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March 24,2000

Commander
Atlantic Division
Naval Facilities Engineering Command
15 10 Gilbert Street (Bldg. N-26)
Norfolk, Virginia 235 11-2699

Attn: Ms. Sherri Eng
***Code* 18322**

Re: Contract **N62470-89-D-48 14**
Navy CLEAN, District III
Contract Task Order (CTO) **040** I
Final Sample Strategy Plan
Stop 7 ½, Naval Reservation
San Juan, Puerto Rico

Dear Ms. Eng:

Baker Environmental, Inc. (Baker) is pleased to submit two **copies *of*** the **Final** Sample Strategy Plan (SSP) for Stop 7 ½, Naval Reservation, San Juan, Puerto Rico. This SSP **has** been developed **based** on **the** Scope of Work dated March 7,2000 and the March **14,2000** site visit. The **SSP** will **be** used **as** a reference for the field activities scheduled to commence on March 27.2000.

Baker appreciates the opportunity to provide continued support to LANTDIV and **looks** forward to continuing project activities in Puerto Rico. Should you have **any** questions or comments, please do not hesitate to contact me at **(412) 269-2047.**

Sincerely,

BAKER ENVIRONMENTAL, INC.

Kenneth J. Martin
Program Director

KJM/lp

cc: Ms. Lee Anne Rapp, P.E., LANTDIV, Code 183 12
Ms. Kathy Molino, LANTDIV, Code 021 I I

FINAL

SAMPLE STRATEGY PLAN
SITE INVES'J'JGATTON
STOP 7 ½ NAVAL RESERVATION
KOOSEVELT ROADS REAL ESTATE
SAN JUAN, PUERTO RICO

CONTRACT TASK ORDER 0401

MARCH 24,2000

Prepared for

DEPARTMENT OF THE NAVY
ATLANTIC DIVISION
NAVAL FACILITIES
ENGINEERING COMMAND
Norfolk, Virginia

Under:

LANTDJV CLEAN PROGRAM
Contract N62470-89-D-4814

Prepared by:

BAKER ENVIRONMENTAL, INC.
Coraopolis, Pennsylvania

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LIST OF ACRONYMS AND ABBREVIATIONS

ACM	Asbestos-Containing Material
AHERA	Asbestos Hazard Emergency Response Act
ASTM	American Standards and Testing Methods
Baker	Baker Environmental, Inc.
CFR	Code of Federal Regulations
CLP	Contract Laboratory Protocols
EBS	Environmental Baseline Study
FBOP	Federal Bureau of Prisons
HUD	Housing and Urban Development
IDW	Investigation Derived Waste
LBP	Lead-Based Paint
MS/MSD	Matrix Spike/Matrix Spike Duplicates
NESHAP	National Emission Standard and Hazardous Air Pollutants
NIST	National Institute of Standards and Technology
NLLAP	National Lead Laboratory Accreditation Program
NVLAP	National Voluntary Laboratory Accreditation Program
PCB	Polychlorinated Biphenyl
PLM	Polarized Light Microscopy
PREQB	Puerto Rico Environmental Quality Board
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RFI	Resource Facility Investigation
ROBC	Reserve Officers Beach Club
SSP	Sample Strategy Plan
TAL	Target Analyte List
TCLP	Toxicity Characteristics Leachate Procedure
TCL	Target Compound List
USEPA	United States Environmental Protection Agency
VOA	Volatile Organic Analysis
XRF	X-Ray Fluorescence

1.0 INTRODUCTION

This Sample Strategy Plan (SSP) describes the proposed field activities that arc to be conducted as part of the Remediation Plan for Stop 7 ½ Naval Reservation, San Juan, Puerto Rico.

The remaining portion of this section presents the purpose and objectives of the SSP. Section 2.0 identifies the site description. The field investigation, sampling and analytical program are described in Section 3.0. Section 4.0 focuses on the organization and responsibilities of personnel associated with the field investigation activities. Section 5.0 lists the references used in the development of this plan.

1.1 Purpose

The primary purpose of the SSP is to describe the proposed sampling and data collection methods for establishing background metal concentrations, confirm and delineate the areas of suspected contamination, establish soil disposal options, and perform a lead and asbestos survey.

This SSP will help ensure that sampling and data collection activities arc carried out in accordance with the United States Environmental Protection Agency (USEPA), Naval Facilities Engineering Service Center, Puerto Kico Environmental Quality Board (PREQB), and the Baker Environmental, Inc. (Baker) Final Resource Conservation and Recovery Act (RCRA) Facility Investigation (KFI) Management Plans (Baker 1995). The proposed sampling and collection methods have been designed to collect data during the field investigation in sufficient quantity and quality to evaluate the presence or absence of the various contaminants of concern.

1.2 Objectives

The objective of the SSP is to gain a better understanding of the presence, quantity, or absence of contamination through completion of the following field investigation tasks:

- Background surface soil sampling for Target Analyte List (TAL) inorganics
- Concrete chip and surface soil sampling at the Transformer Pad for polychlorinated biphenyls (PCBs)

- Surface soil sampling in the vicinity of the former Incinerator for TAL inorganics

- Surface soil sampling near the machine gun pad for Toxicity Characteristics Leachate Procedure (TCLP) analysis

- Lead-based paint (LBP) survey (housing structures)

- Asbestos survey (existing structures)

The data obtained through the completion of these tasks will be used to prepare and implement a remcdiation plan.

2.0 SJTE DESCRIPTION

The U.S. Naval Compound, Stop 7 ½, is located in the Puerto de Tierra section of San Juan, Puerto Rico. Refer to Figure 2-1 to view a site location map. The site consists of 7.7 acres and is divided by Munoz Rivera Avenue. A complete layout of the site is detailed on Figure 2-2.

The Department of the Army acquired this property by Executive Order in June **1903.** The Navy has used the land since 1904. The land **was** officially transferred to the Navy in 1930. The Navy operated the land as a U.S. Naval Radio Station from **1930** to 1952 until the radio station operations were moved to Sebana Seca.

There are fifteen existing buildings identified at the site, including Buildings 28 through 31, Buildings 440 through **449,** and Building 454. Buildings 28 through 31 are on the north side of Munoz Rivera Avenue and are part of the Reserve Officers Beach Club (ROBC). The remaining buildings and transformer area (concrete pad 455) are on the south side of Munoz Rivera Avenue and arc used by the Federal Bureau of Prisons (FBOP) as the administrative offices. Four of these Buildings (445 through 448) are identified as being occupied by FROP employees and families. Buildings 440 and **444** are also residential dwellings, however, they are currently unoccupied. Building **30** is Dumas Restaurant and is open to the public. Table 2-1 provides a listing and description of the buildings and structures and Figure 2-2 is a Site Plan that depicts their locations.

3.0 FIELD JNVESTIGATION AND SAMPLING PROGRAM

This section describes the field investigation and sampling program to be conducted at Stop 7 ½ during March 2000. The detailed soil sampling procedures outlined in the Baker Final RFI Management Plans (Baker 1995) will be consulted, as appropriate. Table 3-1 details the anticipated number of soil and asbestos samples, sample identification, and the laboratory analysis. Table 3-2 details the anticipated number and location of LBP samples.

3.1 Overview

The field investigation tasks will consist of:

- Mobilization
- Background surface soil sampling
- Transformer pad (surface and subsurface) soil and concrete chip samples
- Incinerator area surface soil samples
- Machine gun pad surface soil samples
- Lead-based paint inspection/sampling
- Asbestos inspection/sampling
- Demobilization

The following presents a general overview of the field activities that will be conducted at Stop 7 ½.

3.1.1 Mobilization/Demobilization

Mobilization consists of obtaining the necessary equipment and supplies to perform the field investigation tasks. For this project, minimal equipment/supplies will be required such as, but not limited to: digital camera, stainless steel spoons, asbestos and lead sampling equipment, health and safety equipment, and field log books. Demobilization consists of removing, packaging and shipping all of the non-disposable equipment and supplies back to the United States.

3.1.2 Background Surface Soil Investigation

A total of eleven background soil samples including one duplicate will be acquired from various natural/undisturbed areas identified during the initial site visit. Four of the samples, including one duplicate, will be collected from the ROBC, up gradient of the former machine gun concrete pads. Five samples will be collected inside the FBOP portion of the compound at the far corners of the site near the base of established trees to represent undisturbed soils. Two additional background surface soil samples will be collected from Munoz Rivera Public Park, west of the FBOP, in suspected naturally-occurring soils. Figure 3-1 depicts the approximate background soil sample locations.

All of these samples will be collected from the top 6-inches of soil, after removal of vegetative material, using clean, disposable stainless steel spoons or trowels. The soil will bc placed in the appropriate laboratory supplied containers and stored in a cooler with ice pending transport to the laboratory.

Sample locations will be identified in the field with a wooden stake or pin flag. The sampling points will be measured with respect to nearby landmarks using an engineering/surveyors measuring tape and marked on a field map. The measurements will also be recorded in the field logbook.

Each of these background surface soil samples will be analyzed for TAL metals using Contract Laboratory Protocols (CLP) with a 5-day turnaround time.

3.1.3 Transformer Pad Area Samples

Thirteen samples, including one duplicate, will be collected in the vicinity of the Transformer Pad to assist in delineating the area of contamination. Eight samples will be from soil surrounding the pad and five (including one duplicate) will be concrete chip samples obtained directly from the pad. Seven of the soil samples will be collected from the top 0 to 6-inches and one will be collected from 6 to 12-inches. Four of the eight soil samples will be collected from three locations on the north side of the pad (including the 6 to 12-inch sample); two soil samples will be collected from both the east and west ends of the pad. The sample location that will be used to collect both a 0 to 6-inch and 6 to 12-inch soil sample is based on the highest PCR result (75 milligrams per kilograms [mg/kg] from *SS-5)* obtained during the Phase II Environmental Baseline Study (EBS). The four concrete chip samples

will be collected from the former transformer concrete pad, Building **455,** within a 0 to 1-inch range. Refer to Figure 3-2 to view the designated sample locations.

The same protocol used to collect the background surface soil samples will also be used to identify, collect, and prepare these surface soil samples. Separate stainless steel sampling spoons will be used to collect each soil sample. **A** hammer and chisel will be used to collect the concrete chip samples. The chisel will be wiped with a hexane damp cloth prior to collecting each sample. Both the soil and concrete samples will be placed in the appropriate laboratory supplied containers and stored in a cooler with ice pending transport to the laboratory.

Soil sample locations will be identified in the field with a wooden stake or pin flag. **All** of the sampling points will be measured with respect to nearby landmarks using an engineering/surveyors measuring tape and marked on a field map. The measurcmcnts will also be recorded in the field logbook.

The eight soil samples will be analyzed for Target Compound List (TCL) PCBs. The five concrete chip samples, including one duplicate, will also be analyzed for PCBs. All samples will have a requested 5-day turnaround time.

3.1.4 Former Incinerator **Area**

Concrete and stone remains of what is believed to be the corners of the incinerator footer are visible adjacent to the eastside of the concrete transformer pad. Three surface soil samples will be collected at random locations within this area. These approximate locations are identified on Figure 3-2. These surface soil samples will be identified, collected, and prepared as previously described for the background samples in Section 3.1.2.

The three soil samples collected from the incinerator area will be analyzed for TAL arsenic and lead. In addition, one of these samples will also bc analyzed for full TCLP analysis to assist in disposal planning. **All** samples will have a requested 5-day turnaround time.

3.1.5 Machine Gun Pad Area

There will bc one surface soil sample collected from the ROBC former machine gun pad area. This sample location will be in the vicinity of the highest arsenic result obtained (5 mg/kg from SS-10) from the Phase II EBS. The intended sample location is indicated on Figure 3-1. This surface soil sample will be identified, collected, and prepared as previously described for the background samples in Section 3.1.2.

Additionally, this sample will be analyzed for full TCLP analysis, to assist in disposal planning, as necessary. This sample will have a requested 5-day turnaround time.

3.1.6 Lead-Based Paint Survey

The sampling program for the LBP will consist of collecting paint chips, dust (if necessary), and composite soil samples to evaluate painted surfaces. All paint chips, dust, and soil samples shall be collected and analyzed in accordance with the USEPA 40 Code of Federal Regulations (CFR) 745.

This LRP sampling will only be performed in units designated as residential housing (Building 440 and Buildings 444 through 448). As part ofthe inspection, an inventory ofthe painted surfaces both interior and exterior will be documented. A portable X-ray fluorescence (XRF) analyzer will bc used to determine the presence of LBP onsite. The results of the XRF will be documented on a specific survey form. The information will at a minimum include the building number, XRF sample number, substrate material, paint color, wall location, results in milligrams per cubic centimeter (mg/cm3), and any other pertinent information. Positive results will not require chip samples to be collected and analyzed at a laboratory. In areas that are deteriorated, have irregular surfaces, and/or have inconclusive XRF readings, a paint chip sample will be collected and submitted for laboratory analysis.

Approximately 120 paint chip samples are to be collected from the six residential buildings. This estimate includes 20 samples from each of the six residential buildings. Each paint chip sample will include all layers of paint. The samples will be placed in a plastic, sealable bag, and analyzed at a laboratory recognized by the USEPA under the National Lead Laboratory Accreditation Program (NLLAP). In addition, the laboratory will be based in Puerto Rico and have a Puerto Rico certified chemist.

As part of the risk assessment for lead paint, it is assumed that deteriorated or damaged LBP will be encountered. An anticipated quantity of 30 wipe samples are to be collected from the six residential buildings and analyzed for lead. This estimate includes five samples from each of the rcsidcntial buildings. Collection of dust wipe samples, either composite or single surface samples, from interior window sills and floors in common living areas will be collected in accordance with Housing and Urban Development (HUD) guidelines. This method includes using a wet wipe to collect the sample, placing the wipe into a scalable container, identifying and logging the sample identification, and any other appropriate information.

The LBP investigation surface soil samples will be collected and analyzed for total lead in support of the risk assessment. An anticipated quantity of 24 lead soil samples are to be collected from outside the six residential buildings. This estimate includes four composite samples from the outside area of each residential building. Collection of composite soil samples will occur from the first ½-inch of soil from the dripline/foundation and the midyard areas where bare soil is present. Each composite sample will be made up of two or more subsamples, not to exceed ten locations. Separate composite samples will be collected from bare soils in any children's play areas identified, as necessary.

Each sampling location will bc identified on a sketched diagram of the facility. The sampling points will also be noted in the field logbook by sample identification, media, location description, date and time, and any other pertinent information.

Each of the lead (chip, wipe, and soil) samples will be analyzed according to methods for total lead analysis specified in American Standards and Testing Methods (ASTM) **ES-28-94, ES-36-94** (or ES-**37-94), and ES-1613-94.** The laboratory performing this analysis of lead in the soil, dust, and paint will bc a participant in USEPA's NLLAP and have a Puerto Rico certified chemist. **A** 5-day turnaround time will be requested for the lead samples.

The final determination on the quantity of samples will be based on the inspector's visual observations.

3.1.7 Asbestos Survey

An Asbestos Survey shall be conducted at all intact structures located at the property. The asbestos survey shall detail the location and approximate quantity of each suspect asbestos-containing material **(ACM).** An anticipated 510 bulk samples are to be collected from 15 of the buildings at Stop 7 ½. Bulk samples will be collected in accordance with the USEPA Asbestos Hazard Emergency Response Act (AHERA) procedures and practices. The exact quantity of sample locations will be based upon the inspector's discretion. Typically, the number of bulk samples depend upon the size of the homogeneous area. The typical sampling criteria for surfacing material is as follows:

Size of Homogeneous Sampling Area	Minimum Number of Samples
Less than 1,000 square feet	3
Between 1,000 and 5,000 square feet	5
Greater that 5,000 square feet	7

Typically, at least three random bulk samples per suspect thermal insulation and miscellaneous materials will be collected unless the inspector determines otherwise based on professional judgement. In addition, LANTDIV has requested that approximately six random building concrete and six random paint coatings are analyzed for asbestos.

Each sampling location will be identified on a sketched diagram of the building being inspected. Each homogeneous material will be noted on an Asbestos Survey Form, Attachment A. This form will be used to record consistent information regarding the material in question. The survey form will note a description of the material being sampled (surfacing material, thermal system insulation or miscellaneous material), condition of material, location description, date and time, and any other pertinent information.

The general sampling procedure for potentially friable surfacing and thermal insulation suspect ACM will be as follows:

1. Spread a plastic drop cloth beneath the sample location.
2. Moisten area where sample is to be extracted with water.
3. Put on personal protective equipment (minimum %-face respirator with HEPA cartridges).

4. Extract the sample with a clean knife, utility knife, cork borer, or other similar device to collect a portion of the material. Penetrate all layers of the material.
5. Wet wipe the exterior of the sample container and the sampling tool after sampling.
6. Wet wipe the drop cloth or vacuum with a HEPA vacuum to clean all debris.
7. Fill hole with appropriate caulking compound and/or spray with an encapsulant for appearance and to minimize subsequent fiber release.

Each of the bulk samples will bc analyzed for asbestos using polarized light microscopy (PLM) according to USEPA National Emission Standard and Hazardous Air Pollutants (NESHAP) regulations. The laboratory performing these analysis will be accredited through the National Voluntary Laboratory Accreditation Program (NVLAP) administered by the National Institute of Standards and Technology (NIST). A 5-day turnaround time will be requested for the asbestos bulk samples.

3.2 Quality Assurance/Quality Control Samples

Quality Assurance/Quality Control (QA/QC) requirements for the investigation are as follows.

3.2.1 Trip Blanks

Trip blanks will not be required to accompany the samples because there arc no volatile organic analysis (VOA) samples scheduled for collection. If the testing parameters are changed to include any VOA samples the requirement for trip blanks will be changed accordingly.

3.2.2 Field Duplicate Samples

Field duplicates of the background and transformer pad samples will be collected, homogenized, and split. One duplicate will be collected for every 10 soil or concrete chip samples collected. One duplicate surface soil sample is to be collected during the background surface soil sampling (Section 3.1.2) and one duplicate concrete chip sample is to be collected during the transformer pad sampling (Section 3.1.3). As the remaining soil sampling activities are confirmatory in nature, duplicates will not be collected as part of this investigation.

3.2.3 Matrix Spike/Matrix Spike Duplicates

Matrix Spike/Matrix Spike Duplicates (MS/MSDs) are laboratory derived and are collected to evaluate the matrix effect of the sample upon the analytical methodology. One MS/MSD will be collected for every 20 samples collected of a similar matrix. One MS/MSD will be collected during the background surface soil sampling at the FBOP compound and one at the transformer pad.

3.2.4 Equipment Rinsates

Equipment rinsates are collected from analyte-free water rinse of decontaminated equipment. Equipment rinsate blanks will be collected and submitted to an analytical laboratory for analysis. The results from the blanks will bc used to determine if the sampling equipment was free of contamination. The rinsates are analyzed for the same parameters as the related samples.

It is anticipated that a total of 2 equipment rinsates will be collected. These samples will be associated with the soil sampling. Both of these samples collected will be analyzed for TCL PCBs arid TAL Metals.

3.3 Sample Designation

In order to identify and accurately track the samples, all samples collected during this investigation, including QA/QC samples, will be designated with a unique number. The number **will** serve to identify the sample media, sample location, and QA/QC qualifiers.

The sample designation format will be as follows:

Background, Transformer Pad, Incinerator Area, and Machine Gun Area Surface Soil Samples:

Site # - Location - Media - Sequence

Site # 7.5

Location BG, TP, **TA,** or MG (Background, Transformer Pad, Incinerator Area, or Machine Gun)

Media	CC, SS, or SB	=	Concrete Chip, Surface Soil (0 to 6-inches), or Soil Boring (6 to 12-inches)
Sequence	01 through completion of samples		
QA/QC	D	=	Duplicate

Under this designation format, the example sample number 7.5-BGSS03D refers to:

7.5-BGSS03D Stop 7 ½
7.5-BGSS03D Background
7.5-BGSS03D Surface Soil #3
7.5-BGSS03D Duplicate

Lead-Based Paint Survey Samples:

Site # - Location - Media - Sequence

Site #	7.5		
Location	Building #		
Media	PC	=	Paint Chip
	W	=	Wipe
	S	=	Soil
Sequence	001 through completion of samples		

Under this designation format, the example sample number 7.5-440PC-001 refers to:

7.5-440PC-001 **Stop** 7 ½
7.5-440PC-001 Building 440
7.5-440PC-001 First Paint Chip sample from this Building

Asbestos Survey Samples

Date (month-year) - Location - Sequence - Media #

Month 03

Year	00
Location	Building #
Sequence	001 through completion of samples
Media	A, B, and C = At least three samples are collected for each homogeneous material sampled. The quantity of homogeneous samples collected will be identified with the same sequence number along with sequential lettering.

Under this designation format, the example sample number 0300-440-001B refers to:

0300-440-001B	March 2000
0300-440-001B	Building #
0300-440-001B	First media sample from this Building
0300-440-001B	The second sample of the first media from this Building

3.4 Analytical Requirements

As indicated in Subsection 3.1, the background and transformer surface soil samples will be analyzed for one of the following; TAL metals, TCL PCBs and TAL arsenic and lead, or TCLP. The TCL arid TAL analyses will be performed according to USEPA CLP protocols.

3.5 Chain-of-Custody

Chain-of-Custody procedures will be followed to ensure a documented, traceable link between measurement results and the sample/parameter that they represent. These procedures are inlcnded to provide a legally acceptable record of sample preparation, storage, and analysis.

To track sample custody transfers before ultimate disposition, sample custody will bc documented using a similar chain-of-custody form as shown in Attachment B.

A chain-of-custody form will be completed for each container in which the samples are shipped. The shipping containers for the soil samples will usually bc coolers. Other types of secure shipping containers can be used for the bulk asbestos and lead samples. After the samples arc properly packaged, the shipping container will be sealed and prepared for shipment to the analytical laboratory.

Custody seals will be placed on the outside of the containers to ensure that the samples are not disturbed prior to reaching the laboratory.

3.6 Investigation Derived Waste

It is not anticipated that any investigation-derivcd waste (I DW) will be generated during site investigation activities.

4.0 SITE MANAGEMENT

This section outlines the responsibilities and reporting requirements of field personnel.

4.1 Project Team Responsibilities

The Baker Project Team will be managed by Mr. Kenneth Martin. His responsibilities **will** be to direct the technical performance of the project staff, costs and schedule, ensuring that QA/QC procedures are followed during the course of the project. He will maintain communication with the LANTDIV NTK, Ms. Sherri Eng.

The field portion of this project will consist of one field team managed **by** the Senior Environmental Scientist, Mr. Konald Krivan. Mr. Krivan's responsibilities include directing the Baker field team and subcontractors.

4.2 Reporting Requirements

The Senior Environmental Scientist will maintain a daily summary of each day's field activities. The following infortnation will be included in this summary:

- Raker and subcontractor personnel on site
- Major activities of the day
- Samples collected
- Problems encountered
- Other pertinent site information

The Senior Environmental Scientist will receive direction from the Project Manager regarding any changes in scope of the investigation.

5.0 REFERENCES

Baker Environmental, Inc. (Baker) 2000. Final Implementation Plan and Fee Proposal, Remediation Plan. Stop 7 ½ Naval Reservation. March 2000. Coraopolis, Pennsylvania.

Baker. 1995. Final RCRA Facility Investigation Management Plans. Naval Station Roosevelt Roads. Ceiba. Puerto Rico. September 1995. Coraopolis, Pennsylvania.

ICF Kaiser 1995. Environmental Baseline Survey. Stop 7 ½ Naval Reservation. San Juan. Puerto Rico. January 1995.

Program Management Company 1999. Phase II Environmental Baseline Survey. Stop 7 ½ Naval Reservation. San Juan. Puerto Rico. April 1999.

U.S. Environmental Protection Agency and Department of Defense. 1999. Interim Final Lead-Based Paint Guidelines for Disposal of Department of Defense Residential Real Property – A Field Guide. December 1999.

TABLES

TABLE 2-1
BUILDING LISTING AND DESCRIPTION

STOP 7 ½, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

Building Number	Construction Date	General Use	Comments
28	1945	Men's Bath House	One story. Corrugated asbestos roof reported in 1987, appeared to be composite tar at the time of the March 14, 2000 site visit.
29	1941	Women's Bath House	One story. Corrugated asbestos roof reported in 1987, appeared to be composite tar at the time of the March 14, 2000 site visit.
30	1944	Dumas Restaurant	Public restaurant, reported suspect ACM, vinyl floor tiles.
31	1941	Maintenance Office	Concrete attachment to the side of Building 29.
440	1938	Commanding Office's Quarters	Two-story building, with suspect floor-tiles and suspended acoustical ceiling panels.
441	1938	Administrative Office Space	Two-story building, suspect ACM reported including floor-tile, acoustical ceiling panels, and ceiling tile.
442	1938	Training and Materials Storage	One story. Transformer Pad 455 attached to north side. Unoccupied at time of 2000 site visit.
443	1942	Training and Material Storage	Two-story. Suspect ACM includes thermal insulation.
444	1938	Housing	Two-story. Unoccupied during March 14, 2000 site visit.
445	1938	Housing	Two-story. Occupied during March 14, 2000 site visit.
446	1938	Housing	Two-story. Occupied during March 14, 2000 site visit.
447	1938	Housing	Two-story. Occupied during March 14, 2000 site visit.
448	1938	Housing	Two-story. Occupied during March 14, 2000 site visit.
449	1938	Administrative Office and Community Garage	One-story. Unoccupied during March 14, 2000 site visit.
454	1953	Abandoned	One-story. Large electrical conduit inside, partially demolished and empty.

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
BACKGROUND SURFACE SOIL SAMPLES						
7.5-BGSS01		X				Federal Bureau of Prisons (FBOP)
7.5-BGSS02		X				FBOP
7.5-BGSS03		X				FBOP
7.5-BGSS04		X				FBOP - North Side of Building 446
7.5-BGSS05		X				FBOP - North Side of Building 445
7.5-BGSS06		X				Reserve Officers Beach Club (ROBC) (Two containers - Sample and MS/MSD)
7.5-BGSS07		X				ROBC
7.5-BGSS08		X				ROBC
7.5-BGSS08D		X				ROBC
7.5-BGSS09		X				Munoz Rivera Public Park
7.5-BGSS10		X				Munoz Rivera Public Park
TRANSFORMER PAD SURFACE SOIL SAMPLES						
7.5-TPSS01	X					North side of pad
7.5-TPSB02	X					North side of pad
7.5-TPSS03	X					North side of pad
7.5-TPSBS03	X					North side of pad
7.5-TPSS04	X					West side of pad
7.5-TPSS05	X					West side of pad
7.5-TPSS06	X					East side of pad
7.5-TPSS07	X					East side of pad
TRANSFORMER PAD CONCRETE CHIP SAMPLE						
7.5-TPCC01	X					
7.5-TPCC02	X					
7.5-TPCC02D	X					Duplicate (Two Containers - Sample and MS/MSD)
7.5-TPCC03	X					
7.5-TPCC04	X					

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
INCINERATOR AREA SURFACE SOIL SAMPLES						
7.5-IASS01			X			
7.5-IASS02			X	X		
7.5-IASS02D			X			Duplicate
7.5-IASS03			X			
MACHINE GUN PAD AREA SURFACE SOIL SAMPLE						
7.5-MGSS01				X		Adjacent north of northern machine gun pad
EQUIPMENT RINSATE						
7.5-RS01	X	X				Stainless steel spoon
7.5-RS02	X	X				Aluminum pie pan
BUILDING 28 TENTATIVE BULK ASBESTOS SAMPLES						
0300-028-001A					X	
0300-028-001B					X	
0300-028-001C					X	
0300-028-002A					X	
0300-028-002B					X	
0300-028-002C					X	
BUILDING 29 TENTATIVE BULK ASBESTOS SAMPLES						
0300-029-001A					X	
0300-029-001B					X	
0300-029-001C					X	
0300-029-002A					X	
0300-029-002B					X	
0300-029-002C					X	
BUILDING 30 TENTATIVE BULK ASBESTOS SAMPLES						
0300-030-001A					X	
0300-030-001B					X	
0300-030-001C					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-030-002A					X	
0300-030-002B					X	
0300-030-002C					X	
0300-030-003A					X	
0300-030-003B					X	
0300-030-003C					X	
0300-030-004A					X	
0300-030-004B					X	
0300-030-004C					X	
0300-030-005A					X	
0300-030-005B					X	
0300-030-005C					X	
0300-030-006A					X	
0300-030-006B					X	
0300-030-006C					X	
BUILDING 31 TENTATIVE BULK ASBESTOS SAMPLES						
0300-031-001A					X	
0300-031-001B					X	
0300-031-001C					X	
0300-031-002A					X	
0300-031-002B					X	
0300-031-002C					X	
0300-031-003A					X	
0300-031-003B					X	
0300-031-003C					X	
0300-031-004A					X	
0300-031-004B					X	
0300-031-004C					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-031-005A					X	
0300-031-005B					X	
0300-031-005C					X	
0300-031-006A					X	
0300-031-006B					X	
0300-031-006C					X	
BUILDING 440 TENTATIVE BULK ASBESTOS SAMPLES						
0300-440-001A					X	
0300-440-001B					X	
0300-440-001C					X	
0300-440-002A					X	
0300-440-002B					X	
0300-440-002C					X	
0300-440-003A					X	
0300-440-003B					X	
0300-440-003C					X	
0300-440-004A					X	
0300-440-004B					X	
0300-440-004C					X	
0300-440-005A					X	
0300-440-005B					X	
0300-440-005C					X	
0300-440-006A					X	
0300-440-006B					X	
0300-440-006C					X	
BUILDING 441 TENTATIVE BULK ASBESTOS SAMPLES						
0300-441-001A					X	
0300-441-001B					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-441-001C					X	
0300-441-002A					X	
0300-441-002B					X	
0300-441-002C					X	
0300-441-003A					X	
0300-441-003B					X	
0300-441-003C					X	
0300-441-004A					X	
0300-441-004B					X	
0300-441-004C					X	
0300-441-005A					X	
0300-441-005B					X	
0300-441-005C					X	
0300-441-006A					X	
0300-441-006B					X	
0300-441-006C					X	
BUILDING 442 TENTATIVE BULK ASBESTOS SAMPLES						
0300-442-001A					X	
0300-442-001B					X	
0300-442-001C					X	
0300-442-002A					X	
0300-442-002B					X	
0300-442-002C					X	
0300-442-003A					X	
0300-442-003B					X	
0300-442-003C					X	
0300-442-004A					X	
0300-442-004B					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-442-004C					X	
0300-442-005A					X	
0300-442-005B					X	
0300-442-005C					X	
0300-442-006A					X	
0300-442-006B					X	
0300-442-006C					X	
BUILDING 443 TENTATIVE BULK ASBESTOS SAMPLES						
0300-443-001A					X	
0300-443-001B					X	
0300-443-001C					X	
0300-443-002A					X	
0300-443-002B					X	
0300-443-002C					X	
0300-443-003A					X	
0300-443-003B					X	
0300-443-003C					X	
0300-443-004A					X	
0300-443-004B					X	
0300-443-004C					X	
0300-443-005A					X	
0300-443-005B					X	
0300-443-005C					X	
0300-443-006A					X	
0300-443-006B					X	
0300-443-006C					X	
BUILDING 444 TENTATIVE BULK ASBESTOS SAMPLES						
0300-444-001A					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested				
	Solid Samples				
	Lab Corp				
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-444-001B					X	
0300-444-001C					X	
0300-444-002A					X	
0300-444-002B					X	
0300-444-002C					X	
0300-444-003A					X	
0300-444-003B					X	
0300-444-003C					X	
0300-444-004A					X	
0300-444-004B					X	
0300-444-004C					X	
0300-444-005A					X	
0300-444-005B					X	
0300-444-005C					X	
0300-444-006A					X	
0300-444-006B					X	
0300-444-006C					X	
BUILDING 445 TENTATIVE BULK ASBESTOS SAMPLES						
0300-445-001A					X	
0300-445-001B					X	
0300-445-001C					X	
0300-445-002A					X	
0300-445-002B					X	
0300-445-002C					X	
0300-445-003A					X	
0300-445-003B					X	
0300-445-003C					X	
0300-445-004A					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-445-004B					X	
0300-445-004C					X	
0300-445-005A					X	
0300-445-005B					X	
0300-445-005C					X	
0300-445-006A					X	
0300-445-006B					X	
0300-445-006C					X	
BUILDING 446 TENTATIVE BULK ASBESTOS SAMPLES						
0300-446-001A					X	
0300-446-001B					X	
0300-446-001C					X	
0300-446-002A					X	
0300-446-002B					X	
0300-446-002C					X	
0300-446-003A					X	
0300-446-003B					X	
0300-446-003C					X	
0300-446-004A					X	
0300-446-004B					X	
0300-446-004C					X	
0300-446-005A					X	
0300-446-005B					X	
0300-446-005C					X	
0300-446-006A					X	
0300-446-006B					X	
0300-446-006C					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested				
	Solid Samples				
	Lab Corp				
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
BUILDING 447 TENTATIVE BULK ASBESTOS SAMPLES						
0300-447-001A					X	
0300-447-001B					X	
0300-447-001C					X	
0300-447-002A					X	
0300-447-002B					X	
0300-447-002C					X	
0300-447-003A					X	
0300-447-003B					X	
0300-447-003C					X	
0300-447-004A					X	
0300-447-004B					X	
0300-447-004C					X	
0300-447-005A					X	
0300-447-005B					X	
0300-447-005C					X	
0300-447-006A					X	
0300-447-006B					X	
0300-447-006C					X	
BUILDING 448 TENTATIVE BULK ASBESTOS SAMPLES						
0300-448-001A					X	
0300-448-001B					X	
0300-448-001C					X	
0300-448-002A					X	
0300-448-002B					X	
0300-448-002C					X	
0300-448-003A					X	
0300-448-003B					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
0300-448-003C					X	
0300-448-004A					X	
0300-448-004B					X	
0300-448-004C					X	
0300-448-005A					X	
0300-448-005B					X	
0300-448-005C					X	
0300-448-006A					X	
0300-448-006B					X	
0300-448-006C					X	
BUILDING 449 TENTATIVE BULK ASBESTOS SAMPLES						
0300-449-001A					X	
0300-449-001B					X	
0300-449-001C					X	
0300-449-002A					X	
0300-449-002B					X	
0300-449-002C					X	
0300-449-003A					X	
0300-449-003B					X	
0300-449-003C					X	
0300-449-004A					X	
0300-449-004B					X	
0300-449-004C					X	

TABLE 3-1
SUMMARY OF SOIL AND ASBESTOS SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested					
	Solid Samples					
	Lab Corp					
Sample ID	Target Compound List - Polychlorinated Biphenyls	Target Analyte List (TAL) - Metals	TAL Arsenic and Lead	Toxicity Characteristics Leachate Procedure (TCLP)	Polarized Light Microscopy - Asbestos Bulk	Comments
BUILDING 454 TENTATIVE BULK ASBESTOS SAMPLES						
0300-454-001A					X	
0300-454-001B					X	
0300-454-001C					X	
0300-454-002A					X	
0300-454-002B					X	
0300-454-002C					X	
0300-454-003A					X	
0300-454-003B					X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 440 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-440PC-001	X			
7.5-440PC-002	X			
7.5-440PC-003	X			
7.5-440PC-004	X			
7.5-440PC-005	X			
7.5-440PC-006	X			
7.5-440PC-007	X			
7.5-440PC-008	X			
7.5-440PC-009	X			
7.5-440PC-010	X			
7.5-440PC-011	X			
7.5-440PC-012	X			
7.5-440PC-013	X			
7.5-440PC-014	X			
7.5-440PC-015	X			
7.5-440PC-016	X			
7.5-440PC-017	X			
7.5-440PC-018	X			
7.5-440PC-019	X			
7.5-440PC-020	X			
7.5-440W-001		X		
7.5-440W-002		X		
7.5-440W-003		X		
7.5-440W-004		X		
7.5-440W-005		X		
7.5-440S-001			X	
7.5-440S-002			X	
7.5-440S-003			X	
7.5-440S-004			X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 444 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-444PC-001	X			
7.5-444PC-002	X			
7.5-444PC-003	X			
7.5-444PC-004	X			
7.5-444PC-005	X			
7.5-444PC-006	X			
7.5-444PC-007	X			
7.5-444PC-008	X			
7.5-444PC-009	X			
7.5-444PC-010	X			
7.5-444PC-011	X			
7.5-444PC-012	X			
7.5-444PC-013	X			
7.5-444PC-014	X			
7.5-444PC-015	X			
7.5-444PC-016	X			
7.5-444PC-017	X			
7.5-444PC-018	X			
7.5-444PC-019	X			
7.5-444PC-020	X			
7.5-444W-001		X		
7.5-444W-002		X		
7.5-444W-003		X		
7.5-444W-004		X		
7.5-444W-005		X		
7.5-444S-001			X	
7.5-444S-002			X	
7.5-444S-003			X	
7.5-444S-004			X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 445 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-445PC-001	X			
7.5-445PC-002	X			
7.5-445PC-003	X			
7.5-445PC-004	X			
7.5-445PC-005	X			
7.5-445PC-006	X			
7.5-445PC-007	X			
7.5-445PC-008	X			
7.5-445PC-009	X			
7.5-445PC-010	X			
7.5-445PC-011	X			
7.5-445PC-012	X			
7.5-445PC-013	X			
7.5-445PC-014	X			
7.5-445PC-015	X			
7.5-445PC-016	X			
7.5-445PC-017	X			
7.5-445PC-018	X			
7.5-445PC-019	X			
7.5-445PC-020	X			
7.5-445W-001		X		
7.5-445W-002		X		
7.5-445W-003		X		
7.5-445W-004		X		
7.5-445W-005		X		
7.5-445S-001			X	
7.5-445S-002			X	
7.5-445S-003			X	
7.5-445S-004			X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 446 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-446PC-001	X			
7.5-446PC-002	X			
7.5-446PC-003	X			
7.5-446PC-004	X			
7.5-446PC-005	X			
7.5-446PC-006	X			
7.5-446PC-007	X			
7.5-446PC-008	X			
7.5-446PC-009	X			
7.5-446PC-010	X			
7.5-446PC-011	X			
7.5-446PC-012	X			
7.5-446PC-013	X			
7.5-446PC-014	X			
7.5-446PC-015	X			
7.5-446PC-016	X			
7.5-446PC-017	X			
7.5-446PC-018	X			
7.5-446PC-019	X			
7.5-446PC-020	X			
7.5-446W-001		X		
7.5-446W-002		X		
7.5-446W-003		X		
7.5-446W-004		X		
7.5-446W-005		X		
7.5-446S-001			X	
7.5-446S-002			X	
7.5-446S-003			X	
7.5-446S-004			X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

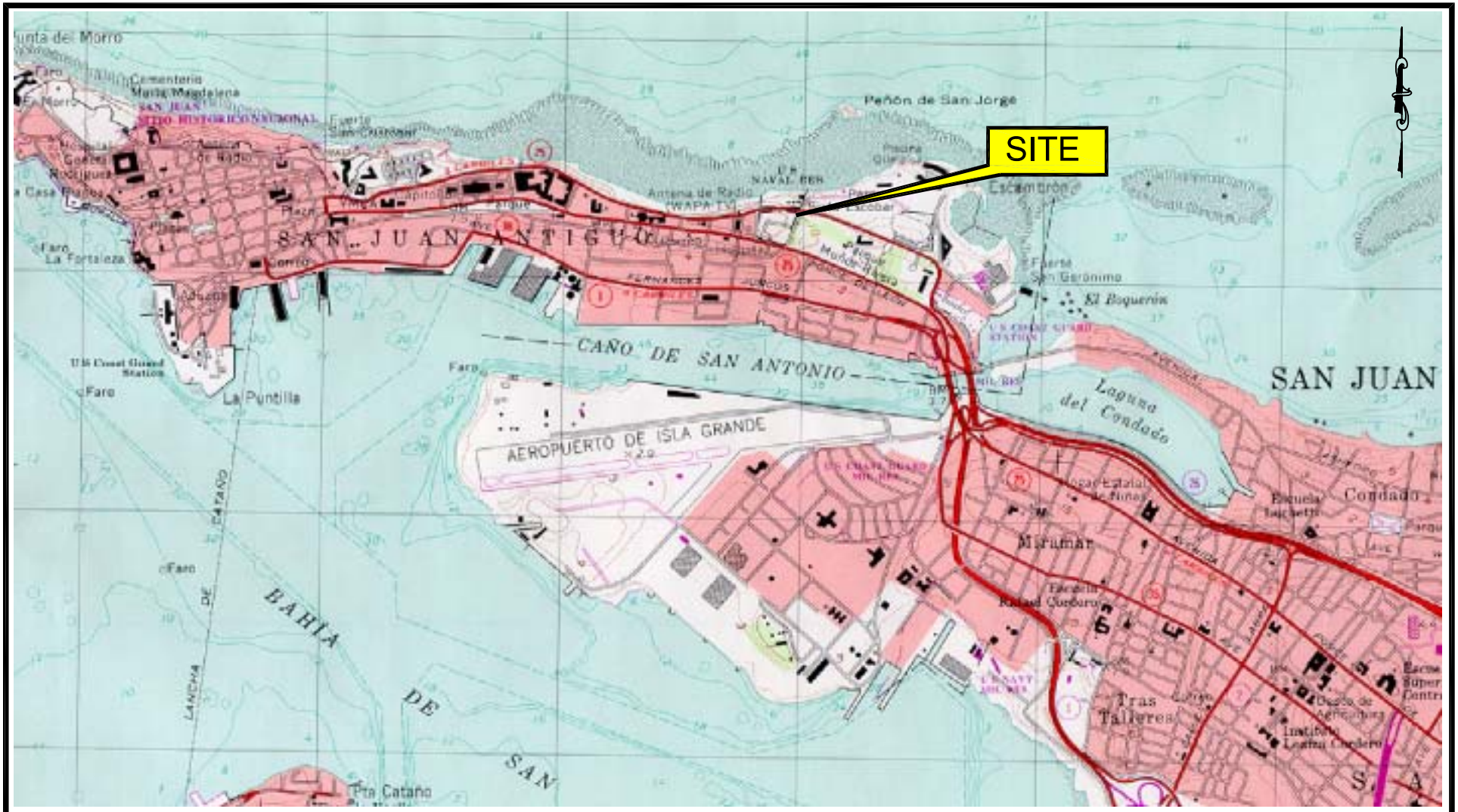
	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 447 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-447PC-001	X			
7.5-447PC-002	X			
7.5-447PC-003	X			
7.5-447PC-004	X			
7.5-447PC-005	X			
7.5-447PC-006	X			
7.5-447PC-007	X			
7.5-447PC-008	X			
7.5-447PC-009	X			
7.5-447PC-010	X			
7.5-447PC-011	X			
7.5-447PC-012	X			
7.5-447PC-013	X			
7.5-447PC-014	X			
7.5-447PC-015	X			
7.5-447PC-016	X			
7.5-447PC-017	X			
7.5-447PC-018	X			
7.5-447PC-019	X			
7.5-447PC-020	X			
7.5-447W-001		X		
7.5-447W-002		X		
7.5-447W-003		X		
7.5-447W-004		X		
7.5-447W-005		X		
7.5-447S-001			X	
7.5-447S-002			X	
7.5-447S-003			X	
7.5-447S-004			X	

TABLE 3-2
SUMMARY OF LEAD-BASED PAINT SAMPLING AND ANALYTICAL PROGRAM

STOP 7 1/2, NAVAL RESERVATION
SAN JUAN, PUERTO RICO

	Analysis Requested			
	Aqueous Samples			
	Puerto Rico Laboratory			
Sample ID	Lead-Based Paint Chip	Lead Wipe	Lead Soil	Comments
BUILDING 448 TENTATIVE LEAD-BASED PAINT SAMPLES				
7.5-448PC-001	X			
7.5-448PC-002	X			
7.5-448PC-003	X			
7.5-448PC-004	X			
7.5-448PC-005	X			
7.5-448PC-006	X			
7.5-448PC-007	X			
7.5-448PC-008	X			
7.5-448PC-009	X			
7.5-448PC-010	X			
7.5-448PC-011	X			
7.5-448PC-012	X			
7.5-448PC-013	X			
7.5-448PC-014	X			
7.5-448PC-015	X			
7.5-448PC-016	X			
7.5-448PC-017	X			
7.5-448PC-018	X			
7.5-448PC-019	X			
7.5-448PC-020	X			
7.5-448W-001		X		
7.5-448W-002		X		
7.5-448W-003		X		
7.5-448W-004		X		
7.5-448W-005		X		
7.5-448S-001			X	
7.5-448S-002			X	
7.5-448S-003			X	
7.5-448S-004			X	

FIGURES



Baker

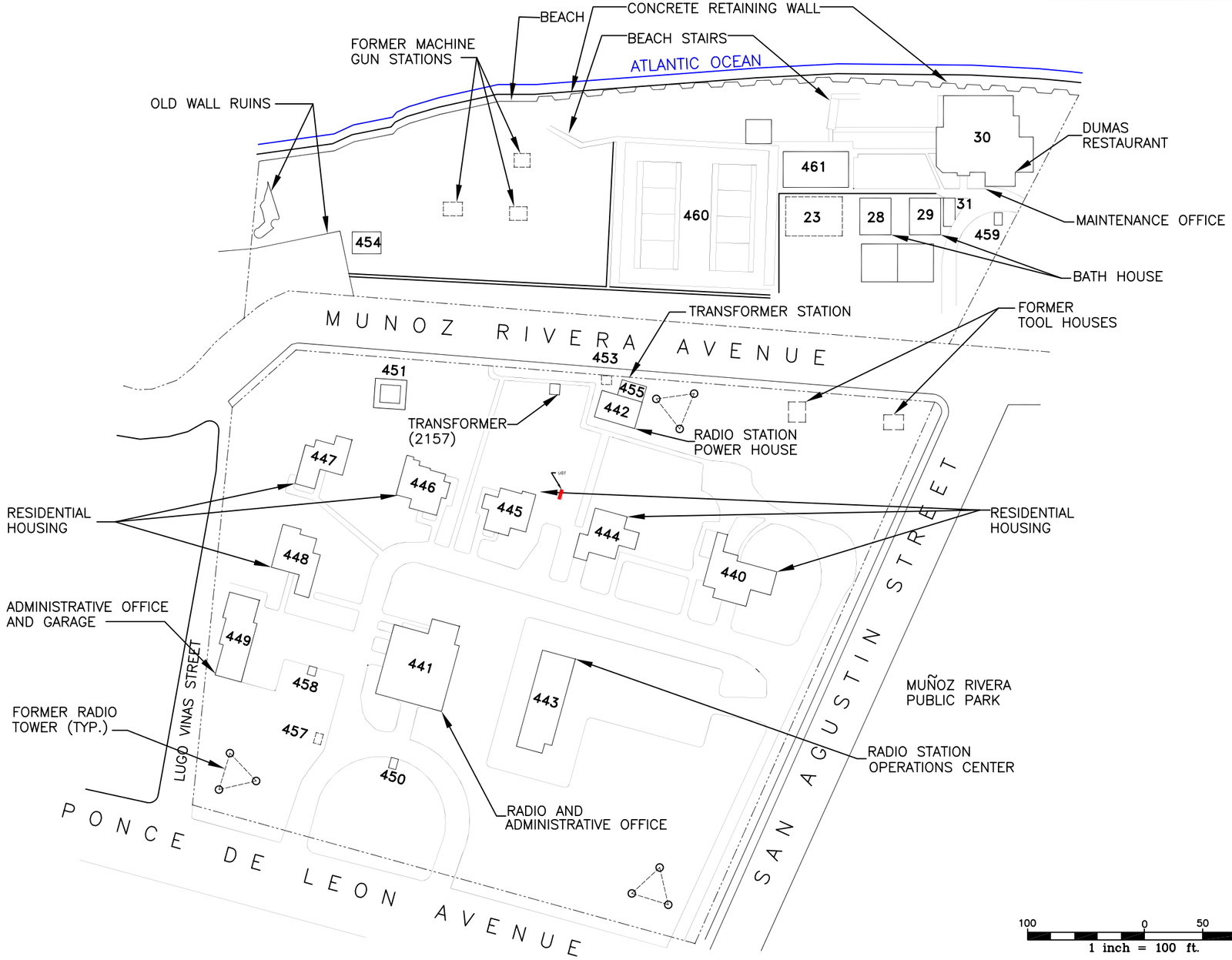
Baker Environmental, Inc.

FIGURE 2–1
SITE LOCATION MAP

SAN JUAN, PUERTO RICO

K\62470\001\GRAPHICS\CAD\ 62470L30

K\62470\001\GRAPHICS\CAD 62470L02



Baker
Baker Environmental Inc.

LEGEND

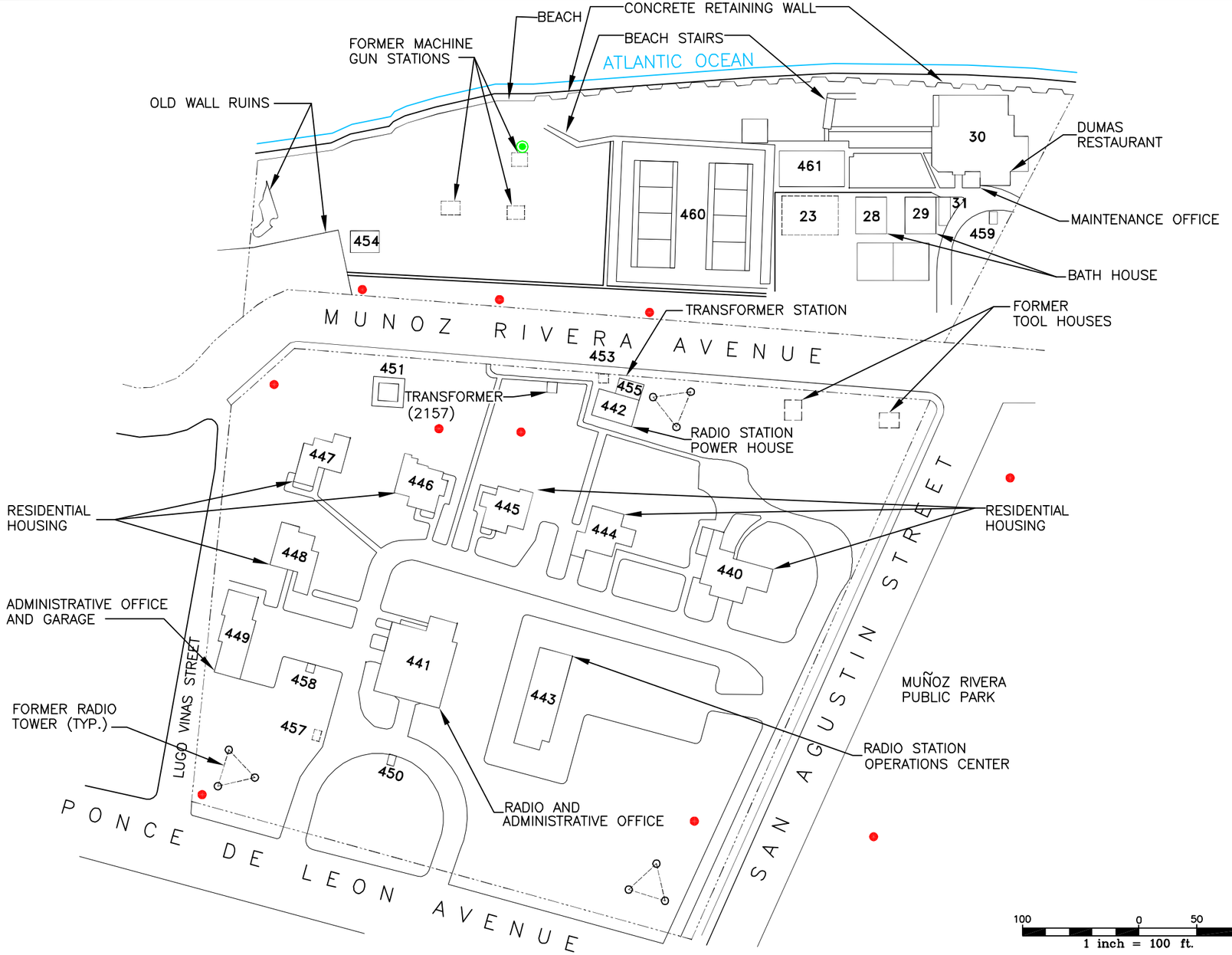
- ☐ – DENOTES FORMER STRUCTURE
- ——— – PROPERTY BOUNDARY
- ▬ – FORMER UST LOCATION

SOURCE: ICF KAISER.

FIGURE 2–2
STOP 7–1/2 SITE PLAN

SAN JUAN, PUERTO RICO

K\62470\001\GRAPHICS\CAD 62470L27



100 0 50 100
1 inch = 100 ft.

Baker
Baker Environmental Inc.

ANTICIPATED BUILDINGS OF ASBESTOS INVESTIGATION

28	440*	444*	448*
29	441	445*	449
30	442	446*	454
31	443	447*	

NOTE
* INCLUDED IN LEAD-BASED PAINT INVESTIGATION

LEGEND
- DENOTES FORMER STRUCTURE
- PROPERTY BOUNDARY
- BACKGROUND SURFACE SOIL SAMPLE LOCATIONS
- MACHINE GUN PAD TCLP SURFACE SOIL SAMPLE LOCATION

FIGURE 3-1
STOP 7-1/2 BACKGROUND AND MACHINE GUN PAD SAMPLING LOCATIONS

SAN JUAN, PUERTO RICO

FENCE

4'6"

FORMER INCINERATOR LOCATION

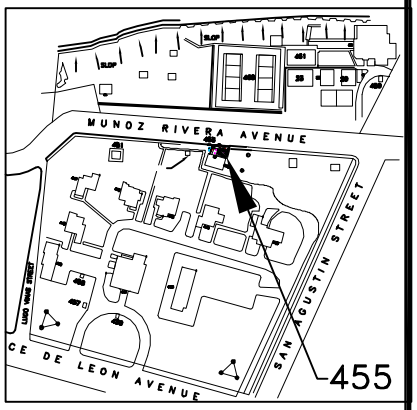
14'8"

28'3"

9'7"

455

BLDG 442



SITE PLAN

5 0 2.5 5

1 inch = 5 ft.

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Baker Environmental Inc.

LEGEND

- – TRANSFORMER PAD SURFACE SOIL SAMPLE LOCATIONS (0–6")
- – TRANSFORMER PAD SURFACE SOIL SAMPLE LOCATIONS (0–6")–(6"–12")
- – CONCRETE CHIP SAMPLES
- – APPROXIMATE INCINERATOR SURFACE SOIL SAMPLE LOCATIONS (0–6")

FIGURE 3–2
STOP 7–1/2
TRANSFORMER PAD AND INCINERATOR SAMPLING LOCATIONS

SAN JUAN, PUERTO RICO

K\62470\001\GRAPHICS\CAD\ 62470L29

ATTACHMENT A
ASBESTOS SURVEY FORM

Baker

STOP 7 ½ ASBESTOS SURVEY FORM
NEW MATERIAL SURVEY FORM

BUILDING NAME: _____ MATERIAL NO.: _____

BUILDING NUMBER: _____ DATE: _____

Material Identification		AHERA Material Category	Material Location *List all Room Numbers where Material is Located*	Quantity	New Sample No's	Friable	Type Damage	Damage Severity and Distrib.	Access	Infl. of Vibr a-tion	Infl. of Air Erosion	Overall Pot. for Damage	Recom-mended Action	Action Priority Number	Portion Related to Action
Code	Description														
		SACM				YES	DETER	UNDAM	LOW	LOW	LOW	LOW POT.	O&M	1 2 3	ALL
		TSIACM				NO	WATER	DAM	MED.	MED.	MED.	POT.	REMOVE	1 2 3	PARTIAL ALL
		MACM					PHYS	SIGDAM	HIGH	HIGH	HIGH	SIG. POT.	ENCAPS.	1 2 3	PARTIAL ALL
				SF LF EA			NONE	____ LOCAL					REPAIR	1 2 3	PARTIAL ALL
								DIST					ENCLOSE	1 2 3	PARTIAL ALL

COMMENTS: _____

_____

_____

_____

_____

_____

The adhesive for this material is Material # _____

This is the adhesive for Material # _____

INSPECTORS: _____

ATTACHMENT B
CHAIN-OF-CUSTODY

Baker Environmental, Inc.
420 Rouser Road, AOP Building 3, Coraopolis, PA 15108

CHAIN -OF-CUSTODY RECORD

Project No.:	Site Name:													
Samplers (Signature):						No. of Containers								Remarks
Station No.	Date	Time	Comp	Grab	Station Location									
Relinquished By (Signature):		Date/Time		Received By (Signature):		Relinquished By (Signature):				Date/Time		Received By (Signature):		
Relinquished By (Signature):		Date/Time		Received By (Signature):		Relinquished By (Signature):				Date/Time		Received By (Signature):		
Relinquished By (Signature):		Date/Time		Received For Laboratory By (Signature):		Date/Time		Remarks:						

Baker

REQUEST FOR ANALYSIS/ CHAIN-OF-CUSTODY RECORD

Baker Environmental Inc.
Airport Office Park, Bldg. #3
420 Rouser Road
Coraopolis, PA 15108
(412) 269-6000

Sheet _____ of _____
S.O.# 62470-401
Laboratory Completing Analysis (Name, Address, Phone, Contact):
Lab Corp, 8040 Villa Park Dr., Suite 250, Richmond, VA 23228
Attn: Mr. Mike Tyler Phone:800-888-8061 ext 5002
Fax
Baker Environmental Contact: Ron Krivan
Subconsultant Agreement Completed? Yes X No
Sample Description: Bulk

Facility/School #:
Date Samples Completed:
Date Samples Shipped:
Date Analysis Required: As per delivery order
Sampling Completed By:
Method of Delivery: Express Mail
Carrier/Waybill Number:
Container Description: Bag

Materl. No.	Bldg. No.	Sample No.	Analyze For	Analytical Method	Special Instructions
			Asbestos	PLM 40 CFR, Part 763, Appendix A, Subpart F	Please fax results to Ron Krivan ASAP upon analysis.
			Asbestos		Fax number: 412-269-6057
			Asbestos		
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			Asbestos		

Relinquished By (Sign): _____
Date/Time: _____
Remarks: _____

Received By (Sign): _____
Date/Time: _____
Remarks: _____

EXAMPLE SAMPLE LABEL

Baker

Baker Environmental Inc.
Airport Office Park, Bldg. 3
420 Rouser Road
Coraopolis, PA 15108

Project: _____ CTO No.: _____

Sample Description: _____

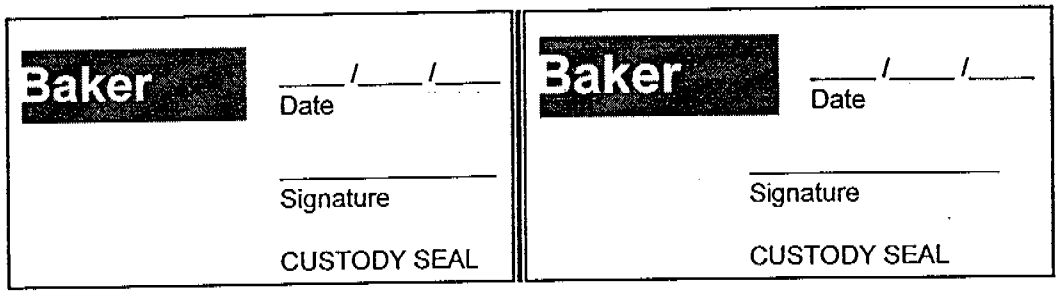
Date: _____ Sampler: _____

Time: _____

Analysis: _____ Preservation: _____

Project Sample No.: _____

EXAMPLE CUSTODY SEAL



ATTACHMENT C
HEALTH AND SAFETY PROCEDURES

SITE INVESTIGATION
STOP 7 ½ NAVAL RESERVATION
HEALTH AND SAFETY PROCEDURES

SECTION I - GENERAL

PROJECT/CLIENT NAME: LANTDIV

S.O. #: 62470-401

LOCATION: Stop 7 ½, San Juan, Puerto Rico

KEY PERSONNEL:

Project Manager: Ken Martin

Site Manager: Ron Krivan

Project Health and Safety Officer: Ron Krivan

Site Health and Safety Officer: Ron Krivan

Contractors: Environmental Xchange of Information and Technology (Miguel Oliveras)

SITE DESCRIPTION

The U.S. Naval Compound, Stop 7 ½, is located in the Puerto de Tierra section of San Juan, Puerto Rico. The site consists of 7.7 acres and is divided by Munoz Rivera Avenue.

The Department of the Army acquired this property by Executive Order in June 1903. The Navy has used the land since 1904. The land was actually transferred to the Navy in 1930 and used as a U.S. Naval Radio Station from 1930 to 1952.

There are fifteen existing buildings identified at the site, including Buildings 28 through 31, 440 through 449, and 454. Buildings 28 through 31 are on the north side of Munoz Rivera Avenue and are part of the Reserves Officers Beach Club (ROBC). The remaining buildings and transformer area (concrete pad 455) are on the south side of Munoz Rivera Avenue and are used by the Federal Bureau of Prisons (FBOP) as the administrative offices. Four of these Buildings (445 through 448) are identified as being occupied by FBOP employees and families. Buildings 440 and 444 are also residential dwellings, however, they are currently unoccupied. Building 30 is Dumas Restaurant and is open to the public.

DESCRIPTION OF TASK(S):

This section describes the field tasks to be conducted at Stop 7 ½ during March 2000. The field investigation tasks will consist of:

- Mobilization
- Background surface soil sampling
- Transformer pad soil and concrete chip samples
- Incinerator area surface soil samples
- Machine gun pad surface soil sample
- Lead-based paint inspection
- Asbestos inspection
- Demobilization

The following presents a general overview of the field activities that will be conducted at Stop 7 ½.

Mobilization/Demobilization

Mobilization consists of obtaining the necessary equipment and supplies to perform the field investigation tasks. For this project, minimal equipment/supplies will be required such as, but not limited to: digital camera, stainless steel spoons, asbestos and lead sampling equipment, health and safety equipment, and field log books. Demobilization consists of removing, packaging and shipping all the non-disposable equipment and supplies.

Background Surface Soil Investigation

A total of nine background soil samples including one duplicate will be acquired from various natural/undisturbed areas identified during the initial site visit. Three of the samples will be collected from the ROBC, up gradient of the former machine gun concrete pads. Four samples, including one duplicate, will be collected inside the FBOP portion of the compound at the far corners of the site near the base of established trees to represent undisturbed soils. Another two background surface soil samples will be collected from Munoz Rivera Public Park, adjacent west of the FBOP, in natural undisturbed soils. Figure 3-1 depicts the approximate background soil

sample locations.

All of these samples will be collected from the top 6-inches of soil, after removal of vegetative material, using clean, disposable stainless steel spoons or trowels. The soil will be placed in the appropriate laboratory supplied containers and stored in a cooler with ice pending transport to the laboratory.

Sample locations will be identified in the field with a wooden stake or pin flag. The sampling points will be measured with respect to nearby landmarks using an engineering/surveyors measuring tape and marked on a field map. The measurements will also be recorded in the field logbook.

Transformer Pad Area Samples

Thirteen samples, including one duplicate, will be collected in the vicinity of the Transformer Pad to assist in delineating the area of contamination. Eight of the thirteen will be soil samples and five (including one duplicate) will be concrete chip samples. Seven of the soil samples will be collected from the top 0 to 6-inches and one will be collected from 6 to 12-inches. The sample location that will be used to collect both a 0 to 6-inch and 6 to 12-inch soil sample is based on the highest PCB result (75 milligrams per kilograms [mg/kg] from SS-5) obtained during the Phase II Environmental Baseline Study (EBS). The four concrete chip samples will be collected from the former transformer concrete pad, 455, within a 0 to 1-inch range.

Former Incinerator Area

Concrete and stone remains of what is believed to be the corners of the incinerator footer are visible adjacent to the eastside of the concrete transformer pad. Three surface soil samples will be collected at random locations within this area.

Machine Gun Pad Area

There will be one surface soil sample collected from the ROBC former machine gun pad area. This sample location will be in the vicinity of the highest arsenic result obtained (5 mg/kg from SS-10) from the Phase II EBS.

Lead-Based Paint Survey

The sampling program for the LBP will consist of collecting paint chips, dust (if necessary), and composite soil samples to evaluate painted surfaces. All paint chips, dust, and soil samples shall be collected and analyzed in accordance with the USEPA 40 Code of Federal Regulations (CFR) 745.

This LBP sampling will only be performed in units designated as residential housing (Building 440 and Buildings 444 through 448). As part of the inspection, an inventory of the painted surfaces both interior and exterior will be documented. A portable X-ray fluorescence (XRF) analyzer will be used to determine the presence of LBP onsite. The results of the XRF will be documented on a specific survey form. The information will at minimum include the building number, XRF sample number, substrate material, paint color, wall location, results in milligrams per cubic centimeter (mg/cm^3), and any other pertinent information. Positive results will not need to have chip samples collected. In areas that are deteriorated, have irregular surfaces, and/or have inconclusive XRF readings, a paint chip sample will be collected and submitted for laboratory analysis.

Approximately 120 paint chip samples are to be collected from the six residential buildings. This estimate includes 20 samples from each of the six residential buildings. Each paint chip sample will include all layers of paint. The samples will be placed in a plastic, sealable bag, and analyzed at a laboratory recognized by the USEPA under the National Lead Laboratory Accreditation Program (NLLAP). In addition, the laboratory will be have a Puerto Rico certified chemist to review the results.

As part of the risk assessment for lead paint, it is assumed that deteriorated or damaged LBP will be encountered. An anticipated quantity of 30 wipe samples are to be collected from the six residential buildings and analyzed for lead. This estimate includes five samples from each of the residential buildings. Collection of dust wipe samples, either composite or single surface samples, from interior window sills and floors in common living areas will be collected in accordance with Housing and Urban Development (HUD) guidelines. This method includes using a wet wipe to collect the sample, placing the wipe into a sealable container, identifying and logging the sample identification, and any other appropriate information.

The LBP investigation surface soil samples will be collected and analyzed for total lead in support

of the risk assessment. An anticipated quantity of 24 lead soil samples are to be collected from outside the six residential buildings. This estimate includes four composite samples from the outside area of each residential building. Collection of composite soil samples will occur from the first ½-inch of soil from the dripline/foundation and the midyard areas where bare soil is present. Each composite sample will be made up of two or more subsamples, not to exceed ten locations. Separate composite samples will be collected from bare soils in any children's play areas identified, as necessary.

The final determination on the quantity of samples will be based on the inspector's visual observations.

Asbestos Survey

An Asbestos Survey shall be conducted at all intact structures located at the property. The asbestos survey shall detail the location and approximate quantity of each suspect asbestos-containing material (ACM). An anticipated 510 bulk samples are to be collected from 15 of the buildings at Stop 7 ½. Bulk samples will be collected in accordance with the USEPA Asbestos Hazard Emergency Response Act (AHERA) procedures and practices. The exact quantity of sample locations will be based on the inspector's discretion.

The general sampling procedure for potentially friable surfacing and thermal insulation suspect ACM will be as follows:

1. Spread a plastic drop cloth beneath the sample location.
2. Moisten area where sample is to be extracted with water.
3. Put on personal protective equipment (minimum ½-face respirator with HEPA cartridges).
4. Extract the sample with a clean knife, utility knife, cork borer, or other similar device to collect a portion of the material. Penetrate all layers of the material.
5. Wet wipe the exterior of the sample container and the sampling tool after sampling.
6. Wet wipe the drop cloth or vacuum with a HEPA vacuum to clean all debris.
7. Fill hole with appropriate caulking compound and/or spray with an encapsulant for appearance and to minimize subsequent fiber release.

SECTION II - HAZARD DESCRIPTION

CHEMICAL HAZARDS:

There is a potential that PCBs, asbestos, lead, and metals (soil) may be present in the work area. The concentrations of hazardous constituents are likely to be low (below OSHA permissible exposure levels) for the chemical hazards listed below, if present. This assumption is based on the site activites to be conducted. Summaries of the health and safety procedures, symptoms of exposures, etc. are provided in the attached material safety data sheets. Protective measures for these materials are described in Section III.

PHYSICAL HAZARDS:

The physical hazards that may be present during the work include the following:

Heat Stress: Heat could be a concern if Level C protective equipment is worn. Protective measures shall include the availability of fluids (water) and work breaks as necessary. Personnel shall visually monitor each other for signs of heat stress that include: profuse sweating, dizziness, heat rash, heat cramps, and pale, cool moist skin.

Eye and Head Injuries: Safety glasses should be worn during the concrete chip sampling to reduce the risk of eye injuries that may result from dusts and/or flying particules.

SECTION III - PERSONAL PROTECTIVE EQUIPMENT/SAFETY PROVISIONS

RESPIRATORY PROTECTION: The only task requiring respiratory protection is during the asbestos bulk sampling. Personnel sampling shall wear a ½-face air-purifying respirator with HEPA cartridges.

PROTECTIVE CLOTHING: All tasks shall be performed in Level D with sturdy shoes and long pants with the exception of the asbestos sampling (respiratory requirement) and the concrete chip sampling (eye protection).

LEVEL OF PROTECTION	REQUIRED PERSONAL PROTECTIVE EQUIPMENT
D	Sturdy Shoes Work Clothes or Coveralls
C	Same as Level D Plus; Half mask respiratory with organic cartridge/HEPA filter combination Boots or tyvek shoe covers

OTHER SAFETY PROVISIONS:

The following items shall be located in the field vehicle:

First Aid Kit
Eyewash/Neutralizer

SECTION IV - TRAINING AND MEDICAL SURVEILLANCE

While it is anticipated that hazardous wastes and/or constituents will not be encountered during the field tasks performed by Baker personnel, Baker field personnel for this project are required to be certified/trained according to the OSHA's HAZWOPER standard (i.e., 40-hour initial training and 8-hour annual refresher training) and Asbestos Inspector/Management Planner current training. This training shall include the proper use of respiratory equipment and other personal protective equipment.

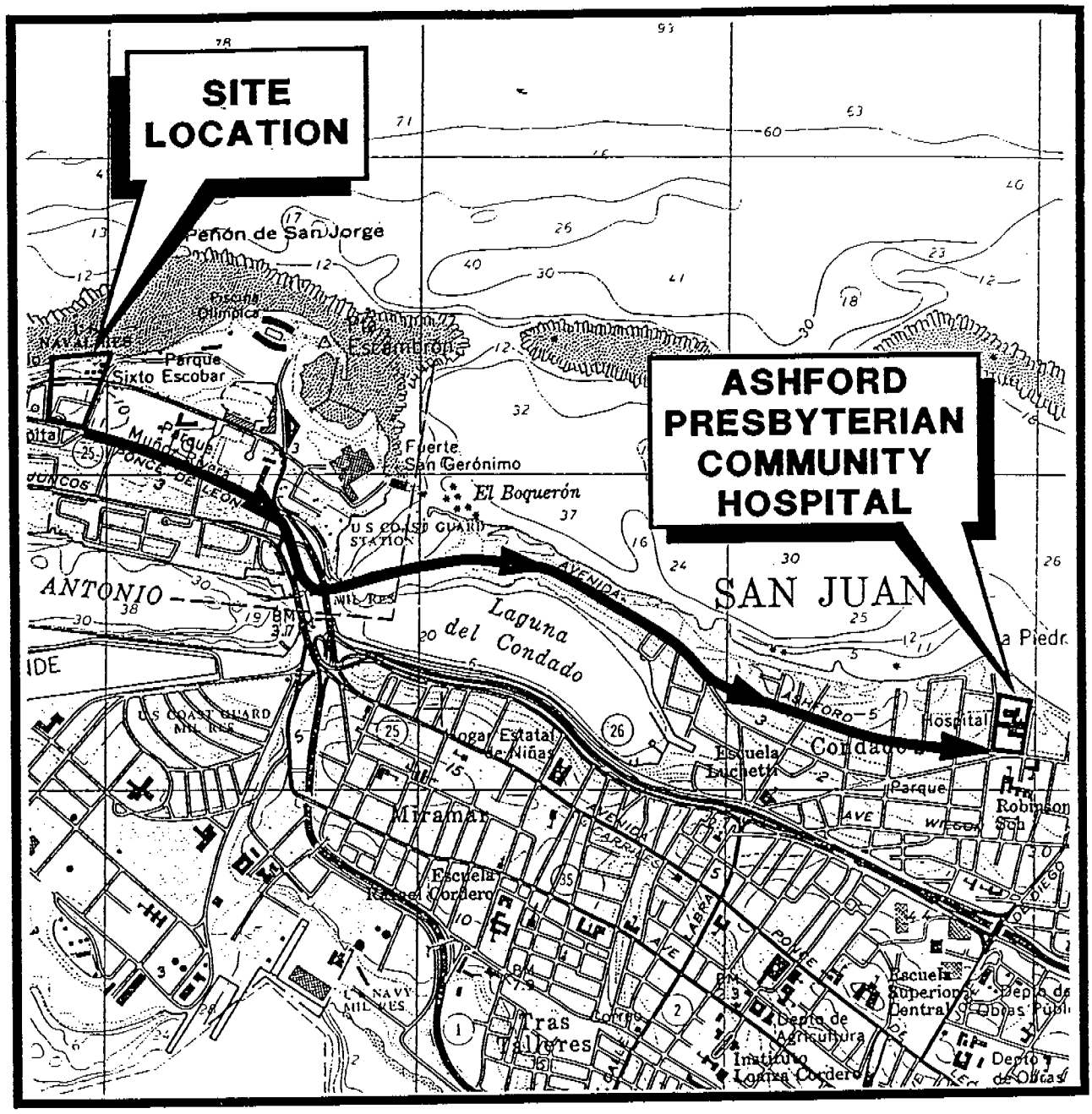
All on-site Baker personnel shall have received a company physical within the last 12 months and shall have received medical clearance to wear respiratory protective equipment.

SECTION V - EMERGENCY PROCEDURES

EMERGENCY PHONE NUMBERS:

HOSPITAL: 787 721-2160
FIRE: 787 343-2330
POLICE: 787 343-2020
AMBULANCE: 787 343-2550

DIRECTIONS TO THE ASHLAND PRESBYTERIAN COMMUNITY HOSPITAL ARE ATTACHED.



Medical Facility: Ashford Presbyterian Community Hospital
787 721-2160

Directions to Hospital: Turn left onto Ponce de Leon Avenue from the Stop 7-½ complex. Take the second detour left, and continue straight. Go through one light and over a bridge. Ponce de Leon Avenue becomes Ashford Avenue. The hospital is on the left, approximately 1 1/2-2 miles from the Stop 7-½ complex.

Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8854

Material Safety Data Sheets Collection:

Sheet No. 296
Arsenic and Compounds

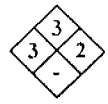
Issued: 4/90

Section 1. Material Identification

Arsenic Description: Obtained from flue dust of copper and lead smelters as white arsenic (arsenic trioxide). Reduction with charcoal and sublimation in an N_2 current yields pure arsenic. Metallic arsenic is used for hardening copper, lead, and alloys; as a doping agent in germanium and silicon solid-state products, special solders, and medicine; and to make gallium arsenide for dipoles and other electronic devices. Arsenic compounds are used in manufacturing certain types of glass; in textile printing, tanning, taxidermy, pharmaceuticals, insecticides and fungicides, pigment production, and antifouling paints; and to control sludge formation in lubricating oils. Arsenic trioxide is the source for 97% of all arsenic products.
Other Designations: CAS No. 7440-38-2; arsen; arsenic black; As; gray arsenic; metallic arsenic.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	1
I	4
S	2
K	0

Genium



HMIS
H 3
F 2
R 2
PPG*
* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Arsenic and soluble compounds, as As

OSHA PEL
8-hr TWA: 0.5 mg/m³,* 0.01 mg/m³†

NIOSH REL, 1987
Ceiling: 0.002 mg/m³

ACGIH TLV, 1989-90
TLV-TWA: 0.2 mg/m³

Toxicity Data‡
Man, oral, TD_{Lo}: 76 mg/kg administered intermittently over a 12-year period affects the liver (tumors) and blood (hemorrhage)
Man, oral: 7857 mg/kg administered over 55 years produces gastrointestinal (in the structure or function of the esophagus), blood (hemorrhage), and skin and appendage (dermatitis) changes
Rat, oral, TC_{Lo}: 605 µg/kg administered to a 35-week pregnant rat affects fertility (pre- and post-implantation mortality)

* Organic compounds.
† Inorganic compounds.
‡ See NIOSH, *RTECS* (CG0525000), for additional mutative, reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: sublimes at 1134 F/612 C
Melting Point: 1497 F/814 C
Vapor Pressure: 1 mm at 702 F/372 C (sublimes)
Atomic Weight: 74.92
Density: 5.724 at 57 F/14 C
Water Solubility: Insoluble†

Appearance and Odor: A brittle, crystalline, silvery to black metalloid. Odorless.

* This data pertains to arsenic only.
† Arsenic is soluble in nitric acid (HNO_3).

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, CO_2, water spray, or foam to fight fires.
Unusual Fire or Explosion Hazards: Flammable and slightly explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Arsenic is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Arsenic can react vigorously on contact with powerful oxidizers such as bromates, peroxides, chlorates, iodates, lithium, silver nitrate, potassium nitrate, potassium permanganate, and chromium (VI) oxide. This material is also incompatible with halogens, bromine azide, palladium, dirubidium acetylide, zinc, and platinum.
Hazardous Products of Decomposition: Thermal oxidative decomposition of arsenic and its compounds produces irritating or poisonous gases.

Section 6. Health Hazard Data

Carcinogenicity: The IARC, NTP, and OSHA list arsenic as a human carcinogen (Group 1). This evaluation applies to arsenic and arsenic compounds as a whole, and not necessarily to all individual chemicals within the group. Studies report that both the trivalent and pentavalent compounds are strongly implicated as causes of skin, lung, and lymphatic cancers. Experimental studies have shown that arsenic has tumorigenic and teratogenic effects in laboratory animals.
Summary of Risks: Arsenic compounds are irritants of the skin, mucous membranes, and eyes. The moist mucous membranes are most sensitive to irritation. Prolonged contact results in local hyperemia (blood congestion) and later vesicular or pustular eruption. Epidermal carcinoma is a reported risk of exposure. Peripheral neuropathy (degenerative state of the nervous system) is common after acute or chronic arsenic poisoning. Symptoms include decreased sensation to touch, pinprick, and temperature; loss of vibration sense; and profound muscle weakness and wasting. Other complications of acute and chronic arsenic poisoning are encephalopathy (alterations of brain structure) and toxic delirium.
Medical Conditions Aggravated by Long-Term Exposure: Damage to the liver, nervous, and hematopoietic (responsible for the formation of blood or blood cells in the body) system may be permanent. Pulmonary and lymphatic cancer may also occur.
Target Organs: Liver, kidneys, skin, lungs, lymphatic system.
Primary Entry Routes: Inhalation, ingestion of dust and fumes, via skin absorption.
Acute Effects: Acute industrial intoxication is more likely to arise from inhalation of arsine. However, with corrosive arsenical vapors, conjunctivitis, eyelid edema, and even corneal erosion may result. Inhalation may result in nasal irritation with perforation of the septum, cough, chest pain, hoarseness, pharyngitis, and inflammation of the mouth. If ingested, metallic or garlic taste, intense thirst, nausea, vomiting, abdominal pain, diarrhea, and cardiovascular arrhythmias (heartbeat irregularities) may occur. Symptoms generally occur within 30 minutes, but may be delayed for several hours if ingested with food. Acute poisoning may result in acute hemolysis (breakdown of red blood cells).
Chronic Effects: Chronic symptoms include weight loss, hair loss, nausea, and diarrhea alternating with constipation, palmar and plantar hyperkeratoses (thickening of the corneous layer of skin on palms and soles of feet), and skin eruptions, and peripheral neuritis (inflammation of the nerves). Leukemia, bone marrow depression, or aplastic anemia (dysfunctioning of blood-forming organs) may occur after chronic exposure.
FIRST AID
Eyes: Flush immediately, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 min.
Skin: *Quickly* remove contaminated clothing. After rinsing affected skin with flooding amounts of water, wash it with soap and water.
Inhalation: Remove exposed person to fresh air and support breathing as needed.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If ingested, have a *conscious* person drink 1 to 2 glasses of water, then induce repeated vomiting until vomit is clear.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: If emesis is unsuccessful after two doses of Ipecac, consider gastric lavage. Monitor urine arsenic level. Alkalinization of urine may help prevent disposition of red cell breakdown products in renal tubular cells. If acute exposure is significant, maintain high urine output and monitor volume status, preferably with central venous pressure line. Abdominal X-rays should be done routinely for all ingestions. Chelation therapy with BAL, followed by n-penicillamine is recommended, but specific dosing guidelines are not clearly established.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel of spill, evacuate all unnecessary personnel, remove all heat and ignition sources, and provide adequate ventilation. Cleanup personnel should protect against dust inhalation and contact with skin and eyes. Use nonsparking tools. With a clean shovel, scoop material into a clean, dry container and cover. Absorb liquid material with sand or noncombustible inert material and place in disposal containers. Do not release to sewers, drains, or waterways. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations*
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as a CERCLA Hazardous Substance† (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [† per Clean Water Act, Sec. 307(a); per Clean Air Act, Sec. 112]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)

OSHA Designations‡
Air Contaminant (29 CFR 1910.1000, Subpart Z): Not listed

* Designations for arsenic only.
‡ Listed as arsenic organic compounds (as As).

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA.
Warning: Air-purifying respirators do *not* protect workers in oxygen-deficient atmospheres.
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact.
Ventilation: Provide general and local explosion-proof ventilation systems to maintain airborne concentrations below the OSHA PELs, ACGIH TLVs, and NIOSH REL (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source.[103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed, properly labeled, containers in a cool, well-ventilated area away from all incompatible materials (Sec. 5) and heat and ignition sources. Protect containers from physical damage.

Engineering Controls: Avoid inhalation or ingestion of dust and fumes, and skin or eye contact. Practice good personal hygiene and housekeeping procedures. Use only with adequate ventilation and appropriate personal protective gear. Institute a respiratory protection program with training, maintenance, inspection, and evaluation. All engineering systems should be of maximum explosion-proof design and electrically grounded and bonded. Provide preplacement and annual physical examination with emphasis on the skin, respiratory system, and blood.

Transportation Data (49 CFR 172.101, .102)

DOT Shipping Name: Arsenic, solid
DOT Hazard Class: Poison B
ID No.: UN1558
DOT Label: Poison
DOT Packaging Requirements: 173.366
DOT Packaging Exceptions: 173.364

IMO Shipping Name: Arsenic, metallic
IMO Hazard Class: 6.1
IMO Label: Poison
IMDG Packaging Group: II
ID No.: UN1558

***MSDS Collection* References:** 7, 26, 38, 53, 73, 85, 87, 88, 89, 100, 103, 109, 123, 124, 126, 127, 130, 136, 138
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Hardies, MD
M4

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Material Safety Data Sheets Collection:

Sheet No. 15
Asbestos and Asbestos-containing Materials

Issued: 11/90

Section 1. Material Identification

33

Asbestos and Asbestos-containing Materials Description: Asbestos is a generic term applied to many naturally occurring, hydrated silicates (minerals) found in rock which separate into flexible fibers when crushed or processed. Commercially important forms are amosite, anthrophyllite (mined and used only in Finland), chrysotile, and crocidolite. Other types include tremolite and actinolite. Most widely used in US industry is chrysotile, a fibrous form of serpentine. Since asbestos is insensitive to chemical attack and incombustible, there are over 2000 uses as processed fiber. It is added to such diverse materials as cement, vinyl, plaster, asphalt, and cotton, although due to its health hazards other materials are now replacing it wherever possible. Its use is now limited to products that bind fibers within the product. The largest use of asbestos is in asbestos cement for pipes in water supply, sewage disposal, and irrigation systems; ducts; and flat and corrugated sheets for a wide variety of construction applications. Other uses include fire-resistant textiles, floor tiles, underlayment and roofing papers, friction materials (brake linings), reinforcing filler in elastomers for packing and gaskets, reinforcing pigment in surface coatings and sealants, thermal and electrical insulation media, as a component of taping compound and industrial talcs, and as filler in industrial greases. About 98% of crocidolite is used in production of asbestos cement pipe. Between 1950 and 1972 asbestos was used as spray insulation in buildings, but OSHA now prohibits spray application of actinolite, anthophyllite, asbestos, or tremolite (29 CFR 1910.1001).

R 0
I 4
S 1
K 0

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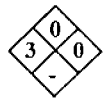

HMIS
H 3
F 0
R 0
PPG*
* Sec. 8

Other Designations: CAS No. 12172-73-5, amosite, brown asbestos; CAS No. 1332-21-4, asbestos; CAS No. 12001-29-5, chrysotile, white asbestos; CAS No. 12001-28-4, crocidolite, blue asbestos; Ascarite; earth flax; mountain cork; stone flax.
Molecular Formulas: Amosite, $(FeMg)SiO_3$; anthophyllite, $(MgFe)_7Si_8O_{22}(OH)_2$; chrysotile, $3MgO{\cdot}2SiO_2{\cdot}H_2O$; crocidolite, $NaFe(SiO_3)_2{\cdot}FeSiO_3{\cdot}H_2O$; tremolite, $Ca_2Mg_5Si_8O_{22}(OH)_2$.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.
Cautions: Asbestos causes three specific diseases: asbestosis (fibrous lung scarring), lung cancer, and mesothelioma (cancer of the chest lining and abdominal cavities). Prevent or maintain exposures at the lowest feasible level.

Section 2. Ingredients and Occupational Exposure Limits

	1989 OSHA PELs*			1990-91 ACGIH TLVs	1988 NIOSH REL
Asbestos	**TWA:** 0.2 f/cc†	**Action Level TWA:** 0.1 f/cc	**Excursion Limit:** 1.0 f/cc‡	**TWA:** 2.0 f/cc§	0.1 f/cc
Amosite	0.2 f/cc	0.1 f/cc	1.0 f/cc	0.5 f/cc	0.1 f/cc
Chrysotile	0.2 f/cc	0.1 f/cc	1.0 f/cc	2.0 f/cc	0.1 f/cc
Crocidolite	0.2 f/cc	0.1 f/cc	1.0 f/cc	0.2 f/cc	0.1 f/cc

1985-86 Toxicity Data for Asbestos (CAS No. 1332-21-4)**
Human, inhalation, TC_{Lo}: 1.2 fb/cc, continuous exposure over 19 years. Toxic to lungs.
* OSHA has proposed a lower asbestos exposure limit of 0.1 f/cc as an 8-hr TWA (*Industrial Safety and Hygiene News*, 8/90).
† Fiber/cm³
‡ Average over a 30-min sampling period.
§ As determined by membrane filter method at 400 to 450X magnification (4-mm objective) phase contrast illumination. Fibers longer than 5µg and with an aspect ratio ≥ 3:1 (ACGIH).
** See NIOSH, *RTECS* (CI6475000), for additional toxicity data.

Section 3. Physical Data

Melting Point: Decomposes
Water Solubility: Insoluble (breaks down slowly in hot water)
Molecular Weight: Varies with asbestos form (Sec. 1)
Appearance and Odor: White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Asbestos is nonflammable. Use dry chemcial, CO_2, water spray, or regular foam. Do not scatter spilled material with high-pressure water streams. **Special Fire-fighting Procedures:** Isolate hazard area and deny entry. Since there may be airborne asbestos fibers, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode; structural firefighter's protective clothing provides limited protection. If feasible, remove containers from fire area. Avoid dust generation. Be aware of runoff from fire control methods. Do not release to sewers or waterways. Develop decontamination procedures for protective clothing and equipment.

Section 5. Reactivity Data

Stability/Polymerization: Asbestos is inert under ordinary room temperature and heated use conditions. It is heat resistant, but decomposes and alters its microscopic fiber structure above 600 C (1112 F). Chrysotile dehydroxylates at 1112 to 1436 F (600 to 780 C); the "asbestos anhydride" in turn breaks down to a mixture of silica (SiO_2) and fosterite (Mg_2SiO_4) at 1472 to 1562 F (800 to 850 C). Above 1832 F (1000 C) magnesium pyroxenes form and melt at ~2642 F (1450 C). **Chemical Incompatibilities:** Strong acids can attack chrysotile and rapidly extract its MgO and H_2O content; glacial acetic acid can decompose it. Hot water slowly breaks down chrysotile. Like other asbestos forms, it resists strong alkali (5M NaOH at least up to 100 C).

Section 6. Health Hazard Data

Carcinogenicity: The NTP, IARC, OSHA, and ACGIH list asbestos as a human carcinogen. **Summary of Risks:** Asbestos may cause 1) asbestosis, 2) lung cancer, 3) mesothelioma, 4) pleural plaques, and 5) several other forms of cancer. *Asbestosis* is fibrosis (scarring) of lung tissue after many years of high-level occupational exposure. Scarring may be progressive even after exposure ceases. Even though detectable in lungs of a high proportion of adults in industrialized areas, asbestosis does not result from lower level environmental exposure. Its symptoms range from mild shortness of breath and dry cough to severe disabling breathlessness, heart failure, and ultimately death. Lung scarring can be seen on X-ray and alterations in lung function can be detected with spirometry (a medical test). Examination typically detects rales (crackling sounds in lungs). Severe cases may have cyanosis (bluish skin discoloration) and clubbing of fingertips. *Lung cancer* can result from lower exposure levels than asbestosis, but also takes many years to develop. Smokers exposed to asbestos are at 5 to 10X higher risk than exposed nonsmokers. *Mesothelioma* is a very aggressive cancer of the pleura (lining around the lungs) or peritoneum (lining of the abdomen), and develops after decades of (sometimes low level) exposure. Symptoms may include chest and abdominal pain, weight loss, and/or shortness of breath, with death within 2 years of diagnosis. *Pleural plaques* are thickenings, sometimes with calcium deposits, of the lungs's lining and may be seen on X-ray. While not associated specifically with health effects, they indicate significant exposure. *Other sites of cancer* include larnyx (vocal cords), portions of digestive tract, and possibly the kidney. Asbestos's toxicity depends on fiber type (crocidolite > amosite > chrysotile), size (longer > shorter), shape (long, thin needle-like > curly), and solubility. Health effects depend on dose (exposure concentration and duration), smoking habits, and individual susceptibility. Prevent or maintain exposures at lowest feasible level.

Continue on next page

Section 6. Health Hazard Data, *continued*

Medical Conditions Aggravated by Long-Term Exposure: Long-term, high-level exposure may aggravate any chronic lung (asthma, emphysema, bronchitis) or heart condition. **Target Organs:** Respiratory system; possibly digestive system. **Primary Entry Routes:** Inhalation, ingestion, dermal contact. **Acute Effects:** Nose, throat, skin and eye irritation are possible with high exposure. **Chronic Effects:** Asbestosis, lung cancer, and mesothelioma typically develop decades (20 to 40 years) after exposure begins, but may occur sooner. **FIRST AID** *Emergency personnel should protect against asbestos exposure.* **Eyes:** Do not rub. Gently lift eyelids and flush with flooding amounts of water. **Skin:** Shower with water and soap. Wet contaminated clothing prior to removal and seal in a plastic bag for disposal as hazardous waste. If rash develops, consult physician. **Inhalation:** Remove to fresh air. Clean any fibers from nose and mouth. Encourage victim to cough, spit, and blow nose to remove fibers. **Ingestion:** Induce vomiting *only* if awake and alert. Consult a physician. **After first aid, consult medical care provider. Note to Physicians:** Asbestos diagnosis is based on chest X-ray with an abnormal ILO "B" reading (small irregular opacities), rales, restrictive pattern spirometry, adequate exposure history, and symptoms. Consider pneumovax, annual flu shot, and other supportive treatment as needed.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel. Cleanup personnel should protect against dust inhalation and skin or eye contact. Avoid dust generation, blowing, dry brushing, and dry mopping. Provide HEPA-filtered (high-efficiency particulate air) portable ventilation systems. Use wet cleaning methods or approved HEPA vacuum cleaning system to pick up spills. The techniques used must collect particulate without dispersing dust into air. Place waste in *properly labeled* dust-tight containers or sealed, heavy-gauge, impervious plastic bags for disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Disposal:** Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations
RCRA Hazardous Waste (40 CFR 261.33): Not listed
Listed as CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a); Clean Air Act, Sec. 112]
Listed as a SARA Toxic Chemical (40 CFR 372.65)
SARA Extremeley Hazardous Substance (40 CFR 355): Not listed
OSHA Designations
Listed as Air Contaminant (29 CFR 1910.1000, Table Z-1-A, Z-3)

Section 8. Special Protection Data

Note: *Do not substitute personal protective clothing or equipment for proper handling and engineering controls.* **Goggles:** Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For airborne concentration of asbestos, tremolite, anthophyllite, actinolite, or a combination of these minerals not in excess of 2 f/cc (10 X PEL), use a half-mask air-purifying respirator, other than a disposable respirator, equipped with high-efficiency filters; not in excess of 10 f/cc (50 X PEL), a full facepiece air-purifying respirator equipped with high-efficiency filters; not in excess of 20 f/cc (100 X PEL), any powered air-purifying respirator equipped with high-efficiency filters or any supplied-air respirator operated in continuous flow mode; not in excess of 200 f/cc (1000 X PEL), a full facepiece supplied-air respirator operated in pressure-demand mode; greater than 200 f/cc (>1,000 X PEL) or unknown concentration, a full facepiece supplied-air respirator operated in pressure-demand mode and equipped with an auxillary positive-pressure self-contained breathing apparatus (29 CFR 1910.1001). *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* **Other:** Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation and dust collection systems to maintain airborne concentrations below OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into work area by controlling it at its source![103] **Safety Stations:** Make available in work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Never enter lunchroom facilities or leave workplace wearing clothing or equipment worn during workshift. Separate contaminated work clothes from street clothes. *If proper hygiene is not rigorously followed, family members can be exposed to asbestos fibers.* Place contaminated protective devices or work clothing in labeled, impermeable, and sealed containers or bags. Do not remove asbestos from clothing by blowing or shaking. Launder contaminated clothing before wearing. Inform laundering service of asbestos-contaminated clothing and of asbestos' potential harmful effects (29 CFR 1910.1001). **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using asbestos, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in closed (dust-tight) containers or heavy-gauge impervious plastic bags in a clean, secure area protected from physical damage. Do not open containers that can release asbestos dust without providing proper enclosure or control measure. **Engineering Controls:** Educate workers about asbestos's and asbestos-containing materials' hazards. Inform employees of asbestos standard (29 CFR 1910.1001). Exposure to asbestos, tremolite, anthophyllite, and actinolite in construction work is covered by 29 CFR 1926.58. ["OSHA is proposing an expanded requirement for a trained 'competent person' to ensure compliance with the standard on all construction operations involving asbestos, and requiring more stringent housekeeping to remove asbestos in general industry." (*Industrial Safety and Hygiene News*, 8/90).] Instruct employees in proper practices for handling asbestos-containing materials and correct use of protective equipment. Prevent or minimize asbestos exposure. Regulate areas where exposure in excess of the PEL is likely. Post warning signs in all regulated areas (see legend below). Work with asbestos only in a sufficient wet state to prevent emission of airborne fibers. Practice good personal hygiene and housekeeping procedures. Do not substitute personal protective equipment for proper handling and engineering controls. If exposures exceed the PEL, ensure employees wear appropriate protective clothing. Inhaling or ingesting asbestos fibers from contamined clothing or skin can be hazardous. Do not allow dusts and asbestos-containing wastes to accumulate. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Monitor work areas that expose employees to airborne concentrations at or above the action level (Sec. 2). Whenever production, process, control equipment, personnel, or work practices change, institute new monitoring. **Other Precautions:** Medical surveillance is required for all employees possibly exposed at or above the action level. Provide preplacement medical examination that includes complete medical and work history, complete physical examination that emphasizes respiratory and cardiovascular systems and digestive tract, the respiratory disease standardized questionnaire, a posterior-anterior 14" x 17" chest roentgenogram, and pulmonary function tests [FVC and FEV(1)]. Annual periodic medical examinations shall include all these elements and an abbreviated questionnaire. If it is 10+ years since first asbestos exposure, an individual should have a chest roentogram: every 5 years (ages 15 to 35), every 2 years (ages 35 to 45), every year (age 45+). Within 30 days of employment termination, an individual should receive a periodic medical examination with the elements listed above. Keep medical surveillance records for duration of employment, plus 30 years.

Transportation Data (49 CFR 172.101, .102)
DOT Shipping Name: Asbestos
DOT Hazard Class: ORM-C
ID No.: -
DOT Label: None
DOT Packaging Exceptions: 173.1090
DOT Packaging Requirements: 173.1090
Other Requirements: Stow and handle to avoid airborne particle
IMO Shipping Name: Asbestos, blue; asbestos, white
IMO Hazard Class: 9
ID No.: UN2212, UN2590
IMO Label: None
IMDG Packaging Group: II, III

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE REQUIRED IN THIS AREA

MSDS Collection **References:** 2-4, 6, 12, 14, 20, 26, 32, 38, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 138-140, 142, 143, 146, 148, 152, 153, 156-158
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:
Sheet No. 397
***n*-Hexane**
Issued: 10/78 Revision: D, 9/92

Section 1. Material Identification

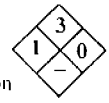
***n*-Hexane ($CH_3(CH_2)_4CH_3$) Description:** Derived by fractional distillation from petroleum (molecular sieve process). Used as a solvent for glues, cements, adhesives, fats, and oils; a lab reagent; liquid in low temperature thermometers (instead of mercury); thinner, cleaning agent; polymerization reaction medium; an alcohol denaturant; in retreading tires for determining the refraction index of minerals.

Other Designations: CAS No. 110-54-3, dipropyl, Gettysolve-B, hexyl hydride, NCI-C60571, Skellysolve-B.

Manufacturer: Contact your supplier or distributor. Consult latest *Chemical Week Buyers' Guide*(73) for a suppliers list.

R 1
I 3
S 2*
K 3
* Skin absorption

NFPA



HMIS
H 2†
F 3
R 0
PPE-Sec. 8
† Chronic effects

Cautions: *n*-Hexane is highly flammable. It is irritating to the eyes, skin, and mucous membranes. Vapor inhalation produces central nervous system (CNS) depression, becoming anesthetic at high concentrations. Chronic exposure may result in polyneuropathy.

Section 2. Ingredients and Occupational Exposure Limits

n-Hexane; commercial hexane is a mixture of *n*-hexane and isomers of methyl pentane and heptane. 1 to 6% benzene may also be present.

1991 OSHA PEL
8-hr TWA: 50 ppm (180 mg/m^3)

1990 IDLH Level
5000 ppm

1990 NIOSH REL
TWA: 50 ppm (180 mg/m^3)

1992-93 ACGIH TLV
TWA: 50 ppm (176 mg/m^3)

1990 DFG (Germany) MAK
TWA: 50 ppm (180 mg/m^3)
Category II: substances with systemic effects
Half-life: < 2 hr
Peak Exposure Limit: 100 ppm, 30 min average value, 4/shift

1985-86 Toxicity Data*
Human, inhalation, TC_{Lo}: 5000 ppm/10 min caused hallucinations and distorted perceptions.
Rat, oral, LD_{50}: 28,710 mg/kg; no toxic effect noted
Rat, inhalation, TC_{Lo}: 1000 ppm/6 hr from the 8th to 16th day of pregnancy produced effects on newborn growth.
Rabbit, eye: 10 mg caused mild irritation.

* See NIOSH, *RTECS* (MN9275000), for additional irritation, mutation, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 156 F (69 C)
Freezing Point: -139 F (-95 C)
Vapor Pressure: 150 mm Hg at 77 F (25 C)
Refraction Index: 1.37486 at 68 F (20 C)
Critical Temperature: 453.2 F (234 C)
Critical Pressure: 29.7 atm
Liquid Surface Tension: 18.4 dyne/cm
Odor Threshold: 65 ppm

Molecular Weight: 86.17
Density: 0.66 at 20/4 C
Saturated Vapor Density (Air = 0.075 lb/ft^3 or 1.2 kg/m^3): 0.1049 lb/ft^3 or 1.678 kg/m^3
Water Solubility: Slightly, 0.014 mg/ml at 68 F (20 C)
Other Solubilities: Alcohol, acetone, chloroform, ether, and most non-polar solvents.
Ionization Potential: 10.18 eV
Viscosity: 0.334 cP at 35 F (2 C), 0.306 cP at 80 F (27 C), 0.276 cP at 145 F (62.5 C)
Appearance and Odor: A colorless, volatile liquid with a gasoline-like odor.

Section 4. Fire and Explosion Data

Flash Point: -7.6 F (-22 C)	Autoignition Temperature: 437 F (225 C)	LEL: 1.2% v/v	UEL: 7.5% v/v

Extinguishing Media: *n*-Hexane is a Class 1B Flammable Liquid. For small fires, use dry chemical, carbon dioxide, water spray, or regular foam. For large fires, use water spray, fog, or regular foam. **Unusual Fire or Explosion Hazards:** Vapors may travel to an ignition source and flash back. Container may explode in heat of fire. *n*-Hexane poses a vapor explosion hazard indoors, outdoors, and in sewers. Burning rate = 7.3 mm/min. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing appar-atus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Structural firefighters' protective clothing provides only limited protection. If possible without risk, move container from fire area. Apply cooling water to sides of container until well after fire is out. Stay away from ends of tanks. For massive fire in cargo area, use monitor nozzles or unmanned hose holders; if impossible, withdraw from fire and let burn. Withdraw immediately if you hear a rising sound from venting safety device or notice any tank discoloration due to fire. Discoloration may indicate danger of BLEVE (boiling liquid expanding vapor explosion). Do not release runoff from fire control methods to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: *n*-Hexane is stable at room temperature in closed containers under normal storage and handling conditions. Hazardous polymerization cannot occur. **Chemical Incompatibilities:** Incompatible with strong oxidizers and may explode at 82.4 F (28 C) when mixed with dinitrogen tetraoxide. **Conditions to Avoid:** Contact with heat and incompatibles.
Hazardous Products of Decomposition: Thermal oxidative decomposition of *n*-hexane can produce acrid smoke and irritating vapors.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,(164) NTP,(169) and OSHA(164) do not list *n*-hexane as a carcinogen. Although there is no data on human carcinogenicity specifically caused by n-hexane, there is an increase in association between Leukemia risk in the rubber industry and exposure to a variety of substances including hexane. **Summary of Risks**: Vapors are irritating to the skin, eyes, and respiratory tract. Inhalation produces varying degrees of CNS depression depending on concentration. High concentrations may lead to asphyxia (oxygen displacement). Chronic exposure (usually at least 60 to 240 ppm) results in neurotoxicity characterized by sensory loss, pain, and neurogenic atrophy of skeletal muscle. Peripheral neuropathy is mostly of the 'stocking & glove' type. *n*-Hexane is ultimately converted to 2,5-hexanedione during metabolism and is considered to be the metabolite responsible for toxicity. Evidence exists that *n*-hexane accumulates in fatty tissue which would explain its affinity for the blood, liver, and brain where lipids are prevalent. After exposure has ceased, the half-life is 64 hrs. Metabolism is inhibited by co-exposure to toluene, methylethyl ketone, or methyl *n*-butyl ketone. *n*-Hexane is absorbed through the skin in both liquid and vapor form. Therefore, dermal vapor absorption raises biological levels above those reached during inhalation of or below the TLV concentration. This is why it is imperative that protective clothing be used so that the TLV levels are sufficient to prevent over-exposure. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, CNS, PNS, and respiratory diseases. **Target Organs:** Eyes, skin, respiratory system, central and peripheral nervous system. **Primary Entry Routes:** Inhalation, skin contact/absorption, eyes, ingestion. **Acute Effects:** Vapor inhalation produced marked vertigo and hallucinations at 5000 ppm/10 min; drowsiness, fatigue, appetite loss, and paresthesia in the distal extremities at 1000 to 2500/12 hrs; muscle weakness, cold pulsation in extremeties, blurred vision, headache, anorexia and onset of polyneuropathy at 500 to 2500 ppm (time not given).

Continue on next page

Section 6. Health Hazard Data

Skin contact causes immediate irritation with redness, painful burning and possible blisters. Eye contact produces irritation, watering, and burning. Ingestion poses a serious aspiration hazard. If aspiration into the lungs occurs, asphyxiation from oxygen displacement may lead to brain damage and cardiac arrest. Cardiac sensitization to epinephrine (the body's adrenalin) may cause rhythm disturbances with potentially fatal consequences. **Chronic Effects:** Polyneuropathy occurs from repeated exposure to levels typically in the 400 to 600 ppm range; there is a case of polyneuropathy after exposure to 54 to 200 ppm/1 year. Initial symptoms include muscle weakness, motor loss, sensation disturbances (numbness and pain without stimulus), and distal symmetric leg pain after 2 to 6 months exposure. Clinical studies indicate muscle atrophy (wasting away), foot drop, decreased muscle tone and strength, and paresthesias of the arms and legs. Vision problems including changes in color vision, retinal pigmentation, and in perifoveal capillaries were found in workers exposed to 420 to 1280 ppm for > 5 years. Progression of neuropathy may continue for several months after exposure has ceased, followed by slow recovery taking on the average of 9 to 10 months and rarely, up to 2 years. Residual spinal cord damage was noted in most severely injured victims.

FIRST AID ***Emergency personnel should protect against exposure***

Eyes: *Do not* allow victim to rub or keep eyes tightly shut. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and administer supplemental oxygen as needed. Intubation may be necessary in severe cases (aspiration of liquid). **Ingestion:** Never give anything by mouth to an unconscious or convulsing person. Contact a poison control center and unless otherwise advised, have that *conscious and alert* person drink 1 to 2 glasses of water to dilute. *Do not* induce vomiting because of severe aspiration hazard. If spontaneous vomiting occurs, position head to avoid aspiration of vomitus.

Note to Physicians: BEI = 2,5-hexanedione in urine, sample at end of shift at workweeks end, 5 mg/g creatine. Also measure *n*-hexane in expired air. Analgesics may be necessary for pain management, there is no specific antidote. Monitor arterial blood gases in cases of severe aspiration.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, isolate and ventilate area, deny entry, and stay upwind. Shut off ignition sources. Cleanup personnel should protect against vapor inhalation and skin/eye contact. Take up small spills with earth, sand, vermiculite, or other absorbent, noncombustible material and place in suitable containers. Dike far ahead of large spill for later disposal or reclamation. For water spills, use oil skimming equipment to lift spill. Absorbent foams can be applied to slick. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Degradation:** If released on soil, *n*-hexane will readily volatilize from moist surfaces although some may absorb to soil. In water, *n*-hexane will volatilize rapidly although some will absorb to sediment. The log bioconcentration factor (log BCF) estimated at 2.24 to 2.89 suggests bioconcentration is not an important factor in aquatic systems. The estimated Koc of 1250 to 4100 indicates that *n*-hexane absorbs to carbon/organic matter. Volatilization half-life from a model river is 2.7 hr at 77 F (25 C), 1 meter deep flowing at 1m/sec with a 3 m/sec wind speed. Volatilization from a model pond (which considers effect of absorption) is estimated at 6.8 days. In the atmosphere, it is expected to exist entirely in the vapor phase. It does not absorb UV light in the environmentally significant range (> 290 nm). It reacts with photochemically produced hydroxyl radicals. Estimated lifetime under photochemical smog conditions is 5.9 hr (SE England). **Disposal:** Spray into an incinerator (may burn quicker by addition of another flammable solvent). Evaporation in a suitable hood may be used for smaller amounts. Landfill is *not* recommended. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

SARA Extremely Hazardous Substance (40 CFR 355): Not listed
SARA Toxic Chemical (40 CFR 372.65): Not listed
Listed as a RCRA Hazardous Waste (40 CFR 261.21): D001, *Characteristic of ignitability*
Listed as 'Unlisted hazardous Waste, *Characteristic of ignitability*' a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 100 lb (45.4 kg) [* per RCRA, Sec. 3001]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. For < 500 ppm, use a supplied-air respirator (SAR) or SCBA. For < 1250 ppm, use a SAR operated in continuous-flow mode. For 2500 ppm, use a SAR with a tight-fitting facepiece operated in continuous-flow mode or a SCBA with a full facepiece. For < 5000 ppm, use a SAR operated pressure demand or other positive-pressure mode. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets made of nitrile, Viton, polyvinyl chloride, or chlorinated polyethylene to prevent skin contact. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a cool, dry, well-ventilated area away from heat, ignition sources, and incompatibles (Sec. 5).

Engineering Controls: To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. Purge all vessels previously containing *n*-hexane with steam before entering for the purpose of repair (cutting, welding). Refer to OSHA's Confined Space Standard (29 CFR 1910.119). **Administrative Controls:** Consider preplacement and periodic medical exams of exposed workers that emphasize the central and peripheral nervous systems, skin, eyes, and respiratory system.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Hexanes
DOT Hazard Class: 3
ID No.: UN1208
DOT Packing Group: II
DOT Label: Flammable Liquid
Special Provisions (172.102): T8

Packaging Authorizations
a) Exceptions: 173.150
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.242

Quantity Limitations
a) Passenger Aircraft or Railcar: 5L
b) Cargo Aircraft Only: 60L

Vessel Stowage Requirements
a) Vessel Stowage: E
b) Other:

MSDS Collection **References:** 26, 73, 100, 101, 103, 124, 126, 127, 132, 133, 139, 140, 148, 149, 153, 159, 162, 163, 164, 167, 168, 171, 174
Prepared by: M Gannon, BA; **Industrial Hygiene Review:** PA Roy, MPH, CIH; **Medical Review:** W Silverman, MD

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Material Safety Data Sheets Collection:

Sheet No. 713
Lead (Inorganic)

Issued: 8/90

Section 1. Material Identification

32

Lead (Inorganic) (Pb) Description: Exists widely throughout the world in a number of ores. Its main commercial source is galena (lead sulphide). Lead mineral is separated from crude ores by blast-furnace smelting, drossing, or electrolytic refining. Lead is used mostly in manufacturing storage batteries. Other uses are in manufacturing tetraethyllead and both organic and inorganic lead compounds in ceramics, plastics, and electronic devices; in producing ammunition, solder, cable covering, sheet lead, and other metal products (brass, pipes, caulking); in metallurgy; in weights and as ballast; as a chemical intermediate for lead alkyls and pigments; as a constuction material for the tank linings, piping, and equipment used to handle the corrosive gases and liquids used in sulfuric acid manufacturing, petroleum refining, halogenation, sulfonation, extraction, and condensation; and for x-ray and atomic radiation protection.
Other Designations: CAS No. 7439-92-1, lead oxide; lead salts, inorganic; metallic lead; plumbum.
Manufacturer: Contact your supplier or distributor. Consult the latest *Chemicalweek Buyers' Guide*(73) for a suppliers list.

R	0
I	4
S	-
K	0

Genium

HMIS
H 3
F 1
R 0
PPG*

Cautions: *Inorganic lead is a potent systemic poison.* Organic lead (for example, tetraethyl lead) has severe, but different, health effects. Occupational lead poisoning is due to inhalation of dust and fumes. Major affected organ systems are the nervous, blood, and reproductive systems, and kidneys. Health impairment or disease may result from a severe acute short- or long-term exposure.

* Sec. 8

Section 2. Ingredients and Occupational Exposure Limits

Lead (inorganic) fumes and dusts, as Pb, ca 100%

1989 OSHA PELs (Lead, inorganic compounds)
8-hr TWA: 50 µg/m³
Action Level TWA*: 30 µg/m³

29 CFR 1910.1025 Lead Standard
Blood Lead Level: 40 µg/100 g

1989-90 ACGIH TLV (Lead, inorganic, fumes and dusts)
TLV-TWA: 150 µg/m³

1988 NIOSH REL
10-hr TWA: <100 µg/m³

1985-86 Toxicity Data†
Human, inhalation, TC_{Lo}: 10 µg/m³ affects gastrointestinal tract and liver
Human, oral, TD_{Lo}: 450 mg/kg ingested over 6 yr affects peripheral and central nervous systems
Rat, oral, TD_{Lo}: 790 mg/kg affects multigeneration reproduction

* Action level applies to employee exposure without regard to respirator use.
† See NIOSH, *RTECS* (OF7525000), for additional mutative, reproductive, and toxicity data.

Section 3. Physical Data

Boiling Point: 3164 F (1740 C)
Melting Point: 621.3 F (327.4 C)
Vapor Pressure: 1.77 mm Hg at 1832 F (1000 C)
Viscosity: 3.2 cp at 621.3 F (327.4 C)
Molecular Weight: 207.20
Specific Gravity (20 C/4 C): 11.34
Water Solubility: Relatively insoluble in hot or cold water*
Appearance and Odor: Bluish-white, silvery, gray, very soft metal.

* Lead dissolves more easily at a low pH.

Section 4. Fire and Explosion Data

Flash Point: None reported	**Autoignition Temperature:** None reported	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use dry chemical, carbon dioxide, water spray, or foam to extinguish fire.
Unusual Fire or Explosion Hazards: Flammable and moderately explosive in the form of dust when exposed to heat or flame.
Special Fire-fighting Procedures: Isolate hazard area and deny entry. Since fire may produce toxic fumes, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode and full protective equipment. Be aware of runoff from fire control methods. Do not release to sewers or waterways.

Section 5. Reactivity Data

Stability/Polymerization: Lead is stable at room temperature in closed containers under normal storage and handling conditions. It tarnishes on exposure to air. Hazardous polymerization cannot occur.
Chemical Incompatibilities: Mixtures of hydrogen peroxide + trioxane explode on contact with lead. Lead is incompatible with sodium azide, zirconium, disodium acetylide, and oxidants. A violent reaction on ignition may occur with concentrated hydrogen peroxide, chlorine trifluoride, sodium acetylide (with powdered lead), ammonium nitrate (below 200 C with powdered lead). Lead is attacked by pure water and weak organic acids in the presence of oxygen. Lead is resistant to tap water, hydrofluoric acid, brine, and solvents.
Conditions to Avoid: Rubber gloves containing lead may ignite in nitric acid.
Hazardous Products of Decomposition: Thermal oxidative decomposition of lead can produce highly toxic fumes of lead.

Section 6. Health Hazard Data

Carcinogenicity: Although the NTP and OSHA do not list lead as a carcinogen, the IARC lists it as probably carcinogenic to humans, but having (usually) no human evidence. However, the literature reports instances of lead-induced neoplasms, both benign and malignant, of the kidney and other organs in laboratory rodents. Excessive exposure to lead has resulted in neurologic disorders in infants. Experimental studies show lead has reproductive and teratogenic effects in laboratory animals. Human male and female reproductive effects are also documented.
Summary of Risks: Lead is a potent, systemic poison that affect a variety of organ systems, including the nervous system, kidneys, reproductive system, blood formation, and gastrointestinal (GI) system. The most important way lead enters the body is through inhalation, but it can also be ingested when lead dust or unwashed hands contaminate food, drink, or cigarettes. Much of ingested lead passes through feces without absorption into the body. Adults may absorb only 5 to 15% of ingested lead; children may absorb a much larger fraction. Once in the body, lead enters the bloodstream and circulates to various organs. Lead concentrates and remains in bone for many years. The amount of lead the body stores increases as exposure continues, with possibly cumulative effects. Depending on the dose entering the body, lead can be deadly within several days or affect health after many years. Very high doses can cause brain damage (encephalopathy).
Medical Conditions Aggravated by Exposure: Lead may aggravate nervous system disorders (e.g., epilepsy, neuropathies), kidney diseases, high blood pressure (hypertension), infertility, and anemia. Lead-induced anemia and its effect on blood presssure can aggravate cardiovascular disease.

Continue on next page

Section 6. Health Hazard Data, *continued*

Target Organs: Blood, central and peripheral nervous systems, kidneys, and gastrointestinal (GI) tract.
Primary Entry Routes: Inhalation, ingestion.
Acute Effects: An acute, short-term dose of lead could cause acute encephalopathy with seizures, coma, and death. However, short-term exposures of this magnitude are rare. Reversible kidney damage can occur from acute exposure, as well as anemia.
Chronic Effects: Symptoms of chronic long-term overexposure include appetite loss, nausea, metallic taste in the mouth, lead line on gingival (gum) tissue, constipation, anxiety, anemia, pallor of the face and the eye grounds, excessive tiredness, weakness, insomnia, headache, nervous irritability, fine tremors, numbness, muscle and joint pain, and colic accompanied by severe abdominal pain. Paralysis of wrist and, less often, ankle extensor muscles may occur after years of increased lead absorption. Kidney disease may also result from chronic overexposure, but few, if any, symptoms appear until severe kidney damage has occurred. Reproductive damage is characterized by decreased sex drive, impotence, and sterility in men; and decreased fertility, abnormal menstrual cycles, and miscarriages in women. Unborn children may suffer neurologic damage or developmental problems due to excessive lead exposure in pregnant women. Lead poisoning's severest result is encephalopathy manifested by severe headache, convulsions, coma, delirium, and possibly death.
FIRST AID
Eyes: Gently lift the eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately.
Skin: *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Consult a physician if any health complaints develop.
Inhalation: Remove exposed person to fresh air and support breathing as needed. Consult a physician.
Ingestion: Never give anything by mouth to an unconscious or convulsing person. If large amounts of lead were ingested, induce vomiting with Ipecac syrup. Consult a physician immediately.
After first aid, get appropriate in-plant, paramedic, or community medical support.
Physician's Note: For diagnosis, obtain blood pressure, blood lead level (PbB), zinc protoporphyrin (ZPP), complete blood count for microcytic anemia and basophilic stippling, urinalysis, and blood urea nitrogen (BUN) of creatinine. Examine peripheral motor neuropathy, pallor, and gingival lead line. Use Ca-EDTA to treat poison, but *never* chelate prophylactically. Consult an occupational physician or toxicologist.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel and evacuate all unnecessary personnel immediately. Cleanup personnel should protect against inhalation of dusts or fume and contact with skin or eyes. Avoid creating dusty conditions. Water sprays may be used in large quantities to prevent the formation of dust. Cleanup methods such as vacuuming (with an appropriate filter) or wet mopping minimizes dust dispersion. Scoop the spilled material into closed containers for disposal or reclamation. Follow applicable OSHA regulations (29 CFR 1910.120).
Disposal: Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.
EPA Designations
Listed as a RCRA Hazardous Waste (40 CFR 261.33, Appendix II—EP Toxicity Test Procedures)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4), Reportable Quantity (RQ): 1 lb (0.454 kg) [* per Clean Water Act, Sec. 307(a)]
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
OSHA Designations
Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133).
Respirator: Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a NIOSH-approved respirator. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.*
Other: Wear impervious gloves, boots, aprons, and gauntlets to prevent skin contact. Protective clothing made of man-made fibers and lacking turn-ups, pleats, or pockets retain less dust from lead.
Ventilation: Provide general and local ventilation systems to maintain airborne concentrations below the OSHA PELs (Sec. 2). Local exhaust ventilation is preferred since it prevents contaminant dispersion into the work area by controlling it at its source![103]
Safety Stations: Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities.
Contaminated Equipment: Never wear contact lenses in the work area: soft lenses may absorb, and all lenses concentrate, irritants. Remove this material from your shoes and equipment. Launder contaminated clothing before wearing.
Comments: Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially washing hands before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in tightly closed containers in a cool, dry, well-ventilated area away from all incompatible materials, direct sunlight, and heat and ignition sources.
Engineering Controls: Educate worker about lead's hazards. Follow and inform employees of the lead standard (29 CFR 1910.1025). Avoid inhalation of lead dust and fumes and ingestion of lead. Use only with appropriate personal protective gear and adequate ventilation. Institute a respiratory protection program that includes regular training, maintenance, inspection, and evaluation. Avoid creating dusty conditions. Segregate and launder contaminated clothing. Take precautions to protect laundry personnel. Practice good personal hygiene and housekeeping procedures. For a variety of reasons, the lead concentration in workroom air may not correlate with the blood lead levels in individuals.
Other Precautions: Provide preplacement and periodic medical examinations which emphasize blood, nervous system, gastrointestinal tract, and kidneys, including a complete blood count and urinalysis. Receive a complete history including previous surgeries and hospitalization, allergies, smoking history, alcohol consumption, proprietary drug intake, and occupational and nonoccupational lead exposure. Maintain records for medical surveillance, airborne exposure monitoring, employee complaints, and physician's written opinions for at least 40 years or duration of employment plus 20 years. Measurement of blood lead level (PbB) and zinc protoporphyrin (ZPP) are useful indicators of your body's lead absorption level. Maintain worker PbBs at or below 40 µg/100 g of whole blood. To minimize adverse reproductive health effects to parents and developing fetus, maintain the PbBs of workers intending to have children below 30 µg/100 g. Elevated PbBs increase your risk of disease, and the longer you have elevated PbBs, the greater your chance of substantial permanent damage.

Transportation Data (49 CFR 172.102)
IMO Shipping Name: Lead compounds, soluble, n.o.s.
IMO Hazard Class: 6.1
ID No.: UN2291
IMO Label: St. Andrews Cross (X, Stow away from foodstuffs)
IMDG Packaging Group: III

MSDS Collection **References:** 26, 38, 73, 84, 85, 88, 89, 90, 100, 101, 103, 109, 124, 126, 132, 133, 134, 136, 138, 139, 142, 143
Prepared by: MJ Allison, BS; **Industrial Hygiene Review:** DJ Wilson, CIH; **Medical Review:** MJ Upfal, MD, MPH; **Edited by:** JR Stuart, MS

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Material Safety Data Sheets Collection:

Sheet No. 683
Polychlorinated Biphenyls (PCBs)

Issued: 11/88 Revision: A, 9/92

Section 1. Material Identification

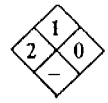
39

Polychlorinated Biphenyls [$C_{12}H_{10-n}Cl_n$ (n=3, 4, 5)] Description: A class of nonpolar chlorinated hydrocarbons with a biphenyl nucleus (two benzene nuclei connected by a single C-C bond) in which any or all of the hydrogen atoms have been replaced by chlorine. Commercial PCBs are mixtures of chlorinated biphenyl isomers with varying degrees of chlorination. Prepared industrially by the chlorination of biphenyl with anhydrous chlorine in the presence of a catalyst such as ferric chloride or iron filings. Except for limited research and development applications, PCBs have not been produced in the US since 1977. When large quantities of PCBs were manufactured in the US, they were marketed under the tradename Aroclor (Monsanto) and were characterized by four digit numbers. The first two digits indicating biphenyls (12), triphenyls (54), or both (25, 44); the last two digits indicating the weight percent of chlorine. PCBs' thermal stability, nonflammability, and high dielectric capability made them very useful in electrical equipment. Formerly used as additives in hydraulic fluids, heat transfer systems, lubricants, cutting oils, printer's ink, fire retardants, asphalt, brake linings, automobile body sealants, plasticizers, adhesives, synthetic rubber, floor tile, wax extenders, dedusting agents, pesticide extenders, and carbonless reproducing paper. PCBs are still used in certain existing electrical capacitors and transformers that require enhanced electrical protection to avoid heating from sustained electric faults.

Other Designations: CAS No. 1336-36-3, Aroclor, Clophen, Chlorextol, chlorinated biphenyls, chlorinated diphenyl, chlorinated diphenylene, chloro biphenyl, chloro-1,1-biphenyl, Dykanol, Fenclor, Inerteen, Kaneclor, Montar, Noflamol, Phenoclor, Pyralene, Pyranol, Santotherm, Sovol, Therminol FR-1

R 1
I 4
S 3*
K 1
* Skin absorption

NFPA



HMIS
H 2‡
F 1
R 0
PPE†
† Sec. 8
‡ Chronic Effects

Cautions: PCBs are potent liver toxins that may be absorbed through skin. Potentially, chronic or delayed toxicity is significant because PCBs accumulate in fatty tissue and may reasonably be anticipated to be carcinogens. PCBs are a bioaccumulative environmental hazard. When burned, decomposition products may be more hazardous than the PCBs.

Section 2. Ingredients and Occupational Exposure Limits

PCBs, contain various levels of polychlorinated dibenzofurans and chlorinated naphthalenes as contaminants

1991 OSHA PELs, Skin
8-hr TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
8-hr TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

1990 DFG (Germany) MAK, Danger of Cutaneous Absorption
TWA (Chlorodiphenyl, 42% chlorine): 0.1 ppm (1 mg/m^3)
Category III: Substances with systemic effects, onset of effect > 2 hr., half-life > shift length (strongly cumulative)
Short-term Level: 1 ppm, 30 min., average value, 1 per shift
TWA (Chlorodiphenyl, 54% chlorine): 0.05 ppm (0.5 mg/m^3)
Category III: (see above)
Short-term Level: 0.5 ppm, 30 min., average value, 1 per shift

1985-86 Toxicity Data*
Rat, oral, TD: 1250 mg/kg administered intermittently for 25 weeks produced liver tumors.
Mammal, oral, TD_{Lo}: 325 mg/kg administered to female for 30 days prior to mating and from the 1st to the 36th day of gestation produced effects on newborn (stillbirth; live birth index; viability index).

1990 NIOSH REL
TWA (Chlorodiphenyl, 42% chlorine): 0.001 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.001 mg/m^3

1992-93 ACGIH TLVs, Skin *
TWA (Chlorodiphenyl, 42% chlorine): 1 mg/m^3
TWA (Chlorodiphenyl, 54% chlorine): 0.5 mg/m^3

* These guidelines offer reasonably good protection against systemic intoxication, but may not guarantee that chloroacne won't occur.
† See NIOSH, *RTECS* (TQ1350000), for additional reproductive, tumorigenic, and toxicity data.

Section 3. Physical Data*

Boiling Point: 644-707 F (340-375 C)
Melting Point: 42%: -2.2 F (-19 C); 54%: 14 F (-10 C)
Vapor Pressure: 1 mm Hg at 100 F (38 C); 10^{-6} to 10^{-3} mm at 20 C
Molecular Weight: 188.7 to 398.5

Specific Gravity: 1.3 to 1.8 at 20 C
Water Solubility: Low solubility (0.007 to 5.9 mg/L)
Other Solubilities: Most common organic solvents, oils, and fats; slightly soluble in glycerol and glycols.

Appearance and Odor: PCBs vary from mobile oily liquids to white crystalline solids and hard non-crystalline resins, depending upon chlorine content.

* Physical and chemical properties vary widely according to degree and to the position of chlorination.

Section 4. Fire and Explosion Data

Flash Point: 286-385 F (141-196 C) OC*	**Autoignition Temperature:** 464 F (240 C)	**LEL:** None reported	**UEL:** None reported

Extinguishing Media: Use extinguishing media suitable to the surrounding fire. Use dry chemical, foam, carbon dioxide (CO_2), or water spray. Water spray may be ineffective. Use water spray to cool fire-exposed containers or transformers. Do not scatter PCBs with high-pressure water streams. **Unusual Fire or Explosion Hazards:** Combustion products (hydrogen chloride, phosgene, polychlorinated dibenzofurans, and furans) are more hazardous than the PCBs themselves. **Special Fire-fighting Procedures:** Because fire may produce toxic thermal decomposition products, wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in pressure-demand or positive-pressure mode. Approach fire from upwind to avoid highly toxic decomposition products. Structural firefighter's protective clothing will provide *limited* protection. Do not release runoff from fire control methods to sewers or waterways. Dike for later disposal.

* Flash points shown are a range for various PCBs. Some forms do not have flash points.

Section 5. Reactivity Data

Stability/Polymerization: PCBs are very stable materials but are subject to photodechlorination when exposed to sunlight or UV (spectral region above 290 nanometers). Hazardous polymerization cannot occur. **Chemical Incompatibilities:** PCBs are chemically inert and resistant to oxidation, acids, and bases. **Conditions to Avoid:** Avoid heat and ignition sources.
Hazardous Products of Decomposition: Thermal oxidative decomposition [1112-1202 F (600-650 C)] of PCBs can produce highly toxic derivatives, including polychlorinated dibenzo-para-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), hydrogen chloride, phosgene and other irritants.

Section 6. Health Hazard Data

Carcinogenicity: The IARC,[164] and NTP[169] list PCBs as an IARC probable carcinogen (overall evaluation is 2A; limited human data; sufficient animal data) and NTP anticipated carcinogen, respectively. **Summary of Risks:** PCBs are potent liver toxins that can be absorbed through unbroken skin in toxic amounts without immediate pain or irritation. PCBs have low acute toxicity, but can accumulate in fatty tissue and severe health effects may develop later. Generally, toxicity increases with a higher chlorine content; PCB-oxides are more toxic. The toxic action on the liver also increases with simultaneous exposure to other liver toxins, e.g. chlorinated solvents, alcohol, and certain drugs. Pathological pregnancies (abnormal pigmentations, abortions, stillbirths, and underweight births) have been associated with increased PCB serum levels in mothers; PCBs can be passed in breast milk. PCBs can affect the reproductive system of adults. **Medical Conditions Aggravated by Long-Term Exposure:** Skin, liver, and respiratory disease. **Target Organs:** Skin, liver, eyes, mucous membranes, and respiratory tract. **Primary Entry Routes:** Inhalation, dermal contact, ingestion. **Acute Effects:** Exposure to PCB vapor or mist is severely irritating to the skin, eyes, nose, throat, and upper respiratory tract. Intense acute exposure to high concentrations may result in eye, lung, and liver injury. Systemic effects include nausea, vomiting, increased blood pressure, fatigue, weight loss, jaundice, edema and abdominal pain. Cognitive, neurobehavior and psychomotor impairment and memory loss have also been seen after acute exposure. **Chronic Effects:** Repeated exposure to PCBs can cause chloroacne; redness, swelling, dryness, thickening and darkening of the skin and nails; swelling and burning of the eyes, and excessive eye discharge; distinctive hair follicles; gastrointestinal disturbances; neurological symptoms including headache, dizziness, depression, nervousness, numbness of the extremities, and joint and muscle pain; liver enlargement; menstrual changes in women; and chronic bronchitis. Cancer, primarily liver, is also a possible result of exposure, but data is inconclusive.

FIRST AID **Eyes:** *Do not* allow victim to rub or keep eyes tightly shut. Rinsing eyes with medical oil (olive, mineral) initially may remove PCB and halt irritation better than water rinsing alone. Gently lift eyelids and flush immediately and continuously with flooding amounts of water until transported to an emergency medical facility. Consult a physician immediately. **Skin:** *Quickly* remove contaminated clothing. Rinse with flooding amounts of water for at least 15 min. Wash exposed area with soap and water. *Multiple soap and water washings are necessary.* Avoid the use of organic solvents to clean the skin. For reddened or blistered skin, consult a physician. **Inhalation:** Remove exposed person to fresh air and support breathing as needed. **Ingestion:** In most cases, accidental PCB ingestion will not be recognized until long after vomiting would be of any value. Never give anything by mouth to an unconscious or convulsing person. Vomiting of the pure substance may cause aspiration. Consult a physician. **Note to Physicians:** Monitor patients for increased hepatic enzymes, chloroacne, and eye, gastrointestinal, and neurologic symptoms listed above. Diagnostic tests include blood levels of PCBs and altered liver enzymes.

Section 7. Spill, Leak, and Disposal Procedures

Spill/Leak: Notify safety personnel, evacuate all unnecessary personnel, provide adequate ventilation, and isolate hazard area. Cleanup personnel should protect against vapor inhalation and skin or eye contact. For small spills, take up with sand or other noncombustible material and place into containers for later disposal. For larger spills, dike far ahead of spill to contain for later disposal. Follow applicable OSHA regulations (29 CFR 1910.120). **Environmental Transport:** PCBs have been shown to bio-concentrate significantly in aquatic organisms. **Ecotoxicity:** Bluegill, TLm: 0.278 ppm/96 hr. Mallard Duck, LD_{50}: 2000 ppm. **Environmental Degradation:** In general, the persistence of PCBs increases with an increase degree of chlorination. **Soil Absorption/Mobility:** PCBs are tightly absorbed in soil and generally do not leach significantly in most aqueous soil systems. However, in the presence of organic solvents, PCBs may leach rapidly through the soil. Volatilization of PCBs from soil may be slow, but over time may be significant. **Disposal:** Approved PCB disposal methods include: incineration with scrubbing, high-efficiency boilers, landfills, and EPA-approved alternative disposal methods. Each disposal method has various criteria. Contact your supplier or a licensed contractor for detailed recommendations. Follow applicable Federal, state, and local regulations.

EPA Designations

RCRA Hazardous Waste (40 CFR 261.33): Not listed
SARA Extremely Hazardous Substance (40 CFR 355): Not listed
Listed as a SARA Toxic Chemical (40 CFR 372.65)
Listed as a CERCLA Hazardous Substance* (40 CFR 302.4): Final Reportable Quantity (RQ), 1 lb (0.454 kg) [* per CWA, Sec. 311(b)(4) and 307(a)]

OSHA Designations

Listed as an Air Contaminant (29 CFR 1910.1000, Table Z-1-A)

Section 8. Special Protection Data

Goggles: Wear protective eyeglasses or chemical safety goggles, per OSHA eye- and face-protection regulations (29 CFR 1910.133). Because contact lens use in industry is controversial, establish your own policy. **Respirator:** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, wear a MSHA/NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Minimum respiratory protection should include a combination dust-fume-mist and organic vapor cartridge or canister or air-supplied, depending upon the situation. For emergency or nonroutine operations (cleaning spills, reactor vessels, or storage tanks), wear an SCBA. *Warning! Air-purifying respirators do not protect workers in oxygen-deficient atmospheres.* If respirators are used, OSHA requires a written respiratory protection program that includes at least: medical certification, training, fit-testing, periodic environmental monitoring, maintenance, inspection, cleaning, and convenient, sanitary storage areas. **Other:** Wear chemically protective gloves, boots, aprons, and gauntlets to prevent all skin contact. Butyl rubber, neoprene, Teflon, and fluorocarbon rubber have break through times greater than 8 hrs. **Ventilation:** Provide general and local exhaust ventilation systems to maintain airborne concentrations below the OSHA PEL (Sec. 2). Local exhaust ventilation is preferred because it prevents contaminant dispersion into the work area by controlling it at its source.[103] **Safety Stations:** Make available in the work area emergency eyewash stations, safety/quick-drench showers, and washing facilities. **Contaminated Equipment:** Separate contaminated work clothes from street clothes and launder before reuse. Segregate contaminated clothing in such a manner so that there is no direct contact by laundry personnel. Implement quality assurance to ascertain the completeness of the cleaning procedures. Remove this material from your shoes and clean PPE. **Comments:** Never eat, drink, or smoke in work areas. Practice good personal hygiene after using this material, especially before eating, drinking, smoking, using the toilet, or applying cosmetics.

Section 9. Special Precautions and Comments

Storage Requirements: Store in a closed, labelled, container in a ventilated area with appropriate air pollution control equipment. **Engineering Controls:** To reduce potential health hazards, use sufficient dilution or local exhaust ventilation to control airborne contaminants and to maintain concentrations at the lowest practical level. **Administrative Controls:** Inform employees of the adverse health effects associated with PCBs. Limit access to PCB work areas to authorized personnel. Consider preplacement and periodic medical examinations with emphasis on the skin, liver, lung, and reproductive system. Monitor PCB blood levels. Consider possible effects on the fetus. Keep medical records for the entire length of employment and for the following 30 yrs.

Transportation Data (49 CFR 172.101)

DOT Shipping Name: Polychlorinated biphenyls
DOT Hazard Class: 9
ID No.: UN2315
DOT Packing Group: II
DOT Label: CLASS 9
Special Provisions (172.102): 9, N81

Packaging Authorizations
a) Exceptions: 173.155
b) Non-bulk Packaging: 173.202
c) Bulk Packaging: 173.241

Quantity Limitations
a) Passenger Aircraft or Railcar: 100 L
b) Cargo Aircraft Only: 220 L

Vessel Stowage Requirements
a) Vessel Stowage: A
b) Other: 34

MSDS Collection **References:** 26, 73, 89, 100, 101, 103, 124, 126, 127, 132, 133, 136, 163, 164, 168, 169, 174, 175, 180
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