) or PCB-containing (>500 ppm PCB) should be disposed of through DPDO in accordance with EPA regulations. Oil which contains <50 ppm PCB may be disposed of as waste POL.

3.5.3 Histoplasmosis Hazard

The floor and equipment surfaces of the first floor of the powerhouse, Building 32, are heavily contaminated by bird droppings and feathers. Pigeons use this building as a rookery. According to Joklik and Smith (1972), in the midwestern United States pigeons are a reservoir for histoplasmosis, a fungus disease of the respiratory system of man. Prior to release of GAAP, the fecal material in Building 32 must be removed and the building made bird-proof to prevent repopulation. During cleanup, workers should wear protective coveralls, dust and fume preventative respirators, and goggles. After removal of the material, the area should be flushed with disinfectant.

3.6 AIR SAMPLING

A total of 34 air samples were collected at GAAP to determine the contamination status of the atmosphere in the buildings with respect to the maximum concentrations of asbestos, cadmium, chromium, lead, mercury, and zinc allowed in air as TWA for the working environment.

Ten sites were located within the Main Manufacturing Building and 15 within the other structures at GAAP. Samples were collected by colocated samplers at three sites in the Main Manufacturing Building and at three sites in the other structures to test sampling variability. Four samples were collected from outside the buildings to serve as background samples. Samples were collected for a period of approximately 2 hours in the abandoned structures in the Main Manufacturing Building and Administration Building (Building 16) since no significant industrial activity was occurring. In the Vulcan Manufacturing Company Machine Shop (Building 62), samples were collected for a period of 6 hours, since this environment represented a true industrial setting. Table 3-9 presents the description of each sampling site and duration of

Table 3-9. Description of Air Sampling Sites at GAAP

Sample and Site ID		Building No.	Duration of Sampling (minutes)	Sample Site Description
M04	A2001	Main Mfg. Building	120	Catwalk near selas furnaces
M05	A1001	Main Mfg. Building	120	Furnaces control rooms
M18	A1001*a	Main Mfg. Building	120	Hydraulic oil reservoir
M18	A1002*a	Main Mfg. Building	120	Projectile storage and conveyor equipment storage
M39	A1001	Main Mfg. Building	120	Tool storage
M41	A1001*b	Main Mfg. Building	120	Vehicle maintenance and storage
M41	A1002*b	Main Mfg. Building	120	Vehicle maintenance and storage
M47	A1001*c	Main Mfg. Building	120	Battery charging area
M47	A1002*c	Main Mfg. Building	120	Battery charging area
M65	A1001	Main Mfg. Building	120	Middle surface treatment area
M78	A2001	Main Mfg. Building	120	Upstairs of old lunchroom
M79	A1001	Main Mfg. Building	120	Paint shop
B13	A1001	13	120	N.E. room-shipment and receiving
B14	A1001	14	120	Oil pump house--1st floor
B16	A0001	16	109	Basement administration bldg.--movie storage area
B16	A1001	16	120	1st floor administration bldg.--main room south end
B18	A0001	18	120	Basement of fire equipment building
B18	A1001	18	120	1st floor fire extinguisher chemical storage
B20	A0001	20	112	Basement of lab building
B20	A2001	20	120	2nd floor chemical testing lab
B21	A0001	21	118	Lower level cooling tower bldg.
B31	A0001*d	31	120	Basement, Railroad Concrete Products Office with sink area
B31	A0002*d	31	120	Basement, Railroad Concrete Products Office with sink area
B31	A1001	31	120	1st floor railroad concrete products storage area
B32	A0001	32	120	Basement to powerhouse
B32	A1001*e	32	120	Boiler room
B32	A1002*e	32	120	Boiler room

Table 3-9. Description of Air Sampling Sites at GAAP (Continued, Page 2 of 2)

Sample and Site ID	Building No.	Duration of Sampling (minutes)	Sample Site Description
B62 A1001	62	360	Vulcan machine shop--N.W. corner
B62 A1002*f	62	360	Vulcan machine shop equipment storage area
B62 A1003*f	62	360	Vulcan machine shop equipment storage area
MM E0501	--	120	Outside Main Manufacturing Building
B18 E0501	--	120	Outside Building 18
B20 E0201	--	120	Outside Building 20
B31 N0501	--	120	Outside Building 31

* Colocated samplers: a = colocated at M18; b = colocated at M41; c = colocated at M47; d = colocated at B31; e = colocated at B32; f = colocated at B62.

Source: ESE, 1982.

sampling. Table 3-10 presents the results of analysis of the air samples at each site. The locations of the sampling sites are shown in Figure 3-5.

The applicable criteria for the allowable metals content in air were the following:

Metal	Maximum Concentration Allowed in Air--TWA (mg/m^3)
Cadmium	0.05
Chromium	0.05
Lead	0.15
Mercury	0.05
Zinc	5.0

These criteria were obtained from the Threshold Limit Value for chemical substances and physical agent in the workroom environment with intended changes for 1980 from the American Conference of Environmental Hygienists (USATHAMA, 1981b).

The criterion for asbestos was specified by OSHA (29 CFR 1910.1001) and is no more than 2.00 fibers greater than 5 microns long per cubic centimeter (c^3) of air as an 8-hour TWA. As shown in Table 3-10, none of the parameters approached the applicable criteria.

No asbestos was detected on any of the filters tested in the field. The detection limit was three orders of magnitude below the criterion. Appendix F presents the filter analysis data report received from UBTL who performed the analyses. The only asbestos detected by UBTL was on the quality control samples sent as described in Section 2.0. Recoveries of asbestos on these filters ranged from 98 to 109 percent of the analyzed value within the Proficiency Analysis Testing program.

No cadmium, lead, or mercury were detected in any of the air samples as shown in Table 3-10. Detection limits for these elements ranged from

Table 3-10. Concentrations of Asbestos and Selected Metals in Air at GAAP

Site ID	Asbestos Fibers/cm^3	Cadmium mg/m^3	Chromium mg/m^3	Lead mg/m^3	Mercury mg/m^3	Zinc mg/m^3
M04 A2001	<0.03	<0.0007	0.007	<0.003	<0.001	0.008
M05 A1001	<0.03	<0.0007	0.010	<0.003	<0.001	0.02
M18 A1001*a	<0.03	<0.0007	0.005	<0.003	<0.001	0.009
M18 A1002*a	<0.03	<0.0007	0.006	<0.003	<0.001	0.008
M39 A1001	<0.03	<0.0007	0.007	<0.003	<0.001	0.009
M41 A1001*b	<0.03	<0.0007	0.006	<0.003	<0.001	0.01
M41 A1002*b	<0.03	<0.0007	0.007	<0.003	<0.001	0.009
M47 A1001*c	<0.03	<0.0007	0.006	<0.003	<0.001	0.01
M47 A1002*c	<0.03	<0.0007	0.006	<0.003	<0.001	0.007
M65 A1001	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007
M78 A2001	<0.03	<0.0007	0.006	<0.003	<0.001	0.03
M79 A1001	<0.03	<0.0007	0.006	<0.003	<0.001	0.03
B13 A1001	<0.03	<0.007	0.004	<0.003	<0.001	0.01
B14 A1001	<0.03	<0.0007	0.004	<0.003	<0.001	0.007
B16 A0001	<0.03	<0.0007	0.006	<0.003	<0.001	0.02
B16 A1001	<0.03	<0.0007	0.004	<0.003	<0.001	0.009
B18 A0001	<0.03	<0.0007	0.004	<0.003	<0.001	0.007
B18 A1001	<0.03	<0.0007	0.005	<0.003	<0.001	0.008
B20 A0001	<0.03	<0.0007	0.006	<0.003	<0.001	0.02
B20 A2001	<0.03	<0.0007	0.005	<0.003	<0.001	0.01
B21 A0001	<0.03	<0.0007	0.005	<0.003	<0.001	<0.007
B31 A0001*d	<0.03	<0.0007	0.003	<0.003	<0.001	<0.007
B31 A0002*d	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007
B31 A1001	<0.03	<0.0007	0.006	<0.003	<0.001	0.008
B32 A0001	<0.03	<0.0007	0.003	<0.003	<0.001	<0.007
B32 A1001*e	<0.03	<0.0007	0.005	<0.003	<0.001	<0.007
B32 A1002*e	<0.03	<0.0007	0.006	<0.003	<0.001	0.008
B62 A1001	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007
B62 A1002*f	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007
B62 A1003*f	<0.03	<0.0007	0.002	<0.003	<0.001	0.01

Table 3-10. Concentrations of Asbestos and Selected Metals in Air at GAAP (Continued, Page 2 of 2)

Site ID	Asbestos Fibers/cm^3	Cadmium mg/m^3	Chromium mg/m^3	Lead mg/m^3	Mercury mg/m^3	Zinc mg/m^3
MM E0501	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007
B18 E0501	<0.03	<0.0007	0.006	<0.003	<0.001	0.009
B20 E0201	<0.03	<0.0007	0.006	<0.003	<0.001	0.02
B31 N0501	<0.03	<0.0007	0.004	<0.003	<0.001	<0.007

* Colocated samples: a = colocated at M18; b = colocated at M41; c = colocated at M47; d = colocated at B31; e = colocated at B32; f = colocated at B62.

Source: ESE, 1982.

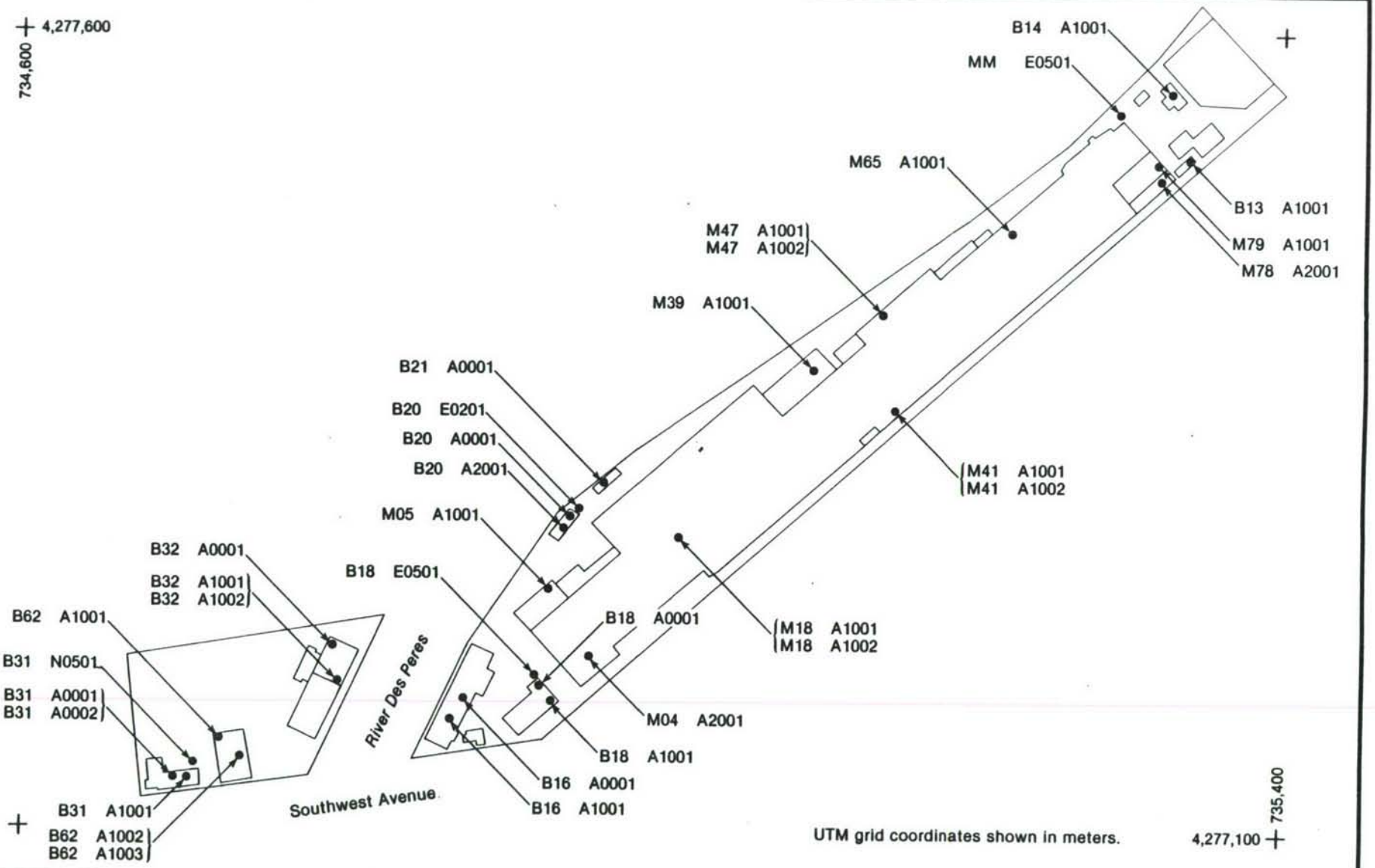


Figure 3-5
AIR SAMPLING LOCATIONS

SOURCES: USATHAMA, 1982; ESE, 1982.

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one order of magnitude (lead) to three orders of magnitude (chromium) below the applicable criteria. Low levels of zinc and chromium were observed, but the concentrations did not approach the criteria. Chromium was observed at 0.01 mg/m^3 at M05 A1001. This is 20 percent of the applicable criterion. This was the closest approach of any sample to the applicable criterion. The remaining chromium analyses were an order of magnitude below the limit. Zinc concentrations in the air were 3 to 5 orders of magnitude lower than the criterion for zinc. The maximum variation in results for chromium and zinc results observed from the colocated samples was 3 parts per thousand (ppt) (0.3 percent). Typical agreement was within 0.1 percent 0.001 mg/m^3. The background and building interior samples were similar in concentration range for the two elements detected.

Based on these results, there are no areas at GAAP which would require clean up to prevent health hazards for industrial use with respect to the air. The similarity to the background samples (outdoors) and the low or nondetectable concentrations observed, indicate that no atmospheric hazards would result in unrestricted use above those present in the outside air. During rennovation for any usage, however, workers performing the dust/dirt removal should wear masks to minimize the particulate intake.

4.0 INSTALLATION ASSESSMENT

As a result of the sampling and analysis, records search, and inspection of Gateway Army Ammunition Plant (GAAP) described in Section 3.0, contamination was found to exist in each of the structures at GAAP except for Buildings 21, 25, and 47. The most serious contamination was found in the Main Manufacturing Building. Based on the Initial Installation Assessment (IIA) (USATHAMA, 1979), the major expected contaminants were asbestos and peeling paint, metals in the sumps of the Main Manufacturing Building, and possible leaking transformers. The survey of GAAP was designed to provide final clearance for release and an alternative assessment and protocol to properly dispose of any contaminants. In Section 3.0 the contaminants which exceeded relevant criteria were identified and the requirements and options for decontamination addressed.

The alternatives assessment for release of GAAP has addressed two use options; release for unrestricted use, and release restricted for industrial use only. In order to release the installation for industrial use, the decontamination requirements are those which would remove any contamination which would exceed criteria based on worker exposure during a normal work day and work week. Decontamination requirements for unrestricted release are more stringent since the criteria achieved would be those which would not allow a health hazard to be present under any circumstances including human habitation or allow environmental standards to be violated in the future as a result of migration of contaminants from past installation operations. Decontamination alternatives to achieve clearance for the two uses considered differ for only two of the contamination problems, peeling paint and friable asbestos insulation. For the other contaminants, the details of corrective action, relevant regulations, and criteria which must be met are identical.

The extensive potential polychlorinated biphenyl (PCB) and total trichlorobenzenes (TCB) contamination of the Main Manufacturing Building

and the PCB and TCB contamination of the Former Oil Tank Farm were unforeseen. GAAP cannot be released without disposal of these and the other contaminants in accordance with the regulations and procedures detailed in the preceding section. Corrective action is necessary to ensure that spilled and leaked hydraulic fluid and oil is prevented from entering the River Des Peres or the St. Louis solid waste collection system. The restoration actions described for the major contamination problems employ hazardous waste disposal and will require post restoration testing to ensure that decontamination was effective. Restoration actions might also include further definition of the extent of contamination by sampling and analysis prior to clean up. Before a quantitative assessment can be made of the release alternatives, a decision as to the most advantageous balance among the following factors must be made:

1. The level of effort for pre-cleanup sampling and analysis, if any;
2. The disposal costs if the worst-case contamination is assumed based on the available data; and
3. The level of post-restoration testing.

The costs for restoration of GAAP to remove the contaminants which require similar levels of effort for both release options vary by a factor of 2 or 3 as a function of combinations of the above variables. As described in Section 3.0 for the PCB cleanup requirements, the recommended strategy to minimize costs is to minimize the predisposal sampling and analysis.

The level of effort required to meet the paint and asbestos criteria for unrestricted use is at least an order of magnitude greater than that required to meet the paint and asbestos criteria for use restricted to industry. This factor, as well as the location of GAAP in a predominantly industrial section of St. Louis, suggests that the most desirable alternative would be release for industrial use.

In the remainder of this section the contamination problems which must be corrected before release are summarized on a building-by-building basis. Details of the disposal/restoration requirements have been specified in Section 3.0 for each type of contamination.

4.1 MAIN MANUFACTURING BUILDING

This building encompasses the majority of the eastern parcel of GAAP. Table 4-1 represents an inventory of the insulation and peeling paint observed within this building. The following contamination and/or contaminant migration problems exist in this building. These are the most significant problems at the installation, and immediate corrective action is required to confirm and mitigate a potential health hazard and contaminant migration problem.

1. The major contamination problem in the Main Manufacturing Building is the presence of hydraulic metal-forming equipment which is leaking fluid, potentially contaminated by PCBs and TCB. Four PCB-containing transformers are leaking in or adjacent to this building. Hydraulic fluid and POL is spilled on the floor in numerous small spills as a result of equipment removal. A major hydraulic fluid spill is present at the area of the hydraulic press reservoirs. As a result, the sumps, underlying spaces, and process sewers are contaminated. This contamination should be prevented from being either flushed into the River Des Peres or disposed of into the St. Louis solid waste collection system.

2. The solid sludges in the sumps and other underlying areas in this building contain sufficient quantities of metals that they could be hazardous by virtue of the EP toxicity test. These must be removed and/or tested as described.

3. Small quantities of POL are stored in the Main Manufacturing Building. These materials are not toxic or hazardous but must be disposed of prior to release.

Table 4-1. Inventory of Insulation and Peeling Paint in Main Manufacturing Building

General Area	Specific Location	Approximate Quantity
Insulation		
Bounded by E-1 to C-1 and E-6 to C-6	Near ceiling	Great deal of fiberglass insulated pipe--good condition
Bounded by E-7 to F-7 and E-13 to F-13 (includes process line)	Near ceiling	Fiberglass insulated pipes--good condition
Office area west side between E-6 and E-13	1st floor--near E-8 to E-10 E-9 door	120 ft asbestos insulated pipe--good condition, one small asbestos insulated pipe--good condition
Tool room	Door at E-11	60 ft asbestos insulated pipe--fair to poor condition
Restroom at E-12		30 ft asbestos insulated pipe--all except 4 feet in good condition
Room w/door at E-13		12 ft of fiberglass insulated pipe--good condition
South Foundry Bay (east side) columns FH-13 to FH-74	At F-29 along long axis of building	Frayed fiberglass insulation; 5 or 6 fiberglass insulated pipes--poor condition
	At F-26 near ceiling	6 ft asbestos insulated pipe--poor to fair condition
	At F-50	Large number of fiberglass insulated pipe--20 feet are in poor condition
	At F-58 to F-59	20 ft fiberglass insulated pipe; fiberglass insulation--fair condition
North Foundry Bay and Process Line E-14 to E-34	Near roof	Fiberglass insulation--good condition

Table 4-1. Inventory of Insulation and Peeling Paint in Main Manufacturing Building (Continued, Page 2 of 4)

General Area	Specific Location	Approximate Quantity
Insulation (Continued)		
Tool room--Area 6		Some fiberglass insulation
Hutment area to E-57	Overhead	Fiberglass insulated pipe
Office area from E-55 to E-62	E-52	100 ft asbestos insulation--good condition
	E-58	Fiberglass insulated pipe--good condition
	E-59	Fiberglass insulation--good condition
	E-60	80 ft asbestos insulated pipe--good condition
	E-60	40 ft asbestos insulation, 2 ft on floor--poor condition
	E-62	6 ft asbestos insulation--poor condition
E-65 (north end)	Past phosphate area	600 ft fiberglass insulated pipe
E-79	Pipe from ceiling to floor	10 ft asbestos insulation--poor condition
Paint room	2nd floor room at 1st landing	Fiberglass insulation--good condition
Rooms behind X-ray room	Ground level	2 ft frayed asbestos insulation
	Basement	Fiberglass insulation,
	2nd floor	Frayed fiberglass insulation
22--Brick structure on east side H-58 to H-60	2nd floor	Fiberglass insulation
	Basement	Fiberglass insulation
	1st floor	4 ft asbestos insulation

Table 4-1. Inventory of Insulation and Peeling Paint in Main Manufacturing Building (Continued, Page 3 of 4)

General Area	Specific Location	Approximate Quantity
Peeling Paint		
Bounded by E-1 to C-1 and E-6 to C-6	On tank and guard rails	90 ft^2
Office area west side between E-6 and E-13	2nd floor--above fire crib each wall	200 ft
	2nd floor--above offices, 1st room on left	250 ft^2
Tool room	Door at E-11	10 ft^2
Restroom at E-12	Around door frame	10 ft^2
South Foundry Bay	Building at H-73	On door
North Foundry Bay and Process Line E-14 to E-34	Overhead crane at E-28	600 ft
Office area from E-55 to E-62	E-52	200 ft
	E-58 on door frame	10 ft^2
	E-58 on wall	2 ft^2
	E-58 on 6-ft pipe	2 ft^2
	E-59 door	On frame and door
	E-60 door	15 ft^2
	E-62 pipes	15 ft
E-65	Phosphate area	30 ft^2
E-65	Pipe	5 ft^2
E-69 to E-79	Overhead cranes in staging area	3,600 ft^2
Paint room	Pipe in 2nd floor room at 1st landing	10 ft
	1st floor inside door	21 ft^2
	Near door--pipe	30 ft
	4 electrical boxes	30 ft^2

Table 4-1. Inventory of Insulation and Peeling Paint in Main Manufacturing Building (Continued, Page 4 of 4)

General Area	Specific Location	Approximate Quantity
Peeling Paint (Continued)		
22--Brick structure on east side H-58 to H-60	2nd floor--stairway	30 ft^2
	1st floor--east wall	200 ft^2
	1st floor--west wall	20 ft^2
	1st floor-south wall	2 ft^2
Waste treatment plant	Pipes	600 ft
	Gratings	80 ft^2
	South wall	300 ft^2
	East wall	50 ft^2
	Electric boxes	20 ft^2
	Recovery tanks	<10 ft^2
	Flocculator tanks	20 ft^2
	Sludge ejector	60 ft^2
	Lime tanks	<50 ft^2

Source: ESE, 1982.

4. Friable asbestos and peeling paint occur as described in Table 4-1. The majority of the insulation in the building is fiberglass and appears in good repair. The unrenovated areas are mainly the office spaces along the north wall from about column 6 to column 35. Three hundred to 400 linear feet of asbestos insulation on pipes were inventoried in this building. The peeling paint was estimated to be approximately 6,000 square feet (ft^2). This represents less than 1 percent of the total painted surfaces in the Main Manufacturing Building. The major area of peeling paint is in the old office area from E-55 to E-62 and the overhead cranes.

No evidence of contamination by other toxic or hazardous material was found in the Main Manufacturing Building.

4.2 BUILDING 13--SHIPPING AND RECEIVING OFFICE/SCALE HOUSE

Building 13 contains only small amounts of peeling paint and asbestos as shown in Table 4-2. These would require removal prior to release. No other evidence of contamination by toxic or hazardous materials were found in this building.

4.3 BUILDING 14--OIL PUMP HOUSE

The following problems must be corrected prior to release of Building 14:

1. The peeling paint and asbestos (Table 4-2) must be disposed properly.
2. The POL stored in this building should be disposed properly, and the spill of POL on the first floor cleaned.

No other evidence of contamination by toxic or hazardous material was found in this building.

4.4 FORMER OIL TANK FARM

The Former Oil Tank Farm contains 10 to 20 spills of oily asphaltic material within the bermed area. One sample of this was found to

Table 4-2. Inventory of Insulation and Peeling Paint in the Other Buildings at GAAP

General Area	Specific Location	Approximate Quantity
Insulation		
Building 13	1st floor	200 ft fiberglass insulation 4 ft worn asbestos insulation
Building 14	Outside north 1st floor	90 ft asbestos insulation--bad condition 1,000 ft fiberglass insulated pipe 150 ft asbestos insulated pipe--bad condition 3 ft^3 pile asbestos on floor
Building 16	Basement 1st floor--north 2nd floor--north	Fiberglass insulation Fiberglass insulation Fiberglass insulation
Building 18		Fiberglass insulation in good condition; small amounts of asbestos
Building 20	2nd floor 1st floor Basement	Fiberglass insulation--good condition Asbestos & fiberglass insulation Fiberglass insulated pipe Asbestos insulation--poor condition
Building 21	Inside on top of light	40 ft fiberglass insulation 1 ft^2 insulating material which proved not to be asbestos when tested.
Building 25		No insulation
Building 47		No insulation
Building 31	Basement Boiler 1st floor 2nd floor	300 ft asbestos insulation--poor condition Some fiberglass insulation 90 ft^2 Asbestos insulation

Table 4-2. Inventory of Insulation and Peeling Paint in the Other Buildings at GAAP (Continued, Page 2 of 4)

General Area	Specific Location	Approximate Quantity
Insulation (Continued)		
Building 32	Area A--1st floor near roof	600 ft fiberglass insulated pipe Asbestos at end of pipe
	Area B	300 ft^2 fiberglass insulated equipment 5,000 ft fiberglass insulated pipe 1,000 ft asbestos insulation
	Area C	300 ft asbestos insulation
	2nd floor, 2 restrooms	40 ft asbestos insulation
	Basement	300 ft fiberglass insulated pipe 10 ft asbestos insulated pipe
	Crawl space	200 ft asbestos insulation 300 ft asbestos insulated pipe
Building 62	Machine shop area	50 ft asbestos insulation Some fiberglass insulation

Table 4-2. Inventory of Insulation and Peeling Paint in the Other Buildings at GAAP (Continued, Page 3 of 4)

General Area	Specific Location	Approximate Quantity
Peeling Paint		
Building 13	1st floor	20 ft^2
Building 14	Equipment on 1st floor	60 ft^2
Building 16	Basement	
	Foyer	2 ft^2
	Room to right of entrance	3 ft^2 on door frame
	Window frame	2 ft^2
	Wall at sprinkler control	60 ft^2
	Near bottom of stairs	10 ft^2
	Next to door frame	10 ft^2
	Movie room	15 ft^2
	1st floor--north	
	Walls and around windows	190 ft^2
	2nd floor--north	
	Room at northwest corner	20 ft^2
	Room south of stairway	20 ft^2
Building 18		No peeling paint
Building 20	2nd floor around doors	5 ft^2
	1st floor	70 ft^2
	Basement--northeast corner	20 ft^2
Building 21		No peeling paint
Building 25		No peeling paint
Building 47		No peeling paint
Building 31	Basement ceiling walls, doors, stairwell	2,500 ft^2
	1st floor--walls and around doors	300 ft^2
	2nd floor	130 ft^2

Table 4-2. Inventory of Insulation and Peeling Paint in the Other Buildings at GAAP (Continued, Page 4 of 4)

General Area	Specific Location	Approximate Quantity
Peeling Paint (Continued)		
Building 32	Area B	
	On boilers	1,200 ft^2
	On tanks	200 ft^2
	On compressors	400 ft^2
	Area C--water system pipe	100 ft
	2nd floor, 2 restroom basins	2 ft^2
Building 62	Foyer	50 ft^2
	Stairwell	100 ft^2

Source: ESE, 1982.

contain 450 micrograms per gram (ug/g) PCBs and 50 ug/g TCB. Because of the bermed configuration of this area and the concrete floor of the area, the contamination migration threat is minimal. PCB contamination in this area must be removed prior to release. No other evidence of contamination by toxic or hazardous materials was found in this building.

4.5 BUILDING 16--ADMINISTRATION BUILDING

This building is still in service and the inhabited portions are in good repair. The only contaminants which would require removal from this building are small quantities of peeling paint and friable asbestos as tabulated in Table 4-2. No other evidence of contamination by other toxic or hazardous materials was found in this area.

4.6 BUILDING 18--FIRE EQUIPMENT BUILDING

Friable asbestos, less than 10 linear feet, (Table 4-2) is the only contaminant in this building which must be removed prior to release. No other evidence of contamination by toxic or hazardous materials was found in Building 18.

4.7 BUILDING 20--QUALITY CONTROL LABORATORY

Peeling paint and friable asbestos are the only materials which must be removed from Building 20 prior to release. The amounts of each are shown in Table 4-2. No other evidence of contamination by toxic and hazardous materials was found.

4.8 BUILDING 21--COOLING TOWER BUILDING

No evidence of contamination by toxic or hazardous materials was found in Building 21, based on inspection and the records search. The insulating material tested did not contain asbestos. Building 21 may be released for unrestricted use with no decontamination action.

4.9 BUILDING 25--STORAGE BUILDING

No evidence of contamination by toxic or hazardous material was found in Building 25, based on inspection and the records search. Building 25 may be released for unrestricted use with no decontamination action.

4.10 BUILDING 47--BUTLER BUILDING

No evidence of contamination by toxic or hazardous materials was found in Building 47, based on the visual inspection and the records search. Building 47 may be released for unrestricted use with no decontamination action.

4.11 BUILDING 31--LEASED TO VULCAN MANUFACTURING COMPANY (SUBLEASED TO RAILROAD CONCRETE PRODUCTS COMPANY)

The unused areas of this building contain considerable amounts of peeling paint, friable asbestos, and other debris which must be removed prior to release. The sales office and showroom areas appeared to be in good condition. Small amounts of industrial chemicals are stored for sale in the former building safe. In the past (see Table 1-1), tenant activities were reported to include infra-red photo development and manufacture of graphical training aids. A developing sink located in the basement is evidence for this former activity. Developing wastes appeared to have been routed to the St. Louis sanitary sewer system.

Two 55-gallon drums, one of cutting oil and the other trichloroethane, and an empty herbicide can were present behind Building 31. The chemicals belong to Vulcan Manufacturing Company. The herbicide can should be disposed of properly.

Beyond the peeling paint and the asbestos, no evidence for residual contamination by toxic and hazardous materials exists in Building 31.

4.12 BUILDING 32--POWERHOUSE

Two types of contamination must be removed before release of Building 32:

1. Peeling paint and friable asbestos inventoried in Table 4-2 are present in relatively large quantities.
2. A biological health hazard is present on the main floor of Building 32. The area is used as a pigeon rookery and is covered by a layer of droppings and feathers. In the midwestern United States, pigeons carry histoplasmosis, a fungus disease of man. This disease may be contracted by breathing dust contaminated by the droppings.

The paint, asbestos, and droppings should be removed and the rookery area disinfected.

No evidence of residual contamination as a result of storage or disposal or wastes ash from the power generating activity was present. No other evidence of contamination by toxic or hazardous materials appear to be present in Building 32.

Exposed pits are located in Building 32. These pits are not covered by adequate bridging nor are they protected by guardrails. A walking hazard, which should be corrected before release of GAAP, is posed by these pits.

4.13 BUILDING 62--LEASED TO VULCAN MANUFACTURING COMPANY

The unused areas of this building contain considerable amounts of peeling paint and friable asbestos (Table 4-2) as well as much other debris. The paint and asbestos must be removed prior to release of Building 62. The present machine shop/metal stamping shop and office areas appeared to be in good condition. Small amounts of solvents and industrial chemicals are in use in the shop area. Wastes from these are either reclaimed or disposed as solid waste to the City of St. Louis.

Except for the peeling paint and friable asbestos, no other evidence of contamination by toxic or hazardous materials appeared to be present at Building 62.

5.0 CONCLUSIONS

1. Gateway Army Ammunition Plant (GAAP) cannot be released without restoration activities to correct the contamination and potential contamination migration problems summarized in the other conclusions numbered below. The only areas of GAAP which need no restoration are Buildings 21, 25, and 47. As a result of the magnitude of the unforeseen potential polychlorinated biphenyl (PCB) contamination of extensive areas in the Main Manufacturing Building and the Former Oil Tank Farm, an alternative cost assessment has been made which is based on a requirement to dispose of all hydraulic fluid as if it contained low levels of PCB. Release restricted to industrial use is the recommended alternative based on costs and the location of GAAP in an industrial area. Other considerations relevant to release options have not been addressed.

   Approximations of the costs of the required decontamination of the installation for unrestricted use and for industrial use are presented in Table 5-1. As shown, the cost for release restricted for industrial use is $23,750 and is approximately one-half the cost of $43,650, which will be required to allow release for unrestricted use. Appendix G contains the basic cost assumptions used to prepare the estimates. The estimated volumes of material have been tabulated in the respective paragraphs of Section 3.0 which deal with each contaminant.

2. Improper control of fluids during the hydraulic metal-forming equipment removal process has resulted in contamination of nearly all of the underlying areas of the Main Manufacturing Building by oil which may be contaminated by PCBs. Large areas of the floor of the Main Manufacturing Building also have spills of this oil. A similar hazard exists near transformer 6TS from which large amounts of PCB oil (ASKAREL) are leaking. Three other PCB transformers are leaking.

Table 5-1. Summary of Costs to Decontaminate GAAP Prior to Release

Contaminant†		Costs* to Release for: Unrestricted Use — Main Manufacturing Building	Unrestricted Use — Remainder of the Installation	Restricted Use — Main Manufacturing Building	Restricted Use — Remainder of the Installation
Leaked Transformer PCB Fluid (includes contents of transformer 6TS; 454 gallons; plus leaked material from other PCB transformers; Table 3-4)		$ 2,000	None	Same as unrestricted use	Same as unrestricted use
Hydraulic Fluid and Sludge (includes estimated hydraulic reservoir volumes and spilled material and sludge in sumps and sewer system)	(3,000 gal)	$ 6,240	None	Same as unrestricted use	Same as unrestricted use
Industrial Chemicals and POL	(490 gal)	$ 1,000	None (The chemical will be used)	Same as unrestricted use	Same as unrestricted use
PCB Material from Former Oil Tank Farm		$ 1,000	None	Same as unrestricted use	Same as unrestricted use
Feathers/Bird Droppings in Power House, Building 32	(5 days @ $900/day)	None	$4,500	Same as unrestricted use	Same as unrestricted use
Asbestos Insulation (Tables 4-1 and 4-2)	(473 ft)	$ 3,500	$18,570 (2,500 ft)	(<50 ft) $370	(750 ft) $5,570
Peeling Paint (Tables 4-1 and 4-2)	(6,000 ft^2) (5 barrels)	$ 3,560	$3,280 (5,500 ft^2) (5 barrels)	(650 ft^2) (1 barrel) $730	(4,000 ft^2) (2 barrels) $2,350
TOTAL COST			$43,650		$23,760

* Based on Appendix G. Labor rates/hour and air monitoring for asbestos and paint were assumed to be the same. The labor cost for cleanup of the rookery in Building 32 was estimated at the same rate per day less air monitoring.
† Details of locations and assumed qualities are contained in Section 3.0.

Source: ESE, 1982.

3. The potentially PCB-contaminated oil in the sumps and sewer systems of the Main Manufacturing Building must not be flushed to the River Des Peres Storm Channel or disposed of into the St. Louis solid waste collution system.

4. Material contaminated by PCBs exists in the bermed area which was the Former Oil Tank Farm. The migration potential for this contamination is low.

5. The solid sludges found in the sumps and underlying areas in the Main Manufacturing Building contain concentrations of cadmium, chromium, and lead which might render them hazardous wastes by virtue of the EP toxicity test. Because of the small total quantity of sludge, the most economical disposal option is to consider the material hazardous since cost of disposal is less than the cost of EP toxicity testing.

6. The lead content of all or nearly all of the chipping and peeling paint at GAAP exceeds the 0.06 percent maximum allowable for unrestricted use. The only buildings which have no peeling paint are Buildings 18, 21, 25, and 47. In order to prevent potential airborne lead concentrations above the American Conference of Governmental Hygienists limit some paint removal will be necessary prior to release of GAAP. In order to release the installation for industrial use only the peeling paint which poses an airborne lead hazard would need to be removed. In order to release GAAP for unrestricted use all peeling paint that poses an ingestion hazard would have to be removed. The removed paint would have to be disposed of as a hazardous waste or tested for potential toxicity or ignitability. Removal of paint for unrestricted use would represent 20 to 100 times the level of effort for release restricted to industrial use. Non-peeling paint does not require removal.

7. Some asbestos insulation removal will be required in order to release GAAP. Only Buildings 21, 25, and 47 contain no such insulation. Encapsulation rather than removal, however, is an option. The drawback to encapsulation is that periodic inspection is required to ensure the integrity of the capsule. This nearly precludes this method as a measure to allow unrestricted release because of lack of control of the area. The viable options range in level of effort as follows (from least to greatest):
   a. Encapsulation of frayed areas. Suitable for release for industrial use.
   b. Removal and disposal of asbestos from frayed areas in accordance with Occupational Safety and Health Agency (OSHA) regulations. Suitable for release for industrial use.
   c. Removal and disposal of all asbestos in accordance with OSHA regulations. Suitable for release for unrestricted use.

8. The fungus disease histoplasmosis is a health hazard present in Building 32, the Powerhouse, because the building is a pigeon rookery. Pigeons carry the disease, and it may be transmitted via dust from dried feces. The affected area must be cleaned and disinfected.

9. The uncovered pits in Building 32 constitute a safety hazard. This problem must be corrected prior to release.

10. Small amounts of petroleum, oil, lubricants (POL), and chemicals are stored in several of the buildings at GAAP. These should be removed and disposed of properly. One empty herbicide can must be disposed of properly. An oil spill exists in the Oil Pump House (Building 14). This must be cleaned up prior to release.

11. No other evidence of toxic or hazardous materials exist at GAAP as a result of past operations or current activity. No airborne contamination by cadmium, chromium, lead, zinc, mercury, or asbestos exists at GAAP.

6.0 RECOMMENDATIONS

1. Immediately assess the polychlorinated biphenyl (PCB) contamination status of the hydraulic metal-forming equipment and take appropriate corrective action to handle and dispose of PCB-contaminated fluids from this equipment in a proper manner. Corrective action is to consider equipment PCB-contaminated until proven otherwise.

2. Immediately label all PCB transformers and suspected PCB-contaminated equipment and transformers, repair all leaking items, clean up PCB spills, and properly dispose of PCB-contaminated material.

3. GAAP should immediately take the following actions to correct probable PCB contamination and to prevent exposure of Voss Machinery Company employees:
   a. Properly label all PCB transformers;
   b. Repair all leaking PCB transformers and properly clean up spills as described;
   c. Test all existing hydraulic reservoirs for PCB. Drain and properly dispose of all PCB-contaminated fluid (>50 ppm). Flush all reservoirs which contain greater than 1,000 ppm PCB with solvent and drain before removal; and
   d. Clean up and containerize all oil material spilled in the Main Manufacturing Building, in accordance with proper protocol for disposal of PCB-contaminated material.

   The drained waste material should be tested for PCB content and may be temporarily stored for 30 days in labeled, approved containers. Any PCB-contaminated material should be disposed through Defense Property Disposal Office (DPDO) in an approved manner. Requirements for storage on site are described in Federal Register, 44(106):31555-31556 (EPA, 1979b). Release of GAAP would be contingent upon the proper disposal of PCB-contaminated material,

proper decontamination, and removal of all PCB-contaminated equipment.

4. Ensure that potentially PCB-contaminated oil and water from the process sewer system basements and sumps of the Main Manufacturing Building is not allowed to be flushed to the River Des Peres storm channel.

5. Determine the disposal strategy for the PCB-contaminated materials in the Main Manufacturing Building and the PCB-contaminated material of the Former Oil Tank Farm, since these are major cost elements. The recommended strategy is the least costly option. This option is to batch test the waste oil material in the largest practicable amounts to minimize analytical costs and to remove visually detectable material and dispose as a PCB item. Soil testing for PCB could be limited to testing of residual surfaces.

6. Based on the strategy developed in Recommendation 4, determine the restrictions on release of GAAP most favorable to the Government.

7. Develop a written decontamination plan to provide for clearance for release of GAAP. This plan should include measures for:
   a. Asbestos Insulation Encapsulation/Removal: Buildings 13, 14, 16, 18, 20, 31, 32, 62, and the Main Manufacturing Building.
   b. Peeling Paint Removal: Buildings 13, 14, 16, 20, 31, 32, 62, and the Main Manufacturing Area.
   c. Removal of hydraulic equipment and transformers with petroleum, oil, and lubricant (POL) and PCB clean up in the Main Manufacturing Building.
   d. Removal of PCB-contaminated material from the Former Oil Tank Farm.
   e. Proper disposal of all containers of waste POL and chemicals.
   f. Clean up of the oil spill in Building 14.

g. Removal and disposal of solid sludges from the Main Manufacturing Building as hazardous waste.

h. Removal of the histoplasmosis hazard in Building 32, the Powerhouse.

The level of effort for release for unrestricted use versus industrial use is higher for Element a and Element b. The level of effort is the same for all other elements.

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APPENDIX A

COPIES OF RESULTS OF ANALYSIS
OF U.S. GOVERNMENT TRANSFORMERS AT GAAP

Performed by CHEMO-SERVICES Associates
St. Louis, Missouri

Original Reports are on File with the
Installation Manager, Gateway Army Ammunition Plant

Best Available Copy

Model _____ Type System Transformer

Unit No. T-1 Main Sub Type Fuel None Type Oil _____ Serial No. _____

Mi/Hrs/Wks/Mths on Sample	Mi/Hrs/Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS											
		Nickel (Ni)	Iron (Fe)	Magnesium (Mg)	Copper (Cu)	Silver (Ag)	Chromium (Cr)	Silicon (Si)	Aluminum (Al)	Tin (Sn)	Lead (Pb)	PBC		SAE No/ Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Detergent Action	Non-susp Solids % Volume	Susp Solids % Volume	% Water	% Glycol		
182		<0.1	0.2	<0.1	<0.1	<0.1	<0.1	2	0.2	1	0.2	ND		9.6	<.5	<.5	<.5	<.5	NA	—	—	<.5	ND	9.16	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	*	1	2	3	4	5	6	7	8
Tests indicate unit and oil are in satisfactory condition									
Abnormal wear and/or oil conditions indicated		X							
Critical wear and/or oil conditions indicated									
Circled Figures bear watching but do not require maintenance action. Condition will be evaluated again at the next sample									
Resample at normal interval ( )		X							
Resample at interval indicated									

ADDITIONAL COMMENTS

SAMPLE CONTAINS MINERAL OIL AND PCB DETECTED

MAINTENANCE RECOMMENDATIONS	*	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

A-1

SILMO SERVICES ASSOCIATES, INC.
2665 S. Brentwood Blvd. / St. Louis, Mo. 63144

Customer Gateway Ammo Co. Address 6703 Southwest Ave. St Louis Mo.

Make _____ Model _____ Type System Transformer

Unit No. T-2 Main Sub Type Fuel None Type Oil _____ Serial No. _____

Lead	Total Mi/ Hrs/ Wks/ Months	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS									
				Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PBC		SAE No/ Visc. @ 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Deters Action	Non-susp Solids % Volume	Susp Solids % Volume	% Water	% Glycol	
L&L				<0.1	0.3	<0.1	<0.1	<0.1	<0.1	3	0.2	0.7	0.2	NO		8.3	NIL	<.05	<.05	<.05	NA	—	—	<.05	NO	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	•	1	2	3	4	5	6	7	8
...sts indicate unit and oil are in satisfactory condition		X							
...normal wear and oil conditions indicated									
...ical wear and oil conditions indicated									
...cled Figures: Keep watching but do not require maintenance ...tion Condition will be evaluated again at the next sample									
...sample at ... intervals		X							
...samples at ... indicated									

ADDITIONAL COMMENTS

SAMPLE CONTAINS MINERAL OIL AND PCB DETECTED

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5	6	7
1 Drain oil								
2 Change oil filter								
3 Flush crankcase								
4 Check injector and valve timing								
5 Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6 Check injector/seals/fuel fittings/pump for leakage								
7 Check oil cooler for proper operation								
8 Check oil flow to and from filter								
9 Check crankcase breathing system for restrictions								
10 Flush cooling system								
11 Check air filter system for leakage (gasket, filter element, housing, etc.)								
12 Tighten (torque) head(s) to proper tension. See your engine manual								
13 Check head gasket(s), cylinder liners, oil cooler for water leakage								
14 Inspect for a cracked head or block								
15 Inspect main and conn rod bearings								
16 Check piston compression								
17 Inspect pistons, rings, cylinders and piston pin assemblies								
18 Inspect valves, valve seats and valve guides								
19 Inspect camshaft bearings/bushings								
20 Inspect gears for wear								
21 Inspect shafts for wear								
22 Inspect clutch plates (wet clutches)								

A-2

CHEMO-SERVICES ASSOCIATES, INC.
2948 S. Brentwood Blvd. / St. Louis, Mo. 63144

Customer Gateway Voss Mach Co. Address 6703 Southwest Ave. St Louis Mo. 63143

Make _____ Model _____ Type System Transformer

Unit No. 3TS Type Fuel None Type Oil _____ Serial No. _____

Sample No.	Total Mi/ Hrs/Wks/ Months	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT											PHYSICAL TESTS										
				Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PCB		SAE No./ Visc at 210°F	% Fuel Dilution	% Total Solids	% Sludge [Calc]	% Carbon [Soot]	% Detrg Action	Non-Asp Solids % Volume	Susp Solids % Volume	% Water	% Glycol	
177				0.7	0.6	<0.1	<0.1	<0.1	<0.1	2	0.2	0.7	0.3			9.76	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.0
178				0.2	<0.1	<0.1	0.1	<0.1	<0.1	2	0.1	0.5	0.2			9.8	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.03
179				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	3	0.1	1	0.2			9.8	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.04
181				<0.1	0.1	<0.1	<0.1	<0.1	<0.1	3	0.1	1	0.1			10.3	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.01
182				<0.1	0.2	<0.1	<0.1	<0.1	<0.1	2	0.3	0.6	0.2	ND		10.2	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.02

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	•	1	2	3	4	5	6	7	8
Indicate unit and oil are in satisfactory condition		X	X	X	X	X			
Normal wear and/or oil conditions indicated									
Wear and/or oil conditions indicated									
Figures bear watching but do not require maintenance Condition will be evaluated again at the next sample									
Sample at normal interval		X	X	X	X	X			
Sample at interval indicated									

ADDITIONAL COMMENTS

SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL = MINERAL OIL NO PCB DETECTED

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5	6	7	8
1. Drain oil									
2. Change oil filter									
3. Flush crankcase									
4. Check injector and valve timing									
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate									
6. Check injector/seals/fuel fittings/pump for leakage									
7. Check oil cooler for proper operation									
8. Check oil flow to and from filter									
9. Check crankcase breathing system for restrictions									
10. Flush cooling system									
11. Check air filter system for leakage (gasket, filter element, housing, etc.)									
12. Tighten (torque) head(s) to proper tension. See your engine manual									
13. Check head gasket(s), cylinder liners, oil cooler for water leakage									
14. Inspect for a cracked head or block									
15. Inspect main and conn rod bearings									
16. Check piston compression									
17. Inspect pistons, rings, cylinders and piston pin assemblies									
18. Inspect valves, valve seats and valve guides									
19. Inspect camshaft bearings/bushings									
20. Inspect gears for wear									
21. Inspect shafts for wear									
22. Inspect clutch plates (wet clutches)									

OK - ALL ITEMS

CHEMO SERVICES ASSOCIATES, INC.
2968 S. Brentwood Blvd. / St. Louis, Mo. 63144

Customer Voss Mach Co. Address 6703 Southwest Ave, St Louis Mo. 63143
Make _____ Model _____ Type System Transferer
Unit No. 478 Type Fuel None Type Oil _____ Serial No. _____

Total Mi. Hrs./Wks. Hours/m	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT											PHYSICAL TESTS										
			Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PCB		SAE No/ Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Debris Action	Non-soap Solids % Volume	Soap Solids % Volume	% Water	% Glycol	
1-77			0.6	0.6	<0.1	<0.1	<0.1	<0.1	2	0.4	1	0.6			9.80	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.02
178			0.5	0.2	<0.1	<0.1	<0.1	<0.1	2	0.1	4	0.3			9.9	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0
174			<0.1	0.1	<0.1	0.2	<0.1	<0.1	1	0.1	2	0.3			9.8	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0.1
181			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	3	0.1	1	0.1			10.3	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	<.05
182			<0.1	0.2	<0.1	<0.1	<0.1	<0.1	2	0.1	0.3	0.2	ND		9.7	NA	<.05	<.05	<.05	NA	—	—	<.05	NA	0

CIRCLED FIGURES INDICATE ABNORMAL VALUESI MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	•	1	2	3	4	5	6	7	8
...ts indicate unit and oil are in satisfactory condition		X	X	X	X	X			
...normal wear and/or oil conditions indicated									
...tical wear and/or oil conditions indicated									
...cled Figures bear watching but do not require maintenance ...ion Condition will be evaluated again at the next sample									
...sampling ...mal interval ( )		X	X	X	X	X			
...sample at interval indicated									

ADDITIONAL COMMENTS

SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL - MINERAL OIL NO PCB DETECTED

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

OK - ALL ITEMS

A-4

CHEMO SERVICES ASSOCIATES, INC.
2942 S. Brentwood Blvd. / St. Louis, Mo. 63144

Customer Voss Mach Co. Address 6703 Southwest Ave St. Louis Mo. 63143

Make _____ Model _____ Type System Transformer

Unit No. 5-TS Type Fuel None Type Oil _____ Serial No. _____

	Total Mi/ Hrs/ Wks/ Months	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS									
				Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PCB		SAE No/ Visc at 100%	% Fuel Dilution	% Total Solids	% Sludge [Gum]	% Carbon [Soot]	% Debris Action	Nonpump Solids % Volume	Acid % Value	% Water	% Soot	
19				<0.1	<0.1	<0.1	0.2	<0.1	<0.1	2	0.1	2	0.3			9.7	NA	<.05	<.05	<.05	NA	—	—	<.05	<.1	
11				<.1	<.1	<.1	<.1	<.1	<.1	4	0.1	1	0.2			10.4	NA	<.05	<.05	<.05	NA	—	—	<.05	<.1	
12				<0.1	0.2	<0.1	<0.1	<0.1	<0.1	3	0.1	0.6	0.2	ND.		9.8	NA	<.05	<.05	<.05	NA	—	—	<.05	<.1	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	*	1	2	3	4	5	6	7	8
...s indicate unit and oil are in satisfactory condition		X	X	X					
...ormal wear and/or oil conditions indicated									
...tal wear and/or oil conditions indicated									
...ted Figures bear watching but do not require maintenance ...on. Condition will be evaluated again at the next sample									
...mple at normal interval ( )		X	X	X					
...mple at interval indicated									

MAINTENANCE RECOMMENDATIONS	*	1	2	3	4	5	6
1. Drain oil							
2. Change oil filter							
3. Flush crankcase							
4. Check injector and valve timing							
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate							
6. Check injector/seals/fuel fittings/pump for leakage							
7. Check oil cooler for proper operation							
8. Check oil flow to and from filter							
9. Check crankcase breathing system for restrictions							
10. Flush cooling system							
11. Check air filter system for leakage (gasket, filter element, housing, etc.)							
12. Tighten (torque) head(s) to proper tension. See your engine manual							
13. Check head gasket(s), cylinder liners, oil cooler for water leakage							
14. Inspect for a cracked head or block							
15. Inspect main and conn rod bearings							
16. Check piston compression							
17. Inspect pistons, rings, cylinders and piston pin assemblies							
18. Inspect valves, valve seats and valve guides							
19. Inspect camshaft bearings/bushings							
20. Inspect gears for wear							
21. Inspect shafts for wear							
22. Inspect clutch plates (wet clutches)							

ITIONAL COMMENTS

SAMPLE NORMAL
SAMPLE NORMAL
SAMPLE NORMAL — MINERAL OIL NO PCB DETECTED

A-5

CHEMSERVICES ASSOCIATES, INC.
[illegible] Brentwood Blvd. / St. Louis, Mo. 63144

Customer: Gateway Ammo Co. Address: 6703 Southwest Ave St. Louis Mo.

Make: _____ Model: _____ Type System: Transformer

Unit No.: Basement #6 Type Fuel: None Type Oil: _____ Serial No.: _____

Date Sampled	Total Mi/Hrs/Wks/Months	Mi/Hrs/Wks/Mths on Sample	Mi/Hrs/Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS									
				Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PBC		SAE Non-Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Debris Action	Non-comp Solids % Volume	Comp Solids % Volume	% Water	% Glycol	
1/80				<0.1	0.1	<0.1	<0.1	<0.1	<0.1	1.0	0.1	1	<0.1			10.2	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	
1/81				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	5	0.1	1	0.2			10.3	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	
1/82				0.6	0.4	<0.1	0.3	<0.1	<0.1	1.2	0.2	0.3	0.4	STR		9.76	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	0.03

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	•	1	2	3	4	5	6	7	8
[illegible] are in satisfactory condition		X	X	X					
[illegible] conditions indicated									
[illegible] conditions indicated									
[illegible] but do not require maintenance [illegible] evaluated again at the next sample									
[illegible]		X	X	X					
[illegible]									

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

ADDITIONAL COMMENTS

SAMPLE NORMAL

SAMPLE NORMAL

SAMPLE NORMAL FLUID IS ALMOST PURE PBC

Type Fuel NONE Type Oil Serial No.

Total Mi/Hrs/Kms/Hrs	Mi/Hrs/Wks/Mths on Sample	Mi/Hrs/Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS										
			Nickel (Ni)	Iron (Fe)	Magnesium (Mg)	Copper (Cu)	Silver (Ag)	Chromium (Cr)	Silicon (Si)	Aluminum (Al)	Tin (Sn)	Lead (Pb)	PCB		Oxidation Value at 110°C	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Chemical Action	Non-Metallic Solids % Volume	Soot % Volume	% Water	% Glycol	
80			<0.1	0.1	<0.1	<0.1	<0.1	<0.1	1	0.1	1	0.2													
82			0.3	0.5	<0.1	0.2	<0.1	<0.1	2	0.2	0.8	0.6	STR		10.3	NIL	<.05	<.05	<.05	NA	—	—	<.05	ND	
															10.9	NIL	<.05	<.05	<.05	NA	—	—	<.05	ND	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	*	1	2	3	4	5	6	7	8
...ers indicate unit and oil are in satisfactory condition		X	X						
...normal wear and/or oil conditions indicated									
...tical wear and/or oil conditions indicated									
...rcled Figures bear watching but do not require maintenance ...tion Condition will be evaluated again at the next sample									
...sample at normal interval ( )		X	X						
...sample at interval indicated									

MAINTENANCE RECOMMENDATIONS	*	1	2	3	4	5	6
1. Drain oil							
2. Change oil filter							
3. Flush crankcase							
4. Check injector and valve timing							
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate							
6. Check injector/seals/fuel fittings/pump for leakage							
7. Check oil cooler for proper operation							
8. Check oil flow to and from filter							
9. Check crankcase breathing system for restrictions							
10. Flush cooling system							
11. Check air filter system for leakage (gasket, filter element, housing, etc.)							
12. Tighten (torque) head(s) to proper tension. See your engine manual							
13. Check head gasket(s), cylinder liners, oil cooler for water leakage							
14. Inspect for a cracked head or block							
15. Inspect main and conn rod bearings							
16. Check piston compression							
17. Inspect pistons, rings, cylinders and piston pin assemblies							
18. Inspect valves, valve seats and valve guides							
19. Inspect camshaft bearings/bushings							
20. Inspect gears for wear							
21. Inspect shafts for wear							
22. Inspect clutch plates (wet clutches)							

...DITIONAL COMMENTS

SAMPLE NORMAL

SAMPLE NORMAL. FLUID IS ALMOST PURE PEG

CHEMICAL SERVICES ASSOCIATES, INC.
[illegible]wood) Blvd. / St. Louis, Mo. 63144

Customer Gateway Ammo Co. Address 6703 Southwest Ave St Louis Mo.

Make _____ Model _____ Type System Transformer

Unit No. # 2 Sub 8 Type Fuel None Type Oil _____ Serial No. _____

Unit Hrs. Used	Total Mi. Hrs. Wks. Months	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS										
				Nickel (Ni)	Iron (Fe)	Magnesium (Mg)	Copper (Cu)	Silver (Ag)	Chromium (Cr)	Silicon (Si)	Aluminum (Al)	Tin (Sn)	Lead (Pb)			SAE-Nor Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Deterg Action	Non-susp Solids % Volume	Susp Solids % Volume	% Water	% Glycol	
180				<0.1	0.1	<0.1	<0.1	<0.1	<0.1	1	0.1	1	0.3			10.1	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	
182				0.2	0.5	<0.1	0.1	<0.1	0.1	2	0.2	0.8	0.6			10.9	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	•	1	2	3	4	5	6	7	8
...ults indicate unit and oil are in satisfactory condition		X	X						
...abnormal wear and/or oil conditions indicated									
...critical wear and/or oil conditions indicated									
...circled figures bear watching but do not require maintenance ...ation. Condition will be evaluated again at the next sample									
...sample at normal interval ( )		X	X						
...sample at interval indicated									

ADDITIONAL COMMENTS

SAMPLE DRAINED

Sample NORMAL. FLUID IS ALMOST PURE PCB

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5
1. Drain oil						
2. Change oil filter						
3. Flush crankcase						
4. Check injector and valve timing						
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate						
6. Check injector/seals/fuel fittings/pump for leakage						
7. Check oil cooler for proper operation						
8. Check oil flow to and from filter						
9. Check crankcase breathing system for restrictions						
10. Flush cooling system						
11. Check air filter system for leakage (gasket, filter element, housing, etc.)						
12. Tighten (torque) head(s) to proper tension. See your engine manual						
13. Check head gasket(s), cylinder liners, oil cooler for water leakage						
14. Inspect for a cracked head or block						
15. Inspect main and conn rod bearings						
16. Check piston compression						
17. Inspect pistons, rings, cylinders and piston pin assemblies						
18. Inspect valves, valve seats and valve guides						
19. Inspect camshaft bearings/bushings						
20. Inspect gears for wear						
21. Inspect shafts for wear						
22. Inspect clutch plates (wet clutches)						

...CES ASSOCIATES, INC.
...Blvd. / St. Louis, Mo 63144

Customer ... Address ...

Make ... Model ... Type System Transformer

Unit No. T-1, Sub 9 Type Fuel None Type Oil ... Serial No. ...

Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS										
	Nickel (Ni)	Iron (Fe)	Magnesium (Mg)	Copper (Cu)	Silver (Ag)	Chromium (Cr)	Silicon (Si)	Aluminum (Al)	Tin (Sn)	Lead (Pb)	PCB		SAE No Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Detrg Action	Non-Lub Solids % Volume	Susp Solids % Volume	% Water	% Glycol	Acidity
	0.6	0.5	<0.1	0.2	<0.1	<0.1	3	0.1	0.7	0.6	STR		10.8	NIL	<0.5	<0.5	<0.5	NA	—	—	<0.5	NO	0.02

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

	*	1	2	3	4	5	6	7	8
...in satisfactory condition		X							
...conditions indicated									
...ations indicated									
...ens do not require maintenance ...ated again at the next sample									
)		X							

MAINTENANCE RECOMMENDATIONS	*	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air/fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. ...k crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

...ENTS

SAMPLE ...IGINAL - FLUID IS ALMOST PURE PBC

...IVICES ASSOCIATES, INC.
...d Blvd. / St. Louis, Mo. 63144

Customer Gateway Ammo Co. Address 6703 Southwest Ave St Louis Mo.

Make _____ Model _____ Type System Transformer

Unit No. T-2, Sub 9 Type Fuel None Type Oil _____ Serial No. _____

...Hrs/ ...Mths ...ample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS										
		Nickel [Ni]	Iron [Fe]	Magnesium [Mg]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]			SAE No/ Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Deters Action	Non-susp Solids % Volume	Susp Solids % Volume	% Water	% Glycol	Acids
		0.4	0.4	<0.1	0.2	<0.1	<0.1	1	0.4	0.6	0.4			10.7	NIL	<0.5	<0.5	<0.5	NA	-	—	<0.5	ND	0.82

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

...NGLE OBSERVATIONS	•	1	2	3	4	5	6	7	8
...s indicate ... are in satisfactory condition		X							
...normal wear ... conditions indicated									
...ical wear ... conditions indicated									
...ed ... but do not require maintenance ... evaluated again at the next sample									
...		X							
...									

...TIONAL COMMENTS

...MPLE = Fluid Almost Pure PBC

MAINTENANCE RECOMMENDATIONS	•	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush couling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

SERVICES ASSOCIATES, INC.
...wood Blvd. / St. Louis, Mo. 63144

Make _____ Model _____ Type System Transformer

Unit No. # 1 Sub 10 Type Fuel None Type Oil _____ Serial No. _____

Sample No.	Date Sample Taken	Mi/Hrs/ Wks/Mths on Sample	Mi/Hrs/ Wks/Mths on Filter	CONCENTRATION EXPRESSED IN PARTS PER MILLION BY WEIGHT												PHYSICAL TESTS										
				Nickel (Ni)	Iron (Fe)	Magnesium (Mg)	Copper (Cu)	Silver (Ag)	Chromium (Cr)	Silicon (Si)	Aluminum (Al)	Tin (Sn)	Lead (Pb)	PBC		SAE Nor. Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Detergent Action	Non-susp Solids % Volume	Susp Solids % Volume	% Water	% Glycol	
160				<0.1	0.1	<0.1	<0.1	<0.1	<0.1	1	0.1	1	0.3			10.5	NIL	<.05	<.05	<.05	NA	—	—	<.05	ND	
82				0.2	0.4	0.1	0.2	<0.1	<0.1	2	0.2	0.7	0.4	MOD		11.0	NIL	<05	<05	<05	NA	—	—	<05	ND	

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS	*	1	2	3	4	5	6	7	8
...sis indicate unit and oil are in satisfactory condition		X	X						
...normal wear and/or oil conditions indicated									
...tical wear and/or oil conditions indicated									
...rcled figures bear watching but do not require maintenance ...tion. Condition will be evaluated again at the next sample									
... ...)		X	X						
... ... indicated									

ADDITIONAL COMMENTS

SAMPLE NORMAL

SAMPLE NORMAL. FLUID MIXTURE OF MINERAL OIL & PBC.

MAINTENANCE RECOMMENDATIONS	*	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

Serial No.

Iron [Fe]	Molybdenum [Mo]	Copper [Cu]	Silver [Ag]	Chromium [Cr]	Silicon [Si]	Aluminum [Al]	Tin [Sn]	Lead [Pb]	PBC
<0.1	0.1	<0.1	<0.1	<0.1	<0.1	1	0.1	2	0.3	
0.2	0.5	0.1	0.2	<0.1	0.1	2	0.2	0.5	0.5	STR

PHYSICAL TESTS

SSU Visc at 100°F	% Fuel Dilution	% Total Solids	% Sludge (Gum)	% Carbon (Soot)	% Debris Action	Non-sep Solids % Volume	Sep Solids % Volume	% Water	% Glycol
10.3	NIL	<.05	<.05	<.05	NA	—	—	<.05	ND
10.7	NIL	<.05	<.05	<.05	NA	—	—	<.05	ND

CIRCLED FIGURES INDICATE ABNORMAL VALUES! MAINTENANCE THAT MAY BE REQUIRED IS INDICATED BY AN "X" IN THE APPLICABLE BOX BELOW. PLEASE ADVISE US OF YOUR FINDINGS.

CONDITION STATUS

	*	1	2	3	4	5	6	7	8
...ere in satisfactory condition									
...conditions indicated		X	X						
...ditions indicated									
...but do not require maintenance ...evaluated again at the next sample									
)		X	X						

MAINTENANCE RECOMMENDATIONS

	*	1	2	3	4	5	6	7
1. Drain oil								
2. Change oil filter								
3. Flush crankcase								
4. Check injector and valve timing								
5. Air-fuel ratio is incorrect. Check air intake for restriction. Check injector nozzles/fuel delivery rate								
6. Check injector/seals/fuel fittings/pump for leakage								
7. Check oil cooler for proper operation								
8. Check oil flow to and from filter								
9. Check crankcase breathing system for restrictions								
10. Flush cooling system								
11. Check air filter system for leakage (gasket, filter element, housing, etc.)								
12. Tighten (torque) head(s) to proper tension. See your engine manual								
13. Check head gasket(s), cylinder liners, oil cooler for water leakage								
14. Inspect for a cracked head or block								
15. Inspect main and conn rod bearings								
16. Check piston compression								
17. Inspect pistons, rings, cylinders and piston pin assemblies								
18. Inspect valves, valve seats and valve guides								
19. Inspect camshaft bearings/bushings								
20. Inspect gears for wear								
21. Inspect shafts for wear								
22. Inspect clutch plates (wet clutches)								

...AL FLUID IS ALMOST PURE PBC

APPENDIX B

SAMPLE LOCATION, IDENTIFICATION, AND COORDINATES: DATA FILE GWSAGMA82099

43	GWSAGMABLDGM18	A1001	520	284	M1	LOC
44	GWSAGMABLDGM18	A1002	520	284	M1	LOC
45	GWSAGMABLDGM2TS	N0504	465	283	M1	LOC
46	GWSAGMABLDGM23	K1001	558	290	M1	LOC
47	GWSAGMABLDGM24T2	F2006	539	322	M1	LOC
48	GWSAGMABLDGM29	F0001	552	346	M1	LOC
49	GWSAGMABLDGM31	K0001	561	353	M1	LOC
50	GWSAGMABLDGM31	K1001	571	342	M1	LOC
51	GWSAGMABLDGM35	K0001	586	367	M1	LOC
52	GWSAGMABLDGM39	A1001	603	389	M1	LOC
53	GWSAGMABLDGM41	A1001	656	363	M1	LOC
54	GWSAGMABLDGM41	A1002	656	363	M1	LOC
55	GWSAGMABLDGM43	K1001	637	396	M1	LOC
56	GWSAGMABLDGM43	K1002	637	396	M1	LOC
57	GWSAGMABLDGM47	A1001	648	424	M1	LOC
58	GWSAGMABLDGM47	A1002	648	424	M1	LOC
59	GWSAGMABLDGM57	F1001	702	436	M1	LOC
60	GWSAGMABLDGM57	F1002	702	436	M1	LOC
61	GWSAGMABLDGM57	K1001	693	448	M1	LOC
62	GWSAGMABLDGM57	P1001	691	455	M1	LOC
63	GWSAGMABLDGM57	W1001	690	458	M1	LOC
64	GWSAGMABLDGM58	W1001	701	461	M1	LOC
65	GWSAGMABLDGM60	P1001	709	469	M1	LOC
66	GWSAGMABLDGM65	A1001	732	476	M1	LOC
67	GWSAGMABLDGM65	W1001	736	475	M1	LOC
68	GWSAGMABLDGM66	K1001	739	481	M1	LOC
69	GWSAGMABLDGM78	A2001	823	509	M1	LOC
70	GWSAGMABLDGM79	A1001	821	519	M1	LOC
71	GWSAGMABLDGM79	P1001	798	544	M1	LOC
72	GWSAGMABLDGM79	P1002	798	544	M1	LOC
73	GWSAGMABLDGM79	W1001	814	523	M1	LOC
74	GWSAGMABLDGM79	W1002	814	523	M1	LOC
75	GWSAGMABLDGM9T2	F2005	476	239	M1	LOC
76	GWSAGMABLDGTF1	E1801	863	584	M1	LOC
77	GWSAGMABLDGTF2	E0402	833	584	M1	LOC

EOF:77

1	GWSAGMABLDGB13	A1001	841	522	M1	LOC
2	GWSAGMABLDGB14	A1001	830	563	M1	LOC
3	GWSAGMABLDGB14	N0101	835	567	M1	LOC
4	GWSAGMABLDGB14	P1001	828	559	M1	LOC
5	GWSAGMABLDGB16	A0001	382	181	M1	LOC
6	GWSAGMABLDGB16	A1001	373	167	M1	LOC
7	GWSAGMABLDGB16	W1001	386	205	M1	LOC
8	GWSAGMABLDGB18	A0001	430	189	M1	LOC
9	GWSAGMABLDGB18	A1001	438	179	M1	LOC
10	GWSAGMABLDGB18	E0501	427	196	M1	LOC
11	GWSAGMABLDGB20	A0001	449	296	M1	LOC
12	GWSAGMABLDGB20	A2001	445	289	M1	LOC
13	GWSAGMABLDGB20	E0201	454	302	M1	LOC
14	GWSAGMABLDGB20	F0001	445	293	M1	LOC
15	GWSAGMABLDGB20	P1001	440	284	M1	LOC
16	GWSAGMABLDGB21	A0001	470	317	M1	LOC
17	GWSAGMABLDGB21	Q1001	476	321	M1	LOC
18	GWSAGMABLDGB31	A0001	197	129	M1	LOC
19	GWSAGMABLDGB31	A0002	197	129	M1	LOC
20	GWSAGMABLDGB31	A1001	206	128	M1	LOC
21	GWSAGMABLDGB31	N0501	210	138	M1	LOC
22	GWSAGMABLDGB31	P1001	200	130	M1	LOC
23	GWSAGMABLDGB31	Q0001	186	136	M1	LOC
24	GWSAGMABLDGB31	Q0002	186	136	M1	LOC
25	GWSAGMABLDGB31	W0001	202	129	M1	LOC
26	GWSAGMABLDGB31	W1001	192	123	M1	LOC
27	GWSAGMABLDGB32	A0001	298	214	M1	LOC
28	GWSAGMABLDGB32	A1001	302	192	M1	LOC
29	GWSAGMABLDGB32	A1002	302	192	M1	LOC
30	GWSAGMABLDGB32	P0001	283	201	M1	LOC
31	GWSAGMABLDGB32	P1001	291	197	M1	LOC
32	GWSAGMABLDGB32	Q1001	298	203	M1	LOC
33	GWSAGMABLDGB62	A1001	226	154	M1	LOC
34	GWSAGMABLDGB62	A1002	240	143	M1	LOC
35	GWSAGMABLDGB62	A1003	240	143	M1	LOC
36	GWSAGMABLDGMM	E0501	797	549	M1	LOC
37	GWSAGMABLDGM04	A2001	461	208	M1	LOC
38	GWSAGMABLDGM05	A1001	436	250	M1	LOC
39	GWSAGMABLDGM06	K0001	458	229	M1	LOC
40	GWSAGMABLDGM10	P1001	464	261	M1	LOC
41	GWSAGMABLDGM14	F1001	492	268	M1	LOC
42	GWSAGMABLDGM17	Q1001	520	277	M1	LOC

APPENDIX C

CHEMICAL DATA FILES

GWSACBI82105

GWSACBX82105

GWSACSW82105

GWSACSE82105

SWSACSO82105

```
1:GWSACBI82054C  BLDGB16  A10010000K82078ESAMF001CD  7SLT7.000-04MGM3.801121215MUR
2:GWSACBI82054C  BLDGB18  A10010000K82078ESAMF002CD  7SLT7.000-04MGM3.801121215MUR
3:GWSACBI82054C  BLDGB18  A00010305K82078ESAMF003CD  7SLT7.000-04MGM3.801121215MUR
4:GWSACBI82055C  BLDGB32  A10010000K82078ESAMF004CD  7SLT7.000-04MGM3.801121215MUR
5:GWSACBI82055C  BLDGB32  A10020000K82078ESAMF005CD  7SLT7.000-04MGM3.801121215MUR
6:GWSACBI82055C  BLDGB31  A10010000K82078ESAMF006CD  7SLT7.000-04MGM3.801121215MUR
7:GWSACBI82055C  BLDGB32  A00010305K82078ESAMF007CD  7SLT7.000-04MGM3.801121215MUR
8:GWSACBI82055C  BLDGB62  A10030000K82078ESAMF008CD  7SLT7.000-04MGM3.801121215MUR
9:GWSACBI82055C  BLDGB62  A10010000K82078ESAMF009CD  7SLT7.000-04MGM3.801121215MUR
10:GWSACBI82055C  BLDGB62  A10020000K82078ESAMF010CD  7SLT7.000-04MGM3.801121215MUR
11:GWSACBI82056C  BLDGB31  A00020305K82078ESAMF011CD  7SLT7.000-04MGM3.801121215MUR
12:GWSACBI82056C  BLDGB31  A00010305K82078ESAMF012CD  7SLT7.000-04MGM3.801121215MUR
13:GWSACBI82048C  BLDGM05  A10010000K82078ESAMF017CD  7SLT7.000-04MGM3.801121215MUR
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17:GWSACBI82049C  BLDGM41  A10020000K82078ESAMF023CD  7SLT7.000-04MGM3.801121215MUR
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19:GWSACBI82049C  BLDGM41  A10010000K82078ESAMF025CD  7SLT7.000-04MGM3.801121215MUR
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21:GWSACBI82049C  BLDGM78  A2001-305K82078ESAMF027CD  7SLT7.000-04MGM3.801121215MUR
22:GWSACBI82049C  BLDGM18  A10010000K82078ESAMF028CD  7SLT7.000-04MGM3.801121215MUR
23:GWSACBI82053C  BLDGB16  A00010305K82078ESAMF032CD  7SLT7.000-04MGM3.801121215MUR
24:GWSACBI82053C  BLDGB20  A00010305K82078ESAMF033CD  7SLT7.000-04MGM3.801121215MUR
25:GWSACBI82053C  BLDGB14  A10010000K82078ESAMF034CD  7SLT7.000-04MGM3.801121215MUR
26:GWSACBI82053C  BLDGB21  A00010305K82078ESAMF035CD  7SLT7.000-04MGM3.801121215MUR
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28:GWSACBI82053C  BLDGB13  A10010000K82078ESAMF037CD  7SLT7.000-04MGM3.801121215MUR
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30:GWSACBI82053C  BLDGB20  A2001-305K82078ESAMF039CD  7SLT7.000-04MGM3.801121215MUR
31:GWSACBI82048C  BLDGM05  A10010000K82078ESAMG001CR  7S  9.676-03MGM3.816769.15MUR
32:GWSACBI82050C  BLDGM39  A10010000K82078ESAMG004CR  7S  6.981-03MGM3.816769.15MUR
33:GWSACBI82050C  BLDGM47  A10010000K82078ESAMG005CR  7S  6.001-03MGM3.816769.15MUR
34:GWSACBI82050C  BLDGM47  A10020000K82078ESAMG006CR  7S  6.246-03MGM3.816769.15MUR
35:GWSACBI82049C  BLDGM41  A10020000K82078ESAMG007CR  7S  6.859-03MGM3.816769.15MUR
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37:GWSACBI82049C  BLDGM41  A10010000K82078ESAMG009CR  7S  6.246-03MGM3.816769.15MUR
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40:GWSACBI82049C  BLDGM18  A10010000K82078ESAMG012CR  7S  4.777-03MGM3.816769.15MUR
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42:GWSACBI82053C  BLDGB20  A00010305K82078ESAMG017CR  7S  5.634-03MGM3.816769.15MUR
43:GWSACBI82053C  BLDGB14  A10010000K82078ESAMG018CR  7S  3.674-03MGM3.816769.15MUR
44:GWSACBI82053C  BLDGB21  A00010305K82078ESAMG019CR  7S  4.532-03MGM3.816769.15MUR
45:GWSACBI82053C  BLDGM65  A10010000K82078ESAMG020CR  7S  3.919-03MGM3.816769.15MUR
46:GWSACBI82053C  BLDGB13  A10010000K82078ESAMG021CR  7S  3.797-03MGM3.816769.15MUR
47:GWSACBI82053C  BLDGM79  A10010000K82078ESAMG022CR  7S  6.124-03MGM3.816769.15MUR
48:GWSACBI82053C  BLDGB20  A2001-305K82078ESAMG023CR  7S  4.777-03MGM3.816769.15MUR
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53:GWSACBI82055C  BLDGB32  A10020000K82078ESAMG029CR  7S  5.634-03MGM3.816769.15MUR
54:GWSACBI82055C  BLDGB31  A10010000K82078ESAMG030CR  7S  6.491-03MGM3.816769.15MUR
55:GWSACBI82055C  BLDGB32  A00010305K82078ESAMG031CR  7S  3.062-03MGM3.816769.15MUR
56:GWSACBI82055C  BLDGB62  A10030000K82078ESAMG032CR  7S  2.450-03MGM3.816769.15MUR
57:GWSACBI82055C  BLDGB62  A10010000K82078ESAMG033CR  7S  4.042-03MGM3.816769.15MUR
58:GWSACBI82055C  BLDGB62  A10020000K82078ESAMG034CR  7S  3.797-03MGM3.816769.15MUR
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62:GWSACBI82050C  BLDGM39  A10010000K82078ESAMH004PB  7SLT3.000-03MGM3.960180115MUR
63:GWSACBI82050C  BLDGM47  A10010000K82078ESAMH005PB  7SLT3.000-03MGM3.960180115MUR
64:GWSACBI82050C  BLDGM47  A10020000K82078ESAMH006PB  7SLT3.000-03MGM3.960180115MUR
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 67:GWSACBI82049C  BLDGM41  A10010000K82078ESAMH009PB   7SLT3.000-03MGM3.960180115MUR
 68:GWSACBI82049C  BLDGM04  A2001-305K82078ESAMH010PB   7SLT3.000-03MGM3.960180115MUR
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 82:GWSACBI82055C  BLDGB32  A10010000K82078ESAMH028PB   7SLT3.000-03MGM3.960180115MUR
 83:GWSACBI82055C  BLDGB32  A10020000K82078ESAMH029PB   7SLT3.000-03MGM3.960180115MUR
 84:GWSACBI82055C  BLDGB31  A10010000K82078ESAMH030PB   7SLT3.000-03MGM3.960180115MUR
 85:GWSACBI82055C  BLDGB32  A00010305K82078ESAMH031PB   7SLT3.000-03MGM3.960180115MUR
 86:GWSACBI82055C  BLDGB62  A10030000K82078ESAMH032PB   7SLT3.000-03MGM3.960180115MUR
 87:GWSACBI82055C  BLDGB62  A10010000K82078ESAMH033PB   7S  7.000-03MGM3.960180115MUR
 88:GWSACBI82055C  BLDGB62  A10020000K82078ESAMH034PB   7SLT3.000-03MGM3.960180115MUR
 89:GWSACBI82056C  BLDGB31  A00020305K82078ESAMH035PB   7SLT3.000-03MGM3.960180115MUR
 90:GWSACBI82056C  BLDGB31  A00010305K82078ESAMH036PB   7SLT3.000-03MGM3.960180115MUR
 91:GWSACBI82054C  BLDGB18  A10010000K82089ESAMJ001HG   2DLT1.100-03MGM31.1010.205MUR
 92:GWSACBI82054C  BLDGB18  A00010305K82089ESAMJ002HG   2DLT1.100-03MGM31.1010.205MUR
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19:GWSACBX82050C BLDGMM   E05010000K82078ESAMF030CD     7SLT7.000-04MGM3.801121215MUR
20:GWSACBX82054C BLDGB20  E02010000K82078ESAMF031CD     7SLT7.000-04MGM3.801121215MUR
21:GWSACBX82050C BLDGB31  N05010000K82078ESAMF040CD     7SLT7.000-04MGM3.801121215MUR
22:GWSACBX82050C BLDGB18  E05010000K82078ESAMG013CR     7S  5.512-03MGM3.816769.15MUR
23:GWSACBX82050C BLDGMM   E05010000K82078ESAMG014CR     7S  4.409-03MGM3.816769.15MUR
24:GWSACBX82054C BLDGB20  E02010000K82078ESAMG015CR     7S  5.512-03MGM3.816769.15MUR
25:GWSACBX82050C BLDGB31  N05010000K82078ESAMG024CR     7S  4.287-03MGM3.816769.15MUR
26:GWSACBX82050C BLDGB18  E05010000K82078ESAMH013PB     7SLT3.000-03MGM3.960180115MUR
27:GWSACBX82050C BLDGMM   E05010000K82078ESAMH014PB     7SLT3.000-03MGM3.960180115MUR
28:GWSACBX82054C BLDGB20  E02010000K82078ESAMH015PB     7SLT3.000-03MGM3.960180115MUR
29:GWSACBX82050C BLDGB31  N05010000K82078ESAMH024PB     7SLT3.000-03MGM3.960180115MUR
30:GWSACBX82050C BLDGB18  E05010000K82089ESAMJ028HG     2DLT1.100-03MGM31.1010.205DYL
31:GWSACBX82050C BLDGMM   E05010000K82089ESAMJ029HG     2DLT1.100-03MGM31.1010.205DYL
32:GWSACBX82054C BLDGB20  E02010000K82089ESAMJ030HG     2DLT1.100-03MGM31.1010.205DYL
33:GWSACBX82050C BLDGB31  N05010000K82089ESAMJ039HG     2DLT1.100-03MGM31.1010.205DYL
34:GWSACBX82050C BLDGB18  E05010000K82090ESAMI013ZN     1N  8.800-03MGM31.07174505BER
35:GWSACBX82050C BLDGMM   E05010000K82090ESAMI014ZN     1NLT6.600-03MGM31.07174505BER
36:GWSACBX82054C BLDGB20  E02010000K82090ESAMI015ZN     1N  1.840-02MGM31.07174.05BER
37:GWSACBX82049C BLDGB31  N05010000K82090ESAMI024ZN     1NLT6.600-03MGM31.07174505BER
38:GWSACBX82053C BLDGTF1  E18010000GB2060ESALV009TRIBZ 2M  5.000+01UGG .761999.10GAR
39:GWSACBX82049C BLDGB31  N0501   0K82077ESAMT024ASBESTOOLT3.000-02FCM3          UBT
40:GWSACBX82049C BLDGB18  E0501   0K82077ESAMT013ASBESTOOLT3.000-02FCM3          UBT
41:GWSACBX82053C BLDGB20  E0201   0K82077ESAMT015ASBESTOOLT3.000-02FCM3          UBT
42:GWSACBX82049C BLDGB14  N0101   0G82076ESAMS005ASBESTOOPP                      UBT
EOF:42            BLDGMM  E0501   0K82077ESAMT014ASBESTOOLT3.000-02FCM3          UBT
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1:GWSACSW82053C  QCBLC001+0.0000000G82085ESAMC001PB    3TLT1.881+01UGL 1.06.40615DYL
2:GWSACSW82053C  QCBLB001+0.0000000G82085ESAMB001CR    3T  1.140+01UGL 1.06.11515DYL
3:GWSACSW82053C  QCBLD001+0.0000000G82085ESAMD001HG    1DLT5.172-01UGL 1.02.83505MUR
4:GWSACSW82053C  QCBLA001+0.0000000G82085ESAMA001CD    3TLT3.747+00UGL 1.06.90915DYL
5:GWSACSW82049C  QCBLC006+0.0000000G82085ESAMC006PB    3TLT1.881+01UGL 1.06.40615DYL
6:GWSACSW82049C  QCBLB006+0.0000000G82085ESAMB006CR    3TLT5.000+00UGL 1.061.1415DYL
7:GWSACSW82049C  QCBLD006+0.0000000G82085ESAMD006HG    1DLT5.172-01UGL 1.02.83505MUR
8:GWSACSW82049C  QCBLA006+0.0000000G82085ESAMA006CD    3TLT3.747+00UGL 1.06.90915DYL
EOF:8
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 1:GWSACSE82053C  QCBLZ001+0.0000000G82089ESALZ001HG    2DLT1.159-01UGG .953.04505MUR
 2:GWSACSE82055C  QCBLZ014+0.0000000G82089ESALZ014HG    2D  1.560-01UGG .953.04505MUR
 3:GWSACSE82055C  QCSPZ014+20.000000G82089ESALZ015HG    2D  8.000-03UGG .9534.5205MUR
 4:GWSACSE82055C  QCSPZ014+10.000000G82089ESALZ016HG    2D  9.000-02UGG .953.45305MUR
 5:GWSACSE82055C  QCSPZ014+ 2.000000G82089ESALZ017HG    2D  1.800-01UGG .953.04505MUR
 6:GWSACSE82053C  QCBLW013+0.0000000G82090ESALW013CD    7SLT5.086+00UGG .971.14515DYL
 7:GWSACSE82055C  QCBLW014+0.0000000G82090ESALW014CD    7SLT5.086+00UGG .971.14515DYL
 8:GWSACSE82055C  QCSPW014+ 3.330000G82090ESALW015CD    7S  3.790+00UGG .971.14515DYL
 9:GWSACSE82055C  QCSPW014+ 1.660000G82090ESALW016CD    7S  1.655+01UGG .971.01515DYL
10:GWSACSE82055C  QCSPW014+ 3.330000G82090ESALW017CD    7S  3.290+01UGG .971.01515DYL
11:GWSACSE82053C  QCBLX013+0.0000000G82090ESALX013CR    7SLT7.536+00UGG .9981.3015DYL
12:GWSACSE82055C  QCBLX014+0.0000000G82090ESALX014CR    7S  1.937+01UGG .998.13015DYL
13:GWSACSE82055C  QCSPX014+ 3.330000G82090ESALX015CR    7S  7.830+00UGG .9981.3015DYL
14:GWSACSE82055C  QCSPX014+ 1.660000G82090ESALX016CR    7S  1.949+01UGG .998.13015DYL
15:GWSACSE82055C  QCSPX014+ 3.330000G82090ESALX017CR    7S  3.766+01UGG .998.13015DYL
16:GWSACSE82053C  QCBLY013+0.0000000G82090ESALY013PB    7SLT8.101+00UGG 1.161.7815DLY
17:GWSACSE82055C  QCBLY014+0.0000000G82090ESALY014PB    7S  4.108+01UGG 1.16.17815DLY
18:GWSACSE82055C  QCSPY014+ 0.330000G82090ESALY015PB    7S  1.109+01UGG 1.16.17815DLY
19:GWSACSE82055C  QCSPY014+ 1.660000G82090ESALY016PB    7S  2.430+01UGG 1.16.17815DLY
20:GWSACSE82055C  QCSPY014+ 3.330000G82090ESALY017PB    7S  4.573+01UGG 1.16.17815DLY
EOF:20
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    1:GWSACS082053C  QCBLF015+0.0000000G82078ESAMF015CD    7SLT5.086+00UGG .8011.2115MUR
    2:GWSACS082053C  QCBLF016+0.0000000G82078ESAMF016CD    7SLT5.086+00UGG .801121215MUR
    3:GWSACS082053C  QCSPF015+ 3.330000G82078ESAMF041CD    7S  2.940+00UGG .8011.2115MUR
    4:GWSACS082053C  QCSPF015+ 1.660000G82078ESAMF042CD    7S  1.207+01UGG .801.12115MUR
    5:GWSACS082053C  QCSPF015+ 3.330000G82078ESAMF043CD    7S  2.683+01UGG .801.12115MUR
    6:GWSACS082053C  QCSPG039+ 3.330000G82078ESAMG041CR    7SLT7.536+00UGG .816.77015MUR
    7:GWSACS082053C  QCSPG039+ 1.660000G82078ESAMG042CR    7S  1.550+01UGG .816.07715MUR
    8:GWSACS082053C  QCSPG039+ 3.330000G82078ESAMG043CR    7S  3.000+01UGG .816.07715MUR
    9:GWSACS082053C  QCBLG039+0.0000000G82078ESAMG039CR    7S  2.474+01UGG .816.07715MUR
   10:GWSACS082053C  QCBLG040+0.0000000G82078ESAMG040CR    7SLT7.536+00UGG .816769.15MUR
   11:GWSACS082053C  QCSPH039+ 3.330000G82078ESAMH041PB    7S  7.700+00UGG .9601.8015MUR
   12:GWSACS082053C  QCSPH039+ 1.660000G82078ESAMH042PB    7S  1.820+01UGG .960.18015MUR
   13:GWSACS082053C  QCSPH039+ 3.330000G82078ESAMH043PB    7S  3.630+01UGG .960.18015MUR
   14:GWSACS082053C  QCBLH039+0.0000000G82078ESAMH039PB    7S  4.470+01UGG .960.18015MUR
   15:GWSACS082053C  QCBLH040+0.0000000G82078ESAMH040PB    7SLT8.101+00UGG .960180115MUR
   16:GWSACS082053C  QCBLJ014+0.0000000G82089ESAMJ014HG    2DLT1.159-01UGG 1.1010.205MUR
   17:GWSACS082053C  QCBLJ015+0.0000000G82089ESAMJ015HG    2DLT1.159-01UGG 1.1010.205MUR
   18:GWSACS082053C  QCSPJ015+ 2.000000G82089ESAMJ041HG    2D  2.364-02UGG 1.101.0205MUR
   19:GWSACS082053C  QCSPJ015+10.000000G82089ESAMJ042HG    2D  9.928-02UGG 1.101.0205MUR
   20:GWSACS082053C  QCSPJ015+ 2.000000G82089ESAMJ043HG    2D  2.222-01UGG 1.10.10305MUR
   21:GWSACS082053C  QCBLI037+0.0000000G82090ESAMI037ZN    1NLT2.479+02UGG 1.0717.405BER
   22:GWSACS082053C  QCBLI038+0.0000000G82090ESAMI038ZN    1NLT2.479+02UGG 1.07.17505BER
   23:GWSACS082053C  QCSPI038+ 5.000000G82090ESAMI039ZN    1N  9.639+00UGG 1.071.7405BER
   24:GWSACS082053C  QCSPI038+ 2.500000G82090ESAMI040ZN    1N  2.892+01UGG 1.07.17505BER
   25:GWSACS082053C  QCSPI038+ 5.000000G82090ESAMI041ZN    1N  5.784+01UGG 1.07.17505BER
   26:GWSACS082053C  QCBLE010+0.0000000G82092ESAME010PB    7SLT8.101+00UGG .77274.415DYL
   27:GWSACS082053C  QCBLE011+0.0000000G82092ESAME011PB    7S  1.437+03UGG .772.07415DYL
   28:GWSACS082053C  QCBLE012+0.0000000G82092ESAME012PB    7S  5.361+02UGG .772.74515DYL
   29:GWSACS082053C  QCBLU005+0.0000000G82060ESALU005PCB0162F  2.000-02UGG 1.25999.10GAR
   30:GWSACS082053C  QCBLU005+0.0000000G82060ESALU005PCB2602M  4.000-02UGG 1.06999.10GAR
   31:GWSACS082053C  QCBLV005+0.0000000G82060ESALV005TRIBZ 2MLT1.000+01UGG .761999.10GAR
EOF:31
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APPENDIX D

UTAH BIOMEDICAL TESTING LABORATORY
ANALYSIS OF ASBESTOS IN INSULATION

Quality Control Comparisons

Reference: Standard PAT sample Chrysotile--
50 percent Utah Biomedical Testing Laboratory
Reported 40-50 percent Chrysotile

Duplicates:

Sample ID	UBTL No.	Content
B31 Q0001	CC01274	Approximately 10% chrysotile; 40-50% amosite
B31 Q0002	CC01288	5-10% chrysotile, approximately 50% amosite
Laboratory split of B31 Q0001		2-5% chrysotile, 40-50% amosite

March 17, 1982

ANALYTICAL REPORT

SUBMITTED TO: Michael A. Keirn, Ph.D., ESE

SUBMITTED BY: S. Stark

REFERENCE DATA:

Analysis of: Asbestos

Identification No.: 82-396

Sample(s): 17 Analyses: 48

UBTL Laboratory No.: CC 01272 through CC 01288

A visual estimation of the percentage of asbestos was made on the above numbered samples utilizing polarized light microscopy and dispersion staining techniques.

Special Consideration: Two different materials were submitted under one sample number and were treated as two separate analyses. Please refer to comments on analytical report form for sample material differentiation information.

The results are tabulated on the following page(s).

S. Stark

Rand Potter

UBTL
520 WAKARA WAY
SALT LAKE CITY,
UTAH 84108
801 581-8267

A DIVISION OF
THE UNIVERSITY OF UTAH
RESEARCH INSTITUTE

MEDICINE
BIOENGINEERING
CHEMISTRY

RESEARCH
DEVELOPMENT
ANALYSIS

UBTL
ANALYTICAL REPORT FORM

Date March 18, 1982

UBTL Identification Number 82-396

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address P.O. Box ESE

Gainesville, Florida 32602

Attention Michael A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis POLARIZED LIGHT MICROSCOPY

Date(s) of Analysis 3/17/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS % AND TYPE
152000	CC01272	Bulk	40-50% CHRYSOTILE
152001	CC01273		~50% CHRYSOTILE
152002	CC01274		~10% CHRYSOTILE, 40-50% AMOSITE
152003	CC01275		~50% CHRYSOTILE
152004	CC01276		~20% CHRYSOTILE, 50-60% AMOSITE
152005	CC01277		50-60% CHRYSOTILE
152006	CC01278		10-20% CHRYSOTILE, 10-20% AMOSITE
152007	CC01279		NO ASBESTOS DETECTED
152008	CC01280		1-2% CHRYSOTILE
152009	CC01281		30-40% CHRYSOTILE, ~10% AMOSITE
152010	CC01282		50-60% CHRYSOTILE
152011	CC01283	↓	NO ASBESTOS DETECTED

Comments _____

Analyst

Reviewer

Laboratory Supervisor

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

UBTL
ANALYTICAL REPORT FORM

Date _____

UBTL Identification Number 82-396

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address _____

Attention Michael A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis POLARIZED LIGHT MICROSCOPY

Date(s) of Analysis 3/17/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS % AND TYPE
152012	CC01284	Bulk	2-5% CHRYSOTILE, 40-50% AMOSITE
152013	CC01285	↓	40-50% CHRYSOTILE
152015	CC01286	↓	~~5~~ ~45% CHRYSOTILE
152016	CC01287	↓	* (A) 50-60% CHRYSOTILE
152022	CC01288	↓	5-10% CHRYSOTILE, ~50% AMOSITE
152016	CC01287	↓	* (B) 60-70% CHRYSOTILE

Comments *TWO DIFFERENT MATERIALS WERE PRESENT UNDER ONE SAMPLE NUMBER. (A) FIBROUS MATERIAL IN PLASTER-LIKE MATRIX. (B) COMPRESSED FIBER PAPER. MATERIALS WERE TREATED AS TWO SEPERATE ANALYSES.

Analyst

Reviewer

Laboratory Supervisor

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

ESE ENVIRONMENTAL SCIENCE AND ENGINEERING, INC.

March 3, 1982

Mr. Rand N. Potter
Senior Marketing Chemist
UBTL
520 Wakara Way
Salt Lake City, Utah 84108

Re: Asbestos Analyses - Bulk and Filters from Gateway Army Ammunition Plant

Dear Mr. Potter:

Accompanying this letter are two sets of samples from the above plant which are to be analyzed for asbestos by PLM as we discussed.

The first set consists of 38 air filters labeled as Sample Numbers 152300 through 152337. Several of the filters represent results of co-located filtrations and four represent filters on which the fiber count is known because they are from previous PAT programs. These check samples have been introduced at random into the sample set and are included in the sample numbering system. Please analyze each filter and report the results in terms of total fibers per filter by sample number. These do not need to be confirmed by x-ray diffraction. I will let you know if any require reanalysis or confirmation.

The second set of samples consists of 17 samples of bulk material collected from pipe insulation suspected of containing asbestos. Several of these represent duplicate portions of the same location either sampled separately in the field or split at ESE before shipment. One sample represents a reference sample selected from those you provided earlier. The samples, duplicates, and reference sample are labeled as Sample Numbers 152000 through 152013, and 152015, 152016, and 152022. Please report the results by sample number.

A check list of sample numbers is enclosed for both sets.

In addition to the results of analysis, please include in your report the results of all internal quality control data. The results of analysis are required by March 22, 1982.

Sincerely yours,

Michael A. Keirn, Ph.D.
Project Manager

MAK:bb
Enc.
cc: M.G.Schultz
P.C.Geiszler

P.O. BOX ESE • GAINESVILLE, FLORIDA 32602 • 904/372-3318 • TWX 810-825-8310

APPENDIX E

GUIDANCE ON HANDLING AND DISPOSAL OF PCBs

DEPARTMENT OF THE ARMY
HEADQUARTERS US ARMY MATERIEL DEVELOPMENT AND READINESS COMMAND
5001 EISENHOWER AVE., ALEXANDRIA, VA. 22333

DRCIS-A

SUBJECT: Polychlorinated Biphenyls (PCBs)

SEE DISTRIBUTION

1. Reference:

a. Message, DRCPA-E, HQ DARCOM, 261915Z May 78, subject: Disposal and Marking, Polychlorinated Biphenyls (PCBs).

b. Letter, DRCIS-RI, DARCOM I&SA, 20 November 1978, subject: Askarel Filled Equipment.

c. Message, DRCIS-A, HQ DARCOM, 271030Z Sep 79, subject: Polychlorinated Biphenyl (PCB) Use and Disposal.

d. Message, HQ DLA, 062044Z Nov 79, subject: Disposition of Liquid Cooled Transformers; Retransmitted, DRCIS-A, HQ DARCOM, 081405Z Nov 79.

e. Letter, DRCIS-RI-IU, DARCOM I&SA, 13 November 1979, subject: Electrical Equipment Marking.

f. Engineer Technical Note 78-10, Supplements 1-6 (Suppl 6 dated 10 January 1979), subject: Marking and Disposal of Polychlorinated Biphenyls (Askarels).

g. Message, DRCIS-A, HQ DARCOM, 201215Z Feb 80, subject: Polychlorinated Biphenyls (PCB) in Hydraulic Metal-Forming Equipment.

h. Federal Register, 31 May 1979, p.31550.

i. Federal Register, 29 November 1979, pp.68489.

2. Substantial guidance has been provided concerning PCB (references 1a-i). This letter consolidates previous HQ DARCOM guidance.

a. Use of PCB.

(1) There is no requirement to remove or dispose of serviceable PCB or PCB-containing equipment. Sampling to determine PCB content of serviceable equipment is not required; however, unserviceable equipment should be sampled prior to either servicing or disposal, since handling procedures to be followed differ depending upon PCB content. Analytical services may be obtained upon request, thru HQ DARCOM (DRCSG), to the US Army Environmental Hygiene Agency (USAEHA), ATTN: HSE-EW-S, Aberdeen Proving Ground, MD 21010.

(2) Servicing which requires removal of the core from transformers with 500 ppm or more PCB is prohibited. After 1 July 1984, all servicing (including topping off) of transformers containing 50 ppm or more PCB which involves handling transformer fluid is prohibited.

(3) Transformer fluids containing more than 500 ppm PCB can be used or reused only to service transformers containing 500 ppm or more PCB. Mixing or dilution with fluids of lesser PCB concentration is not allowed. Retrofilling (refilling) transformers with non-PCB fluids or fluids of lesser PCB concentration is against Army policy because of the large volume of waste solvent and PCB waste generated, requirements to derate the transformer from its original rating, and problems with insulation, gaskets, and other fittings.

(4) Fluids containing more than 50 ppm PCB to be used for servicing transformers may be transported between installations, if prior permission is obtained from EPA. Fluids must be stored in facilities meeting the same standards as facilities for PCB and PCB-containing items in storage prior to disposal.

(5) In-service transformers should be periodically inspected to detect leaks, and leaks immediately repaired and cleaned-up. Each transformer location should be evaluated for spill prevention countermeasure and control requirements, and drip pans, pads and diking installed, as appropriate. Spills of transformer fluids should be treated as PCB spills, until known otherwise, and appropriate notification, spill containment and cleanup measures taken.

(6) Under occupational exposure conditions worker protective equipment should include protective gloves and aprons. Organic vapor

respirators are required unless industrial hygiene survey indicates exposures do not exceed the current occupational health standard. Protection from PCBs in non-liquid form usually requires only protective gloves and boots.

b. Inventory, Recordkeeping and Reporting, Marking.

(1) Facilities using or storing at least 45 kg (99.4 pounds) of PCB, one or more PCB transformers, or 50 or more PCB capacitors containing 1.36 kg (3 pounds) or more fluid must develop and maintain records on the disposition of PCB and PCB items. /Note: transformers or capacitors (1.36 kg or more fluid) must be considered to contain PCB unless actual PCB content is known from the manufacturer's label or laboratory test./ These records must be compiled NLT 1 July each year for the previous calendar year, and maintained for at least 5 years after the facility ceases using or storing PCB and PCB items in the prescribed quantities. Information required includes: (a) Dates and quantities PCB and PCB items removed from service, placed in storage, and shipped for disposal, (b) Location/operator of storage or disposal facility, (c) Quantities PCB and PCB items remaining in service (includes items with unknown PCB content). Reporting is required only for the environmental MBO Report (RCS DD-M(SA)1485).

(2) Containers, transformers and capacitors (1.36 kg or more) with unknown PCB content or containing more than 500 ppm PCB, storage areas, and transport vehicles loaded with more than 45 kg PCB in concentrations more than 50 ppm must be marked (see reference 1f for label specifications).

c. Storage.

(1) Storage facility criteria for serviceable transformers and capacitors are not specified by the Federal PCB regulations (references 1h and 1i), but state and local regulations may apply.

(2) Storage facility criteria for PCB fluids on hand for servicing transformers, and PCB and PCB items in storage for disposal, include roof and walls, curbing, seamless impervious flooring without drains, siting above the 100-year flood water elevation and spill prevention and contingency plans. Exceptions are: (a) Temporary storage in facilities not meeting these criteria for up to 30 days provided that leaking PCB items are placed in non-leaking containers with sufficient sorbent to totally contain the PCB, and provided spill prevention and contingency plans have been prepared; (b) Storage

of non-leaking capacitors and transformers with PCB concentrations between 50 and 500 ppm on pallets next to the storage facility until 1 January 1983 provided the immediately available storage inside the facility is 10% or less of the volume of the capacitors and transformers outside the facility, and provided weekly leakage checks are made.

(3) Storage containers must meet Department of Transportation (DOT) shipping container specifications or Occupational Safety and Health (OSHA) standards for storage of flammable and combustible liquids. Handling precautions include worker protection, as noted above, monthly leakage checks, and prompt cleanup of spills and leakage. Contaminated movable handling equipment in the storage facility will not be removed without decontamination.

d. Disposal.

(1) PCB and PCB items stored for disposal prior to 1 January 1983, must be removed from storage and disposed of prior to 1 January 1984. PCB and PCB items stored for disposal after 1 January 1983 must be removed from storage and disposed of within 1 year.

(2) Disposal options depend on PCB concentration and material to be disposed of (Inclosure 1). Alternative methods may be used upon demonstration to EPA that the alternative method provides equivalent destruction and control of PCB. Local Defense Property Disposal Offices (DPDO) will accept liquid-cooled transformers for disposal provided: (a) the transformer is factory-sealed, without access ports, and shows no trace of leakage; or (b) the transformers contain less than 50 ppm PCB; or (c) the transformer is completely drained and did not contain more than 500 ppm PCB. Incinerators have not yet been approved by EPA; a listing of EPA-approved landfills was provided in reference 1f. Dilution to reduce PCB concentration and processing into non-liquid forms to circumvent high-temperature incineration requirements is prohibited.

(3) Packaging and transport for disposal is subject to DOT shipping regulations, PCB marking regulations, and EPA hazardous waste manifesting regulations, when effective in the fall of 1980.

(4) Waste oil must be considered to be contaminated by PCB unless laboratory test proves otherwise. All waste oil will be subject to EPA hazardous waste regulations; waste oil containing

concentrations greater than or equal to 50 ppm PCB is subject to PCB disposal regulations. Use of waste oil as a sealant, coating or dust control agent is prohibited by Army Regulation (AR 200-1; AR 420-47).

e. Hydraulic Systems. Hydraulic metal production and forming equipment (e.g., die-casting, metal forging, foundry, etrusion) where high temperature stable PCB hydraulic fluids were likely to have been used, and hydraulic equipment (e.g., forklift trucks, elevator lifts, loading dock levelers) where PCB fluids may have been used for convenience, require special testing for PCB. Where fluids contain greater than 50 ppm PCB, draining and proper disposal of the fluid is required. Once refilled, retesting is required for PCB not sooner than 3 months nor later than 1 year.

3. POC this headquarters is MAJ Borkowski (AV 284-8122).

FOR THE COMMANDER:

DONALD K. EMIG, Ph.D., P.E.
Chief, Environmental Quality Div.
Directorate for Installations
and Services

1 Incl
as

DISTRIBUTION:
B
C

DISPOSAL OPTIONS

Material	PCB [1] Incinerator	Chem [1] Landfill	Hi-Effcy Boiler	Alt [1] Disposal	Sanitary Landfill	DPDO
Liquid (≥ 500ppm PCB)	X					
Mineral Oil Dielectric (50- < 500ppm PCB)	X	X	X[2]			
Liquids (50- < 500ppm PCB)	X	X	X[1]			
Non-Liquid (soil, rags, debris)	X	X				
Dredge Material Municipal Sewage Treatment Plant Sludges	X	X		X		
Transformers (≥ 500ppm PCB)	X					
Drained Transformers/ Containers[4] (previously held ≥ 500ppm PCB)		X				X
Capacitors (< 1.36kg or 3lbs fluid)					X	
Capacitors (≥ 1.36kg fluid)	X					
Hydraulic Machines (drained)					X[3]	X
Other items (≥ 500ppm PCB)	X					
Containers (Full or empty, PCB ≥ 500ppm)	X					X (If decontaminated)

INCL 1

DISPOSAL OPTIONS

Material	PCB [1] Incinerator	Chem [1] Landfill	Hi-Effcy Boiler	Alt [1] Disposal	Sanitary Landfill	DPDO
Drained Containers (Prior content PCB ≥500ppm)		X				
Drained Containers (Prior content PCB <500ppm)						X

1 EPA Approval Required for PCB Disposal.

2 EPA Notification Required

3 May be salvaged (if PCB ≥1000ppm must be rinsed)

4 Transformers must be solvent - Rinsed Prior to Disposal.

HSE-EW-S/WP

MEMORANDUM FOR RECORD

SUBJECT: PCB's, and PCB Transformers and Capacitors

1. REFERENCES.

a. Title 40, Code of Federal Regulations (CFR), 1979 ed., Part 117, Determination of Removability of Hazardous Substances, as cited in 44 Federal Register (FR) 50776, 29 August 1979.

b. Title 40, CFR, 1979 ed., Part 761, Polychlorinated Biphenyls (PCBs), Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions.

c. Office of Toxic Substances, US Environmental Protection Agency (EPA) publication, EPA's Final PCB Ban Rule: Over 100 Questions and Answers to Help You Meet These Requirements, June 1979.

d. Leaflet FESA-UE-E, US Army Facilities Engineering Support Agency, 28 December 1979, entitled Some Questions and Answers About PCB's Based on EPA "Final Rule" of 31 May 1979.

2. PURPOSE. The intent of this MFR is to summarize the current PCB regulations concerning transformers and capacitors. It is hoped that this information can be used to quickly answer the increasing number of telephone queries from Army installations.

3. DISCUSSION.

a. Identification.

(1) A transformer is classified as a PCB Transformer if (a) the nameplate indicates that the transformer contains PCB dielectric fluid, or (b) the transformer's dielectric fluid has been tested and found to contain 500 ppm or greater PCB's. If a transformer does not have a nameplate or there isn't any information to indicate the type of dielectric fluid in it, the transformer must be assumed to be a PCB Transformer.

(2) A transformer is classified as a PCB-contaminated Transformer if the dielectric fluid has been tested and found to contain 50 or more ppm but less than 500 ppm PCB's. All mineral oil transformers must be assumed to be PCB-contaminated Transformers unless tested and found not to contain between 50 and 500 ppm PCB's.

(3) A transformer is classified as a Non-PCB Transformer if its dielectric fluid has been tested or otherwise verified to contain less than 50 ppm PCBs.

(4) A capacitor that cannot be shown to be PCB-free by examining the label or nameplate information must be assumed to be a PCB Capacitor.

b. Labeling Requirements.

(1) PCB Transformers (500 ppm or greater PCB's) are required to be labeled, including those in service.

(2) PCB-contaminated Transformers (between 50 and 500 ppm PCB's) are not required to be labeled.

(3) Large (3 lbs or more of dielectric fluid), high-voltage (2000 volts or above) PCB Capacitors have to be labeled, including those in service.

(4) Large, low-voltage (less than 2000 volts) PCB Capacitors have to be labeled when they are taken out of service.

(5) Small PCB Capacitors do not have to be labeled.

(6) All labels are to be put on the exterior of PCB Items in a place that can be easily seen and read by anyone inspecting or servicing them.

Exception: Large, high-voltage PCB Capacitors installed in protected locations. In such instances the particular pole, fence, or structure shall be marked with the appropriate label.

(7) Labels can be obtained from these sources:

(a) LABELMASTER
7525 North Wolcott Ave.
Chicago, Illinois 60626
Phone: 312-973-5100

(b) W. H. BRADY CO.
Facilities, Identification, Products Division
727 W. Glendale Ave.
Milwaukee, Wisconsin
Phone: 414-33Z-8100 (Ext 624)

c. Servicing

(1) PCB Transformers.

(a) Nonleaking PCB Transformers can continue in service indefinitely because by definition they are totally enclosed.

(b) Routine servicing, which includes testing the dielectric fluid, filtering the fluid, and replacing the gasket is permitted.

(c) Rebuilding or any servicing which involves the removing of coils from the transformer casing is prohibited.

(d) PCB Transformer fluid (500 ppm or greater PCB's) that has been mixed with dielectric fluid containing less than 500 ppm PCB's cannot be used as dielectric fluid in any transformer. The purpose is to avoid dilution of PCB Transformer fluid to less than 500 ppm and subsequent use in PCB-contaminated Transformers.

(e) PCB Transformers can be reclassified as PCB-contaminated Transformers if they have been drained, flushed, and refilled with non-PCB dielectric fluid and if they are tested and found to contain less than 500 ppm PCB after at least 3 months of inservice use.

(2) PCB-contaminated Transformers can be serviced and rebuilt only with dielectric fluid containing less than 500 ppm PCB's.

(3) Non-PCB Transformers require no exemptions for servicing.

(4) Persons who handle PCB's (50 ppm or greater) for purposes of servicing transformers must be granted an exemption by the EPA. Owners may continue to service their own transformers without such an exemption.

d. Storage.

(1) Temporary storage is permitted up to 30 days from the date of removal from service of the following items:

(a) Nonleaking PCB Transformers, Contaminated Transformers, and Capacitors.

(b) Leaking PCB Transformers, Contaminated Transformers, and Capacitors if these items have been placed in nonleaking containers that contain sufficient sorbent materials to absorb the remaining dielectric fluid within the item.

(c) Containerized nonliquid PCB's such as contaminated soil, rags, and debris.

(2) Adequate spill prevention is required at all temporary storage sites.

(3) Thirty day temporary storage is also permitted for PCB containers containing liquid PCB's at a concentration between 50 and 500 ppm, provided a Spill Prevention Control and Countermeasure Plan (SPCCP) has been prepared for the site, and the area between the storage tank and secondary containment dike must be impervious to PCB's to prevent ground-water contamination. Temporary storage of Liquid PCB's at a concentration of 500 ppm or greater is not permitted.

(4) After 30 days of temporary storage, PCB's and PCB items must be addressed in one of the following three options:

(a) Repair or service the item and return it to operations or to a standby mode.

(b) Dispose of the item or fluid.

(c) Place the item or fluid into "storage for disposal."

(5) "Storage for disposal" requires that the storage facility meet a number of conditions:

(a) Adequate roof and walls to prevent water from reaching the stored items.

(b) A floor which has a minimum curb of 6 inches. The floor and curb must be able to contain two times the volume of the largest item or 25 percent of the volume of all the items and containers stored.

(c) Floors and curbing constructed of continuously smooth and impervious materials, such as Portland cement concrete or steel, to prevent or minimize penetration of PCB's.

(d) No drain valves, floor drains, expansion joints, sewer lines, or other openings that would permit liquids to flow from the curbed area.

(e) Not located at a site that is below the 100 year flood water elevation.

(6) Nonleaking and structurally undamaged PCB Large, High-voltage Capacitors and PCB-contaminated Transformers that have not been drained of free flowing dielectric fluid may be stored on pallets next to the "storage for disposal" facility provided that this facility has available unfilled storage space equal to 10 percent of the volume of capacitors and transformers stored outside. These capacitors and transformers shall be checked for leaks weekly.

(7) PCB-contaminated Transformers that have been drained of free-flowing dielectric fluid are not subject to the above storage provisions; however these storage requirements still apply to drained PCB Transformers and PCB Large Capacitors.

(8) Unless otherwise regulated, all PCB Articles (transformers, capacitors, and containers) in storage shall be checked for leaks once every 30 days.

e. Spills/Leaks.

(1) As outlined in reference 1a, a spill of 10 lbs or more of PCB's to navigable waters is a reportable quantity requiring notification of the EPA. When there is uncertainty as to the amount that was spilled or there appears to be imminent and substantial danger to the public health or welfare, then it would be wise to report the spill.

(2) Despite the size of the PCB spill, the owner of the leaking or spilled PCB article is responsible for the cleanup and mitigation action. Unfortunately there is no uniform guidance for determining how clean must the cleanup be. As a general rule the cleanup effort should reduce the level of contamination to below 50 ppm PCB's; however, the EPA may set other standards on a case by case basis.

(3) In handling spills or leaks, the following guidance is given:

(a) PCB contaminated soil and asphalt must be removed and placed into storage for disposal.

(b) Less porous or impervious substances such as concrete or metal surfaces, can be cleaned with the use of absorbents and subsequently washed with organic solvents such as kerosene, hexane, and 1,1,1 trichloroethane. Washing with the more volatile solvents requires direct application with absorbent-type material, whereas washing with less volatile, kerosene-type solvents allows for collection of contaminated fluids. The installation Safety Office will rule on the particular hazards involved with specific solvent s. The contaminated solvent will be handled and disposed of per PCB regulations.

(c) Leaks from active PCB Items should be sealed with epoxy or other sealants if possible. Otherwise, they will have to be removed from service and placed into nonleaking containers.

f. Personal Protection.

(1) Individuals should avoid contact of skin and eyes with PCB's. Respiratory protection should be required for working with PCB fluids in confined, unventilated areas.

(2) The following precautions should be taken when encountering PCB's:

Situation	Protective Clothing
(a) PCB-contaminated soil or asphalt	Rubber boots, rubber gloves, thick coveralls
(b) PCB Liquids	Keep the body covered as much as possible: coveralls, cap, face shield or goggles, rubber gloves, rubber apron.
(c) PCB liquids in enclosed area with little or no ventilation, or servicing a PCB item where volatile organic solvents are present.	Same as above plus an organic vapor respirator.
(d) Hot liquid PCB's with organic solvents in enclosed area with no ventilation.	Complete rubber suit with fullface organic vapor respirator or air breathing system.

(3) Accidental contact with PCB's should be treated in the following manner:

(a) Skin - 15 minutes of soap washing and contact physician.

(b) Eyes - 15 minutes of eye flushing and contact physician.

g. Disposal Requirements.

Item	Disposal Method
(1) PCB Transformer fluid or other liquids containing 500 ppm or greater PCB's Note: These fluids cannot be solidified for disposal.	Incinerator

(2)	PCB-contaminated fluid or other liquids containing between 50-500 ppm	- Incinerator - High-efficiency boilers - Chemical waste landfill
(3)	Waste Oil (PCB's less than 50 ppm PCB's)	No restrictions except a prohibition against its use as a sealant, coating or dust control agent.
(4)	PCB Transformer (not drained)	Incinerator
(5)	PCB Transformer (drained)	Chemical waste landfill
(6)	PCB-contaminated Transformer (drained)	Not regulated; can be placed in a municipal landfill.
(7)	Large PCB Capacitors	Incinerator
(8)	Small PCB Capacitors	Incinerator if stockpiled Municipal landfill if not stockpiled
(9)	Nonliquid PCB's (soil, rags, and other debris)	Incinerator Chemical waste landfill
(10)	PCB Container	Incinerator
(11)	PCB Container (drained of PCB's greater than 500 ppm)	Chemical waste landfill
(12)	PCB Container (drained of PCB's less than 500 ppm)	Municipal landfill

h. Records.

(1) Each facility which uses or stores at one time 99 lbs of PCB fluids, one or more PCB Transformers, or 50 or more PCB Large Capacitors must maintain a record on the disposition of PCBs and PCB Items (transformers, capacitors, and containers).

(2) An annual document must be compiled on 1 July of each year covering the previous calendar year.

(3) This document must include the following information:

(a) The dates when PCB's and PCB Items were removed from service, placed into "storage for disposal," and placed into transport for disposal.

(b) The location of the initial disposal or storage facility for PCB's and PCB Items removed from service.

(c) The total quantity of PCB's and PCB Items remaining in service at the end of the calendar year.

(4) The quantities of PCB's and PCB Items will be identified according to the following breakdown:

(a) Total weight of PCB's and PCB Items in PCB containers including the identification of container contents.

(b) Total number of PCB Transformers and total weight of any PCB's contained in the transformers.

(c) Total number of PCB Large Capacitors.

(5) The records and documents must be kept on file for at least 5 years after PCB's and PCB Items are no longer in use or stored.

(6) The EPA makes periodic PCB compliance inspections to insure regulations are being carried out.

WILLIAM FIFTY, P.E.
Chemical Engineer
Water Quality Engineering Division

NNNNJTTUZYUW RUKLDAR6945 3471306-UUCC--RUWJETA.
ZNR UUUCC
RM1CD9033CDECAB3X VA //DRCIS-A//
TC AIG 865
RUCDGDA/DIVENG HUNTSVILLE AL //HNDED-PM//
INFO RULNAPG/CDRUSATHAMA APG MD //DRXTH-ES//
RULNAPG/CDRUSAEHA APG MD //HSE-ES//
RUCIAFA/CDRDARCOM I&SA ROCK ISLAND IL //DRCIS-PRO//
RUEADWD/HQDA WASHDC //DAEN-ZCE//
BT
UNCLAS
SUBJ OPEN BURNING/OPEN DETONATION GROUNDS - COMPLIANCE WITH EPA HAZARDOUS WASTE REGULATIINS.
1. OPEN BURNINGL(OB)/OPEN DETONATION (OD) IS AN ACCEPTABLE TRJATMENT METHOD FOR WASTE EXPLOSIVES UNDER THE EPA INTERIM STATUS STANDARDS FOR HAZARDOUS WASTE MANAGEMENT FACILITIES. HOWEVER, LEAVING THE ASH AND RESIDUE IN OR ON THE LAND, WILL BE CONSIDERED LANDFILLING UNLESS ANALYSIS HAS SHOWN THE ASH AND RESIDUE TO BE NON-HAZARDOUS AND, IF DERIVED FROM A LISTED HAZARDOUS WASTE, HAS BEEN DELISTED BY PETITION TO THE APPROPRIATE REGULATORY AUTHORITY. WHERE HAZARDOUS ASH OR RESIDUE IS DISPOSED OF BY LEAVING IT ON OR IN

PAGE 02 RUKLDAR6945 UNCLAS
THE LAND, SUCH FACILITY IS SUBJECT TO THE GENERAL HAZARDOUS WASTE FACILITY STANDARDS AND SPECIFIC LANDFILL REQUIREMENTS, INCLUDING THE GROUND WATER MONITORING REQUIREMENTS. IF THE ASH OR RESIDUE IS REACTIVE, IT MAY NOT BE LEFT IN THE LANDFILL UNLESS ANALYSIS SHOWS THAT THE RESULTING MIXTURE OR DISSOLUTION OF MATERIAL NO LONGER MEETS THE DEFINITION OF A REACTIVE WASTE AND THE RESULTS OF THE ANALYSIS IS RETAINED BY THE FACILITY.
2. ANALYSIS OF OB/OD RESIDUES BY THE US ARMY ENVIRONMENTAL HYGIENE AGENCY (USAEHA) INDICATE THAT WHILE MOST RESIDUES ARE NON-HAZARDOUS SOME RESIDUES REMAIN REACTIVE DUE TO DEFICIENCIES IN OB/OD PROCEDURES. ADDRESSEES, AS APPLICABLE, SHOULD INSURE ANALYSIS OF REPRESENTATIVE SAMPLES OF RESIDUES AGAINST EPA HW CRITERIA, CORRECT OB/OD PROCEDURES WHERE NECESSARY, AND DISPOSE OF RESIDUES IN COMPLIANCE WITH APPLICABLE ENVIRONMENTAL REGULATIONS. REQUESTS FOR EVALUATION BY USAEHA SHOULD BE SUBMITTED THROUGH CHANNELS IAW DARCOM SUPPL 1 TO AR 40-5.
3. RESIDUES FOUND TO BE HAZARDOUS ON THE BASIS OF CRITERIA OTHER THAN REACTIVITY SHOULD, WHERE POSSIBLE, BE ACCUMULATED AND STORED IAW THE APPLICABLE HW REGULATIONS UNTIL PROPER DISPOSAL PROCEDURES CAN BE DETERMINED, AND THIS HQ (ATTN: DRCIS-A) ADVISED OF THE

PAGE 03 RUKLDAR6945 UNCLAS
SITUATION. AN ACCEPTABLE STORAGE METHOD MIGHT BE TO ACCUMULATE AND MANAGE THE HAZARDOUS WASTE AS A WASTE PILE.
4. IF CONTINUATION OF ON-SITE DISPOSAL OF NON-HAZARDOUS RESIDUES IS DESIRED, APPLICATION SHOULD BE MADE AS APPROPRIATE FOR A NON-HAZARDOUS LANDFILL PERMIT. ADDRESSEES SHOULD INSURE THAT SAFETY CONSIDERATIONS INVOLVING UNEXPLODED ORDNANCE FROM HISTORICAL OPERATIONS ARE INCLUDED IN ALL PHASES OF THE PERMITTING PROCESS.
5. POC THIS HQ, MAJ BORKOWSKI, AUTOVON 284-8122.
BT
#6945

APPENDIX F

UTAH BIOMEDICAL TESTING LABORATORY
RESULTS FOR ASBESTOS FIBERS ON AIR SAMPLING FILTERS

Results of Analysis of PAT Reference Samples

UBTL Sample No.	PAT No.	Asbestos* (Fibers/m^3) Nominal	Found	Percent Recovery
CC01235	A651	184,541	251,000	109
CC01236	A652	303,134	322,000	106
CC01270	A653	244,565	254,000	106
CC01271	A653	158,390	155,000	98

* Calculated based on a hypothetical 2-hour sampling period.

March 23, 1982

ANALYTICAL REPORT

SUBMITTED TO: Michael A. Keirn, Ph.D.

SUBMITTED BY: S. Stark

REFERENCE DATA:

Analysis of: Asbestos

Identification No.: 82-395

Sample(s): 38 Analyses: 38

UBTL Laboratory No.: CC 01234 through CC 01271

The above-numbered samples were analyzed for asbestos according to the method below.

Filter samples were analyzed according to NIOSH Method P&CAM 239. Asbestos fibers with a minimum length of 5 microns were counted on a Leitz Phase Contrast Microscope. The microscope is equipped with a 40x objective and a 10x eyepiece containing a Patterson globe and circle reticle.

A minimum of 100 fibers in 20 fields or a maximum of 100 fields was counted per sample and the average fibers per field calculated.

The results are reported in total fibers/filter. The following calculation is performed to convert fibers/filter to fibers/cc.

$$\frac{\text{Fibers/Filter}}{(\text{Sample Vol. L.})(1000)} = \text{Fibers/cc}$$

The limit of detection is 0.03 fibers per fields or 4500 fibers per filter.

Special Consideration: Samples CC 01235 , CC 01236, CC 01270, and CC 01271 were submitted on 25 mm filters.

The results are tabulated on the following page(s).

S. Stark

Rand Potter

UBTL
520 WAKARA WAY
SALT LAKE CITY,
UTAH 84108
801 581-8267

A DIVISION OF
THE UNIVERSITY OF UTAH
RESEARCH INSTITUTE

MEDICINE
BIOENGINEERING
CHEMISTRY

RESEARCH
DEVELOPMENT
ANALYSIS

UBTL
ANALYTICAL REPORT FORM

Date _____

UBTL Identification Number 82-395

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address P.O. Box ESE

Gainesville, Florida 32602

Attention Michael A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis P & CAM 239

Date(s) of Analysis 3/18/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS FIBERS / FILTER
152300	CC01234	Filter	<4500
152301	CC01235		201,000 *
152302	CC01236		322,000 *
152303	CC01237		<4500
152304	CC01238		<4500
152305	CC01239		<4500
152306	CC01240		<4500
152307	CC01241		<4500
152308	CC01242		<4500
152309	CC01243		<4500
152310	CC01244		<4500
152311	CC01245		<4500

Comments * 25 mm filter

Analyst

Reviewer

Laboratory Supervisor

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

UBTL
ANALYTICAL REPORT FORM

Date _____

UBTL Identification Number 82-395

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address _____

Attention Michael A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis P&CAM 239

Date(s) of Analysis 3/18/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS FIBERS/FILTER
152312	CC01246	Filter	<4500
152313	CC01247	"	<4500
152314	CC01248	"	<4500
152315	CC01249	"	<4500
152316	CC01250	"	<4500
152317	CC01251	"	<4500
152318	CC01252	"	<4500
152319	CC01253	"	<4500
152320	CC01254	"	<4500
152321	CC01255	"	<4500
152322	CC01256	"	<4500
152323	CC01257	"	<4500

Comments _____

Analyst

Reviewer

Laboratory Supervisor

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

UBTL
ANALYTICAL REPORT FORM

Date _____

UBTL Identification Number 82-395

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address _____

Attention Michale A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis P & CAM 239

Date(s) of Analysis 3/18/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS FIBERS/FILTER
152324	CC01258	Filter	<4500
152325	CC01259	↓	<4500
152326	CC01260		<4500
152327	CC01261		<4500
152328	CC01262		<4500
152329	CC01263		<4500
152330	CC01264		<4500
152331	CC01265		<4500
152332	CC01266		<4500
152333	CC01267		<4500
152334	CC01268		<4500
152335	CC01269		<4500

Comments _____

Analyst _____

Reviewer _____

Laboratory Supervisor _____

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

UBTL
ANALYTICAL REPORT FORM

Date _____

UBTL Identification Number 82-395

Corporate/Agency Name Environmental Science and Engineering, Inc.

Address _____

Attention Michael A. Keirn, Ph.D. Telephone (904)372-3318

Sampling Collection and Shipment

Sampling Site _____ Date of Collection _____

Date Samples Received at UBTL March 10, 1982

Analysis

Method of Analysis P&CAM 239

Date(s) of Analysis 3/18/82

Analytical Results

Field Sample Number	UBTL Lab Number	Sample Type	Results ASBESTOS FIBERS/FILTER
152336	CC01270	Filter	254,000 * 706.1
152337	CC01271	Filter	155,000 * 457.3

Comments * 25 mm filter

Analyst _____

Reviewer _____

Laboratory Supervisor _____

520 Wakara Way / Salt Lake City, Utah 84108 / 1-800-453-5653 ext. 8267

Purchase Order No. _____

Date _____

UBTL Identification Number _____

Corporate/Agency Name ESE

Address _____

_____

Person to Contact _____ Telephone _____

Sample Collection

Sampling Site _____

Industrial Process _____

Date of Collection _____ Air Temperature _____ °C

Date of Sample Shipment to UBTL _____

Request for Analyses

Field Sample Number	UBTL Lab Number	Sample Type	Results
152300	cc01234	FILTER	
152301	cc01235		
302	cc01236		
303	cc01237		
304	cc01238		
305	cc01239		
306	cc01240		
307	cc01241		
308	cc01242		
309	cc01243		
310	cc01244		
311	cc01245		
312	cc01246		
313	cc01247		
314	cc01248		
315	cc01249		
316	cc01250		
317	cc01251		
318	cc01252		
319	cc01253		
320	cc01254		
321	cc01255		
322	cc01256		
152323	cc01257		

Purchase Order No. _____

Date _____

UBTL Identification Number _____

Corporate/Agency Name ESE

Address _____

_____

Person to Contact _____ Telephone _____

Sample Collection

Sampling Site _____

Industrial Process _____

Date of Collection _____ Air Temperature _____ °C

Date of Sample Shipment to UBTL _____

Request for Analyses

Field Sample Number	UBTL Lab Number	Sample Type	Results
152324	cc01258		
325	cc01259		
326	cc01260		
327	cc01261		
328	cc01262		
329	cc01263		
330	cc01264		
331	cc01265		
332	cc01266		
333	cc01267		
334	cc01268		
335	cc01269		
336	cc01270		
152337	cc01271		

APPENDIX G

COST PROJECTION DATA

PCB Incineration--April 1982

Company: ENSCO Energy Systems Company
El Dorado, Arkansas
(501) 375-8444
Mr. Bob Garner

Cost:	Concentration 500-25,000 ppm	$87.50/drum
	>25,000 ppm	$275.00/drum
	Contaminated Soil	$150.00/drum
	Transportation (480 miles)	$3.00/loaded mile

Paint Landfilling--April 1982

Company: Bob's Home Service, Inc.
Wright City, Missouri
(314) 745-3371
Mr. Mike Gill

Cost: $30-20/drum (landfill)
Transportation: $50

Insulation Removal--April 1982

$7.43/linear foot, as outlined on the following cost derivation

COST OF ASBESTOS INSULATION REMOVAL

I. ASSUMPTIONS

A. All workers wear protective clothing and respirators

B. Air monitoring may be required (price as option)

C. Asbestos is sprayed with "amended" water containing a sealout

D. Wetted asbestos is cut, stripped, and placed in polyethylene bags and sealed

E. One laborer removes 15 linear feet/hour

II. CALCULATIONS*

A. Scaffolding:

Total Cost = $35 per 100 square feet (average) per day (materials, installation)

Assume one laborer requires 100 square feet per day

B. Asbestos Removal

1. Labor

Carpenter:	8 hours @ $12.65 each =	$101.20/day
Laborer:	8 hours @ $12.65 each =	$101.20/day
		$202.40/day

2. Equipment

Air Compressor (20 cfm) with sprayer	$ 15
Respirators (2 @ $5/day)	10
Tools	20
Truck	45
Water Tank (200 gallons)	10
	$100

3. Materials

Bags (75 @ $0.40)	$ 30
Sealant (5 gallons @ $15)	75
Protective Clothing	15
	$120/day

C. Cleanup of Area

1. Two laborers @ 2 hours each = $50.60/day

2. Equipment

Respirators (2 @ $5/each)	$ 10
Tools	10
Bags, disposable gloves, etc.	5
	$ 25

D. Air Monitoring (if required)

1. Labor (serves 3 buildings at once)

Technician (8 hours @ $11/hour) = $88/day

2. Equipment

Monitoring Equipment (3 units @ $15/day	$ 45
Truck	$ 45
	$ 90

3. Materials

Sample analysis (3 @ $60 = $180/day)

III. SUMMARY

Labor:	$341
Equipment and Materials:	$550
TOTAL	$891

@ 15 linear feet/hour = 120 linear feet/day = $7.43/linear foot

*Building Construction Cost Data, Means, 1981.
Robert Snow Means Company, Inc.