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HEALTH CONSULTATION

Final Release

North Ridge Estates
(a.k.a. Former Marine Recuperational Barracks)

T38S, Section 15, R9EWM
Northridge Drive, Hunters Ridge Road, Old Fort Road
Klamath Falls, Oregon 97603
Klamath County, Oregon

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Oregon Department of Human Services
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Agency for Toxic Substances and Disease Registry

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Purpose and Health Issues

The Oregon Department of Environmental Quality (ODEQ) contacted the Oregon Department of Human Services (ODHS) Superfund Health Investigation and Education (SHINE) program in May 2002 to help assess the health risks of exposure to fragments of asbestos-containing material (ACM). The ACM were scattered over approximately 50 acres in the North Ridge Estates residential subdivision, 3 miles north of the City of Klamath Falls in Klamath County. In the summer of 2002, more than 49 tons of the ACM fragments were removed from the surface of 30 lots in the subdivision [1, 2]. The ACM are remnants from the demolition of the Marine Recuperational Barracks, a complex of over 80 buildings constructed in 1944 to provide care for soldiers recovering from tropical diseases [3] (See Figure 1 on next page). Fragments continue to be found throughout the subdivision. Underground asbestos-insulated piping and more than 13 known and suspected disposal sites with ACM have also been identified on several lots [4, 5].

Sampling confirmed that the fragments were composed of 10%–90% asbestos [6, 7]. The ACM were determined to be friable [8], as they had been fragmented through demolition and were crumbling or deteriorating to the touch. As soil sampling data on asbestos fiber content is not yet available, this health consultation does not evaluate the severity of health risk from the exposure to asbestos fibers in soil at this site. In addition, the extent of the ACM from the demolition of the Marine Barracks structures has not been adequately determined.

The volume and extent of friable ACM fragments found on the site surface in North Ridge Estates, now and before the 2002 cleanup, pose a clear risk for health effects from exposure. There are also a number of physical hazards, including rebar in various locations throughout the site, large open pipes at the former swimming pool, and cisterns at the former sewage treatment plant.

In April 2003, ODHS/SHINE released the public comment version of this health consultation. That report found the site to be a past and present public health hazard because of the risks of exposure to ACM and physical hazards at the site. At ODEQ's request, the U.S. Environmental Protection Agency (EPA) became involved at the site in May 2003 and initiated a time-critical removal action (TCRA). More than 7 tons (15,700 lbs.) of ACM were removed from the surface of the property from June through October 2003 [5]. EPA conducted soil sampling for asbestos and lead, as well as air and dust sampling for asbestos, from July through November of 2003. These sampling results will be evaluated in future health consultations.

Background—Site Description and History

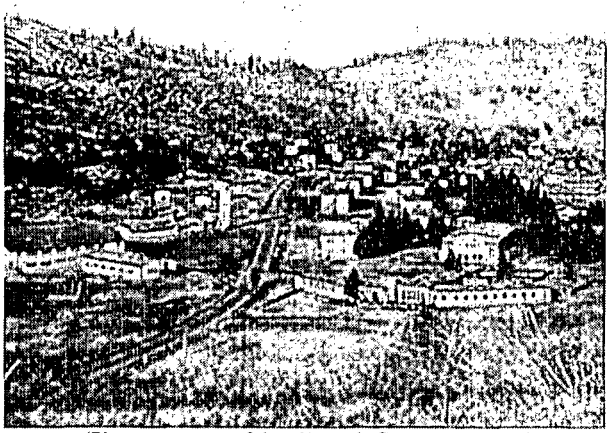
North Ridge Estates is located in south-central Oregon in a high desert area (elevation of 4,500 feet). The 422-acre subdivision is 3 miles north of the City of Klamath Falls, along both sides of Old Fort Road. (See Figure 2 on page 3.) Vegetation in the area is sparse, with some scattered ponderosa pines and sagebrush. Soil is volcanic and rocky in places. The climate is relatively dry, with an average annual rainfall of 13.2 inches.

There are 77 current residents, including 35 children (15 children age 6 years or younger), in the area surveyed in 2002 for ACM fragments. In this section of the subdivision, there are 22 homes,

nine vacant home sites, and a memorial park that is privately owned but open to the public. East of Old Fort Road are several homes, a five-unit apartment building, and additional North Ridge Estates lots. Land to the west, north, and east of the subdivision is zoned for forestry, grazing, and agriculture. According to the 2000 U.S. Census, there are 98 residents, including 14 children ages 6 years and younger, within ½-mile of the property.

Most of the Marine Barracks buildings, as well as a service station, a coal-fired power plant, maintenance shop, and laundry buildings, were west of Old Fort Road [3, 9]. A sewage treatment facility and horse barns were built ¼-mile to the north [3]. A medical laboratory, dispensary, medical staff housing, the brig, and a rifle range were built on the hillside on the other side of Old Fort Road. The only remaining military buildings are a warehouse (vacant), the brig (renovated into a 5-unit apartment building), and the medical staff housing (residences on Thicket Court). (Figures 3 and 4 on page 5 show the former military complex and present subdivision plat in relation to each other and current subdivision roads.) Electrical substations were located near the junction of Old Fort Road and Scotts Valley Road and west of Old Fort Road in the northeast area of the subdivision. Substation parts were reportedly salvaged on-site [9].

Figure 1 – Former Marine Recuperational Barracks



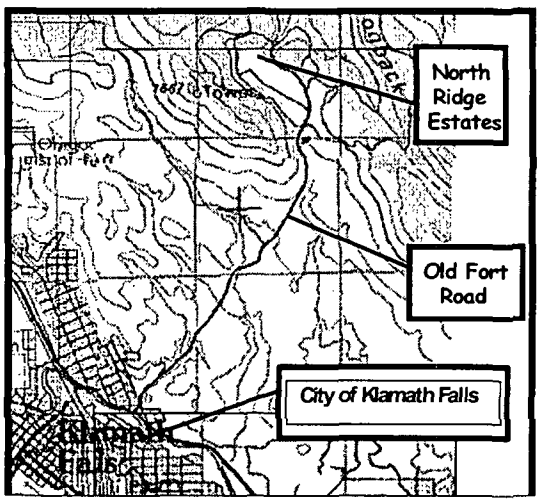
(Photo courtesy of the Klamath County Museum)

No information was available on when military buildings east of Old Fort Road were demolished, nor where demolition debris from this area was disposed. This area of the subdivision was not included in the area surveyed in 2002 for ACM and for locations of disposal sites and underground piping, however ACM fragments were observed by ODEQ staff on these properties during the January 2003 site visit. During a site visit in May 2003, SHINE and ATSDR staff also observed ACM fragments on the hillside by the former brig (now a 5-unit apartment building) east of Old Fort Road.

The buildings at the Marine Recuperational Barracks were occupied from 1944–1946 by the military, followed by the Oregon Technology Institute (now called the Oregon Institute of Technology) until 1964. The property has been privately owned since 1966. From 1966 through the mid-1970s, property owners stripped the vacant buildings of salvageable materials such as

copper and wood. According to former site workers, asbestos insulation was stripped from piping and boilers; metal was sold, and the insulation remained at the site. The property caretaker (from 1966 through 1979), who lived off-site, was often called to the site at night to respond to reports of vandalism. Most of the buildings were reportedly demolished in the mid- to late-1970s; a few remaining buildings, including the auditorium and swimming pool, were demolished in the 1980s. The property was purchased in 1977 by MBK partnership, the present property developer. Klamath County approved subdivision plans, and construction of homes in the subdivision began in 1993.

Figure 2 – North Ridge Estates Location



In the late 1970s, ODEQ responded to a complaint of openly accumulated asbestos debris at the property. Staff observed a bulldozer being driven over 4–6 acres of demolition debris described as "a great amount of white, fluffy insulation materials being blown by strong winds" [10]. At that time the local landfill reportedly would not accept asbestos materials. Because of that, and concerns about health risks to workers in removing such a large quantity of materials, ODEQ agreed to allow the property owner to dispose of the asbestos-contaminated materials on-site.

An EPA compliance order in 1979 required that coverage and maintenance of the disposal site conform to the National Emission Standards for Hazardous Air Pollutants (NESHAP) requirements for inactive waste sites [11]. There was no indication in records available for review that NESHAP requirements for proper disposal were met. In addition, there was no indication in the records reviewed by ODHS that locations of ACM disposal sites have ever been recorded on property deeds or similar documents, as was required by the 1979 EPA Compliance Order.

In June 2001, ODEQ received a complaint of two large piles (180 linear feet) of asbestos-insulated pipe on the surface of a lot being developed in North Ridge Estates [8]. The ODEQ inspector observed "white to pale brown colored platy looking" fragments on the lot and on other lots throughout the subdivision. Samples of the piping and fragments were found to contain from

10%–90% asbestos. A notice of non-compliance was issued to the property developer, who then removed the piping piles from the property surface in the summer of 2001.
In response to these violations, ODEQ and MBK entered into a Mutual Agreement and Order in May 2002 [12]. Under the terms of the order, MBK agreed to take the following actions:

- Complete a survey of properties in the subdivision to identify any visible ACM and to identify the locations of underground asbestos-containing pipe and ACM disposal sites;
- Inform property owners if their lots contain exposed or buried ACM;
- Remove exposed ACM;
- Either remove ACM from sites where ACWM was buried, pursuant to the EPA-authorized cleanup, or record on property deeds the presence and locations of those burial sites;
- Record on property deeds the location of underground asbestos-containing pipe, and
- Pay a $10,484 civil penalty.

MBK has since removed more than 49 tons of ACM from the property surface, submitted maps to ODEQ showing known and presumed locations of burial sites and underground piping, paid the civil penalty, and sent notifications to property owners. (More than 7 additional tons of ACM were removed from the surface of the property during the EPA 2003 TCRA [5].)

Discussion

Data Used

ODHS/SHINE reviewed ODEQ records, which included sampling reports, compliance orders (EPA and ODEQ), military site reports (historical and environmental), correspondence, maps, real estate transfer records, and subdivision plats. ODHS/SHINE and Agency for Toxic Substance and Disease Registry (ATSDR) staff visited the site in October 2002 and met with local and regional ODEQ staff. ODHS/SHINE and ODEQ staff visited the site again in January 2003 and met with residents on-site. SHINE co-sponsored meetings on January 16, 2003—one with residents and a second meeting open to the public. Interviews with residents, former workers at the site, and staff from Klamath County Health, Planning, and Public Works Departments provided information on the site history, health concerns, and asbestos issues that will be described further in following sections of this document.

Sampling and ACM Survey

ACM fragments and asbestos piping insulation were sampled by ODEQ in July 2001 and by the property developer in April 2002. As of April 2003, there had been no soil sampling to determine the amount of asbestos fibers within the soil itself. Outdoor and indoor air had, as of April 2003, not been adequately sampled for suspended asbestos fibers, nor had there been sampling of indoor dust. (From July through November 2003, EPA conducted sampling of soil, outdoor and indoor air, and indoor dust. These sampling results will be analyzed in future health consultations.)

In July 2001, ODEQ analyzed 13 samples of the waste material for asbestos. The highest percentage of asbestos was detected in the white insulation found on the ground and inside the piping, which was 90% amosite and chrysotile asbestos. (See Appendix A for additional

information on types of asbestos.) The remaining samples were 10%–70% chrysotile asbestos. (See Table 1 on page 6.) ACM fragments were determined by ODEQ to be friable, as they were shattered or crumbling to the touch, and were described as having varying degrees of weathering and stability.

Figure 3 – Site Plan of Former Marine Recuperational Barracks
(Not Drawn to Scale)

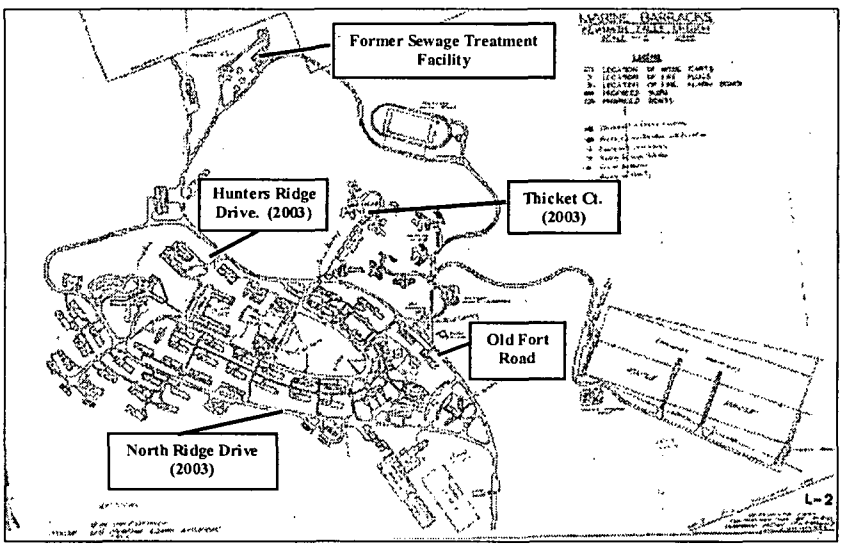
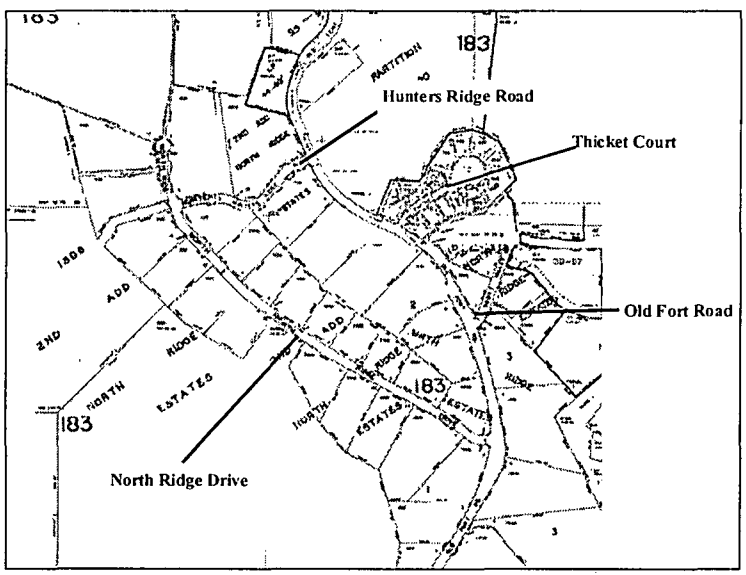


Figure 4 – North Ridge Estates County Assessors Map



An asbestos survey was conducted by the developer in April 2002. On the 28 lots 1.5 to 5.5 acres in size, ACM was reported on more than 50 acres of the 81 acres surveyed. ACM was also reported on 3.5 acres on two of the three larger lots that comprise 223 acres of the property [2].

(Lots 1 and 2 of Tract 1267 and most of the acreage of the three larger lots were not surveyed, as they were determined by the asbestos abatement contractor to be outside of the area where military buildings had been demolished [13].) Figure 5 on page 7 shows locations where ACM were found in April 2002 on the surface of lots and locations of five of the known disposal sites.

Table 1 - ODEQ Samples from Site, July 2001

Description	% Asbestos	Asbestos type	
White insulation	90%	Amosite	Chrysotile
Gray cardboard-like material	70%		Chrysotile
White, stiff, flat material	10%		Chrysotile
Black paper on outside of pipe	50%		Chrysotile
Insulation and black paper	60%	Amosite	Chrysotile
Black paper in pipe	40%		Chrysotile

Ten samples of the surface waste material were analyzed in 2002 and found to contain 5%–45% chrysotile asbestos (see Table 2). Fragments of cement asbestos board (CAB)/transite siding, roofing paper (30% asbestos), and hardboard material (35% asbestos) were found on 30 lots. Gray paper was found on eight lots; red vinyl flooring tile chips and black mastic were found on seven lots; and TSI pipe wrap was found on two of the lots [2]. (See Appendix B for examples of ACM found at the site.)

Table 2 - Asbestos Survey Summary - 2002*

Number of lots surveyed for ACM	30	
Number of lots not surveyed for ACM	2	
Number of acres w/surface ACM	53	
Number of lots with homes	22	
Number of lots where disposal sites identified	7	
Material	**% Asbestos**	**Number of lots where ACM fragments located on surface**
Transite siding (cement asbestos board/CAB)	25%	30
Roofing paper	30%	30
Hardboard	35%	30
TSI pipe wrap	45%	2
Vinyl tile	6%–7%	7
Mastic	5%	7

** Lots surveyed west of Old Fort Road; approximately 80 acres of the 422-acre subdivision site.*

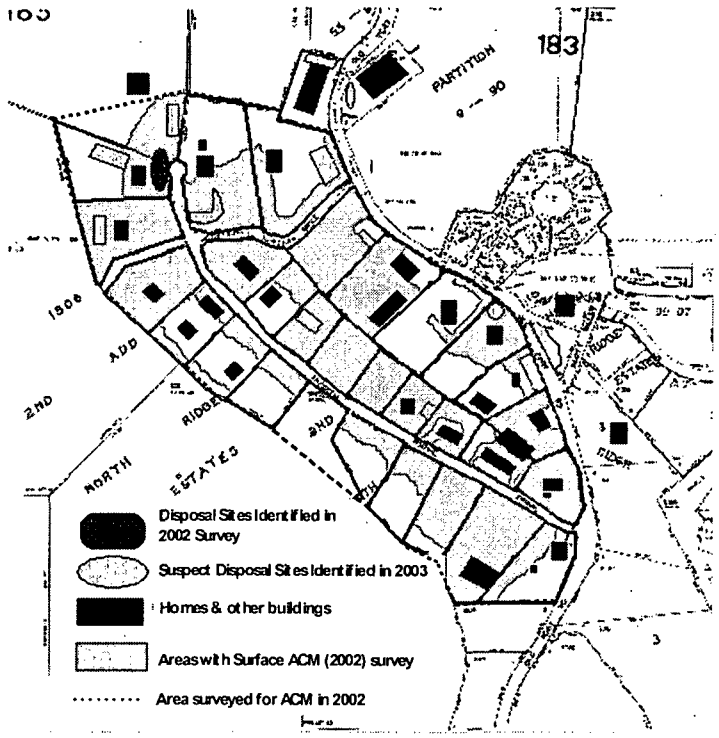
Other Locations where ACM may be present

Figure 5 (page 7) shows five known ACM disposal sites identified in the 2002 subdivision area survey and additional known and suspect disposal sites identified during the 2003 time-critical removal action (TCRA) [5]. In January 2003, ODEQ staff identified potential disposal sites on

portions of three additional lots: a vacant lot on North Ridge Drive; a residential lot on Old Fort Road; and at the former location of the family dispensary for the Marine Barracks east of Old Fort Road.

Subsurface sampling was not used to investigate all disposal site locations and dimensions, and there is reason to believe that there may be additional disposal sites on the property or on other areas of the former military site. The U.S. Army Corps of Engineers (USACE) visited the site in 1993 and reported that demolition debris had been buried in a swimming pool, sewage lagoon, and other locations at the site [14, 15]. At public meetings residents also reported that, rather than haul the materials to local dump sites, residents buried the debris in their own yards.

Figure 5 – Asbestos Survey Summer 2002
Locations of Surface ACM & Disposal Sites



Underground steam piping from the former Marine Barracks has been located and mapped in some areas of the subdivision and in additional areas east and west of Old Fort Road in areas where former military buildings were heated by steam. This piping is wrapped on the inside and outside in ACM. The asbestos abatement contractor reported that piping is 24 inches below the surface [4]; however, at the January public meeting residents reported locating the piping at only 6 inches below the surface while doing yard work.

Site Visits and Community Meetings

Staff from ODHS/SHINE (Janice Panichello), the ATSDR regional office (Karen Larson and Ric Robinson), and ODEQ (Frank Messina and Cindy Foster) visited the site with a representative of

the developer in October 2002. Staff walked through subdivision areas where asbestos had been surveyed, including the memorial park, vacant lots, and the warehouse. They also drove through adjacent neighborhoods. Although the developer indicated that cleanup of surface ACM had been completed in September, staff noticed additional ACM fragments throughout the subdivision area visited. Several homes have play equipment (including swing sets and basketball hoops) in their yards. Campfire areas were seen on two of the vacant lots. Lawn and landscaping cover approximately one-fourth to one-half of each home site, with large remaining areas comprised of dirt, rock, and sparse vegetation.

ODHS (Janice Panichello and Michael Heumann) and ODEQ staff (Frank Messina, Cindy Foster, Jane Hickman, and Peter Brewer) visited the site again in January 2003. Residents of six of the lots pointed out areas on and adjacent to their properties where disposal sites are located and where ACM fragments continue to pepper the surface. ACM fragments were more abundant and noticeable at and adjacent to disposal sites. Residents also pointed out additional areas where ACM has either resurfaced since the cleanup in the summer of 2002 or may have been areas missed in the 2002 cleanup. Fragments similar to those found during the April 2002 site survey were also seen on lots east of Old Fort Road at the former sites of the Marine Recuperational Barracks family dispensary and medical laboratory.

At the January public meetings, staff from ODHS/SHINE, ODEQ, EPA, and the Klamath County Health Department provided updated information and responded to questions and concerns. Residents of the subdivision and other community attendees provided additional information on specific sites and historical information about the property.

ODHS/SHINE sponsored a public meeting in May 2003 to discuss the draft health consultation, respond to questions, and request comments and additional site information. EPA and ODEQ staff provided the community an update on sampling and cleanup activities planned for the site. ODHS staff (Janice Panichello and Amanda Guay) also participated with EPA and DEQ staff at neighborhood meetings held in residents' homes. A meeting was held in January 2004 to update residents on the sampling process and findings to date. Additional public meetings are planned by EPA to provide residents with the remaining sampling results.

Health Effects Evaluation

Health Effects from Exposure to Asbestos-Containing Material (ACM)

Residents, construction workers, utility workers, building/utility inspectors, and visitors have been exposed to asbestos through contact with ACM fragments, and possibly to asbestos fibers in soil and air, at the North Ridge Estates subdivision. More than 56 tons of ACM fragments have been removed from the property surface since July 2002. Additional ACM fragments continue to cover many areas of the subdivision, particularly in the area of the disposal sites. ACM fragments also reportedly resurface annually with the freeze-thaw cycle and after soil-disturbing activities on the property. Asbestos fibers may be released through processes such as wind erosion, but human disturbances are likely to be of greater concern, especially under conditions when the soil is dry. This might include walking or playing in sparsely vegetated areas, or disturbing soil with mechanical devices such as bikes or lawn mowers, or during

construction on their own or on neighboring lots [16]. ACM has also reportedly been collected in the past by residents and burned, which may cause asbestos fibers to be released to the air.

The exposures to ACM described above could result in adverse health effects. When asbestos fibers are breathed in, they may get trapped in the lungs. In general, health risks increase with longer times of exposure and with greater amounts of asbestos fibers in the exposures. Short-term high-level or chronic low-level asbestos inhalation exposures have been associated with lung cancer, mesothelioma, and pleural disorders [17]. (See Appendix A for additional information on asbestos.)

ACM fragments currently on the property surface are remnants of an incomplete cleanup of the site[1] and from resurfacing of ACM since the clean-up actions in 2002 and 2003. Continued exposure to ACM fragments is likely based on site history. In addition to the continuing health threat from resurfacing visible ACM, asbestos fibers from the breakup of ACM during demolition of the Marine Barracks and other activities may be present in the soil. Appropriate sampling is needed to identify the location of ACM buried in the soil and to determine whether there are levels of asbestos fibers of health concern in the soil and air.

Physical Hazards

ODHS staff observed at least two partially grated concrete holes, a few feet in diameter, during site visits. These holes, located in the former swimming pool and gymnasium areas near the intersection of North Ridge Drive and Old Fort Road, could be attractive to children. Insulated steam pipe was seen not far from the entrance of one of the holes. On the surface of one of the disposal sites, staff noticed holes several inches in diameter.

At the January 2003 site visit, ODHS staff observed rebar from 8 inches to 3 feet in length sticking out of the ground in various areas of the property. This poses a hazard for people walking or playing, particularly in the areas where the rebar is partially hidden by shrubs.

ODHS staff drove by the area of the former Marine Barracks sewage treatment facility. This area, which is not owned by the developer of North Ridge Estates, was identified by the USACE in 1995 as having a number of physical hazards, including large open cisterns [18]. From the road, staff could not confirm whether physical hazards exist at the site. It is unknown at this time whether the site is accessed by the public or whether it is likely to be accessed by the public in the near future.

Health Outcome Data Evaluation

Health outcome data may help determine whether the incidence rates of certain adverse health effects are higher than expected in the area potentially affected by site contaminants. ATSDR conducts a review of health outcome data when the toxicological evaluation of a completed exposure pathway indicates the likelihood of adverse health outcomes. The evaluation of health

[1] ACM was not removed from all areas within the footprint of the former Marine Recuperational Barracks. The 2003 Statement of Work required cleanup of only those ACM fragments larger than 1 inch in diameter, and ACM surficial removal was not required on vacant lots in the subdivision [5].

outcome data may give a general picture of the health of a community, or it may confirm the presence of excess disease or illness in a community. However, elevated rates of a particular disease may not necessarily be caused by hazardous substances in the environment. Other factors, such as personal habits, socioeconomic status, and occupation, also may influence the development of disease. In contrast, even if elevated rates of disease are not found, a contaminant may still have caused illness or disease.

The Superfund law requires that health outcome (for example, mortality and morbidity) data be considered in a PHA [19]. Steps to achieve that are discussed in the *ATSDR Public Health Assessment Guidance Manual* and a 1996 revision to that guidance [20,21]. The main requirements for evaluating health outcome data include the following:

- presence of a completed human exposure pathway,
- great enough contaminant levels to result in measurable health effects,
- sufficient persons in the completed pathway for health effects to be measured, and
- a health outcome database in which disease rates for population of concern can be identified.

The North Ridge Estates site meets 3 of these 4 requirements for conducting a health outcome data evaluation. There is a completed current or past exposure pathway for asbestos. Site-related exposure has been occurring since 1944. As discussed earlier, asbestos levels are high enough to cause adverse health effects. Asbestos is classified as a human carcinogen [22]. The Oregon Cancer registry does have data for this area. However, there are not sufficient individuals in this pathway (100 or so) to permit measurement of site-related health effects. Therefore, a health outcome data evaluation will not be done.

Children's Health Considerations

ATSDR recognizes that infants and children might be more vulnerable to exposures than adults in communities faced with environmental contamination. Because children depend completely on adults for risk identification and management decisions, ATSDR is committed to evaluating their special interests at the site.

The effects of asbestos on children and on adults are thought to be similar. Children, however, could be especially vulnerable to asbestos exposures because of the following factors:

- Children are more likely to disturb fiber-laden soils or indoor dust while playing.
- Children are closer to the ground and thus more likely to breathe contaminated soils or dust.
- Children have faster breathing rates, which can increase their level of exposure to asbestos.
- Children could be more at risk than people exposed later in life because of the long latency period between exposure and onset of asbestos-related respiratory disease.

Children playing in their own yards and on vacant neighboring lots are exposed to physical hazards, such as rebar and large open holes, while riding bikes, playing, and exploring.

Community Concerns

Residents with health concerns were referred by ODEQ to ODHS staff. Questions and concerns were also expressed during site visits and at community meetings. The following health questions have been asked of ODHS staff.

Is it safer to remove materials from the disposal sites compared to leaving them in place?

Response: Residents should avoid contact with ACM. All clean up and removal of ACM fragments in yards, disposal sites, and underground piping should be conducted according to ODEQ regulations and guidance by licensed asbestos abatement contractors. Although waste removal by an asbestos abatement contractor may eliminate the long-term risks associated with a site, removal activities involving a large quantity of asbestos waste can significantly increase short-term risks, particularly in areas where terrain conditions, poor access, unanticipated events (including windy weather), or other factors make excavation difficult. ODEQ and EPA will be working closely with asbestos abatement contractors during the planning and clean up of materials at disposal sites where ACM are expected to be found.

I don't live in the neighborhood, but my child has a friend who lives there. Is it safe for my child to visit her friend?

Response: Yes, it is safe for children to visit friends who live in the North Ridge area. However, all children living or visiting the area should reduce their risk of exposure to asbestos by avoiding play activity in the dirt.

I want to build a home on property I own across Old Fort Road from the area surveyed for asbestos. Is there a potential problem with asbestos at my property?

Response: Yes, there is a potential problem with asbestos on properties east of Old Fort Road. ODEQ staff observed ACM fragments on a site visit in January 2003 in areas across Old Fort Road that have not been surveyed for ACM, disposal sites, and underground piping. There were a few military buildings in this area; however the details on the demolition of these buildings and debris disposal are unknown at this time. Additional surveying is recommended to identify properties in and adjacent to North Ridge Estates with ACM demolition debris, disposal sites, and underground steam piping from the former Marine Barracks infrastructure. If soil sampling from areas west of Old Fort Road finds high levels of asbestos fibers, air monitoring and other site evaluations may be necessary to assess whether asbestos fibers were carried to other sites by the wind. EPA, with the assistance of ODEQ, is overseeing the site assessment and cleanup at North Ridge Estates and can provide property owners with additional information on options and plans for surveying properties for asbestos.

Are disposal sites lined? Can asbestos migrate into groundwater and cause health problems?

Response: Some of the disposal sites are on top of foundations of the former military buildings, however some of the sites may have no lining of concrete, plastic, or other materials. Since asbestos fibers are not readily transported through soil, it is unlikely that asbestos fibers would reach groundwater. Groundwater at North Ridge Estates is not used as a drinking water source, so exposure to asbestos by ingestion of groundwater is unlikely.

What can I do in the meantime to reduce my health risks from exposure to asbestos?

Response: Here are some general guidelines for those who have been exposed to asbestos:

- If you are a smoker, you can stop smoking. Smoking and asbestos exposure together greatly increases the risk of lung cancer.
- Get regular health checkups from a doctor experienced with asbestos-related diseases.
- It may be advisable for you to receive vaccines against flu and pneumonia. Discuss this with your physician.
- Get prompt medical attention for any respiratory illness.

See Appendix C for additional suggestions for reducing exposure to asbestos inside your home, in your yard, and in areas at or adjacent to ACM disposal sites.

A section of North Ridge Estates east of Old Fort Road near the former firing range has recently been subdivided. Is there a health risk in this area?

Response: We don't know whether a health risk exists. ODEQ is working with the U.S. Army Corps of Engineers to evaluate this area.

Public Review

This health consultation (HC) was available for public review at the Klamath Falls Public Library. The document was released on April 18, 2003, and was available for public comment until June 16, 2003. The document was also available on the web at http://www.healthoregon.org/superfund.

The public comment period was announced in the *Klamath Falls Herald and News* on April 18, 2003. ODHS issued a press release on April 22, 2003. A public meeting was held on May 8, 2003, to discuss the public health consultation and request comments. The HC was sent to residents and property owners within the area of North Ridge Estates surveyed for ACM; MBK; Brandsness, Brandsness & Rudd, PC (attorneys representing MBK); Malot Environmental; the Oregon Department of Environmental Quality; the Klamath County Public and Environmental Health Departments; Kennedy/Jenks Consultants; the Klamath County Building, Planning, and Public Works Departments; the former site caretaker; the Seattle District Corps of Engineers; and two area banks (Klamath First and South Valley Bank & Trust).

Comments were received from Kennedy/Jenks Consultants on behalf of the Klamath Falls Homeowners Coalition, which represents residents of 13 homes in the North Ridge Estates subdivision. The comments and ODHS/SHINE responses to them can be found in Appendix E on page 34.

Conclusions

1. Due to the known health risks from exposure to friable asbestos, and due to the volume and extent of site coverage of friable ACM fragments on the site surface before cleanup in 2002 and 2003 and the large amount of ACM that continues to periodically surface at the site, North Ridge Estates is considered a **past and present public health hazard**. The existing and potential physical hazards at the site are also considered a public health hazard by ODHS as well.

2. There is not enough information to determine the extent of exposure to asbestos in the vicinity of the disposal areas and other areas of the property.

3. Since the location of all piping is not known, and since known steam pipe locations are not recorded in property deeds, there is the potential for exposure to asbestos from disturbing underground piping insulated with asbestos.

Recommendations

1. ODHS recommends that the surface distribution and vertical distribution through the soil of ACM fragments throughout the site be determined to prevent exposure to ACM through surface and below surface contact activities. In addition, ODHS recommends asbestos levels in the soil near suspect areas be measured and that outdoor air sampling be conducted, particularly during dry and windy conditions and during simulation of soil-disturbing activities.

2. Location, size, and depth of cover should be determined for disposal sites throughout the subdivision and other areas in the footprint of the former Marine Recuperational Barracks buildings. Unless sampling indicates otherwise, the disposal sites should be treated as contaminated with asbestos.

3. ODHS/SHINE recommends that, prior to any site-disturbing activities (such as construction or installation of utilities), the locations of underground asbestos-insulated piping be determined, and that dust mitigation be conducted during excavations, on any property within the footprint of the former developed area of the Marine Recuperational Barracks (including areas on the north and east sides of Old Fort Road). On properties where locations are known, ODHS recommends that locations be recorded on property deeds so that future property owners may avoid disturbing these areas.

4. Eliminate access to or fill in the large holes at the site of the former swimming pool and smaller holes at disposal sites then properly maintained to prevent injury. Rebar and piles of boards should be removed. The site of the former sewage treatment plant should be evaluated for physical hazards and accessibility to the public.

Public Health Action Plan

The Public Health Action Plan for the site contains a description of actions that have been or will be taken by ODHS and other government agencies at the site. The purpose of the Public Health Action Plan is to ensure that this public health consultation both identifies public health hazards and provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ODHS to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken include the following:

- ODHS developed and distributed a flyer with site-specific recommendations for residents to reduce exposures to asbestos. (See Appendix C.) Additional information materials on health effects of exposure to asbestos were provided and distributed at the meetings and in response to requests by residents.
- ODEQ developed a fact sheet for North Ridge Estates which was distributed to area residents and is available on the ODEQ website (http://www.deq.state.or.us/news/northridgeestates.pdf).
- ODEQ and EPA have been diligently working with the developer, in consultation with public health agencies, to evaluate options for sampling and cleanup of the site that protect public health and reduce risks of exposure and to respond to community concerns.
- ODEQ requested that EPA assume the lead role for sampling and cleanup at the site. EPA completed a preliminary site assessment and initiated a time critical removal action.
- ODHS/SHINE reviewed and provided comments to EPA on sampling plans, burial site removal plans, preliminary assessment, statement of work, and risk management plans. ODHS regularly participates in conference calls with EPA and ODEQ.
- ODHS co-sponsored public meetings and conducted site visits in September 2002, January 2003, May 2003, and January 2004. ODHS and ATSDR conducted a site visit with EPA and ODEQ and met with residents in October 2003.
- Educational materials on health effects of asbestos exposure and ways to minimize exposure to asbestos and reduce health risks were provided to the community by ODHS in partnership with the local health department.

The public health actions to be implemented follow:

- EPA and ODEQ will develop a plan to manage any ACM discovered in the future and will oversee cleanup at the site.
- ODHS and ATSDR will continue to provide assistance to regulatory agencies during planning for site sampling and cleanup.
- ODHS will complete a second public health consultation on health risks at the site after sampling is completed on soil and disposal sites.
- State and local public health agencies will participate in future public meetings to provide updated information and respond to questions and concerns.
- ODHS, ODEQ, and EPA will continue to respond to the community's concerns and questions.
- ODHS will continue to develop fact sheets and other educational materials as indicated.

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Appendix A - Asbestos Overview

Asbestos is a general name applied to a group of silicate minerals consisting of thin, separable fibers. Different criteria are used to identify asbestos fibers, depending on the context.

Asbestos minerals fall into two classes: serpentine and amphibole. Serpentine asbestos has relatively long and flexible crystalline fibers. This class includes chrysotile, the predominant type of asbestos used commercially. Amphibole asbestos minerals are brittle and have a rod- or needle-like shape. Regulated amphibole minerals include amosite, tremolite, actinolite, anthophylite, and crocidolite [22]. According to the Oregon Department of Environmental Quality (ODEQ), amphibole asbestos fibers are more difficult than chrysotile fibers to subdue with wetting. At North Ridge Estates, the insulation on underground piping is primarily amosite (an amphibole form of asbestos). The asbestos in the fragments of transite siding/CAB, vinyl tile, and roofing materials at the site is the chrysotile form of asbestos. Soil on the property has not been sampled (to date) to determine the amount or types of asbestos fibers in the soil from demolition and later from the weathering of the asbestos-containing materials (ACM) and asbestos insulation.

Asbestos fibers do not have any detectable odor or taste. They do not dissolve in water, do not evaporate, and are resistant to heat, fire, and chemical and biological degradation. They are generally not broken down to other compounds in the environment and will remain virtually unchanged over long periods. Asbestos fibers may break into shorter pieces or separate into a larger number of individual microscopic fibers as a result of physical processes. Small diameter fibers and fiber-containing particles may remain suspended in the air for a long time and be carried long distances by wind before settling.

Asbestos Health Effects

Inhalation of Asbestos

When asbestos fibers are breathed in, they may get trapped in the lungs. In general, health risks increase with longer exposure and greater amounts of asbestos fibers in the exposures. Short-term high-level or chronic low-level asbestos inhalation exposures have been associated with lung cancer, mesothelioma, and pleural disorders [17]. Breathing any type of asbestos increases the risk of the following health effects:

Malignant mesothelioma – Cancer of the lining of the lung (pleura) and the lining of other internal organs. This cancer can spread to tissues surrounding the lungs or other organs. Most of the mesothelioma cases are attributable to asbestos exposure [22]. Mesothelioma can occur with low asbestos exposure; however, very low background environmental exposures carry only an extremely low risk [17]. An estimated 1,500 cases of mesothelioma per year occur in the United States (compared with an average of 130,000 cases of lung cancer per year). Latency periods for mesothelioma due to asbestos exposure are generally 20–30 years or more.

Lung cancer – Cancer of the lung tissue. The exact mechanism relating asbestos exposure with lung cancer is not completely understood [22]. The combination of tobacco smoking and asbestos exposure greatly increases the risk of developing lung cancer. Latency periods are generally 10–30 years or more for lung cancer.

Noncancer effects – these include *asbestosis*, where asbestos fibers lodged in the lung cause scarring and reduce lung function; *pleural plaques*, localized or diffuse areas of thickening of the pleura (lining of the lung); *pleural thickening*, extensive thickening of the pleura which restricts breathing; *pleural calcification*, calcium deposition on pleural areas thickened from chronic inflammation and scarring; and *pleural effusions*, fluid buildup in the pleural space between the lungs and the chest cavity [22]. Either heavy exposure for a short time or lower exposure over a longer period may result in asbestosis; some cases have resulted from intense 1-day exposure [17]. No minimal risk levels (MRL) have been determined for inhalation or oral exposure to asbestos for any duration [22]. Latency periods for the development of asbestos-related nonmalignant respiratory effects are usually 15–40 years from the time of initial exposure to asbestos.

There is not enough evidence to conclude whether inhalation of asbestos increases the risk of cancers at sites other than the lungs, pleura, and abdominal cavity [22].

Amphibole asbestos may be more toxic than chrysotile asbestos, mainly because of physical characteristics that allow chrysotile to be broken down and cleared from the lungs, whereas amphibole is not removed and builds up to high levels in lung tissue [23]. Some researchers believe the resulting increased duration of exposure to amphibole asbestos may significantly increase the risk of mesothelioma and, to a lesser extent, asbestosis and lung cancer.

Ingestion and Dermal Exposure to Asbestos

Ingestion of asbestos causes little or no risk of noncancer effects [22]. There is some evidence, however, that acute oral exposure might induce precursor lesions of colon cancer, and that chronic oral exposure might lead to an increased risk of gastrointestinal tumors.

Skin nodules (corns) from handling asbestos-containing materials can also occur [17].

Current Standards, Regulations, and Recommendations for Asbestos

ODEQ and other regulatory agencies commonly define "asbestos-containing materials" as any material with greater than 1% bulk concentration of asbestos [24]. It is important to note that 1% is not a health-based level, but instead represents the practical detection limit in the 1970s when Occupational Safety and Health Administration (OSHA) regulations were created. Studies have shown that disturbing soils containing less than 1% amphibole asbestos can suspend fibers at levels of health concern [16].

Friable asbestos (asbestos that is crumbly and can be broken down to suspendable fibers) is listed as a hazardous air pollutant on EPA's Toxic Release Inventory [25]. EPA has determined that, if

severely damaged, otherwise non-friable materials can release significant amounts of asbestos fibers.
Low levels of asbestos can be detected in almost any air sample. In rural areas, for example, there are typically 10 fibers in a cubic meter (fibers/m^3) of outdoor air. (A cubic meter is about the amount of air someone breathes in 1 hour.) Health professionals often report the number of fibers in cubic centimeters (f/cc); 10 fibers per cubic meter is the equivalent of 0.00001 f/cc. Typical levels found is cities are about 10 times higher. Close to an asbestos mine or factory, levels may reach 10,000 fibers/m^3 (or 0.01 f/cc) or higher. Levels could also be above average near a building being torn down or renovated that contains asbestos products or near a waste site where asbestos is not properly covered up or stored to protect it from wind erosion [22].

Asbestos is a known human carcinogen. EPA has calculated an inhalation unit risk for cancer of 0.23 per f/cc of asbestos [26]. (These criteria are currently under review by EPA.) The concentration resulting in an increased lifetime cancer risk of 1 in 10,000 is 0.0004 f/cc; the concentration resulting in an increased lifetime cancer risk of 1 in 1 million is 0.000004 f/cc.

OSHA has set a permissible exposure limit (PEL) for workers of 0.1 f/cc for asbestos fibers greater than 5 μm in length (1 μm is about 1/25,000 of an inch) and with a length-to-width ratio greater than 3:1, as determined by phase contrast microscopy (PCM) [27]. This value represents a time-weighted average (TWA) exposure level based on 8 hours a day for a 40-hour workweek; at or above this level, an employer must take action to reduce employee exposure. In addition, OSHA has determined an exposure limit for workers to no more than 1 f/cc as averaged over a sampling period of 30 minutes.

The National Institute of Occupational Safety and Health (NIOSH) set a recommended exposure limit (REL) for workers of 0.1 f/cc for asbestos fibers greater than 5 μm in length [27]. This REL is a TWA for up to a 10-hour workday in a 40-hour workweek. The American Conference of Government Industrial Hygienists (ACGIH) has also adopted a TWA of 0.1 f/cc as its threshold limit value [28].

The Asbestos Hazard Emergency Response Act (AHERA) passed in 1986 set specific standards for asbestos air quality in schools for allowing reentry following an asbestos abatement. The AHERA standard of 70 structures per millimeter squared (s/mm^2), is not health-based, but was based on background air contamination levels determined by collecting air samples using filters that were available in 1987. Due to filter improvements since 1987, the amount of background contamination in air has been found to be considerably less, however the AHERA standard has not been revised [29].

The EPA National Emissions Standards for Hazardous Air Pollutants (NESHAP) program established criteria for identifying asbestos-containing material (ACM) subject to demolition and renovation work practices. Material containing at least 1% asbestos, by volume, is considered ACM and subject to NESHAP regulations. The 1% threshold is also not a health-based standard, but was based on the smallest amount measurable using polarized light microscopy (PLM).

A number of methods are used to measure asbestos content in air and soil. ODEQ staff have been functioning in an advisory role to EPA in evaluating potential sampling methodologies at North Ridge Estates.

Methods for Measuring Asbestos Content

Measuring asbestos content in air samples and in bulk materials that could become airborne involves both quantifying fibers and determining whether the fibers are asbestiform. For air samples, fiber quantification is traditionally done through phase contrast microscopy (PCM) by counting fibers longer than 5 μm and with a length-to-width ratio greater than 3:1. This is the standard method by which regulatory limits were developed [22]. The disadvantages of this method include the inability to detect fibers smaller than 0.25 μm in diameter and the inability to distinguish between asbestos and nonasbestos fibers.

Asbestos content in bulk samples is determined using polarized light microscopy (PLM). This method uses polarized light to distinguish between asbestos and nonasbestos fibers and between different types of asbestos. Fibers are first quantified through PCM. The PLM method is also limited by resolution; fibers finer than about 1 μm in diameter cannot be identified by PLM.

Scanning electron microscopy (SEM) and, more commonly, transmission electron microscopy (TEM) are more sensitive methods and can detect smaller fibers than light microscopic techniques. One disadvantage of electron microscopic methods is that it is difficult to determine bulk asbestos concentration. Generally, a combination of PCM and TEM is used to describe the fiber population in a particular sample.

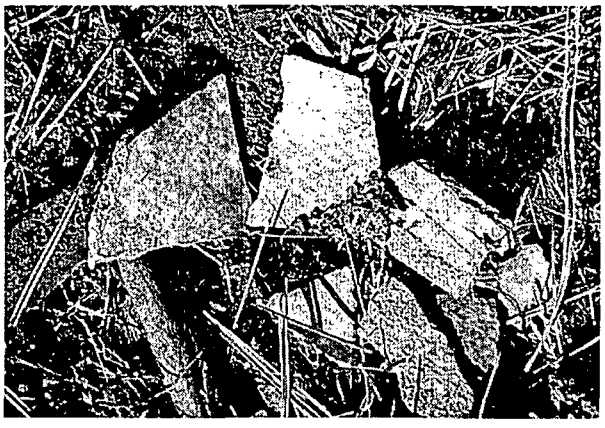
Counting fibers using the regulatory definitions does not adequately describe the risk of health effects, as fiber size, shape, and composition contribute collectively to risks in ways that are still being studied. For example, shorter fibers appear to preferentially deposit in the deep lung, but longer fibers might disproportionately increase the risk of mesothelioma [22, 30]. Fiber diameters greater than 2 μm are considered above the upper limit of respirability and do not contribute significantly to risk [30]. Methods are being developed to assess the risks posed by varying types of asbestos and are currently awaiting peer review.

EPA is currently working with several contract laboratories and others to develop, refine, and test a number of methods, such as PLM, infrared (IR) and SEM, for screening bulk soil samples.

Appendix B: Types of Asbestos-Containing Material found at the North Ridge Estates Subdivision

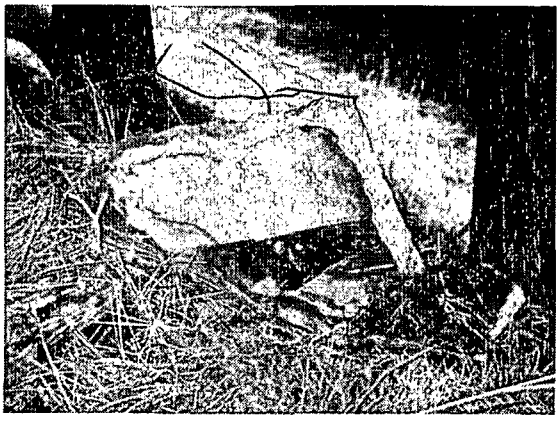
Cement Asbestos Board (CAB) was used as siding on the former Marine Barracks buildings. CAB is platy in shape with a light to dark brown color; some of the CAB at the site had been painted with light green and yellow paint.

Figure 6: Cement Asbestos Board



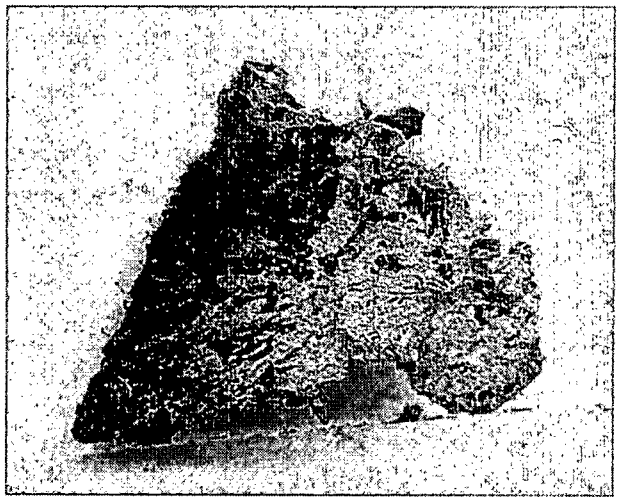
Vinyl floor tiles (VAT) are 9 by 9 inch tiles that were used on concrete and wooden floors of the former Marine Barracks buildings. Some tiles are red with white swirls, and others are blue. Broken VAT can come in many different platy shape sizes, and may have flat or curved shapes.

Figure 7: Vinyl Floor Tile



Roofing material from the former Marine Barracks buildings is gray and black (the black material is tar).

Figure 8: Roofing Material



Asbestos-containing steam pipe is located underground at the site from the former Marine Barracks steam power plant. The asbestos-containing steam pipe is a metal corrugated pipe (8 inches in diameter, in some places larger) wrapped in black felt paper (asbestos-containing). The inside of the corrugated pipe is lined with a black felt paper with about 2 inches of wooly material (90% asbestos). In the center of the wooly material is a metal pipe about 4 inches in diameter.

Figure 9: Asbestos-Containing Steam Pipe

Appendix C - **REDUCING YOUR EXPOSURE TO ASBESTOS**

WHAT IS ASBESTOS AND WHY SHOULD I BE CONCERNED ABOUT IT?

Asbestos is a naturally occurring mineral fiber that makes an excellent thermal and electrical insulator. It has been widely used in products and materials for over 50 years. New use of asbestos is banned in the US, because exposure to it is now known to cause diseases such as asbestosis, lung cancer, and mesothelioma. In general, the more asbestos a person is exposed to, the greater the risk of developing an asbestos-related disease. People are mainly exposed to asbestos through breathing in microscopic fibers in the air. For individuals living in areas contaminated with asbestos, there can be many ways to come into contact with fibers in the air. Exposures can happen in a variety of ways, from children playing in the dirt to asbestos containing dust from building construction to soil being tracked into homes.

WHEN IS ASBESTOS DANGEROUS?

Asbestos is only dangerous if it becomes airborne. As long as asbestos containing materials are not damaged, the fibers will not become airborne and do not pose a health threat. Asbestos containing materials pose a hazard when they are "friable", that is, when they are flaking or crumbling. These materials should not be disturbed, except by a certified asbestos abatement contractor.

HOW CAN I PREVENT EXPOSURE IF I HAVE A BURIAL SITE ON MY LAND?

To limit the potential for your family's exposure to asbestos, the following activity and property use restrictions should be strictly observed if there is an asbestos disposal site on your land.

- If you find any exposed asbestos, contact DEQ right away
- Do not dig in areas of asbestos or through the soil that covers it
- Do not plan land development with underground systems (including septic systems, sprinkler systems, and swimming pools) in the area of the burial site
- Do not plant trees and large shrubs on top of the burial site
- Do not plant vegetable or flower gardens on the burial site (unless you plant them in raised beds)
- If you have dogs that dig, do not tie them around the disposal area
- Do not drive motor vehicles, heavy equipment, or ATVs over the area
- Do not alter drainage patterns in a way that erodes any cover materials
- Regularly inspect the surface of the ground and look for any exposed asbestos
- Inspect the area for asbestos fragments after snow melt, heavy rain, dry weather, animal burrowing, and around tree bases near the site

How can I prevent EXPOSURE if I discover asbestos in the soil on my property?

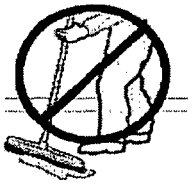
If asbestos is found on your property, the risk that it poses may or may not be significant. Risk depends on the concentration of asbestos and the length of time someone is exposed to airborne asbestos. The following steps will limit your exposure to asbestos you find in the soil.

- If the discovery is made during excavation activities, stop all work right away
- Take care not to walk through, drive through, touch or otherwise make direct contact with the material
- Keep pets and children away from the area, contact with the asbestos may contaminate skin and clothes
- For as long as asbestos is exposed, prevent access to the site
- Keep any exposed material moist
- Plant grass and small shrubs over bare soil areas in the yard

WHAT DOES ASBESTOS CONTAMINATION MEAN FOR MY HOME?

For homes built on or near contaminated soil, asbestos can be tracked into the home and can also enter as fibers suspended in outdoor air. Once these fibers are indoors, they can become airborne again through normal household activities, such as vacuuming (many fibers will simply pass through vacuum cleaner bags), walking on carpets, sweeping, and dry dusting. The following steps will help to minimize indoor exposure.

- Have family members and guests remove shoes at the door to reduce tracking in fibers (a major entry route of outdoor asbestos fibers)
- Use outside door mats to wipe feet
- Wash face and hands regularly, especially before meals
- Keep windows and doors closed on windy days and when soil may be disturbed, such as during construction
- Use a wet rag to dust all surfaces instead of a duster
- Use washable area rugs on your floors
- Do not dry sweep, but try wet mopping instead
- Consider fitting your vacuum with a High Efficiency Particulate Air (HEPA) filter



Don't Dry Sweep

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Appendix D - Glossary of Environmental Health Terms

ACM — Asbestos-containing material. ACM is any material, including particulate matter, that contains more than 1% asbestos as determined using polarized light microscopy (PLM).

Acute Exposure — Contact with a chemical that happens once or only for a limited period of time. ATSDR defines acute exposures as those that might last up to 14 days.

Adverse Health Effect — A change in body function or the structures of cells that can lead to disease or health problems.

Amosite Asbestos — A special form of the amphibole mineral that displays separable, long, thin fibers often arranged in parallel in a column or in matted masses. The fibers are generally strong enough and flexible enough to be spun and woven, are heat resistant, and are chemically inert.

Amphibole — A large group of silicate minerals with more than 40–50 members. The molecular structure of all amphiboles consists of two chains of SiO_4 molecules that are linked together at the oxygen atoms. In the earth's crust, amphibole minerals are mostly nonasbestiform; asbestiform amphiboles are relatively rare. See definitions of asbestiform and mineral.

Asbestiform — A habit of crystal aggregates displaying the characteristics of asbestos: groups of separable, long, thin, strong, and flexible fibers often arranged in parallel in a column or in matted masses. Mineralogists call asbestiform amphibole minerals by their mineral name followed by "asbestos." Thus, asbestiform amosite is called amosite asbestos.

Asbestos — A group of highly fibrous minerals with separable, long, thin fibers often arranged in parallel in a column or in matted masses. Separated asbestos fibers are generally strong enough and flexible enough to be spun and woven, are heat resistant, and are chemically inert. See definitions of fibrous and mineral. Currently, U.S. regulatory agencies recognize six asbestos minerals: the serpentine mineral, chrysotile; and five asbestiform amphibole minerals, actinolite asbestos, tremolite asbestos, anthophyllite asbestos, amosite asbestos (also known as asbestiform cummingtonite-grunerite), and crocidolite asbestos (also known as asbestiform riebeckite).

Asbestosis — Interstitial fibrosis of the pulmonary parenchymal tissue in which asbestos bodies (fibers coated with protein and iron) or uncoated fibers can be detected. Pulmonary fibrosis refers to a scar-like tissue in the lung which does not expand and contract like normal tissue. This makes breathing difficult. Blood flow to the lung can also be decreased, and

	this causes the heart to enlarge. People with asbestosis have shortness of breath, often accompanied by a persistent cough. Asbestosis is a slow-developing disease that can eventually lead to disability or death in people who have been exposed to high amounts of asbestos over a long period. Asbestosis is not usually of concern to people exposed to low levels of asbestos.
ATSDR	The **A**gency for **T**oxic **S**ubstances and **D**isease **R**egistry. ATSDR is a federal health agency in Atlanta, Georgia, that deals with hazardous substance and waste site issues. ATSDR gives people information about harmful chemicals in their environment and tells people how to protect themselves from coming into contact with chemicals.
Background Level	An average or expected amount of a chemical in a specific environment, or amounts of chemicals that occur naturally in a specific environment.
Cancer	A group of diseases which occur when cells in the body become abnormal and grow, or multiply, out of control.
Carcinogen	Any substance shown to cause tumors or cancer in experimental studies.
Chronic Exposure	A contact with a substance or chemical that happens over a long period of time. ATSDR considers exposures of more than one year to be *chronic*.
Chrysotile Asbestos	A fibrous member of the serpentine group of minerals. Chrysotile asbestos fibers are flexible and have a curved morphology. It is the most common form of asbestos used commercially, also referred to as white asbestos.
Completed Exposure Pathway	See **Exposure Pathway**.
Concentration	How much or the amount of a substance present in a certain amount of soil, water, air, or food.
Contaminant	See **Environmental Contaminant**.
Dermal Contact	A chemical getting onto your skin (see **Route of Exposure**).
Dose	The amount of a substance to which a person might be exposed, usually on a daily basis. Dose is often explained as "amount of substance(s) per body weight per day."
Dose / Response	The relationship between the amount of exposure (dose) and the resultant change in body function or health.

Duration	The amount of time (days, months, years) that a person is exposed to a chemical.
Environmental Contaminant	A substance (chemical) that gets into a system (person, animal, or the environment) in amounts higher than the **Background Level**, or what would be expected.
Environmental Media	Usually refers to the air, water, and soil in which chemicals of interest are found. Sometimes refers to the plants and animals eaten by humans. **Environmental Media** is the second part of an **Exposure Pathway**.
U.S. Environmental Protection Agency (EPA)	The federal agency that develops and enforces environmental laws to protect the environment and the public's health.
Epidemiology	The study of the different factors that determine how often, in how many people, and in which people will disease occur.
Exposure	Coming into contact with a chemical substance. (For the three ways people can come in contact with substances, see **Route of Exposure**.)
Exposure Assessment	The process of finding the ways people come in contact with chemicals, how often and how long they come in contact with chemicals, and the amounts of chemicals with which they come in contact.
Exposure Pathway	A description of the way a chemical moves from its source (where it began) to where and how people can come into contact with (or get exposed to) the chemical. ATSDR defines an exposure pathway as having five parts: 1. Source of contamination, 2. Environmental media and transport mechanism, 3. Point of exposure, 4. Route of exposure, and 5. Receptor population. When all five parts of an exposure pathway are present, it is called a **Completed Exposure Pathway**. Each of these five terms is defined in this Glossary.
Fiber	Any slender, elongated mineral structure or particle. For the purposes of counting asbestos fibers in air samples, regulatory agencies commonly count particles that have lengths >5 μm and length:width ratios >3:1 as fibers. For detecting asbestos fibers in bulk building materials, particles with length:width ratios >5:1 are counted as fibers.

Fibrous	A mineral habit with crystals that look like fibers. A mineral with a fibrous habit is not asbestiform if the fibers are not separable and are not long, thin, strong, and flexible.
Frequency	How often a person is exposed to a chemical over time; for example, every day, once a week, twice a month.
Friable ACM	Friable asbestos-containing material is any asbestos-containing material that can be crumbled, pulverized or reduced to powder by hand pressure when dry. Friable asbestos material includes any asbestos-containing material that is shattered or subjected to sanding, grinding, sawing, abrading, or has the potential to release asbestos fibers.
Hazardous Waste	Substances that have been released or thrown away into the environment and, under certain conditions, could be harmful to people who come into contact with them.
Health Consultation (HC)	A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with **Public Health Assessment**].
Health Education	Programs designed with a community to help the community know about health risks and how to reduce these risks.
Health Effect	ATSDR deals only with **Adverse Health Effects** (see definition in this Glossary).
Indeterminate Public Health Hazard	The category used in Public Health Assessment documents for sites where important information is lacking (missing or has not yet been gathered) about site-related chemical exposures.
Ingestion	Swallowing something, as in eating or drinking. It is a way a chemical can enter your body (see **Route of Exposure**).
Inhalation	Breathing. It is a way a chemical can enter your body (see **Route of Exposure**).
Interstitial	A term used as an adjective relating to spaces within a tissue or organ. Pulmonary interstitial fibrosis refers to fibrosis (scarring) developing within lung tissue.
Mesothelioma	Cancer of the thin lining surrounding the lung (the pleura) or the abdominal cavity (the peritoneum). Mesotheliomas are rare cancers in

	the general population.
Mineral	Any naturally occurring, inorganic substance with a crystal structure.
MRL	Minimal Risk Level. An estimate of daily human exposure—by a specified route and length of time—to a dose of chemical that is likely to be without a measurable risk of adverse, noncancerous effects. An MRL should not be used as a predictor of adverse health effects.
NESHAP	National Emission Standards for Hazardous Air Pollutants are EPA emission standards for hazardous air pollutants.
No Apparent Public Health Hazard	The category is used in ATSDR's Public Health Assessment documents for sites where exposure to site-related chemicals could have occurred in the past or is still occurring but the exposures are not at levels expected to cause adverse health effects.
No Public Health Hazard	The category used in ATSDR's Public Health Assessment documents for sites where there is evidence of an absence of exposure to site-related chemicals.
NPL	The National Priorities List is a list kept by EPA of the most serious uncontrolled or abandoned hazardous waste sites in the country. An NPL site needs to be cleaned up or at least looked at to see if people can be exposed to chemicals from the site.
Oregon Department of Environmental Quality (ODEQ)	The state agency that develops and enforces environmental laws to protect the environment and public health.
ODHS – Oregon Department of Human Services	The state public health agency; ODHS has a cooperative agreement with ATSDR to conduct health assessments and consultations at Superfund/NPL and other hazardous waste sites in Oregon.
Parenchymal	Cells in a tissue or organ that are responsible for the function of the tissue or organ.
PLM	Polarized Light Microscopy is standard method used to quantify asbestos fibers.
Pleura	A thin lining or membrane around the lungs or chest cavity. This lining can become thickened or calcified in asbestos-related disease.
Pleural	Having to do with or involving the pleura.

Pleural calcification	As a result of chronic inflammation and scarring, pleura becomes thickened and can calcify (or harden). White calcified areas can be seen on the pleura by x-ray.
Pleural cavity	The cavity, defined by a thin membrane (the pleural membrane or pleura), which contains the lungs.
Pleural effusion	Cells (fluid) can ooze or weep from the lung tissue into the space between the lungs and the chest cavity (pleural space) causing a pleural effusion. The effusion fluid can be clear or bloody. Pleural effusions might be an early sign of asbestos exposure or mesothelioma and should be evaluated.
Pleural plaques	Localized or diffuse areas of thickening of the pleura (lining of the lungs) or chest cavity. Pleural plaques are detected by chest x-ray, and appear as opaque, shiny, and rounded lesions.
Pleural thickening	Thickening or scarring of the pleura that might be associated with asbestos exposure. In severe cases, the normally thin pleura can become thickened like an orange peel and restrict breathing.
Point of Exposure	The place where someone can come into contact with a contaminated environmental medium (air, water, food, or soil). Some examples include the area of a playground that has contaminated dirt, a contaminated spring used for drinking water, or the backyard area where someone might breathe contaminated air.
Public Health Assessment (PHA)	An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with **Health Consultation**].
Public Health Hazard	The category is used in PHAs and HCs for sites with certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects.
Public Health Hazard Criteria	PHA/HC categories given to a site which tell whether people could be harmed by conditions at the site. Each are defined in the Glossary. The categories are: ▪ Urgent Public Health Hazard ▪ Public Health Hazard ▪ Indeterminate Public Health Hazard ▪ No Apparent Public Health Hazard ▪ No Public Health Hazard

Pulmonary interstitial fibrosis	Scar-like tissue that develops in the lung parenchymal tissue in response to inhalation of dusts of certain types of substances such as asbestos.
Route of Exposure	The way a chemical can get into a person's body. The three exposure routes are: ▪ breathing (also called inhalation), ▪ eating or drinking (also called ingestion), and ▪ getting something on the skin (also called dermal contact).
SHINE	Superfund **H**ealth **In**vestigation and **E**ducation program. The Oregon Department of Human Services program that works with communities and agencies to evaluate and prevent health effects from exposure to hazardous substances.
Source (of Contamination)	The place where a chemical comes from, such as a landfill, pond, creek, incinerator, tank, or drum. Contaminant source is the first part of an **Exposure Pathway**.
Superfund	See **NPL.**
Toxic	Harmful. Any substance or chemical can be toxic at a certain dose (amount). The dose is what determines the potential harm of a chemical and whether it would cause someone to get sick.
Toxicology	The study of the harmful effects of chemicals on humans or animals.
Tumor	Abnormal growth of tissue or cells that have formed a lump or mass.
Urgent Public Health Hazard	This category is used in ATSDR's Public Health Assessment documents for sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects. This category requires quick intervention to stop people from being exposed.

Appendix E – Responses to Public Comments

All comments to the health consultation report are reproduced here in their entirety.

The only comments submitted on the health consultation were from Kennedy/Jenks Consultants on behalf of the Klamath Falls Homeowners Coalition, which represents residents of 13 homes in the North Ridge Estates subdivision.

1. *We appreciate the hard work that obviously went into the [health consultation], and overall agree with the conclusions. However, we have a few minor comments that we feel should be addressed in the [health consultation]. They are discussed below.*

Response: We appreciate receiving your comments. Responses to each comment are addressed below.

2. *The discussion in the Health Issues section on page 2 mentions other possible contaminants at the site, including lead from lead-based paint (LBP); however, the Health Effects Evaluation section on page 9 does not address the potential for lead exposure health effects, particularly effects on developing children. The discussion should also consider the potential additive effects of asbestos and lead exposure (lead is classified as B2, a probable human carcinogen). Likewise, North Ridge Estates is located in an area with exposed volcanic rock that may have elevated levels of naturally occurring arsenic. We trust that the health assessment will be updated to reflect these concerns when site-specific information on lead and arsenic is available. Meantime, please consider these potential risks in the ranking of the current health risk.*

Response: A health consultation (HC) generally addresses one specific question at a site. At North Ridge Estates, the specific request by ODEQ was the evaluation of health impacts from exposure to asbestos in ACM in soil, piping, and burial sites. As we learned during site investigation that lead-based paint was used in the demolished barracks buildings, ODHS added a recommendation to the HC that soil be sampled for lead contamination. Lead sampling was completed in July 2003 as part of the EPA removal action. In July 2003, ODHS reviewed the draft lead sampling results and sent EPA a memo an initial evaluation of the lead sampling results. SHINE developed and distributed a fact sheet and gave a presentation on the lead sampling results to the North Ridge Estates community at a public meeting in January 2004. The lead sampling memo, lead sampling fact sheet, and other information (including brochures on "Reducing Your Exposure to Heavy Metals" and "Reducing Your Exposure to Asbestos") are available on the SHINE website - www.healthoregon.org/superfund.

3. *The Health Issues discussion on page 9 mentions the construction workers who performed demolition of the original buildings and moved material around for burial; the excavation workers who prepared the site for construction; and the construction workers. These workers had the potential for short-term, higher level exposure to asbestos (and potentially the other contaminants mentioned above). Although this group is mentioned on page 9, their conditions of exposure are not addressed in other parts of the document, as are the potential exposure of residents. These types of exposure should be more thoroughly discussed.*

Response: After soil sampling results are available, ODHS/SHINE will complete a health consultation that will evaluate the health effects from exposure to asbestos in soil at the site. Exposure to asbestos by construction workers will be evaluated in more detail in this subsequent HC. Air monitoring at the time of demolition in 1979 would have provided key information, but to our knowledge, no air monitoring was conducted.

4. *The Health Issues section on page 2 and other parts of the HC state that the principal mechanism of the asbestos release was demolition of the structures. Based on site visit observations and other records, it appears that a large volume of the construction debris was also burned onsite. Burning asbestos and lead containing debris could have resulted in larger area releases of contaminants, release of fibers from their matrix (especially burning of asbestos-containing asphalt roofing materials), and release of lead fumes and soot.*

Response: The HC has been modified to add that neighbors have reported past burning of ACM. At this time, however, the frequency and amount of ACM burned at the subdivision is unknown, and we have received very little input from residents on burning activities at the site. Lead sampling completed by EPA indicates that the soil at residences does not contain lead at levels that would cause adverse health effects and that there is not an elevated health risk from exposure to lead in soil at North Ridge Estates.

5. *The HC should consider the potential that, given the age of the structures, "Galbestos" type products made from asbestos bound with polychlorinated biphenyls (PCBs) and PCB-containing paint may have been present in the building materials. Also, PCB containing transformers and fluorescent light ballasts may have been used and disposed or burned at North Ridge Estates. Hence, testing for PCBs should be included in the recommendations and considered in the health assessment.*

Response: SHINE has found no evidence at this time to prove or disprove that "galbestos type" products and PCB-containing paint were used in buildings at the site. There is evidence, however, that transformers had been used at certain areas of the subdivision, and the HC has been modified to add this information. As part of its time-critical removal action, EPA conducted an initial screening for PCBs in the former locations of the transformers. Based on soil screening tests and on seeing no physical evidence of PCBs on surface soil, EPA has concluded that it is highly unlikely that PCBs were used in transformers at the site [9].

6. *The response to the question on page 11 regarding exposure to children visiting North Ridge Estates does not include the potential of exposure to dust inside the house. The parent may be left with the impression that if the child stays inside and does not play out in the lot, he/she would not be exposed. This may mislead parents to believe that there is no exposure risk indoors. Please consider revising this response to indicate that the indoor exposure risk is not known at this time.*

Response: The HC mentions in several sections (including the sections on Children Health Risks, Sampling, and Appendix C – "Reducing Your Exposure to Asbestos") the potential exposure to asbestos in dust and ways to reduce those exposures. Dust sampling has been conducted as part of the EPA TCRA, and the sampling results will be reviewed in the follow-up HC after SHINE receives those results.

7. *The Recommendations section of page 12 and the Public Health Action Plan on page 13 do not include sampling of indoor settled dust. Please consider adding this recommended action to resolve the resident's concern over indoor exposures.*

Response: Dust sampling has been conducted as part of the EPA TCRA, and the sampling results will be reviewed in the follow-up PHC after SHINE receives those results. As no soil sampling data has been analyzed for asbestos, our primary concern was that sampling of soil be completed immediately.

8. *The section on Current Standards, Regulations, and Recommendations for Asbestos, beginning on page 18, does not discuss the Asbestos Hazard Emergency Response Act (AHERA) clearance sampling acceptance threshold of 0.01 fibers per cubic centimeters (f/cc) by phase contrast microscopy or 70 structures per square millimeter by transmission electron microscopy, which is roughly equivalent to 0.02 f/cc. This standard was set for schools and presumably attempts to take into account health risks for children. However, like the Occupational Safety and Health Administration (OSHA) permissible exposure limit, this clearance level should not necessarily be applied to residential exposures at North Ridge Estates. Risk-based site-specific air quality criteria should be developed that takes into account the age of receptors, the duration of exposure, and the overall lifetime risk from the exposure.*

Response: The HC has been revised to include information on AHERA standards as suggested. AHERA, however, is not a health-based standard, but is based on background air contamination levels determined through use of filters that were available in 1987. Filters used today show background contamination to be considerably less than the AHERA standard of 70 structures/mm^2, however the AHERA standard has not been revised [29]. Health risk standards that will be used to evaluate air and soil sampling data will take into account "the age of receptors, the duration of exposure, and the overall lifetime risk from exposure."

9. *Given the concerns above and the risks outlined in the HC, we feel that the HC should conclude that the North Ridge Estates site presents an "Urgent Public Health Hazard," rather than just a "Public Health Hazard." We feel that the hazard is urgent because of the potential for ongoing exposure to sensitive receptors and the ever-increasing lifetime risk to residents that continues to mount with each passing day that residents are exposed to asbestos and other substances of concern while awaiting action by the responsible parties.*

Response: The ATSDR public health hazard categories have specific criteria that were used for the determination. A "public health hazard" is a "site with certain physical features or evidence of chronic, site-related chemical exposure that could result in adverse health effects."
An "urgent public health hazard" is a "site that has certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects. This category requires quick intervention to stop people from being exposed."
No soil, air, or dust sampling results were available to indicate whether there is or was an "urgent" public health hazard at the site. There was evidence, however, that friable ACM fragments were scattered and buried throughout the site. As residents do not directly handle large quantities of these fragments on a frequent basis, and as residents could take efforts to avoid

contact with ACM, the site was not determined at this time to be an "urgent" public health hazard.

Certification

The Superfund Health Investigation and Education Program of the Oregon Department of Human Services prepared the North Ridge Estates Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. This document is in accordance with approved methodology and procedures.

John R. Crellin, Ph.D.
Technical Project Officer for Oregon, SSAB, DHAC

I have reviewed this health consultation, as the designated representative of the Agency for Toxic Substances and Disease Registry and concur with its findings.

Roberta Erlwein
Leader, Cooperative Agreement Team, SSAB, DHAC