MBK Partnership/ North Ridge Estates Subdivision Responsible Party Removal Action Report Klamath Falls, Oregon TDD: 03-07-0011

Contract: 68-S0-01-01
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Region 10

START-2

Superfund Technical Assessment and Response Team

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MBK PARTNERSHIP/ NORTH RIDGE ESTATES SUBDIVISION RESPONSIBLE PARTY REMOVAL ACTION REPORT
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LIST OF ACRONYMS

Acronym	Abbreviation
%R	percent recovery
ACM	asbestos containing material
AHERA	Asbestos Hazard Emergency Response Act
AOC	Administrative Order on Consent
bgs	below ground surface
BLWP	burial location work plan
CAB	concrete asbestos board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DQOs	data quality objectives
DUP	duplicate
E & E	Ecology and Environment, Inc.
ED	electron diffraction
EDXA	energy dispersive X-ray analysis
EPA	United States Environmental Protection Agency
ESL	Environmental Services Laboratory
f/cc	fibers per cubic centimeter
FUDS	Formerly Used Defense Site
Geopotential	Geopotential, Inc.
GPR	ground penetrating radar
ISO	International Organization of Standardization
l/min	liters per minute
Lab/Cor	Lab/Cor, Incorporated
MAO	mutual agreement and order
MBK	Melvin Bercot Kenneth Partnership
MCP	mobile command post
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MS	matrix spike
Navy	United States Navy

LIST OF ACRONYMS (CONTINUED)

Acronym	Abbreviation
NIOSH	National Institute for Occupational Safety and Health
NON	Notice of Noncompliance
NRE	North Ridge Estates
NVL	NVL Laboratories, Incorporated
ODEQ	Oregon Department of Environmental Quality
ODHS	Oregon Department of Human Services
OSC	On-Scene Coordinator
OSHA	Occupational Safety and Health Administration
OTI	Oregon Technical Institute
PA	Preliminary Assessment
PBS	PBS Engineering and Environmental
PCBs	polychlorinated biphenyls
PCM	phase contrast microscopy
PCME	phase contrast microscopy equivalent
PEL	permissible exposure limit
PPE	personal protective equipment
PRG	preliminary remediation goal
PSPs	personal sample pumps
PST	Pacific Strike Team
QA	quality assurance
QAPP	quality assurance project plan
QC	quality control
RA	removal action
RCA	Rose City Abatement
RCRA	Resource Conservation and Recovery Act
RI/FS	remedial investigation/feasibility study
RMCat	RMCat Environmental Services, Inc.
RP	responsible party
RPD	relative percent difference

LIST OF ACRONYMS (CONTINUED)

Acronym	Abbreviation
s/cc	structures per cubic centimeter
SAP	Sampling Analysis Plan
SRA	streamlined risk assessment
SSSPs	site-specific sampling plans
START	Superfund Technical Assessment and Response Team
TCLP	toxicity characteristic leaching procedure
TEM	transmission electron microscopy
USCG	United States Coast Guard
XRF	X-ray fluorescence
°F	degrees Fahrenheit

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1. INTRODUCTION

On July 27, 2001, the Oregon Department of Environmental Quality (ODEQ) was contacted by an excavation contractor that had uncovered 12 linear feet of asbestos-insulated pipe on a residential property located on North Ridge Drive in the North Ridge Estates (NRE) subdivision, near Klamath Falls in Klamath County, Oregon. The ODEQ approved an emergency asbestos removal of this material by an asbestos abatement contractor. On July 29, 2001, the ODEQ received a complaint regarding asbestos pipe insulation laying on the ground and exposed to the atmosphere along North Ridge Drive. On July 31, 2001, an ODEQ air specialist traveled to the excavation site at 3533 North Ridge Drive, approximately 3 miles northwest of Klamath Falls, Oregon (Figure 1-1). The ODEQ observed 180 linear feet of insulated pipe placed in two piles on the property. The ODEQ also observed a white platy material scattered throughout this and several other properties.

Samples of the white pipe insulation, the tar paper on the pipe, and the broken platy material were collected for analysis. Upon contacting the NRE subdivision developer on August 1, 2001, the ODEQ representative was told that the property was formerly a military base in the 1940s and that most of the buildings had been razed since that time. On August 3, 2001, the ODEQ approved the removal and disposal of the 180 linear feet of asbestos-insulated pipe by the same excavation contractor that notified the ODEQ. Analytical results received by the ODEQ on August 7, 2001, indicated that the white pipe insulation contained 90% asbestos; the tar paper contained up to 70% asbestos; and the platy material, believed to be concrete asbestos board (CAB), contained 10% asbestos. The NRE subdivision developer was cited by the ODEQ in a letter dated September 21, 2001, for removing 180 linear feet of asbestos containing pipe from the ground without notifying the ODEQ, as required by law, and for the open accumulation of asbestos containing material (ACM; ODEQ 2001).

The NRE subdivision developer, Melvin Bercot Kenneth Partnership (MBK), entered into a mutual agreement and order (MAO) with the ODEQ in May 2002 to remove all openly accumulated ACM at the NRE subdivision and either deed restrict or remove buried ACM and asbestos-containing pipe. The abatement contractor hired by MBK removed 50 tons of ACM and debris from the subdivision during the summer of 2002 (ODEQ 2004).

The ODEQ requested the assistance of the United States Environmental Protection Agency (EPA) in April 2003 after negotiations between the ODEQ and MBK ceased because they did not agree on the scope of necessary future remedial actions. The EPA and MBK signed an Administrative Order on Consent (AOC) on May 21, 2003, which required MBK to complete a removal action (RA) and streamlined risk assessment (SRA) under the EPA's oversight (EPA 2003a). The AOC stipulated several actions to be performed under the RA and SRA that included:

- Completing a surficial removal work plan and conducting a surficial cleanup of residential properties.
- Completion of a preliminary assessment (PA).
- Prepare sampling and analysis plans (SAPs) to support the RA.
- Prepare a burial location work plan (BLWP) and conduct a geophysical analysis to locate buried asbestos-insulated steam pipe on residential properties.
- Prepare an SRA work plan for asbestos in ambient air, indoor dust, and soil.
- Submit a final RA and SRA report.
- Evaluate the need for further sampling to determine the extent of potential hazardous substance contamination.

The EPA tasked Ecology and Environment, Inc. (E & E) under Superfund Technical Assessment and Response Team (START)-2 Contract Number 68-S0-01-01, Technical Direction Document Number 03-07-0011, to provide technical support and monitor the progress of a time-critical RA to be conducted by the responsible party (RP) at the MBK/NRE subdivision site. The START-2 documented removal activities, provided technical support to the EPA, conducted ambient air sampling, collected split air and soil samples for ACM analysis, completed a soil sampling survey for lead, and performed activity-based air sampling.

The RA site activities began in June 2003. Most of the RP removal activities were conducted from June to November 2003, although the localized removal of lead-contaminated soil, asbestos-insulated steam pipe, and limited ACM from the surface soil were completed in 2004. In October 2004, the RP also placed rock, soil, and/or permeable fabric over exposed areas of ACM on three properties subject to high levels of erosion. Selected photographs of site activities are included as Appendix A.

This report is organized into the following sections: Introduction (Section 1), Site Conditions and Background (Section 2), Quality Assurance/Quality Control (QA/QC; Section 3), Removal

Activities (Section 4), Sample Collection and Analysis (Section 5), Community Relations (Section 6), Health and Safety (Section 7), Summary of Removal Action and Streamlined Risk Assessment (Section 8), and References (Section 9).

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2. SITE CONDITIONS AND BACKGROUND

2.1 SITE DESCRIPTION

Although the precise size of the MBK/NRE site is not known because subsurface soils have not been characterized, the portion of the NRE subdivision assessed during the RA lies in a valley and consists of approximately 140 acres that have been divided into dozens of developed and undeveloped residential lots near Old Fort Road, approximately 3 miles northeast of Klamath Falls, Oregon. The primary roads in the subdivision are Old Fort Road, North Ridge Drive, and Hunters Ridge Road (Figure 2-1).

A survey of properties for ACM fragments in soil conducted in 2002 by the Oregon Department of Human Services (ODHS) included 22 residences, nine vacant lots, and a memorial park. In addition to this portion of the NRE development west of Old Fort Road, several residential properties and a five-unit apartment building east of Old Fort Road have been identified with ACM in the surface soils and buried, asbestos-insulated steam lines. Land to the west, east, and north of the subdivision is zoned for forestry, animal husbandry, and agriculture. The United States Census Bureau lists 98 residents, including 14 children, within 0.5 mile of the subdivision (ODHS 2004).

The remaining buildings from the former military base include a warehouse presently utilized for contractor supply storage, the former brig which has been renovated into a five-unit apartment building, and several residences on Thicket Court which may have been utilized as medical staff housing (Figure 2-2; ODHS 2004). A guard shack for a military shooting range also remains standing east of the subdivision, but is being investigated separately by the ODEQ as a Formerly Used Defense Site (FUDS).

Although the other former military base structures at the site have been razed, the concrete foundations for many of these buildings remain intact. Some of the old roads from the base are still visible, although they are cracked and vegetation is growing through them. At the site, Old Fort Road and North Ridge Drive appear to follow approximately the same routes they did when the base was operating (ODHS 2004).

2.1.1 Climate

The climate in the Klamath Basin and surrounding mountains is influenced by air masses moving west from the Pacific Ocean, which are greatly influenced by the Coastal Range and Cascade Mountains. The continental air masses moving down from the western interior of Canada also affect the weather pattern and result in a much drier climate than western Oregon, which can have extreme temperatures. (NRCS 1985)

Average annual precipitation in the surrounding hills where the site is located ranges from 16 to 25 inches (NRCS 1985). About 44% of the moisture occurs in the winter with snowfall accounting for as much as 50% of the yearly precipitation (NRCS 1985). In Klamath Falls, the average annual maximum temperature is 60.2 degrees Fahrenheit (°F) and the average annual minimum temperature is 33.3°F (WRCC 2004). November, December, January, and February have the highest monthly rainfall averages of 2.06, 1.88, 1.79, and 175 inches, respectively (WRCC 2004).

2.1.2 Geology/Hydrogeology

The MBK/NRE site lies in the Klamath Basin east of the Sierra-Cascade Mountain province and west of the Basin and Range province. The well-drained soil at the site is made of gravelly material weathered from tuff, basalt, andesite, and some pumiceous ash. Bedrock is typically found at a depth of 25 to 40 inches below ground surface (bgs).

The Klamath Basin lies in a transitional zone between the Cascade Mountains and the Basin and Range Province which results in complex geology. Basin and Range-style faulting has divided the Klamath Basin into a series of small sub-basins (NRCS 1985).

A geothermal system within the Klamath Basin is evident by the presence of hot springs and hundreds of warm water wells in the Klamath Falls area. These waters are heated to 266°F before they move upward into the shallow groundwater system. Most of the thermal discharge moves outward from the fault conduits into permeable zones in basalts where it mixes with the cooler shallow groundwater. North of Klamath Falls, flowing artesian wells in the vicinity of Upper Klamath Lake and a large number of springs indicate that strong upward groundwater flow occurs in many areas around the Klamath Basin (NRCS 1985). The NRE site is not located within a floodplain (FEMA 1984).

2.2 SITE HISTORY, OPERATIONS, AND OWNERSHIP

Between 1943 and 1944, the United States Navy (Navy) purchased approximately 745 acres of land, including nearly 11 acres for utility easements, near Klamath Falls, Oregon, from private parties for the Marine Recuperation Barracks. Records have not been located that indicate how much of the property was utilized by the Navy for the military base. Construction of the base began on January 27, 1944. The initial barracks construction plan included two-deck barrack buildings, a dispensary, a sick bay, laboratories, Navy and United States Marine Corps personnel quarters, a large mess hall, and a post exchange building (Figures 2-2 and 2-3). The base ultimately was composed of nearly 80 buildings designed to accommodate 5,000 marines (Figure 2-4). Personnel had staffed the base by April 30, 1944, and the first contingent of marine casualties arrived on May 27, 1944. The barracks officially closed on February 28, 1946, after the end of World War II in September 1945. The entire 745 acres were declared surplus property by the Navy in May 1946, and the land was transferred to the War Assets Administration for distribution. (Matthews 1992)

In March 1947, the State of Oregon acquired the property to be utilized for the Oregon Technical Institute (OTI), now known as the Oregon Institute of Technology, where vocational courses were offered beginning in the fall of that year (Matthews 1992). OTI vacated the facility in 1964 and has since established a campus closer to Klamath Falls, Oregon (Matthews 1992). The site, or portions of the site, were owned by various parties until MBK purchased much of the property in December 1977.

According to the public health consultation report published by the ODHS Superfund Health Investigation and Education Program, the present NRE subdivision developed by MBK encompasses an area of 422 acres, although many of the lots have not been sold.

2.3 REGULATORY AND ENFORCEMENT HISTORY

Prior to August 28, 1979, the EPA discovered demolition debris believed to contain ACM on the property currently owned by MBK. Because this demolition debris was exposed and uncontained on the MBK owned property, MBK was issued a compliance order by the EPA pursuant to Section 113 (a)(3) of the Clean Air Act regarding the requirement to develop a plan for disposal of ACM contained within demolition debris on September 17, 1979 (EPA 1979). The compliance order stated that MBK "failed to properly strip asbestos containing materials from the insulation pipes when the pipes became exposed as required..." (EPA 1979). It further stated that "The company caused or permitted asbestos containing waste material to remain exposed, uncontained and undisposed of at the demolition site" (EPA 1979). The compliance order required MBK to submit a plan addressing the ACM from "...the present demolition operation and all material remaining from previous demolition" (EPA 1979). The plan was to provide the EPA with a detailed description of the ACM disposal site (EPA 1979). After proper disposal of the ACM, the order further required MBK to register the inactive waste site with Klamath County

(EPA 1979). In 2003, the EPA and the START-2 were unable to identify any deed restrictions for ACM disposal sites at NRE.

On April 13, 1993, a preliminary inspection, completed under the Defense Environmental Restoration Program, found that there were no hazardous conditions at the former Marine Recuperation Barracks. The memorandum stated that only two buildings, the warehouse and former brig, remained at the site. There is no reference to asbestos or ACM in the memorandum (USACE 1993).

The ODEQ became aware of asbestos-insulated steam pipe at the site when it was unearthed by a contractor during excavation activities associated with home construction and development of the property. After the discovery of ACM in late July 2001, the ODEQ issued MBK a Notice of Noncompliance (NON; AQ-ERB-01-7715) on September 21, 2001, for the illegal removal and open accumulation of friable ACM (ODEQ 2001).

In April 2002, MBK entered into a MAO with the ODEQ which required a survey of all properties currently or previously owned by the partnership for the presence of ACM and required the removal of openly accumulated ACM (ODEQ 2002). Additional requirements for MBK included either removing buried ACM or placing a deed restriction on properties known to have buried ACM pursuant to the 1979 compliance order and on the properties with buried asbestos containing pipe. Approximately 50 tons of ACM were collected from the site and disposed by Malot Environmental, Inc., an MBK contractor, in 2002.

In March 2003, the ODEQ and ODHS determined that the friable asbestos not removed from the site in 2002 continued to pose a significant public health hazard (ODEQ 2004). The ODEQ immediately began negotiations with MBK to prepare a remedial investigation/feasibility study (RI/FS) to include a site characterization, human health risk assessment, and remedy identification. MBK and the ODEQ were unable to agree on the scope of the RI/FS; therefore, the Region 10 EPA was consulted to lead a RA or oversee the RP’s efforts in performing a RA. On May 21, 2003, MBK entered into an AOC with the EPA for a RA and SRA (EPA 2003a). Initial site activities for the RA, which involved the hand collection of surficial ACM from all residential lots at the site, commenced on June 10, 2003. Activities conducted by MBK and the EPA during the RA are discussed in Section 4.

3. QUALITY ASSURANCE/QUALITY CONTROL

QA/QC data are necessary to determine precision and accuracy and to demonstrate the absence of interferences and/or contamination of sampling equipment, glassware and reagents. Specific QC requirements for laboratory analyses are incorporated in the *Contract Laboratory Program Statement of Work for Inorganic Analyses* (EPA 2004). These QC requirements, or equivalent requirements, found in the analytical methods were followed for analytical work on the project. This section describes the QA/QC measures taken and provides an evaluation of the usability of data presented in this report. Data validation memorandum for the samples collected by the START-2 are provided in Appendix B.

All samples were collected following the guidance of the site-specific sampling plans (SSSPs; E & E 2003a and 2004) and the START-2 quality assurance project plan (QAPP; E & E 2003b) for field activities. The START-2 subcontracted NVL Laboratories, Inc. (NVL), in Seattle, Washington, to perform lead analyses by EPA SW-846 method 7420. Asbestos analyses were performed using the following methods: International Organization of Standardization (ISO) Method 10312; National Institute for Occupational Safety and Health (NIOSH) Method 7402; Modified EPA-II Method; EPA-600-R-93/116; Method 68-02-3266, and Method 40 Code of Federal Regulations Chapter 1 (1-1-87, Part 763, Subpart F, Appendix A) analyses were performed by Lab/Cor, Inc. (Lab/Cor), in Seattle, Washington, and/or Pacific Rim Environmental, Inc., also in Seattle, Washington.

Data from the START-2 subcontracted commercial laboratories were reviewed and validated (when applicable) by a START-2 chemist. Data qualifiers were applied as necessary according to the following guidance:

- EPA (1990) *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures*; and
- EPA (2004) *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*.

In the absence of other QC guidance, method-specific QC limits were also utilized to apply qualifiers to the data.

3.1 SATISFACTION OF DATA QUALITY OBJECTIVES

The following EPA (EPA 2000) guidance document was used to establish data quality objectives (DQOs) for this project:

- *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), EPA/600/R-96/055.

The EPA On-Scene Coordinator (OSC) determined that definitive data without error and bias determination would be used for the sampling and analyses conducted during the field activities. The data quality achieved during the fieldwork produced sufficient data that met the DQOs stated in the SSSPs (E & E 2003a and 2004). A discussion of accomplished objectives is presented in the following subsections.

3.2 QUALITY ASSURANCE/QUALITY CONTROL SAMPLES

QA samples included media blank samples. Rinsate blank samples are not required as all samples were collected using dedicated equipment. Trip blank samples are not required as volatile organic compounds were not analyzed for this project. Media blank samples are discussed in subsection 3.4.3. QC samples included matrix spike (MS)/duplicate (DUP) samples for inorganic analyses at a rate of one MS/DUP per matrix per analysis.

3.3 PROJECT-SPECIFIC DATA QUALITY OBJECTIVES

The laboratory data were reviewed to ensure that DQOs for the project were met. The following describes the laboratories' ability to meet project DQOs for precision, accuracy, and completeness and the field team's ability to meet project DQOs for representativeness and comparability. The laboratory and the field team were able to meet DQOs for the project.

3.3.1 Precision

Precision measures the reproducibility of the sampling and analytical methodology. Laboratory and field precision is defined as the relative percent difference (RPD) between duplicate sample analyses. The laboratory duplicate samples or MS/DUP samples measure the precision of the analytical method.

The RPD values were reviewed for all commercial laboratory samples. All laboratory duplicate sample results were within QC limits. The DQO for precision of 85% was met.

3.3.2 Accuracy

Accuracy measures the reproducibility of the sampling and analytical methodology. Laboratory accuracy is defined as the MS percent recovery (%R) for all analyses. The MS %R values were reviewed for all MS analyses. All MS sample results were within QC limits. The project DQO for accuracy of 85% was met.

3.3.3 Completeness

Data completeness is defined as the percentage of usable data (usable data divided by the total possible data). All data were reviewed for usability. No sample results were rejected, therefore the project DQO for completeness of 90% was met.

3.3.4 Representativeness

Data representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or environmental condition. The number and selection of samples were determined in the field to account accurately for site variations and sample matrices. The DQO for representativeness of 85% was met.

3.3.5 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared to another. Data produced for this site followed applicable field sampling techniques and specific analytical methodology. The DQO for comparability was met.

3.4 LABORATORY QUALITY ASSURANCE/QUALITY CONTROL PARAMETERS

The laboratory data also were reviewed for holding times/temperature, laboratory blank samples, and media blank samples. These QA/QC parameters are summarized below. In general, the laboratory and media QA/QC parameters were considered acceptable.

3.4.1 Holding Times/Temperature

All samples were maintained with the temperature QC limits and were analyzed within QC holding time limits.

3.4.2 Laboratory Blanks Samples

All laboratory blanks met the frequency criteria. No analytes were detected in any analyses that affected sample results.

3.4.3 Media Blank Samples

The media blanks were submitted at a frequency of one or two per batch of cassette filters for asbestos analyses. No asbestos fibers were detected in any media blanks except the phase contract microscopy (PCM) blanks J067781 and J067756, each with two total fibers; no action was taken as the laboratory used the average of the two blanks to reduce the gross counts of the test samples.

3.5 X-RAY FLUORESCENCE FIELD SCREENING

The START-2 collected a total of 150 soil samples and screened them in the field for the presence of lead using a Niton® X-ray fluorescence (XRF) spectrometer. A total of 19 soil samples were submitted to a subcontracted commercial laboratory for confirmation analysis with EPA Method 7420.

To satisfy the QC elements using the XRF, the data were documented and statistically compared to the commercial laboratory results to assess comparability. According to EPA guidance, a minimum correlation coefficient of 0.700 is necessary to consider field analytical results acceptable when compared with laboratory confirmation results. The correlation coefficient for the agreement between the XRF screening results and confirmation analytical results for lead was 0.99, which is significantly better than the EPA QC requirement.

4. REMOVAL ACTIVITIES

Field activities for the RA were initiated on June 10, 2003, in response to the immediate risk to the public and the environment posed by the presence of ACM in the surface soil at the site. The RP subcontracted PBS Engineering and Environmental (PBS) of Portland, Oregon, to act as the general consultant for removal activities. Rose City Abatement (RCA) was subcontracted to remove, by hand, the surficial ACM at the site. This section describes the objectives and strategies of the RA (subsection 4.1), provides a chronology of events that occurred over the course of the RA (subsection 4.2), and discusses the actions taken during the RA (subsections 4.3).

4.1 REMOVAL OBJECTIVES AND STRATEGIES

The primary purpose of the RA was to reduce the risk to human health and the environment posed by the release of friable asbestos and other Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) hazardous substances in accordance with the National Contingency Plan (40 CFR Part 300). The objectives of the RA were to mitigate the immediate threat to the residents and other visitors to the site posed by friable asbestos in soil; to characterize the site; and to design and implement a permanent remedy. Developed residential properties are referred to in this report with a one or two letter identifier to protect the privacy of the residents. MBK-owned lots referred to in this report are identified with "MBK" followed by a single letter identifier (Figures 5-1, 5-2, and 5-3).

To meet these objectives, the START-2 assisted the EPA OSC in monitoring the performance of specific tasks conducted by the RP's subcontractors. The RP contractors' scope of work was divided into the following two phases of work, the tasks of each phase are included below:

Phase 1: Tasks for the Time-Critical RA

- Prepare and submit to the EPA a surficial removal work plan;
- Prepare and submit to the EPA a health and safety plan;
- Mobilize and set-up temporary office trailers with electricity and telephone service;
- Conduct the surficial RA;

- Prepare and submit a BLWP;
- Conduct geophysical analysis to locate buried abandoned steam pipe at site;
- Prepare and submit a SAP;
- Conduct sampling of residential soils, homes, and ambient environment;
- Complete a PA for the site;
- Stabilize and/or secure burial locations; and
- Arrange for the proper transportation and disposal of site wastes to approved disposal facilities in accordance with applicable regulations.

Phase 2: Field Investigation and Risk Assessment

- Conduct sampling for the SRA; and
- Prepare and submit a SRA report.

The START-2 scope of work for the RA included the following activities:

- Provide the EPA with technical support during the RP's implementation of the RA;
- Conduct various media sampling as determined by the OSC during the course of the RA;
- Document any threat or potential threat to public health or the environment posed by the site and ensure the public's safety during removal activities;
- Coordinate with federal, state, and local government during the entire course of the RA;
- Document site activities with photographs;
- Maintain a site log; and
- Prepare the final RA report.

4.2 CHRONOLOGY OF EVENTS

The following is a list of the significant events that occurred during the RA:

- **05/21/03:** The EPA OSC issues an action memorandum for the NRE site to perform an EPA-led removal of asbestos at the site. The EPA-led removal is not conducted because the RP signs the AOC (EPA 2003b).
- **05/21/03:** The EPA and representatives of MBK sign an AOC for conducting the RA and SRA. The order states that work to be performed will include the surficial removal of ACM from site soils (EPA 2003a).

- **06/11/03-10/17/03:** The EPA, the START-2, PBS, and RCA initiate the RA at the site. RCA conducts the ACM removal under the supervision of a PBS project manager. RCA is tasked to pick up ACM that is larger than 1 inch in diameter. This may include roofing material, insulation, floor tile, CAB, and other suspect pieces. PBS conducts personal asbestos air sampling in compliance with applicable Occupational Safety and Health Administration (OSHA) regulations for the RCA workers. The group begins removing ACM on the warehouse property, owned by MBK, because access agreements to some of the residential properties have not been obtained.
- **06/17/03–06/20/03:** PBS crew collects "baseline" composite soil samples to assess conditions in the surface soils prior to the surficial removal of the ACM. Their plan calls for the collection of 10 composite samples collected from a grid laid over the site area.
- **07/06/03:** Two members of the United States Coast Guard (USCG) Pacific Strike Team (PST) arrive at the site to monitor the overall health and safety for all personnel working at the site. They also assist in collecting meteorological data for the EPA.
- **07/22/03:** Geopotential, Inc. (Geopotential), an RP-subcontracted company, arrives at the site to conduct a Ground Penetrating Radar (GPR) and/or magnetometer survey at the site to locate the underground steam lines once utilized to heat the buildings on the base. Identifying the location of the asbestos-insulated steam lines is one of the tasks specified in the AOC.
- **07/23/03:** Wayne Berman, Ph.D., a consultant for the RP, conducts a meeting at the ODEQ office in Klamath Falls with the EPA and the ODEQ, to explain a method for asbestos soil collection and analysis he has developed. Dr. Berman asserts that the risk to residents living at the site for asbestos may be determined by "elutriating" processed soil samples from the site and measuring a specific range of respirable asbestos particles. Two community meetings are conducted in the evening at residents' homes with the EPA, the ODEQ, and residents in attendance. The meetings address site progress and future actions.
- **07/24/03:** Exploratory trenching is conducted by Tomahawk Construction, an asbestos abatement contractor, where Geopotential notes potentially buried pipe. Steam pipe covered with asbestos wrap is identified at some of these test pit locations. A map of the buried steam pipe locations is to be developed by PBS.
- **07/25/03:** Twelve surface soil samples are collected by the PST and the START-2 from three sites where electrical transformers may have been situated at the military base. Screening of all the samples indicates that polychlorinated biphenyls (PCBs) are not present at detectable concentrations.
- **07/28/03-08/01/03:** The START-2 screens site soils for lead content utilizing an XRF spectrometer. Approximately 150 surface soil samples are collected from 35 properties for screening analysis with 10% of the samples submitted for confirmation analysis.
- **07/30/03-08/01/03:** Composite samples collected in June by PBS for the baseline study are processed by PBS in accordance with a SAP work plan prepared by Dr. Berman. The sample preparation occurs in the MBK warehouse building on site.
- **08/03/03:** The PST brings a mobile command post (MCP) to the site. The MCP provides a base of operations for the EPA, PBS, and the START-2 to conduct administrative

duties and to store non-expendable air sampling equipment. Power and a phone line to the MCP are provided by the RP. The MCP replaces the small trailer previously provided by the RP that was not large enough to store equipment and provide a meeting space.

- **08/14/03:** PBS informs the EPA that the abatement crews have removed approximately 6,800 pounds of ACM from the site at this time.
- **08/19/03 :** The START-2 begins collecting ambient air samples from an air monitoring network of six stations established throughout the site.
- **08/19/03-09/05/03:** PBS collects indoor and outdoor air samples from 22 residences as specified in the SAP. The START-2 collects split samples at six of the residences by establishing air samplers adjacent to the RP's samplers for ISO Method 10312 asbestos analysis.
- **09/15/03-09/19/03:** The START-2 conducts biased asbestos surface soil sampling at 22 residences. All sample points are documented in a logbook and geo-referenced utilizing a GPS unit. An asbestos soil sample map is created from this data.
- **09/22/03-9/24/03:** The START-2 documents steam pipe burial locations with a GPS unit as directed by the EPA OSC.
- **09/23/03-9/25/03:** PBS processes soil samples from "hot-spot" locations for elutriator analysis to be utilized in the RP-funded risk assessment.
- **09/26/03-10/2/03:** The START-2 processes the 22 residential composite soil samples collected earlier in the month via the method outlined in the RP's SAP. Twelve of the 22 samples are submitted for "elutriation" to capture respirable asbestos particles on air filters by the ISO Method 10312. The filters are submitted to a commercial laboratory and analyzed.
- **10/06/03-10/16/03:** PBS, the EPA OSC, and PST oversee the removal of concentrated areas of ACM in surface soils, known as hot spots, at four residential properties. RMCat Environmental Services, Inc. (RMCat) is the excavation abatement contractor hired by the RP to remove the ACM in soils with an excavator. RMCat removes approximately 77 tons of ACM for disposal at the Klamath County landfill, located 1 mile south of the site.
- **10/21/03-10/23/03:** Excavation of suspected piles of buried debris is conducted to assess the presence of ACM. The areas were identified due to their unnatural topographic shape. The EPA and PBS agrees upon 13 locations to be explored throughout the site. Most of the piles contain ACM within the top 3 feet.
- **10/30/03:** A community meeting is held by the EPA at the Klamath County Extension Center to discuss the removal activities completed and to explain the risk assessment process.
- **10/31/03:** The START-2 and the EPA OSC collect eight discrete soil samples from locations specified by an EPA Site Assessment Manager. The samples are submitted for ACM analysis. Results are to be utilized in a site investigation report to be prepared by the EPA contractor, Weston Solutions, Inc.

- **11/4/03-11/6/03:** PBS collects dust samples from the carpet of 21 residences following a procedure outlined by Dr. Berman. The EPA does not collect splits of these samples. The preparation of these samples for analysis has not been finalized since there is no approved method.
- **04/26/04-4/29/04:** Based on the results of the lead survey conducted by the START-2 in July 2003, the START-2 conducts a second phase of concentrated grid sampling on the MBK-C lot where elevated levels of lead were detected.
- **05/17/04-05/18/04:** The START-2 collects GPS readings with the EPA OSC to document the location of additional ACM that has resurfaced in site soils after the 2003 removal and documents the location of ACM on MBK-owned lots which were not addressed in 2003.
- **07/19/04-7/23/04:** The EPA and the START-2 conduct activity-based sampling on the MBK-A, MBK-B, and MBK-C lots. These activities are meant to mimic various actions (and resultant exposures) that residents may undertake at the site. The scenarios to be examined include a child playing in the dirt, a resident rototilling his yard, and a resident using a weed trimmer. While START-2/EPA conduct these actions with respiratory protection, personal air sampling pumps are worn to collect the dust generated by the specific activity. An upwind air sampling pump is deployed near the area of activity to collect a background air sample. The personal sample pump air filters are screened on site via PCM analysis for dust loading so that the study may be adjusted to produce valid (non-overloaded) samples. The air samples are then submitted to an off-site laboratory for transmission electron microscopy (TEM) analysis to confirm asbestos content.
- **10/05/04-10/07/04:** PBS and RMCat conduct stabilization activities at select locations throughout the site to reduce the impact of water erosion in areas of concentrated ACM in soils. Stabilization activities involved the placement of a geosynthetic fabric, rock, and/or soil at lot C, lot F, and MBK warehouse properties. Steam pipe that is at the ground surface is also removed (and disposed) from lot A and the lot on the southeast corner of Old Fort Road and Thicket Court properties.
- **10/06/04-10/07/04**: Lead-contaminated soil is excavated from the MBK-C lot where elevated levels of contamination were delineated by the START-2 in July 2004. An area approximately 25 feet in diameter and 1.5 to 2 feet deep is excavated. Four confirmation soil samples are collected by PBS in the excavated area for lead analysis. A composite sample of the lead-contaminated soil is also collected by PBS for toxicity characteristic leaching procedure (TCLP)-lead analysis for proper disposal.

4.3 REMOVAL ACTIONS

A time-critical RA was initiated at the site on June 10, 2003, to address the imminent hazards to human health. The RA was funded by the RP and oversite of the activities were conducted by the EPA and the START-2. The RP hired asbestos abatement contractors to remove the ACM from the surface soils that had not been addressed in the 2002 removal. The contractors combed the site to remove pieces as small as 1 inch in diameter. Excavation equipment was also utilized to remove concentrated, localized areas of ACM. Another priority of the removal was to locate buried asbestos-insulated steam pipe at the site because sections of the pipe were known to have been excavated during residential development. The locations were mapped during the removal to prevent further unintended exposure to the asbestos insulation. The RP was also required to stabilize and cover the burial piles at the site where concentrated ACM was readily exposed to the air by erosion. The RP addressed these areas under the RA by filling holes in the piles with soil and covering ACM with rock, synthetic fabric, and/or soil.

4.3.1 Surficial Removal of ACM

The immediate concern at the site was the presence of ACM such as roofing material, CAB siding, floor tiles, and insulation in the site surface soils remaining after the 2002 gross removal of debris conducted by the RP under the MAO with the ODEQ. Approximately 50 tons of material were removed under the 2002 removal but smaller pieces of ACM remained in the surface soils throughout the footprint of the former military base. PBS, the RP consultant, submitted the surficial removal work plan as directed in the EPA AOC in early June 2003. The EPA and the START-2 mobilized to the site on June 10, 2003, to monitor removal activities performed by the RP's abatement contractor, RCA.

Under the direction of PBS, a four-person crew from RCA initiated surficial ACM removal on the MBK-owned warehouse property, since access to the many of the residential properties had not been granted at that time. Workers, trained in the identification of ACM, removed CAB, roofing material, vinyl floor tile with mastic, and pipe insulation from site soils. The ACM was placed in large clear plastic bags that were labeled with asbestos warnings. PBS fitted RCA personnel with personal sampling pumps (PSPs) to monitor worker exposure to airborne fibers as required by OSHA regulations. Workers also wore respiratory protection while conducting the surficial removal. PBS analyzed the PSP filters as required under the NIOSH 7400 PCM method to determine if the exposure level to the workers exceeded the permissible exposure level (PEL) of 0.1 fibers per cubic centimeter (f/cc). The asbestos PEL is the level at which workers must wear respiratory protection while conducting abatement work in an 8-hour work day as mandated by OSHA.

After several weeks of personnel monitoring, it was determined by PBS that the asbestos levels were consistently below the PEL, therefore, workers could conduct the surficial removal work without respiratory protection. Although respiratory protection was no longer required for surficial removal work, the EPA did require PBS to conduct additional air sampling and wear respiratory protection for each new task involving work with ACM (e.g., excavation of soil), as stated in the PBS health and safety plan. Workers also wore dermal protection, such as Tyvek® coveralls and gloves, while conducting removal activities.

As the surficial ACM removal progressed, it became clear that the meticulous nature of the task would require more personnel from RCA. At the height of the surficial ACM removal, approximately 15 personnel from RCA were on site surveying the soil for ACM. In order to increase confidence levels that ACM was removed from site soils as thoroughly as possible, PBS and RCA conducted the surficial ACM removal on a lot-by-lot basis. As most of the properties did not have fences to delineate properties, the PBS supervisor utilized marking tape to separate the lots. The RCA contractors worked in a group and surveyed each property by beginning on one side and making overlapping passes until reaching the opposite side. Surveyed properties ranged in size from a few acres up to several dozen acres. At the conclusion of the surficial removal on October 17, 2003, 7 tons of ACM were removed from 25 developed residential properties and several MBK-owned lots (PBS 2004b).

4.3.1.1 Hot Spot Removal

In addition to the site-wide removal of surficial ACM, areas of concentrated ACM debris, referred to as hot spots, were identified on nine properties. To expedite the removal of this material, much of the ACM was excavated in July 2003 and October 2003. During excavation of the hot spots, workers were required to wear respiratory protection and water was sprayed on the material as it was loaded for disposal to suppress dust and airborne particulates. According to PBS records, approximately 77 tons of excavated material were removed from the hot spot locations for disposal as contaminated waste material at the Klamath County landfill (PBS 2004b). The hot spot removal locations are provided in the PBS's *Report of Surficial Removal and Burial Location Actions* (PBS 2004b).

4.3.2 Burial Pile Exploration

Under the EPA AOC, the RP was required to determine the locations of suspect ACM burial piles on the site and conduct subsurface investigations to characterize the content of the piles. These piles are located where some of the demolition debris was placed when the former military base buildings were razed. The investigation likely did not identify all of the burial locations as the terrain has been altered greatly since the base was in operation. In general, areas with unnatural topography such as mounds or high concentrations of surfacing ACM debris were investigated as part of the burial pile investigation.

From October 21 to 23, 2003, the EPA, PBS, and the RP's excavation subcontractor, RMCat, investigated 13 suspected burial locations by excavating 35 test pits (PBS 2004b). Based on the limited burial pile investigation conducted at the site, eight burial piles on nine residential properties were identified as containing ACM material. According to the PBS report, the full horizontal and vertical extent of the piles was not determined (PBS 2004b).

4.3.3 Buried Steam Pipe Assessment

The ODEQ was notified in July 2001 that piping covered with asbestos insulation had been excavated on a residential property in North Ridge Estates. It was later determined that the pipe was insulated steam pipe that originated from a coal-powered boiler on the north side of the former military base. The buried steam pipe likely heated nearly all 80 buildings on the base. The ODEQ subsequently tested the insulation from the steam pipe and found that it contained 90% amosite asbestos (ODEQ 2001). Although the insulated pipe did not pose a threat if it remained buried, the on-going residential development at the site increased the probability of steam pipe being excavated, thereby exposing workers and residents to airborne asbestos.

The RP agreed under the EPA AOC to conduct a geophysical survey at the site to locate the buried steam pipe. The main lines of the steam pipe were reportedly 4 inches in diameter surrounded by wooly asbestos-containing insulation that was wrapped in asbestos-impregnated paper and covered with 8- to 12-inch diameter corrugated steel.

Geopotential, a geophysical surveyor, conducted the buried steam pipe survey for two weeks in July 2003. Prior to the fieldwork, PBS compiled a base map indicating the approximate locations of some of the buried steam lines utilizing historical photos, plans, and other documents. Although GPR had been initially proposed as one technology to locate the steam pipe, the heterogeneous soil conditions, and possibly buried debris, hindered the ability of the GPR equipment to provide useable information. Instead, a magnetometer, a highly sensitive metal detector, was utilized by the surveyor. Several thousand feet of buried steam pipe were located during the survey. The survey also indicated that some of the steam lines appeared to have breaks in them (PBS 2004b). These breaks may have occurred through various construction activities at the site over the past several decades, including the installation of water supply lines and septic disposal lines. Because of the construction activities that have occurred at the site, it is unknown if all of the buried asbestos insulated pipe has been identified.

To confirm the presence of buried steam pipe along the routes identified by Geopotential, several test pits were excavated. The presence of steam pipe was verified when corrugated steel which wrapped the insulated piping was observed at depths ranging from 2 to 6 feet bgs. Although the pipe may have originally been buried at a uniform depth, the extensive earth work that has been conducted at the site is likely responsible for the steam pipe depth ranging from 2 to 6 feet bgs.

4.3.4 ACM Burial Site Stabilization

Since several ACM burial locations were either concentrated ACM debris piles or areas where concentrated ACM was surfacing along a steep embankment, the EPA required the RP to stabilize these locations which were subject to rapid erosion. Seven burial locations were identified by PBS and the EPA that required stabilization. Six of the seven locations were situated on residential properties while one was located to the north of the warehouse on an MBK-owned lot. Stabilization methods ranged from the placement of top soil, water permeable fabric, 6-inch minus rock; the installation of water diversion piping; and formally documenting the locations for future actions at the site. All seven ACM burial locations are described with the corresponding time-critical removal remedy in the *Burial Pile Stabilization Report* completed by PBS in November 2004 (PBS 2004a).

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5. SAMPLE COLLECTION AND ANALYSIS

Prior to and during the RA at the MBK/NRE site, a number of samples were collected by both the RP and the START-2. Samples of various matrices were collected fro a number of reasons including assessing the extent of asbestos and lead contamination in site soils, assessing the levels of asbestos in indoor and outdoor air, and assessing the risk associated with conducting routine activities in asbestos-contaminated soil.

PBS conducted soil sampling for asbestos content prior to the surficial removal of ACM to assess the levels of respirable asbestos fibers in the soil. Composite samples were collected from residential lots by PBS and the START-2 as detailed in subsections 5.1.1 and 5.1.2. As directed by the the EPA OSC, PBS also collected soil samples from localized areas of concentrated ACM to assess if these areas release more respirable fibers than soils at the residential lots. These samples are discussed in subsection 5.1.1.

PBS collected indoor and outdoor asbestos air samples at 22 residences to evaluate if asbestos released from ACM in site soils is tracked into homes and re-suspended in indoor air. The indoor and outdoor air samples at each residence were collected simultaneously to measure and compare if any variances exist between the indoor and outdoor air quality. The START-2 collected air samples at six of the 22 residences sampled by PBS. The sampling and analytical results assessing indoor air quality are discussed in subsections 5.2.1 and 5.2.2.

The START-2 deployed six high volume air samplers throughout the site to measure ambient levels of airborne asbestos. The air sampling network provided ambient air data in the fall of 2003 and the spring of 2004. The sampling network and results are discussed in subsection 5.2.3.

In addition to assessing asbestos contamination at the site, the START-2 characterized lead soil contamination at the site by collecting 150 soil samples and screening the samples on site with an XRF spectrometer. The lead contamination was delineated to an area of approximately 25 feet in diameter. Lead-contaminated soil was removed by the RP based on the sampling results discussed in subsection 5.3.

Activity-based air sampling was conducted by the START-2 in 2004 to measure the levels of airborne asbestos dust liberated from the site soil while conducting three specific tasks that are common activities conducted by residents living at the site. This sampling activity was performed as an alternative method to soil sampling in assessing the impact of ACM on airborne asbestos content. Results of this sampling will likely be used to assess the risk associated with conducting these activities in asbestos-contaminated soils. Subsection 5.4 discusses the sampling procedure and analytical results.

5.1 SOIL SAMPLING

The RP retained the services of Dr. Berman, representing his firm Aeolus, Inc., to assess the risk posed by the ACM in the soils. The RP collected both composite soil samples encompassing several acres of the site and discrete soil samples from areas of highly concentrated ACM to assess the airborne asbestos exposure to residents. The START-2 was tasked by the EPA to collect composite soil samples from 22 residential properties at the site. The sample collection procedures and analyses utilized by the RP and the START-2 are discussed in subsections 5.1.1, 5.1.2, and 5.1.3.

5.1.1 Baseline and Hot Spot Sample Collection

To evaluate the ACM content in soils over a large portion of the site, Dr. Berman proposed the collection of composite soil samples prior to the removal of surficial ACM. As described in the *Preliminary Sampling and Analysis Plan* (2003b) dated June 16, 2003, and reiterated in the *Sampling and Analysis Plan for a Fast-Track Sampling Program at the North Ridge Estates Site* (2003a) prepared by Dr. Berman, an area of approximately 140 acres was subdivided into 120 uniformly sized squares. This contiguous area represented the soils on which the highest concentration of military buildings were once situated. The 120 squares were then grouped into 10 sets with 12 aliquots being collected from each set; thus, a total of 10 composite samples were collected by homogenizing the 12 component samples collected from each set.

Sample collection conducted between June 17 and 20, 2003, by PBS employees followed the procedures outlined in the *Superfund Method for the Determination of Releasable Asbestos in Soils and Bulk Materials* prepared by Dr. Berman and A.J. Kolk in 1997, with modifications for the composite sampling (Berman and Kolk 1997). Equal volumes of soil were collected from each grid utilizing a template measuring 8 inches by 8 inches and removing 1 inch of top soil. The aliquots were then individually placed in plastic bags, labeled, and grouped in a plastic bucket corresponding to each of 10 composite samples.

Sample preparation was conducted inside the vacant MBK warehouse by PBS personnel who were wearing respiratory and dermal protection. The purpose of the sample preparation was to reduce each sample's size of approximately 20 to 25 kilograms of soil to a more manageable sample size of approximately 200 to 320 grams of soil. Sample prep also included separating the readily visible ACM components (e.g., CAB, roofing material, floor tile) from the soils for separate analysis. The procedure for homogenizing and splitting the samples is described in the SAP prepared by Dr. Berman (Berman 2003b). The START-2 monitored the collection and preparation of the soil samples by the RP and donned appropriate respiratory and dermal personal protective equipment (PPE).

PBS also collected seven soil samples from concentrated ACM "hot spot" locations at the site identified by the EPA OSC. These locations are displayed in the RP's *Report of Surficial Removal and Burial Location Actions* (PBS 2004b). These samples were prepared in the same manner as the composite samples collected for the baseline assessment, as these samples also required homogenization and reduction to a representative sample of 200 to 3,200 grams. The concentrated ACM samples were collected to assess if samples from these specific areas released more asbestos to the air than the areas where composite baseline samples were collected. The 18 processed soil samples (10 composites, seven hot spots, and one background) were submitted by PBS to the RP-subcontracted laboratory, EMS Analytical in Pasadena, California, for asbestos TEM analysis via the ISO Method 10312. Analytical results are provided in Dr. Berman's 2004 report.

5.1.2 START-2 Residential Soil Sampling

Because residents and the EPA were concerned with the exposure from ACM on each property, the EPA tasked the START-2 to collect composite soil samples that could be referenced to each residential property. In contrast to the approach employed by the RP contractor, samples locations were preferentially targeted in areas where residents were likely to frequent on their property and/or in areas that contained ACM. Twenty-two residential properties were sampled by the START-2 with 10 aliquots collected from each property to develop one composite sample. As stated in the START-2 *MBK Partnership/North Ridge Estates Subdivision Site-Specific Sampling Plan,* sampling targeted areas on each residence suspected of containing ACM (E & E 2003a). This information was obtained by reviewing historical photographs and maps and by noting areas that contained ACM during the surficial removal. It should be noted that this activity was tasked to the START-2 after most of the surficial removal had been completed by RSA.   Since the material on the surface had been removed from most of the lots, the samples were collected from a depth of 0 to 2 inches within the 8-inch by 8-inch template, instead of the 0 to 1 inch depth the RP utilized before the surficial removal was conducted. As a result of collecting from this depth, visible ACM was obtained in many of the samples.

In addition to targeting sample collection from areas believed to contain ACM, samples were obtained from areas on the property utilized frequently by residents (e.g., children's play equipment; areas adjacent to decks and patios; gardens or landscaped areas; and front and back yard walkways). In areas where grass/sod was present in a target area, a soil sample was collected from beneath the sod, because ACM below the grass is believed to migrate to the surface with the freeze/thaw cycles that occur at the site.

Samples were collected from September 15 to 19, 2003. Each sample location was geo-referenced with a Trimble® GPS unit and a map was created identifying all of the sample points (Figure 5-1). The processing of all of the sample aliquots to create the 22 composite samples was identical to the method employed by the RP. Twelve of the 22 samples were randomly chosen and submitted to the START-2 subcontracted laboratory, Lab/Cor, in Seattle, Washington, for ISO Method 10312 TEM analysis. The remaining 10 samples were kept in EPA custody pending the results of the initial 12 samples.

5.1.3 Analytical Summary for Soil Samples

The 18 soil samples submitted for analysis by the RP and the 12 soil samples submitted for analysis by the START-2 were all processed by a method developed by Dr. Berman. The Modified Elutriator Method (Berman and Kolk 2000) developed for this site involved the introduction of approximately 50 to 80 grams of the homogenized sample (25% of the 200 to 320 gram sample submitted) to a specially designed dust-generator, known as the elutriator, in an attempt to separate the respirable fraction of each sample. The respirable fraction is deposited on a TEM air sampling filter located in the elutriator, weighed, and prepared for analysis by TEM. The following paragraph from Dr. Berman's report describes how the Modified Elutriator Method may quantify the concentration of asbestos for the entire soil sample:

> As has been shown (Berman and Kolk 2000), by reporting the results of samples analyzed as described in this method as the ratio of the number of asbestos structures per gram of the respirable dust that is produced, the resulting measurements reflect the concentration of asbestos that is an inherent property of the original, bulk sample. In fact, the preparation steps of Berman and Kolk (2000) are designed specifically to assure that the microgram quantities analyzed by TEM remain representative of the kilogram-sized samples collected in the field. Such measurements are thus unique among the kinds of bulk asbestos measurements that can be

derived using available methods and are particularly suited for supporting risk assessment.

The data collected by the RP and the START-2 has been incorporated into the *Final Soil Sampling and Preliminary Risk Assessment for the North Ridge Estates* site report prepared by Dr. Berman and as of the authoring of this report, is under review by the EPA (Berman 2004).

In addition to the samples processed by the Elutriator Method, the EPA separately funded an alternate method of processing 12 split samples of the START-2 collected soil samples. The composited samples were provided to representatives from the EPA Region 10 Manchester Environmental Laboratory for processing utilizing manual agitation, instead of elutriation, in a sealed compartment known as a "glove box" with personal sampling pumps collecting filter samples within the compartment. The sample filter cassettes were then submitted to Lab/Cor to conduct the ISO Method 10312 TEM analysis. The method for processing the soil samples is detailed in the EPA QAPP prepared by the Office of Environmental Assessment group (EPA 2003c).

For the purpose of this report, a summary of the asbestos particulates counted in the air filters for the 12 soil samples collected by the START-2 are provided in Table 5-1. These 12 samples were processed by both the Elutriation Method and the glove box method. However, a direct comparison cannot be made since a processed sample, with the ACM source material removed, was not utilized for the glove box sample collection.

As mentioned previously, the ISO Method 10312 TEM analysis was employed for this task to identify the asbestos structures. In general, the TEM method can positively identify asbestos particulates of specific dimensions. This method differs from the less expensive PCM technique in that PCM counts all particulates (asbestos or other dust) that meet certain dimension criteria and appear to be "asbestiform" based on visual observation under an optical microscope. The TEM technique, which has much higher magnification, positively confirms that the material is asbestos using electron diffraction (ED) and energy dispersive X-ray analysis (EDXA). The TEM method can also classify what are known as phase contract microscopy equivalent structures (PCME). Structures identified with the PCME technique follow the same dimensional criteria as the PCM method; however, the structures are positively identified using ED and EDXA. The PCME structure counts are pertinent because most of the historical health effect studies for asbestos exposure are based on PCM counts. Table 5-1 displays the asbestos structure counts from the 12 residential soil samples utilizing the counting rules for ISO Method 10312 TEM, PCME, and the Protocol structures which were all analyzed by a TEM instrument. Protocol asbestos structures are those defined by Dr. Berman with distinct dimensional criteria and are different from the ISO Method 10312 or PCME definition.

Interpretation of this data and the RP sample data is detailed the preliminary risk assessment report submitted to the EPA by Dr. Berman (Berman 2004). The data obtained from the glove box analysis was not reviewed in the report but may be utilized by the EPA for future risk assessment decisions.

5.2 ASBESTOS AIR SAMPLING

5.2.1 Residential Air Sampling

Residential air sampling was conducted by PBS at 22 residences at the site to evaluate the potential for asbestos from ACM in site soils to impact the air quality inside the homes. According to the SAP, the project design included air sampling from inside and outside of each residence simultaneously to evaluate the degree to which indoor airborne concentrations may be uniquely attributable to secondary sources, including tracked in soils in the residence (Berman 2003c).

The RP collected samples over three weeks with approximately six to eight residences sampled each week. The START-2 collected split samples at two residences each week. In addition to the 46 indoor/outdoor air samples collected at the 22 residences[1] by PBS and the 12 split samples collected by the START-2, three background samples were collected each week by PBS on a hillside south of the site. Each air sample was collected over a three-day period for approximately 8 hours per day at a flow rate of 2 liters per minute (l/min). The low volume personal sample pumps were erected inside and outside each residence with the sample cassette raised on a stand to approximately 1.5 meters. The sample cassettes were collected, sealed, and stored in a locked compartment inside the PST MCP each night during the three-day sampling period. Based on the flow rate and the sample period, each sample was expected to have between 2,500 and 3,000 liters of air drawn through them.

5.2.2 Residential Air Sampling Analytical Results

Samples collected by both PBS and the START-2 were analyzed by the ISO Method 10312 TEM method for the determination of asbestos content in the residential air samples. The analytical results from the 46 RP-collected samples at 22 residences and nine background samples were interpreted by Dr. Berman and are included in the *Preliminary Air Sampling Results for the North Ridge Estates Site* report

[1] Sampling at one residence was repeated so that two additional air samples were collected.

dated November 2003 (Berman 2003c). The review notes that the highest number of asbestos structures detected in any of the air samples was two. In addition, 46 of the 55 air samples collected by PBS had no asbestos structures identified in the sample results.

Based on this set of analytical data, there appeared to be no statistically significant difference between samples collected inside or outside of each residence. The ISO Method 10312 employs the Poisson distribution when interpreting data, which means that structure counts observed on different samples are compared statistically. This statistical interpretation indicates that there is no statistical difference between air samples that contain from zero to three structures. Thus, the air samples collected for the residential sampling are not distinguishable from background air samples.

The 12 split air samples collected by the START-2 had structure counts similar to those discussed in the RP report with no structures detected in any of the 12 air samples (Table 5-2). The property location identifiers for each of the six properties the START-2 collected split residential air samples are indicated in Table 5-2 and displayed on Figure 5-2.

5.2.3 START-2 Ambient Air Sampling Network

In addition to collecting split residential indoor and outdoor air samples, the EPA tasked the START-2 to conduct ambient air sampling at the site to assess general levels of airborne asbestos particles over several weeks in the fall of 2003 and the spring of 2004. This was accomplished by utilizing a set of six high volume air samplers to create a site air sampling network. The high volume samplers were set at a flow rate of approximately 10 l/min and operated for five hours to capture a volume of over 3,000 liters each day. The samplers, labeled Aa through Ff, were deployed at the six locations shown on Figure 5-2, with the southernmost location (sample location Cc) designated as the background sampler. Since these high volume sample pumps could not operate on battery power, several residents provided access to their power outlets and utility cords were run approximately 50 to 150 feet to the sample pumps. Samples were collected over the course of 13 days between August 20, 2003 and September 23, 2003 and then for another two days from April 28 to 29, 2004.

The START-2 collected a total of 90 air samples from the air sampling network and submitted them for TEM analysis by the Modified EPA-II Method. This method is similar to the Asbestos Hazard Emergency Response Act (AHERA) clearance test conducted in buildings upon completion of an abatement project. Although the method does not utilize the same counting rules utilized by the ISO Method 10312, the AHERA method does provide a regulatory benchmark of 0.01 f/cc that must be met before clearance is achieved. Since the method is conducted with TEM technology, it positively identifies asbestos structures. The asbestos structure count and resultant asbestos concentration in f/cc for all 90 air samples collected from the air sampling network is provided in Table 5-3. Most of the ambient air samples had no asbestos structures counted. The highest concentration of asbestos fibers was detected in sample 04040205, which was collected from sample location Ee on April 28, 2003, at 0.004 f/cc (Table 5-3). Based on this data, it is likely that the ambient levels of asbestos dust do not pose an immediate threat to human health at the site, although this data may be further evaluated by the EPA and other parties.

5.3 LEAD IN SOIL ASSESSMENT, DELINEATION, AND REMOVAL

A subordinate concern to the ACM contamination at the site is the presence of lead in the soils potentially resulting from lead-based paint that coated most of the buildings and subsequently leached into the soils through either the demolition activities or exposure to the elements. Building debris with light green-colored paint has been observed at the site, primarily on the MBK lots that were not part of the 2003 removal. Although other sources of lead contamination may exist at the site (e.g., car batteries, lead pipe, solder, etc.), none of these items have been observed in the surface soils.

The START-2 conducted soil sampling and analytical screening for lead from July 28, 2003, through August 1, 2003, to assess the extent of lead contamination in the site soils. The RP was not involved with this assessment. A biased sampling approach was employed by the team to identify potentially contaminated areas. The START-2 collected soil samples from 150 locations at a total of 35 properties targeting areas of visual soil staining, exposed soils, and where debris was visible (Figure 5-3). Thirteen duplicate split samples were collected and screened as well. Screening results of all the samples collected as part of this effort are provided in Appendix C.

Grab samples from each property were collected using a clean, stainless steel spoon from the top 2 inches of soil at each location. The samples were homogenized in aluminum pie pans and subsequently placed in sampling cups for screening with a Niton® XRF spectrometer. Field screening with the XRF was performed on site by the START-2 following the manufacturer’s instructions and *Quality Assurance Technical Information Bulletin-Field Portable X-Ray Fluorescence* (EPA 1991) guidance.

Approximately 12% of the samples field screened by the XRF were submitted to NVL, in Seattle, Washington, for confirmation analysis by EPA Method 7420 for lead. Based on the XRF results, 19 samples ranging from non-detect to the highest detection (943.2 mg/kg) were prepared for submittal to a commercial laboratory (Table 5-4). Confirmation analytical results from NVL indicated that only one sample exceeded the EPA Region 9 Preliminary Remedial Goal (PRG) benchmark for lead in residential soil of 400 milligrams per kilogram (mg/kg). Sample 0307123, collected from a discolored and bare area on the MBK-C property, contained 1,500 mg/kg lead. The XRF data had indicated that two samples, 03070123 and 03070129, exceeded the PRG benchmark with concentrations of 943 mg/kg and 444 mg/kg, respectively. Laboratory data indicated that sample 03070129 had a lead concentration of 320 mg/kg. The analytical results of the samples submitted to a commercial laboratory are provided on Table 5-4.

After the 2003/2004 winter snow had thawed, the START-2 returned to the site to delineate the extent of lead-contaminated soils identified in the initial assessment. Interpretation of the XRF screening data indicated that the contaminated area was localized since the samples collected for the lead assessment on the MBK-C property and all five samples collected on adjoining lot Q to the south had less than 50 mg/kg lead according to XRF analysis (Figure 5-3, Appendix D).

To delineate the extent of contamination on the MBK-C property, a concentrated soil sampling grid was established by centering on the contaminated area with grid nodes spaced 15 feet apart. Surface soil samples were collected from 49 locations over an area measuring 90 feet by 90 feet (Figure 5-4). Samples were collected in the same manner as described for the assessment sampling. The XRF was used to conduct screening analysis on all 49 samples, seven of the 49 samples were submitted to NVL for confirmation analysis.

In-situ screening of soils at 18 inches bgs, where natural rock was encountered, was conducted at three additional locations outside of the grid near the discolored soils. In all of three of these locations, the XRF data indicated the contamination was near background levels.

Analytical results indicated that three samples (samples 04040125, 04040131, and 04040132), had elevated levels of lead ranging from 610 mg/kg to 8,200 mg/kg (Table 5-5). The corresponding XRF values for these samples ranged from 306 mg/kg to 4,710 mg/kg (Table 5-5). The three samples with lead contamination exceeding the EPA Region 9 PRGs were collected from adjacent grid points E3, E4, and D4. Based on the distance between these three points, the maximum area of contamination was determined to be approximately 25 feet in diameter (Figure 5-4). None of the samples from the adjacent residential property to the south (A1 to C7) had elevated levels of lead contamination (Appendix D, Figure 5-4).

Based on the results of the delineation of lead-contaminated soils conducted by the START-2, the RP agreed to conduct a removal of the contaminated material. RMCat was subcontracted by the RP to excavate the soils with confirmation and disposal sampling performed by PBS. On October 6, 2004, the soils were excavated to a depth ranging from 1.5 to 2 feet in a triangular area measuring 28 feet by 30 feet by 40 feet. Because the RP had difficulty obtaining a container for the excavated soils, the material was placed atop plastic sheeting that was laid on a level area on the MBK-C property. Approximately 26.5 tons of material were removed and covered with additional plastic sheeting (Appendix A). On October 7, 2004, four confirmation samples were collected by PBS from the base and sides of the excavation zone and submitted for total lead analysis to Environmental Services Laboratory (ESL) in Portland, Oregon, on October 8, 2004.

According to PBS, the ESL analytical report indicated the total lead results for the four, at-depth confirmation samples were 56 mg/kg, 170 mg/kg, 290 mg/kg, and 410 mg/kg. Although one sample was slightly higher than the PRG benchmark of 400 mg/kg, the removal was deemed complete by the EPA because the sample was collected at depth and the area had subsequently been covered with 2 feet of soil, preventing exposure.

The excavated material was disposed as lead-contaminated soil at the Klamath County landfill on October 12, 2004 (PBS 2004). A composite sample of the excavated material had passed the TCLP lead test with a result of 0.50 milligrams per liter (mg/L).

5.4 ACTIVITY-BASED SAMPLING

Another method to assess the exposure and risk associated with the asbestos contained in the site soils is to conduct specific activities and measure levels of airborne asbestos in the breathing space and ambient air. Activity-based sampling (also referred to as simulation sampling) measures the level of human exposure to contaminants that may result from performing specific tasks over a period of time and under specific atmospheric conditions. Those measurements and conditions are then extrapolated and modeled via dust emission models to calculate the risk associated with performing those activities. This type of sampling is being conducted at numerous sites by the EPA.

The EPA and the START-2 performed activity-based sampling at the MBK/NRE site the week of July 18, 2004. Three activities that had varying levels of soil disturbance were performed at the site to gauge the impact on airborne asbestos levels in the breathing space. The three activities conducted at the site included weed-trimming with an electric trimmer, tilling soil with a gas-powered rototiller, and a child playing in the dirt. The activities for this work were chosen after evaluating input from several regulatory agencies and from residents at a community meeting. Samples were collected utilizing personal sampling pumps worn around the waistline by personnel with the sample inlet at chest height. A particulate dust monitor was also worn to measure the total airborne dust concentration

The EPA Region 10 mobile laboratory was utilized at the site to analyze the samples via the asbestos PCM method to ensure the samples were not overloaded. Overloading occurs when too much particulate matter is collected on the filter and it cannot be analyzed. Based on the analysis of the samples by the on-site laboratory, the sample period and flow rate of the pumps was adjusted to provide samples that can be analyzed.

The sampling was conducted on three MBK lots, MBK-A, MBK-B, and MBK-C, where surficial removal of ACM had not occurred under the 2003 removal, although some cleanup was done in 2002 by the RP prior to the EPA's involvement. This area was chosen to conduct the sampling because there are no residents living on these properties and the concentration of ACM in the surface soils are believed to reflect the conditions at the site before the RA was conducted.

5.4.1 Child Play Activity

There are many children of various ages living in the NRE residential development and both the residents and regulatory agencies advocated the development of a scenario to measure the children's exposure to airborne asbestos while playing in the site soil. The area selected contained various types of ACM including floor tile, roofing shingles, and CAB. This activity was conducted within an area of approximately 25 square feet on the MBK-A property. All air samples were collected on July 20, 2004.

As detailed in the START-2 SSSP for activity-based sampling (E & E 2004), the START-2 donned the appropriate respiratory and dermal PPE and wore two personal sampling pumps while conducting the activity. The task called for filling and emptying a bucket every five minutes and repeating three times before turning a quarter turn and starting the set of filling/emptying the bucket three times again. This activity was to be conducted for a period of two hours. While conducting the first sampling activity, it became apparent that the dust generated from dumping the soil from the bucket to the ground would overload the air filters before the two hour period was completed. The sampling was reduced to 70 minutes for analysis by the on-site laboratory via the PCM method. Analysis of the samples indicated they were both overloaded with dust.

Based on these results, the sample time was adjusted to 40 minutes at two flow rates, 1.5 l/min and 2.0 l/min. Personnel conducting the activity then filled/emptied the bucket one time for 5 minutes, instead of three times for 15 minutes, before turning a quarter turn and repeating. In this manner, the activity cycle was repeated eight times so that the subject made two complete revolutions to finish the task. The task was then conducted two more times with new filters. The on-site mobile laboratory analyzed six of the filter samples, and the four samples that did not appear to be overloaded (samples 04070002, 04070004, 04070005, and 04070006), were submitted to Lab/Cor for TEM analysis.

Of the four samples submitted to the laboratory, two were rejected (samples 04070002 and 04070005) by the laboratory as they were not suitable for TEM analysis. The remaining two samples were analyzed via the ISO Method 10312, providing structure concentrations and counts. Sample 04070004 had a reported concentration for PCME structures of 0.047 structures per cubic centimeter (s/cc) and sample 04070006 had a reported concentration for PCME structures of 0.058 s/cc. Analytical results of these samples are provided on Table 5-6.

The asbestos concentrations identified in these two samples are the highest of any air samples collected by the START-2 during the activity-based sampling. This is primarily due to the height of the filter inlets being closer to the ground as the subject was sitting and the aggressive agitation of the soils while performing this task.

5.4.2 Weed-Trimming Activity

The second activity conducted by the EPA and the START-2 personnel was weed trimming utilizing an electric trimmer in an area straddling the MBK-B and MBK-C properties measuring approximately 50 feet by 100 feet. Again, the area soils contained a mixture of ACM which had not been removed during the 2003 RA. Personnel wore respiratory and dermal protection while conducting this activity.

The study area was divided into nine equal grids in which the weed trimming was performed by facing one direction for a specified time period before moving to the next grid and turning a quarter turn before continuing the activity. A test run was conducted to determine how long the activity could be performed before the air filters would be overloaded with dust. Based on the analysis by the on-site mobile laboratory, the activity period was set at five minutes within each of the nine grids with a two-minute interval that allowed for setting up in the next grid and facing a new direction. To collect one sample, the subject completed the weed trimming activity in all of the nine grids. As with the child play activity, the subject wore two personal sample pumps and a dust monitor data collector. Both sample pumps were set initially at 1.5 l/min so that a backup sample was collected in case of a pump fault.

Three rounds of weed trimming air sampling were conducted on July 21, 2004, not including the initial test run. Of the six air samples collected for this activity, the on-site laboratory indicated that four samples (samples 04070012, 04070013, 04070014, and 04070015) were acceptable for submittal to a commercial laboratory.

Three of the four samples were accepted by Lab/Cor for TEM analysis. Sample 04070013 was not suitable for TEM analysis. The asbestos structure PCME concentrations for the three samples (samples 04070012, 04070014, and 04070015) indicated the levels were lower than the child play activity at 0.012 s/cc, 0.018 s/cc, and 0.019 s/cc. The lower concentrations of asbestos fibers in these samples are likely due to the sample inlet being at chest height while standing and the less aggressive agitation of the soils by weed trimming. Analytical results of these samples are provided on Table 5-6.

5.4.3 Soil Tilling

The final activity-based sampling activity completed by the EPA and the START-2 was to till soil utilizing a gas-powered rototiller (Appendix A). The tilling activity was conducted on July 22, 2004, in the same study area utilized for the weed trimming activity the previous day. Again, as detailed in the START-2 SSSP (E & E 2004), the area was subdivided into nine grids (laid out in a rectangle of three grids by three grids) so that the activity could be conducted facing four different directions at timed intervals. The subject wore two sample pumps set at a flow rate of 1.5 l/min and a dust particulate monitor. As with the weed trimming activity, the sample inlets were placed at chest height on a standing adult.

Since the tilling activity would require a great deal of physical effort to conduct while wearing respiratory and dermal protection, the length of time conducting the activity in each grid was reduced to three minutes. The interval between tilling and moving to the next grid was set at three minutes to allow time for the operator to move the equipment, turn one quarter turn, and provide a short rest. Thus, the entire soil tilling activity required 54 minutes to complete with six minutes spent in each of the nine grids.

The PCM analysis conducted by the on-site EPA mobile laboratory indicated that samples 04070017, 04070018, 04070019, and 04070021 could be submitted for analysis, even though some of these samples were close to being overloaded with dust.

The commercial laboratory rejected filter samples 04070017 and 04070021 as the laboratory determined the samples were overloaded and could not be properly analyzed to provide a credible result via the TEM method. The remaining two samples, 04070018 and 04070019, had PCME concentrations of 0.026 s/cc and 0.021 s/cc. Analytical results of these samples are provided on Table 5-6.

These results were lower than the child play activity which is likely due to the height of the sample inlet. However, the agitation of the soil during the tilling was high compared to the weed trimming activity. As a result, the asbestos PCME concentrations for the soil tilling activity are higher than the weed trimming activity.

5.4.4 Soil Sample Collection from Activity-Based Study Areas

On July 19, 2004, soil samples were collected from both areas where the activity-based sampling occurred. As described in the START-2 SSSP, one grab sample was collected from the child play area and two composite samples were collected from the nine grids in the weed-trimming and soil-tilling study area (E & E 2004). Soil samples were collected from the upper 2 inches of soil in a square template with 8-inch sides.

The samples were collected for processing through the elutriation method and then submitted for TEM analysis. The data garnered from the soil samples and its relationship to the activity-based air samples will be included in a report to be prepared by the RP.

5.4.5 Background Samples

Upwind samples were collected each day of the sampling activity and submitted for TEM analysis. A high volume sampling pump was deployed approximately 100 feet upwind of the sample area and set at a flow rate of 10 l/min. Samples 04070023, 04070024, and 04070025, collected each day of the activity-based sampling, had no PCME fibers detected. Analytical results of these samples are provided on Table 5-6.

5.4.6 Summary of Activity-Based Sampling

Three activity-based air sampling tasks were performed on three days in late July 2004. Child play, weed trimming, and soil tilling were chosen as appropriate tasks which could be administered at the site without disrupting the normal routine of residents. These activities were selected as they are likely to be carried out by residents at the site. Analytical results suggest the highest exposure to fibers occurred from the child play activity. This was likely a result of the lower height of the sample inlet due to the subject sitting and the high level of soil agitation caused by dumping the soil out of a bucket.

For both the weed-trimming and soil tilling activities, exposure to dust visually appeared to be lower when there was a breeze as the dust would generally blow away from the subject before reaching the breathing space. When there was no breeze, the dust slowly rose around the subject’s breathing space. During both the weed trimming and soil tilling activities, there were periods with and without noticeable wind. A meteorological station was erected near the study area to measure wind direction, wind speed, temperature, and barometric pressure. The meteorological data, combined with the dust particulate data and the soil sample results, will be utilized by the EPA and the RP in estimating the exposure and risk associated with each of these activities.

Table 5-1

SOIL SAMPLE RESULTS–ASBESTOS STRUCTURE COUNTS
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

EPA Sample Number	Property Location[a]	ISO TEM Analysis (>5 microns)		PCME Analysis[b]		Protocol Analysis[c]	
		Elutriator Method	Glove Box Method	Elutriator Method	Glove Box Method	Elutriator Method	Glove Box Method
03090500	P	0	**1**	0	**1**	0	**1**
03090503	A	**1**	**2**	0	**2**	0	NA
03090504	Q	**6**	**18**	**2**	**8**	**4**	**4**
03090505	H	0	0	0	0	0	0
03090506	B	0	**2**	0	**1**	0	**1**
03090508	F	0	**2**	0	0	0	NA
03090509	E	0	**13**	0	**2**	0	NA
03090512	R	**1**	**11**	0	**4**	0	NA
03090513	X	0	**1**	0	0	0	0
03090514	L	0	**3**	0	**3**	0	NA
03090518	Y	**1**	0	**1**	0	0	NA
03090519	S	**8**	**24**	**1**	**8**	**1**	NA

[a] Refer to Figure 5-1 for location identifier.
[b] PCME structures are longer than 5 microns with an aspect ratio greater than 3 to 1.
[c] Protocol structures are generally longer than 5 microns and thinner than 0.5 microns.

Note: Bold text indicates that asbestos structures were identified. All samples analyzed by TEM. TEM structures column follow ISO 10312 counting rules.
Key:

EPA = United States Environmental Protection Agency.
ISO = International Organization for Standardization.
NA = Not applicable. The protocol reporting was not completed by the laboratory for this sample.
PCME = Phase contrast microscopy equivalent.
TEM = Transmission electron microscopy.

Table 5-2

INDOOR/OUTDOOR RESIDENTIAL AIR SAMPLING RESULTS
ISO 10312 TEM
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

Sample Location[a]	Date	EPA Sample Number	Asbestos Structure Count	
			EPA Sample	RP Sample
Outside (G)	8/19-21/2003	03080010	0	0
Indoor (G)	8/19-21/2003	03080011	0	1
Outside (B)	8/19-21/2003	03080012	0	0
Indoor (B)	8/19-21/2003	03080013	0	0
Indoor (L)	8/26-28/2003	03080042	0	0
Outside (L)	8/26-28/2003	03080043	0	0
Indoor (M)	8/26/28/2003	03080044	0	0
Outside (M)	8/26-28/2003	03080045	NA	0
Indoor (X)	9/3-5/2003	03090019	0	0
Outside (X)	9/3-5/2003	03090020	0	0
Indoor (Z)	9/3-5/2003	03090021	0	0
Outside (Z)	9/3-5/2003	03090022	0	0

[a] Property location is identified by letter on Figure 5-2.

Key:

NA = Not applicable.
U = Analyte not detected below specified detection limit.

Table 5-3

AMBIENT AIR SAMPLING (AIR MONITORING NETWORK)
MODIFIED EPA-II ANALYSIS
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

Sample Location[a]	Sample Date	Sample Number	Asbestos Concentration (Structure/cc)	Asbestos Structure Count
Aa	8/20/03	03080014	0.001 U	0
	8/22/03	03080018	0.001 U	0
	8/26/03	03080029	0.002 U	0
	8/27/03	03080035	0.001 U	0
	8/28/03	03080036	0.001 U	0
	9/3/03	03090001	0.001 U	0
	9/4/03	03090007	0.001 U	0
	9/5/03	03090013	0.001 U	0
	9/17/03	03090025	0.001 U	0
	9/18/03	03090031	0.001 U	0
	9/19/03	03090038	0.001 U	0
	9/22/03	03090050	0.001 U	0
	9/23/03	03090056	**0.002**	**2**
	4/28/04	04040201	0.001 U	0
	4/29/04	04040207	**0.001**	**1**
Bb	8/20/03	03080015	0.001 U	0
	8/22/03	03080019	0.002 U	0
	8/26/03	03080024	**0.003**	**2**
	8/27/03	03080030	0.002 U	0
	8/28/03	03080037	0.001 U	0
	9/3/03	03090002	0.001 U	0
	9/4/03	03090008	0.001 U	0
	9/5/03	03090014	0.001 U	0
	9/17/03	03090026	0.001 U	0
	9/18/03	03090036	0.001 U	0
	9/19/03	03090044	0.001 U	0

Table 5-3

**AMBIENT AIR SAMPLING (AIR MONITORING NETWORK)
MODIFIED EPA-II ANALYSIS
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON**

Sample Location[a]	Sample Date	Sample Number	Asbestos Concentration (Structure/cc)	Asbestos Structure Count
Bb (cont'd)	9/22/03	03090055	0.001 U	0
	9/23/03	03090061	0.001 U	0
	4/28/03	04040202	**0.001**	**2**
	4/29/03	04040208	0.001 U	0
Cc	8/20/03	03080016	0.001 U	0
	8/22/03	03080020	0.002 U	0
	8/26/03	03080026	0.002 U	0
	8/27/03	03080032	0.002 U	0
	8/28/03	03080039	0.001 U	0
	9/3/03	03090003	0.001 U	0
	9/4/03	03090010	**0.001**	**1**
	9/5/03	03090016	0.001 U	0
	9/17/03	03090028	0.001 U	0
	9/18/03	03090033	0.001 U	0
	9/19/03	03090040	0.001 U	0
	9/22/03	03090052	**0.001**	**1**
	9/23/03	03090058	0.001 U	0
	4/28/03	04040204	**0.001**	**1**
	4/29/03	04040210	0.001 U	0
Dd	8/20/03	03080017	0.001 U	0
	8/22/03	03080021	0.002 U	0
	8/26/03	03080028	0.002 U	0
	8/27/03	03080034	0.002 U	0
	8/28/03	03080041	0.001 U	0
	9/3/03	03090006	**0.002**	**3**
	9/4/03	03090012	0.001 U	0

Table 5-3

AMBIENT AIR SAMPLING (AIR MONITORING NETWORK)
MODIFIED EPA-II ANALYSIS
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

Sample Location[a]	Sample Date	Sample Number	Asbestos Concentration (Structure/cc)	Asbestos Structure Count
Dd (cont'd)	9/5/03	03090018	0.001 U	0
	9/17/03	03090030	0.001 U	0
	9/18/03	03090035	0.001 U	0
	9/19/03	03090042	0.001 U	0
	9/22/03	03090054	**0.001**	**1**
	9/23/03	03090060	**0.001**	**1**
	4/28/03	04040203	0.001 U	0
	4/29/03	04040209	0.001 U	0
Ee	8/26/03	03080025	0.001 U	0
	8/27/03	03080031	0.002 U	0
	8/28/03	03080038	0.001 U	0
	9/3/03	03090004	0.001 U	0
	9/4/03	03090009	0.001 U	0
	9/5/03	03090015	0.001 U	0
	9/17/03	03090027	0.001 U	0
	9/18/03	03090032	0.001 U	0
	9/19/03	03090039	0.001 U	0
	9/22/03	03090051	**0.001**	**1**
	9/23/03	03090059	**0.001**	**1**
	4/28/03	04040205	**0.004**	**5**
	4/29/03	04040211	**0.001**	**1**
Ff	8/26/03	03080027	**0.002**	**1**
	8/27/03	03080033	0.002 U	0
	8/28/03	03080040	0.001 U	0
	9/3/03	03090005	0.001 U	0
	9/4/03	03090011	**0.001**	**1**

Table 5-3

AMBIENT AIR SAMPLING (AIR MONITORING NETWORK)
MODIFIED EPA-II ANALYSIS
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

Sample Location[a]	Sample Date	Sample Number	Asbestos Concentration (Structure/cc)	Asbestos Structure Count
Ff (cont'd)	9/5/03	03090017	0.001 U	0
	9/17/03	03090029	0.001 U	0
	9/18/03	03090034	0.001 U	0
	9/19/03	03090041	0.001 U	0
	9/22/03	03090053	0.001 U	0
	9/23/03	03090057	**0.001**	**1**
	4/28/03	04040206	0.001 U	0
	4/29/03	04040212	0.001 U	0

Note: Bold text indicates that asbestos structures were identified.

Key:

AHERA = Asbestos Hazard Emergency Response Act.
EPA = United States Environmental Protection Agency.
structure/cc = Structure per cubic centimeter.
U = Analyte not detected above specified detection limit.

Table 5-5

XRF LEAD AND LABORATORY CONFIRMATION SAMPLE RESULTS COMPARISON–MAY 2004 MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION RESPONSIBLE PARTY REMOVAL ACTION REPORT KLAMATH FALLS, OREGON

Sample ID	Grid Location*	Analytical Result (mg/kg)	XRF Result (mg/kg)
04040103	A3	33 U	28 U
04040119	C5	33 U	23 U
04040125	D4	**8,200**	**4,710**
04040131	E3	**1,500**	**367**
04040132	E4	**610**	**306**
04040141	F6	32 U	24 U
04040144	G2	**93**	**73.8**
EPA PRG		400	

* Sample point can be located by referring to Figure 5-4.

Note: Bold texts indicates analyte detected. Shaded boxes indicate a result above the PRG.

Key:

EPA = United States Environmental Protection Agency.
mg/kg = Milligrams per kilogram.
PRG = Preliminary Remediation Goal.
U = Analyte not detected above detection limit.
XRF = X-ray fluorescence.

Table 5-6

ACTIVITY-BASED AIR SAMPLING RESULTS BY TEM–JULY 2004
MBK PARTNERSHIP/NORTH RIDGE ESTATES SUBDIVISION
RESPONSIBLE PARTY REMOVAL ACTION REPORT
KLAMATH FALLS, OREGON

Activity	Date	EPA Sample Number	PCME Structure Count	PCME Asbestos Concentration (structure/cc)
Child Play	7/20/2004	04070004	7	0.047
Child Play	7/20/2004	04070006	4	0.058
Weed Trimming	7/21/2004	04070012	4	0.012
Weed Trimming	7/21/2004	04070014	2	0.018
Weed Trimming	7/21/2004	04070015	5	0.019
Soil Tilling	7/22/2004	04070018	3	0.026
Soil Tilling	7/22/2004	04070019	2	0.021
Background	7/20/2004	04070023	0	0.006 U
Background	7/21/2004	04070024	0	0.005 U
Background	7/22/2004	04070025	0	0.007 U
Media Blank	7/22/2004	04070026	0	NA

Key:

NA = No concentration calculated. No structures were counted.
PCME = Phase Contrast Microscopy Equivalent.
structure/cc = Structure per cubic centimeter.
U = Analyte not detected above specified detection limit.

6. COMMUNITY RELATIONS

Communications with the public, community officials, and state agency representatives occurred throughout the duration of the removal activity at several community meetings conducted in Klamath Falls, Oregon. A reporter for the *Klamath Falls Herald and News* regularly interviewed the EPA OSC and wrote several articles about the actions at the site. Media coverage expanded to Portland, Oregon, with an investigative report conducted by the NBC television network affiliate and a front page story written by *The Oregonian*. The ODEQ and residents also were interviewed for several of the articles as well as for the television report. The EPA and the ODEQ both have established Web sites to share information about the site with the general public. The Web site created for the EPA project is located at http://yosemite.epa.gov/r10/cleanup.nsf/sites/NRE.

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7. HEALTH AND SAFETY

The EPA OSC maintained ultimate authority and responsibility for site safety during the RA. The USCG PST assisted the EPA in maintaining site safety. The START-2 and the RP consultants and contractors developed and implemented site-specific safety plans tailored to their scope of work.

Safety meetings to discuss chemical and physical hazards associated with the day's activities were conducted each morning before work began. Personnel from the EPA, the PST, the START-2, and the RP contractors attended the meetings.

Protective clothing, including a hard hat, a protective suit, and steel-toed boots, were required for conducting work that involved soil disturbance. Physical hazards at the site included heavy equipment operation, noise, and slips, trips, and falls. Respiratory hazards included airborne asbestos and lead caused by aggressive agitation of the soils. The major concern was inhalation and ingestion of particulate matter contaminated with these elements. To control the dust level, water was sprayed during excavation activities. To minimize the exposure of the on-site workers to a potential release of airborne contaminants, personnel were required to wear Level C PPE, which included a respirator, while conducting removal activities (e.g., excavation, activity-based sampling, etc.) that had the potential to greatly increase airborne particulates.

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intentionally left blank.

8. SUMMARY OF REMOVAL ACTION AND STREAMLINED RISK ASSESSMENT

In May 2003, MBK entered into an AOC with the EPA to conduct an RA and SRA at the North Ridge Estates subdivision located near Klamath Falls, Oregon. The MBK/NRE site formally was home to a military base. Demolition of the military base buildings likely resulted in the ACM and lead found in site soils. ACM in site soils posed a potential threat to human health as site disturbance could result in unsafe levels of airborne asbestos. The AOC required the RP to conduct a removal of ACM from the surficial soil, map the location of the buried asbestos-wrapped steam line from the base, and stabilize the debris burial piles on the site.

The surficial removal of ACM began in June 2003 with approximately 7 tons of ACM removed from the site by October 2003. In April 2004, ACM was once again observed in the site surface soils where the removal had been conducted the previous year. Based on visual observations by the EPA and the START-2, the ACM in the site soil appeared to be less concentrated than it had been prior to the 2003 RA. Water erosion and ground heaving resulting from the seasonal freeze/thaw cycle exposed ACM which had previously been covered by shallow soil. The EPA is currently assessing additional alternatives to remediate the site soil.

In addition to the surficial ACM removal, a survey crew located thousands of feet of buried asbestos-insulated steam pipe at the site in July 2003 utilizing a sensitive magnetometer. When the military base had been in operation, the steam pipe conveyed heat to most of the buildings from a central coal-powered boiler on the north side of the base. The location of the pipe was verified by carefully excavating overlying soil where the survey crew marked the route of the buried line. It is unknown if all the buried pipe has been located because several breaks in the steam line from residential construction and capital improvements have made it difficult to verify with the magnetometer. A map of the known locations has been completed by the RP.

Stabilization of buried piles of ACM identified during the 2003 removal were addressed by filling in the open spaces in the piles with soil and mitigating the impact of surface water erosion by covering the soil with synthetic fabric and rock and utilizing water diversion techniques. These measures were not intended to address the long-term stabilization requirements. Those issues will likely be addressed under future remedial activities at the site.

The START-2 conducted soil sampling at the site to identify areas with lead contamination resulting from the lead-based paint used on the former military base buildings. The team was able to delineate a small area at the site, approximately 25 feet in diameter and 18 inches deep, which contained levels of lead above health-based benchmarks. The contamination was identified on an undeveloped RP-owned lot. Based on the START-2 field screening data obtained during the sampling event, the RP agreed to excavate and properly dispose of the lead-contaminated soil. A total of 26.5 tons of lead-contaminated soil was removed in October 2004.

The AOC also required the completion of an SRA to evaluate the release of asbestos fibers from ACM in the site soil and assess its impact on human health. Data was gathered for the SRA by conducting soil and air sampling for asbestos at the site. There is no established regulatory level which specifies unsafe levels of asbestos in soil. In addition, there is no EPA-approved method for relating asbestos concentrations in soil to unsafe levels of respirable asbestos. The RP hired a consultant that developed a method to predict airborne asbestos exposures based on bulk soil measurements. The method states that the data obtained from this processing and analysis of soil samples can be incorporated into published dust emission and dispersion models to predict airborne asbestos exposures and their associated risk. Soil and air sampling were conducted concurrently with the RA at the site throughout the summer and fall of 2003. Soil samples were collected for asbestos analysis from 22 residential properties and from localized areas of concentrated ACM at the site. Air samples were collected inside and outside of 22 residences for asbestos analysis as well. Analytical data for samples collected at the site have been incorporated into the SRA prepared by the RP. The SRA, currently under review by the EPA, indicates that the risks related to asbestos at the site do not pose an immediate threat to the residents but further study is recommended to gather more data and conduct a complete site characterization to facilitate making important risk management decisions in the future. The SRA states that to develop a permanent remedy for the site, additional, focused soil sampling will need to be conducted to define the areal and vertical distribution of the ACM. This data may then be utilized to support more accurate exposure and risk estimates.

The EPA is assessing the most appropriate actions to take at the site to be certain that residents are living in a safe environment. A remedial investigation is expected to proceed in the spring of 2005 to provide additional resources in addressing the concerns to human health at the site.

9. REFERENCES

Berman, D. Wayne, Ph.D., 2004, *Soil Sampling Results and Preliminary Risk Assessment for the North Ridge Estates Site*, Klamath Falls, Oregon, submitted to the United States Environmental Protection Agency, Portland, Oregon.

______, 2003a, *Sampling and Analysis Plan for a Fast-Track Sampling Program at the North Ridge Estates Site*, Klamath Falls, Oregon, submitted to the United States Environmental Protection Agency, Portland, Oregon.

______, 2003b, *Preliminary Sampling and Analysis Plan for Sampling of Initial Conditions at the North Ridge Estates Site*, Klamath Falls, Oregon, submitted to the United States Environmental Protection Agency, Portland, Oregon.

______, 2003c, *Preliminary Air Sampling Results for the North Ridge Estates Site*, Klamath Falls, Oregon, submitted to the United States Environmental Protection Agency, Portland, Oregon.

Berman, D. Wayne, Ph.D. and A.J. Kolk, May 23, 2000, *Draft: Modified Elutriator Method for the Determination of Asbestos in Soils and Bulk Materials, Revision 1*, submitted to the United States Environmental Protection Agency, Region 8.

______, 1997, *Superfund Method for the Determination of Releasable Asbestos in Soils and Bulk Materials*, submitted to the United States Environmental Protection Agency.

Branowski, Emil, 1945, photograph taken by patient at military base.

Ecology and Environment, Inc. (E & E), July 2004, *MBK Partnership/North Ridge Estates Site-Specific Sampling Plan for Activity-Based Sampling*, prepared for the United States Environmental Protection Agency, Contract No. 68-S0-01-01, Seattle, Washington.

———, July 2003a, *MBK Partnership/North Ridge Estates Site-Specific Sampling Plan*, prepared for the United States Environmental Protection Agency, Contract No. 68-S0-01-01, Seattle, Washington.

———, January 2003b, *Generic Quality Assurance Project Plan for Removal Program Sampling*, prepared for the United States Environmental Protection Agency, Contract No. 68-S0-01-01, Seattle, Washington.

Federal Emergency Management Agency (FEMA), 1984, Flood Insurance Rate Map, Klamath County, Oregon (Unincorporated Areas), Community-Panel No. 410109 1065B.

Maptech, Inc. (Maptech), 2001, *Terrain Navigator 2001, Oregon*, Andover, Massachusetts.

Matthews, Richard, 1992, *Taking Care of Their Own: The Marine Barracks at Klamath Falls, Oregon, 1944-1946*, Oregon Historical Quarterly.

Messina, Frank, 1968, air specialist, Oregon Department of Environmental Quality, aerial photograph or former military base with structures still standing.

National Resources Conservation Service (NRCS), 1985, *Soil Survey of Klamath County, Oregon, Southern Part.*

Oregon Department of Environmental Quality (ODEQ), December 14, 2004, *North Ridge Estates*, http://www.deq.state.or.us/er/NorthRidge.htm.

______, 2002, Mutual Agreement and Order Memorandum, MBK Partnership, No. AQ/AB-ER-01-258A.

______, 2001, Notice of Noncompliance, MBK Partnership, AQ-ERB-01-7715.

Oregon Department of Human Services (ODHS), 2004, *North Ridge Estates Public Health Consultation -Final Release*, Klamath Falls, Oregon.

PBS Environmental and Engineering (PBS), November 2004a, *Burial Pile Stabilization Report, North Ridge Estates, Klamath Falls, Oregon*.

______, January 2004b, *Report of Surficial Removal and Burial Location Actions, North Ridge Estates, Klamath Falls, Oregon*.

______, June 2003, *Preliminary Assessment Report, North Ridge Estates, Klamath Falls, Oregon.*

The Oregon Map, January 7, 2004, Plat Maps for Klamath County, Oregon, accessed by the Internet at: http://www.ormap.org/maps/taxmaps/klam/t38sr09e/38s09e15a.pdf.

United States Army Corps of Engineers (USACE), 1993, DERP-FUDS Inventory Project Report (INPR) for Site No. F100R057000, Marine Recuperation Barracks, Klamath Falls, Oregon.

United States Environmental Protection Agency (EPA), February 2004, *Contract Laboratory Program Statement of Work for Inorganic Analyses*, EPA 540-F-04-001.

______, May 21, 2003a, *Administrative Order on Consent for Removal Action and Streamlined Risk Assessment, North Ridge Estates*, Klamath County, Oregon, Docket No. CERCLA-10-2003-0088.

______, May 21, 2003b, *Action Memorandum Regarding the Removal Action at the North Ridge Estates Asbestos Site*, Klamath County, Oregon, CERCLIS ID #ORN001002476.

______, 2003c, *Quality Assurance Project Plan for Air Monitoring for Asbestos in Soil Samples from North Ridge Estates*, prepared by the Office of Environmental Assessment, Seattle, Washington.

———, August 2000, *Guidance for the Data Quality Objectives Process* (EPA QA/G-4), EPA/600/R-96/055.

______, 1991, *Quality Assurance Technical Information Bulletin-Field Portable X-Ray Fluorescence*.

______, April 1990, *Quality Assurance/Quality Control Guidance for Removal Activities, Sampling QA/QC Plan and Data Validation Procedures, Interim Final*, EPA/540/G-90/004, OSWER Directive 9360.4-01.

______, 1979, Section 113 Compliance Order, Demolition Operation, certified mail to MBK Company, EPA File No. X79-08-14-113.

Western Regional Climate Center (WRCC), December 15, 2004, Division of Atmospheric Sciences, Desert Research Institute, accessed by the Internet at http://www.wrcc.dri.edu/.

This electronic version of the *MBK Partnership / North Ridge Estates Subdivision Responsible Party Removal Action Report* does not include Appendices A through D.