Health Consultation

YERINGTON ANACONDA MINE SITE
(A/K/A ANACONDA MINE)

YERINGTON, NEVADA

EPA FACILITY ID: NVD083917252

AUGUST 22, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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HEALTH CONSULTATION

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Prepared By:

Office of Tribal Affairs
Federal Facilities Assessment Branch
Division of Health Assessment and Consultation
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

Table of Contents

Statement of Issues and Background

In July, 2004, the Yerington Paiute Tribe (YPT) requested that the Agency for Toxic Substances and Disease Registry (ATSDR) conduct a public health assessment of the Yerington Anaconda Mine site (YAM). The assessment's purpose was to determine whether exposure to mine site contaminants adversely affected the health of tribal and community members living nearby. In March, 2005, a group of concerned citizens organized as the Yerington Community Action Group (YCAG) also requested that ATSDR conduct a community health assessment of possible adverse health effects from exposure to mine-related contaminants.

In response to these requests, ATSDR obtained and reviewed a number of reports and data sets related to environmental monitoring of the YAM site. ATSDR also visited the YAM site and surrounding Yerington community. As part of the site visit, ATSDR held two public sessions that provided community members the opportunity to tell ATSDR representatives of any specific health concerns related to potential exposures from the YAM site. This health consultation summarizes ATSDR's findings regarding the potential community exposures to YAM-contaminants, provides recommendations related to ongoing environmental monitoring of those contaminants, and provides an outline of future health assessment actions that ATSDR will undertake for this community.

Background

The YAM site is an inactive copper mine and processing facility in Mason Valley, Lyon County, Nevada (Figure 1). The site is located approximately 1 mile west of the Town of Yerington and about 2.5 miles south of the Yerington Paiute Tribe Reservation. The site comprises 3,468 acres of disturbed land and buildings with approximately one-half of the site privately owned, and the remaining half within the custody and control of the Bureau of Land Management (BLM). Agricultural fields (alfalfa and onions) and residential lots are directly adjacent to the site boundary on the north, and commercial and residential properties along Highway 95 bound the facility to the south and east. Most of the area west of the site is the sparsely populated Singatse Range. The former site worker community of Weed Heights is however, currently occupied as rental housing.

Demographic Information for Potentially Affected Areas

Figure 1 shows an estimate of the number of people living within 1 and 3 miles of the YAM site boundary. Approximately 2,250 people live within 1 mile of the site boundary and about 5,730 people within 3 miles. Most of these people live in the town of Yerington, to the east and southeast of the mine site. Although the areas to the west and north are more sparsely populated, residential development is currently underway north of the mine site.

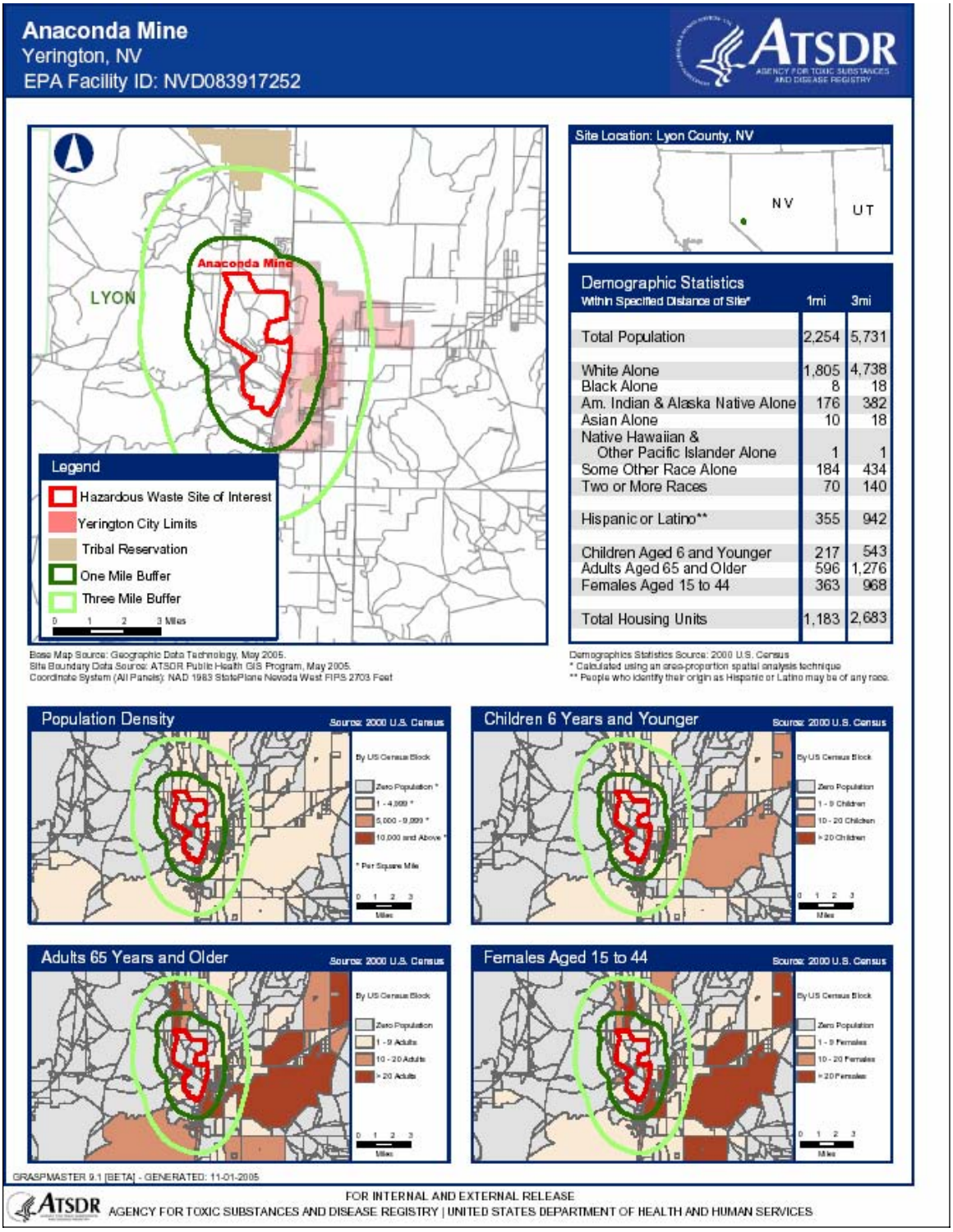

Figure 1. Population characteristics of the area adjacent to the Yerington Anaconda Mine site, Yerington Nevada.

Figure 1 also shows that the adjacent population includes about 175 members of the Yerington Paiute Tribe living in the Yerington Colony (east of the mine site) and about 400 tribal members living on the reservation north of the site (Figure 1). Figure 1 also shows the relative number of people in each area who may be especially susceptible to adverse health effects from exposure to hazardous substances. This population includes young children, older adults (aged 65 and older), and females of child-bearing age (15–44 years).

Facility History and Operations

The site began operations around 1918 as the Empire Nevada Mine (EPA 2005). It was acquired and operated by the Anaconda Mining Corporation beginning in 1953. In 1977, the Atlantic Richfield Company (ARC) bought the Anaconda Mining Corporation. ARC terminated mining operations at the YAM site in 1978 and in 1982 sold its lands to private interests (EPA 2005). The lands were subsequently resold (with the exception of Weed Heights) to Arimetco, Inc. With the exception of the federally controlled lands (BLM) and Weed Heights, Arimetco is the current owner of the YAM site. From 1989 until 1999 Arimetco reprocessed the tailings piles to recover copper. Arimetco terminated reprocessing operations in 1999 and is currently under the protection of the United States Bankruptcy Court in Tucson, AZ (EPA 2005).

Facilities associated with mining operations at the site include a (currently flooded) open pit mine, various operational and abandoned buildings, tailings piles, leachate holding ponds, and the currently occupied residential area (Weed Heights). The ore processing facilities include a network of leach vats, heap leaching pads, an electro-winnowing plant, and evaporation ponds (EPA 2005).

During the 25-year period that Anaconda and ARC operated the mine, it removed approximately 360 million tons of material from the mine pit, most of which remains in tailings or in leach heap piles. Copper was processed from the extracted ore using two distinct processes (USGS 1982). Copper oxide ore (from the upper portion of the pit) was either leached directly with sulfuric acid in large vats to produce a copper solution precipitated by passing it over scrap iron, or it was leached successively in acid and kerosene solutions with subsequent electroplating onto stainless steel sheets. Copper sulfide ores (from the lower portion of the pit) were processed by crushing, and the copper sulfide particles were recovered by flotation, during which calcium oxide was added to the solution to maintain an alkaline pH (USGS 1982).

Both types of ore processing resulted in large quantities of either acidic or alkaline leachate fluids that were transferred to evaporation ponds covering a total of 1,377 acres. Although fluids from these ponds were collected for reuse, it is likely that contaminants from these ponds—some asphalt lined, others unlined—have migrated into the underlying groundwater system (USGS 1982; Anaconda Minerals Co. 1983).

In addition to Anaconda and ARC's vat processing, Anaconda and Arimetco, Inc. also reprocessed the tailings piles by leaching with an acid solution to produce a copper leachate solution. This leachate was collected from the heap leach pads and, after the original processing, processed to extract the copper remaining in the tailings. The leach heaps/tailings piles continue to produce acidic leachate (EPA 2005).

Community Health Concerns

As part of its site-specific health assessment process, ATSDR often conducts public availability meetings to provide community members an opportunity to discuss health concerns that could be site-related. These confidential discussions provide ATSDR staff local knowledge about site conditions and potential releases that are then addressed in subsequent public health activities.

This health consultation summarizes these community health concerns, which were collected at two ATSDR-sponsored meetings held in the Yerington area (August 2nd and 4th, 2005), and, as noted, during an EPA-sponsored meeting (August 3, 2005). Some comments were also received via written correspondence and telephone conversations between community members and ATSDR staff.

Although these concerns were expressed in a variety of ways, they are summarized here as six general topics or issues (Table 1). The approximate locations that prompted the concerns, as communicated to ATSDR staff, are shown in Figure 2. This map shows that people living near the YAM site have a number of both general and specific concerns about the air and water migrating to their residences and potentially affecting their health.

In addition to the health concerns related to people living near the site, several people have provided anecdotal observations regarding the health issues of former mine workers. Although this concern is somewhat beyond the specific scope of this health consultation, ATSDR will review a pending survey of former mine workers to determine if additional evaluation is warranted.

The following sections of this health consultation specifically address the other five health concerns summarized in Table 1. The "ATSDR comment" column also indicates how ATSDR will address the concerns. Although this health consultation does evaluate the potential for adverse health effects from exposure to groundwater and airborne contaminants from the YAM site, the monitoring data currently available for making these determinations appear to have significant limitations. Consequently, this health consultation should be considered preliminary, and additional evaluations will be conducted as more reliable data become available.

Table 1. Community health concerns related to the Yerington Anaconda Mine site, Yerington, NV.

Community Concern	*ATSDR Comment*
Potential exposure to contaminated groundwater	Groundwater flow is generally north to northwest from the mine site towards a number of private residential drinking water wells. Mine operations resulted in contaminated on-site groundwater that has probably migrated off site. Past groundwater monitoring data are not adequate to evaluate whether exposure at the off-site wells has or may occur. Upon receipt of additional information, a future ATSDR health consultation will address this issue.
Potential exposure to dust or airborne contaminants from mine-site. This concern also includes potential contamination of off-site soils due to deposition of airborne contaminants.	The direction of the strongest winds is towards the north and northeast at the YAM site. The tailings piles and evaporation ponds represent a potential source of suspendable air particulates, including various metals and respiratory irritants such as sulfates and sulfides. These particles are only likely to become airborne during peak wind events. Current air monitoring programs designed to assess long-term average conditions are not adequate to evaluate short-term conditions. Upon receipt of additional sampling data during wind events, a future ATSDR health consultation will address this issue.
Adequacy of groundwater and air monitoring activities	As noted above, ongoing air and groundwater monitoring programs have significant limitations for assessing potential past and future exposures to the off-site community. This health consultation includes recommendations for exposure-specific monitoring activities.
Site access restrictions and on-site physical hazards	The YAM site contains major on-site physical hazards and contaminated areas that may present acute hazards for unauthorized visitors. Improvements to current access restrictions are in progress.
Specific diseases from past exposures	Locations of disease-concern areas are indicated in Figure 2. Although some of the specific disease concerns communicated to or observed by ATSDR staff are plausible health outcomes for the contaminants present in the YAM site area, ATSDR has not determined that any specific health outcomes are related to releases from the YAM facility. ATSDR has completed health education training for the Yerington medical community to improve medical diagnoses of potential contaminant exposures. Further evaluation of potential contaminant-specific exposures will be conducted in the air and groundwater health consultations.
Specific diseases in former mine workers	The YCAG is currently conducting an informal survey of health concerns of former mine workers. ATSDR has provided comments on the survey process and will review the results in order to determine if additional evaluation is warranted.

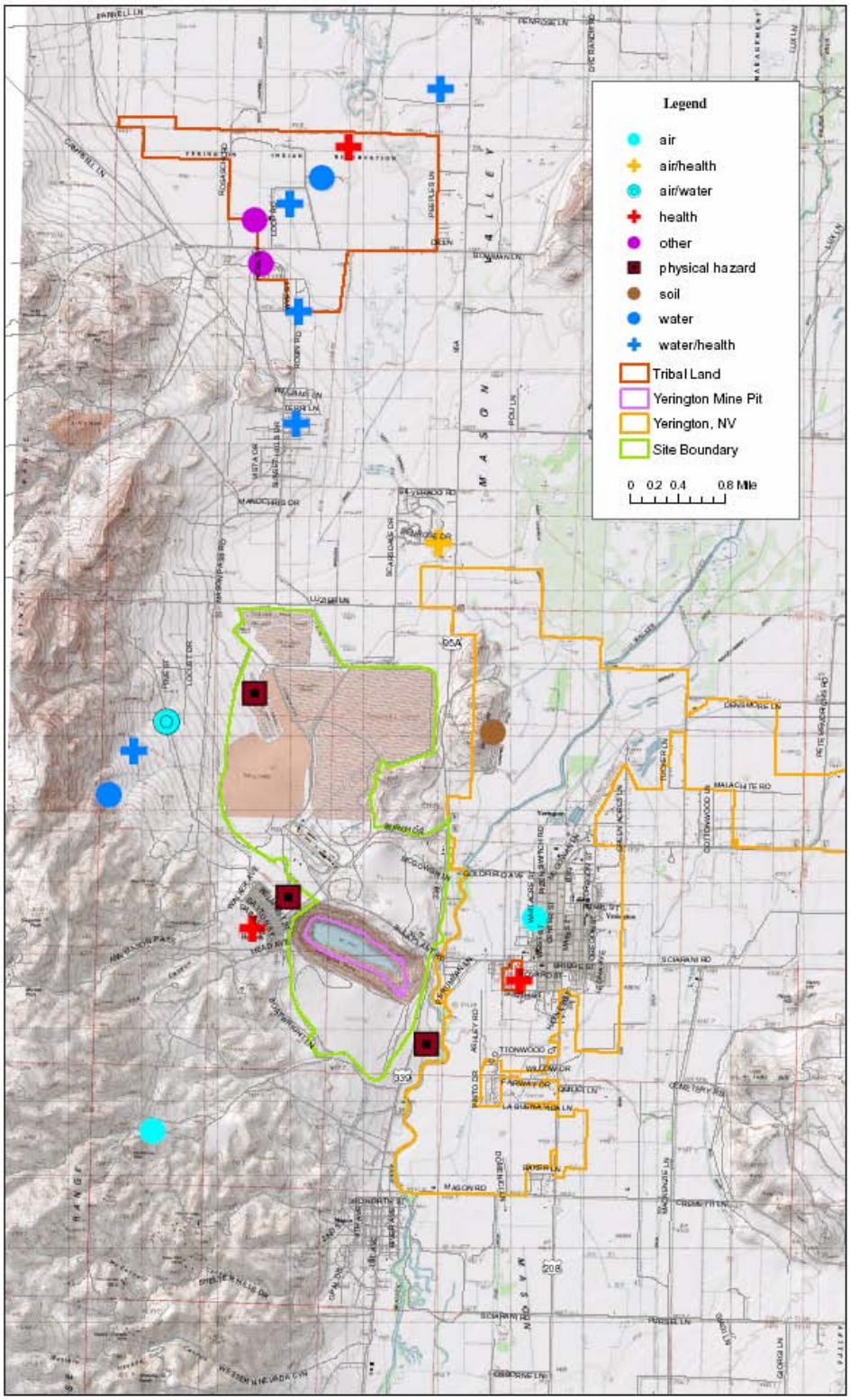

Figure 2. Approximate locations and types of community health concerns related to the YAM site. These symbols show locations of concerns identified by community members.

Groundwater Contamination

The United States Geological Survey study of groundwater downgradient of the YAM site established the general geologic and hydrogeologic conditions of this area (USGS 1982). Groundwater occurs primarily in unconsolidated sedimentary deposits that overlie consolidated igneous bedrock (USGS 1982). The sedimentary deposits consist of relatively permeable sand and gravel alluvial deposits along the west margin of the valley. These alluvial deposits are interbedded with clay, silt, and fine sand from stream and lake deposits that become more frequent toward the valley floor. Additional details on the geology of the YAM site and surrounding area are reviewed in several documents (USGS 1982; Anaconda Minerals Co. 1983; ARC 2005c)

Groundwater in the Mason Valley is primarily recharged by downward percolation from the Walker River and associated irrigation ditches and irrigated fields. In general, the groundwater flow direction also follows the northward-flowing Walker River. Localized groundwater flow directions are, however, also affected by drawdown from pumped wells. During the operational period of the mine, extensive pumping to dewater the mine pit and produce water for mine operations substantially lowered groundwater levels under the YAM site and caused groundwater to flow towards the pumping wells (USGS 1982). The net effect of this groundwater flow reversal during this time period would be to limit the northward migration of contaminants.

USGS (1982) documented the resumption of normal (pre-pumping) northward groundwater flow after mining operations ceased in the late 1970s. Although groundwater levels under the YAM site have apparently recovered to pre-pumping levels, ongoing evaporation of water from the pit lake lowers the pit water level below the surrounding area (ARC, 2003). Because evaporation greatly exceeds precipitation, the pit lake must still receive a localized southward flow of groundwater (ARC 2005). Also, ongoing pumping of mine site perimeter wells, and agricultural irrigation well-pumping in the fields immediately north of the YAM site, create area(s) of localized groundwater drawdown and may intercept some of the northward migrating groundwater contaminants from the mine site.

USGS (1982) and Anaconda Minerals Co. (1983) reports both document that in the early 1980s mine-related groundwater contaminants were present in wells immediately north of the mine boundary. That said, the more recent groundwater monitoring data evaluated in this health consultation are not adequate to determine how far northward (downgradient) mine-related contaminants have migrated. An ongoing monitoring program should provide useful information for such an evaluation (data from this program are expected in 2006).

Subsurface leachate from on-site sources such as the tailings piles and the evaporation ponds probably represent the largest source of groundwater contaminants. Anecdotal observations indicate that in the past, process wastes may have been released to the Wabuska Drain. If so, this irrigation drainage ditch may have been an off-site source of groundwater contamination. As water in the ditch flowed northward, it would recharge the underlying shallow aquifer. Any contaminants would enter the groundwater flow system downgradient of the mine site.

Although the available groundwater monitoring data are not adequate to determine the source of contaminants present in drinking water wells down-gradient of the YAM site, the data are sufficient to provide an initial assessment of the public health implications of water consumption from those wells. At least three rounds of groundwater sampling have occurred from the residential drinking water wells around the YAM site. The analytical results of these sample events (December 2003, March and June 2004) have been electronically transmitted to ATSDR

as a series of Excel© spreadsheets. These data sets contain little sample documentation and little quality control/assurance information. Consequently, it is difficult to determine whether these data are spatially representative of down-gradient groundwater contaminant concentrations. Appendix A on "Groundwater Data Needs" briefly presents the data requirements for a more comprehensive public health assessment of Mason Valley groundwater contaminant concentrations.

In addition to the domestic water well sampling in those data sets, shortly after Anaconda/ARC ceased mining operations in the late 1970s the United States Geological Survey completed an assessment of groundwater conditions in the same area (USGS 1982). Applied Hydrology Associates also conducted groundwater analyses for the Anaconda Minerals Company in the same area and in the same time frame (Anaconda Minerals Co. 1983). More recent groundwater sampling data are also available for on-site monitor wells. Assuming that these collective data are representative of groundwater contaminant concentrations in the YAM site area, they do provide an initial basis for a public health determination of exposure to groundwater downgradient of the YAM site.

Table 2 lists seven contaminants detected in drinking water wells in the area north of the YAM site, the range of concentrations measured, and the respective health comparison values for each contaminant. Health comparison values (CVs) are calculated concentrations of a substance in air, water, food, or soil that are unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in concentrations greater than their CVs are further evaluated in the public health assessment process.

The monitoring data also included 35 other elements and chemical parameters (such as pH and alkalinity) and four other radioisotopes (or activities). None of these 39 other parameters had analytical measurements above their respective comparison values. The seven listed contaminants were measured at concentrations above their respective comparison values. The health implications of exposure to these contaminants are further evaluated in the following sections.

The locations of drinking, irrigation, and monitoring wells downgradient of the YAM site are shown in Figure 3. This figure also shows the locations of wells with uranium concentrations greater than the 30 µg/L comparison value. Very few wells had measured uranium concentrations above 30 µg/L. Whether all wells were analyzed for uranium is unknown. The analytical data provided to ATSDR do indicate that all downgradient wells (figure 3) were not tested for all analytes.

ATSDR understands that people with well water uranium concentrations greater than 25 µg/L are currently provided with bottled water. Prior to receiving bottled water those people were consuming well water with contaminant concentrations as listed in Table 2. Additionally, people continue to use well water for other purposes such as bathing, cleaning, and irrigation. Several people participating in the ATSDR public availability sessions questioned whether such nonpotable uses were safe. The following sections provide a brief overview of the potential health effects associated with ingestion of the seven contaminants with concentrations greater than their respective CVs.

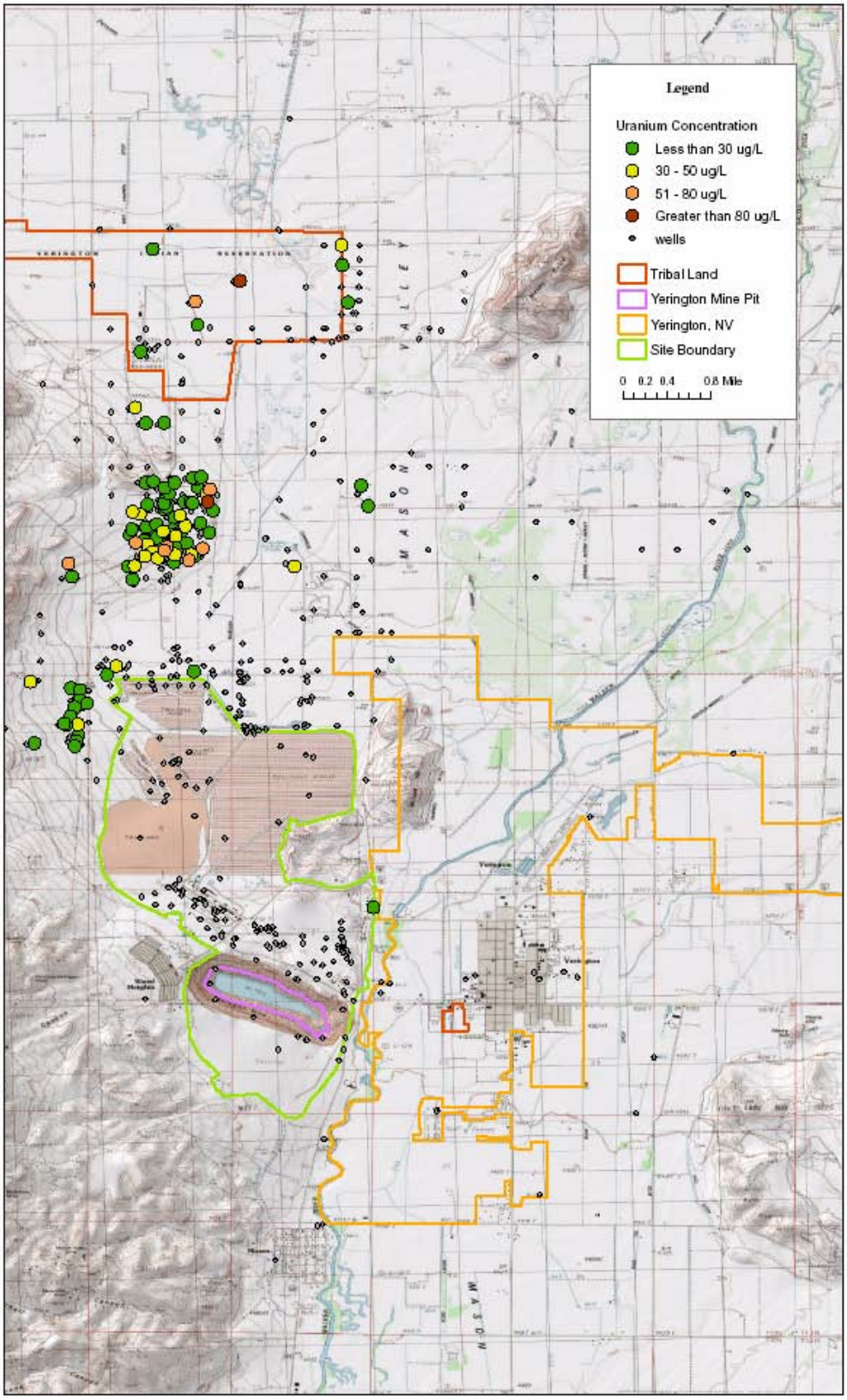

Figure 3. Locations of residential, agricultural, and monitoring wells around the YAM site. Offsite wells that have been analyzed for, and detected uranium are shown as colored circles. Not all wells have had uranium analyses. Green circles represent uranium detections below the drinking water standard (30 µg/L).

Table 2. Concentrations and health comparison values of groundwater contaminants in drinking water wells downgradient of the YAM site, Yerington NV.

Contaminant	*Concentration range*	*Comparison value**	*Estimated dose†*
Arsenic	5—24 µg/L	10 µg/L MCL 3 µg/L RMEG $_{child}$	0.0007 mg/kg/day (adult) 0.0015 mg/kg/day (child)
Boron	160—270 µg/L	100 µg/L EMEG $_{inter/child}$	0.0063 mg/kg/day (child)
Fluoride	130—870 µg/L	600 µg/L RMEG $_{child}$	0.054 mg/kg/day (child)
Uranium	3—107 µg/L	30 µg/L MCL	0.0067 mg/kg/day (child)
Thorium	Non-Detect	None	None; see text for discussion
Radium 226 Radium 228	ND—1.2 pCi/L ND—2.7 pCi/L	5 pCi/L MCL	3 mrem/year
Gross alpha	8—78 pCi/L	15 pCi/L MCL	See discussion

MCL—Maximum contaminant level: The maximum permissible level of a contaminant in water delivered to any user of a public system. MCLs are enforceable standards under the Safe Drinking Water Act.

RMEG-- Reference Media Evaluation Guide (RMEG): A concentration in air, soil, or water below which noncancer health effects are not expected to occur. RMEGs are derived from EPAs Reference Dose or Reference Concentration, and are for chronic exposures.

EMEG—Environmental media evaluation guide: A concentration in air, soil, or water below which no adverse noncancer health effects are expected to occur. EMEGs are derived from ATSDR's Minimal Risk Level (MRL), and are expressed for acute, intermediate (14–365 days), and chronic exposures. They are used in selecting environmental contaminants for further evaluation.

*Comparison value-- A concentration of a given contaminant in soil, water, or air below which no adverse human health effects are expected to occur. Comparison values are used by ATSDR health assessors to select environmental contaminants for further evaluation and can be based on either carcinogenic effects or noncarcinogenic effects.

†Dose (for nonradioactive chemicals): The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (substance) per kilogram (body weight) per day (or mg/kg/day) when people eat or drink contaminated water, food, or soil.

Arsenic

Arsenic is an element that is widely distributed in the earth's crust (this summary is derived from the ATSDR toxicological profile on arsenic, ATSDR 2005). Elemental arsenic is ordinarily a steel grey, metal-like material that occurs naturally. Arsenic is, however, usually found in the environment combined with other elements such as oxygen, chlorine, and sulfur. Arsenic combined with these elements is called inorganic arsenic. Arsenic combined with carbon and hydrogen is referred to as organic arsenic. Inorganic arsenic occurs naturally in soil and in many kinds of rock, especially in minerals and ores that contain copper or lead. Consequently, inorganic arsenic also occurs naturally in groundwater in many areas, including the area downgradient of the YAM site (and throughout Mason Valley).

Since ancient times inorganic arsenic has been recognized as a human poison, and large oral doses (above 60,000 ppb in food or water) can result in death. If lower levels of inorganic arsenic (ranging from about 300 to 30,000 ppb in food or water) are swallowed, irritation of the stomach and intestines may result, with symptoms such as stomachache, nausea, vomiting, and diarrhea. Other effects from swallowing inorganic arsenic include decreased production of red and white blood cells, which may cause fatigue, abnormal heart rhythm, blood-vessel damage resulting in

bruising, and impaired nerve function causing a "pins and needles" sensation in the hands and feet.

Perhaps the single most characteristic effect of long-term oral exposure to inorganic arsenic is a pattern of skin changes. These include a darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso, and are often associated with changes in the blood vessels of the skin. A small number of the corns may ultimately develop into skin cancer. If someone has direct skin contact with inorganic arsenic compounds, that person's skin may become irritated, with some redness and swelling. It does not appear however that skin contact is likely to lead to any serious internal effects.

Swallowing arsenic has also been reported to increase the risk of cancer in the liver, bladder, kidneys, prostate, and lungs. The Department of Health and Human Services (DHHS) has determined that inorganic arsenic is a known human carcinogen. The International Agency for Research on Cancer (IARC) has determined that inorganic arsenic is carcinogenic to humans. EPA also has classified inorganic arsenic as a known human carcinogen. Figure 4 shows the daily arsenic doses associated with various cancers. This figure also shows the doses associated with daily ingestion of drinking water at concentrations of 24 and 60 µg/L. Residential well arsenic concentrations of 40 to 60 µg/L are reported for four wells near Locust and Luzier Lanes (EPA 2005). Although those results are not in the data sets obtained by ATSDR, the resulting dose would be about three times larger than the maximum dose listed in Table 2 (as shown in Figure 4).

Children who are exposed to arsenic may have many of the same effects as adults, including irritation of the stomach and intestines, blood vessel damage, skin changes, and reduced nerve function. Thus, all health effects observed in adults are of potential concern in children. Some evidence also suggests that long-term exposure to arsenic in children may result in lower IQ scores. We do not know whether absorption of arsenic from the gut in children differs from adults. Some information suggests that children may be less efficient at converting inorganic arsenic to the less harmful organic forms. For this reason, children may be more susceptible than adults to health effects from inorganic arsenic.

The estimated arsenic dose from chronic ingestion of Mason Valley groundwater is based on body weights and intake rates of a child (16-kg body weight; 1 liter per day water ingestion). The estimated maximum arsenic dose of 0.0015 mg/kg/day, based on a concentration of 24 µg/L, is lower than most of the cancer effect levels shown in Figure 4. The single study with a cancer effect level lower than the Mason Valley well water arsenic dose is a Chilean study that examined the combined effects of cigarette smoking and arsenic ingestion. The results of that study, adjusted for socioeconomic factors, smoking, and other factors, show no significant increase in cancer rates at arsenic concentrations less than 60 µg/L (Ferreccio et al. 2000). Additionally, studies of U.S. populations exposed to arsenic in drinking water have not shown any increase in cancer incidence in people drinking water with arsenic concentrations less than 60 µg/L (Lamm et al. 2004).

In addition to past ingestion of arsenic from well water, dermal exposure to arsenic is ongoing as people continue to use well water for washing, cleaning, and other household uses. Some studies have shown dermal sensitization in workers exposed to arsenic dusts (ATSDR 2005). Arsenic is not, however, readily absorbed through the skin such that arsenic concentrations of 580,000 µg/L have not produced observable adverse dermal health effects in laboratory animals. Similarly, past

and ongoing dermal exposure to Mason Valley well water is also unlikely to produce adverse health effects.

The estimated arsenic dose from chronic ingestion of Mason Valley groundwater of 0.0015 mg/kg/day is based on the highest measured arsenic concentration of 24 µg/L (as reported to ATSDR). Because of sampling data limitations, whether this is the highest concentration present, or whether concentrations are increasing or decreasing over time, is unknown.

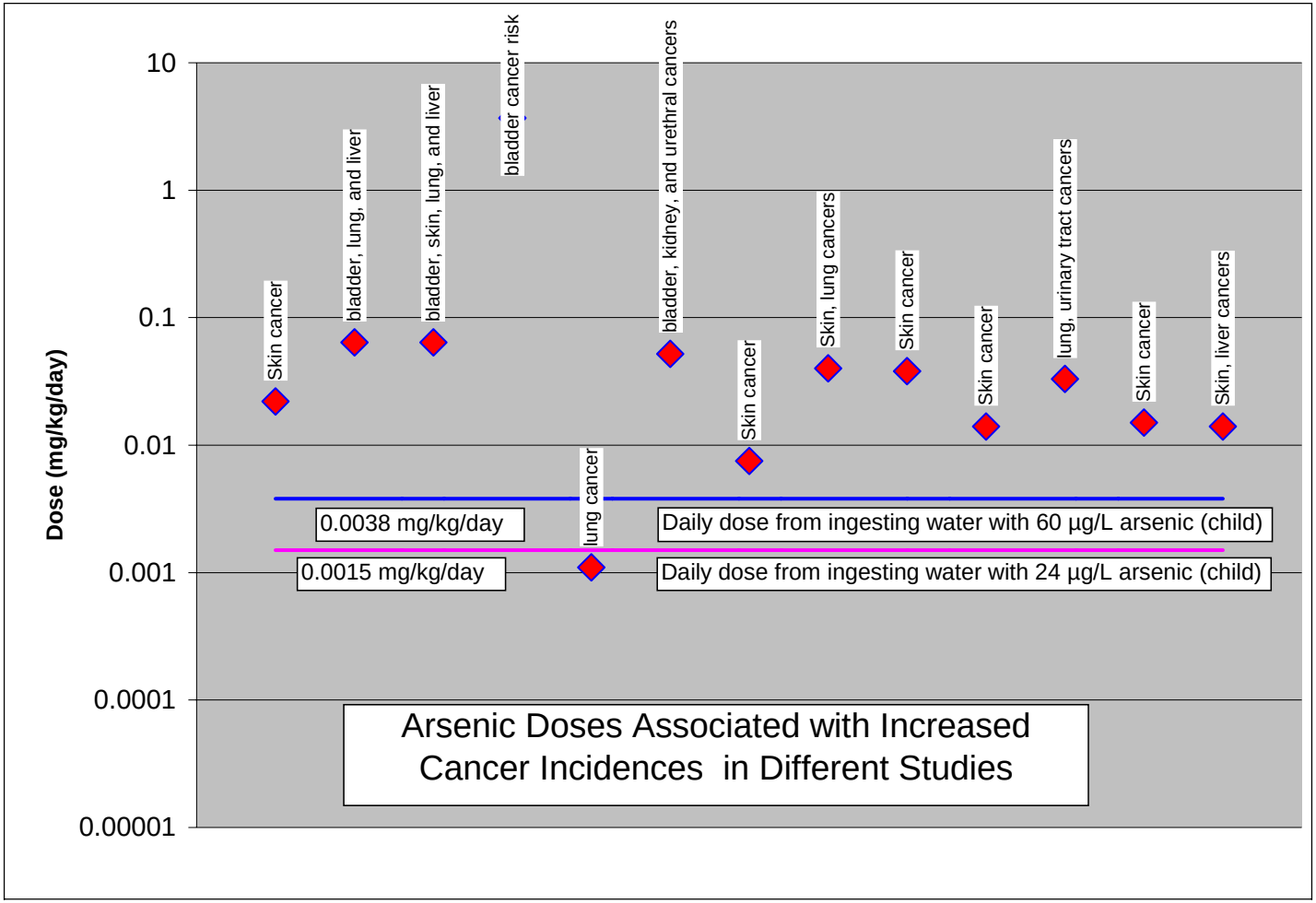

Figure 4. Arsenic ingestion doses associated with increased cancer incidence from 13 different studies (from ATSDR, 2005). Doses from drinking Mason Valley well water with 24 or 60 µg/L arsenic are lower than all dose response studies (when corrected for age, smoking and other factors). The lowest lung cancer dose response (0.001 mg/kg/day), which includes the effects of smoking, should not be compared with the maximum Mason Valley child doses (0.0015 or 0.0038 mg/kg/day).

Boron

Boron is an elemental substance that commonly occurs in the rocks, minerals, and groundwater of western Nevada and California (this summary is derived from the ATSDR toxicological profile on boron, ATSDR 1992). Boron usually does not occur alone, but is often found in the environment combined with other atoms to form compounds called borates. Common borate compounds include boric acid, salts of borates, and boron oxide. Boron and salts of borate have been found at hazardous waste sites. Boron compounds occur mainly in the environment through release into air, water, or soil after natural weathering processes. Glass manufacturing, coal-burning power plants, copper smelters, and agricultural fertilizer and pesticides can also release boron compounds. Releases from these sources are estimated as less than through natural weathering processes.

Irritation of the nose and throat or eyes has occurred in long-term borax workers (mean inhalation exposures to 4.1 mg/m³ in air; ATSDR 1992). Boron compounds (as borates or boric acids) has caused irritation of the nose in animals exposed to large amounts (air concentrations of 470 mg/m^3, ATSDR 1992) for long periods of time. These effects have not been seen in humans. Large amounts of boron (more than 90 mg/kg/day for an infant) eaten by humans over short periods of time can affect the stomach, intestines, liver, kidney, and brain, and can eventually lead to death.

Animal studies indicate that the male reproductive organs, especially the testes, are affected if large amounts (doses greater than 40 mg/kg/day, ATSDR 1992) of boron compounds are eaten or drunk for short or long periods of time. Studies in animals also indicate delayed development and structural defects in offspring, primarily in the rib cage, from maternal exposure to boron during pregnancy. These effects have not been seen in humans. In laboratory studies, chronic boron doses (soluble boric acid) of 4.4 to 17.5 mg/kg/day to dogs and rats did not produce any observable adverse health effects (NOAEL; ATSDR 1992). Doses of 26 to 44 mg/kg/day did produce reversible adverse health effects in rats (partial testicular atrophy). No information is available on whether boron compounds are likely to cause cancer in humans. No evidence is available of cancer in animals exposed to boron compounds for long periods of time.

The estimated boron dose from chronic ingestion of Mason Valley groundwater is based on body weights and intake rates of a child (16-kg body weight, 1 liter per day water ingestion). The estimated maximum dose is about 0.0063 mg/kg/day and is much lower than any doses related to adverse health effects in animals or humans (ATSDR 1992). No adverse health effects are expected from ingestion of boron in well water at the measured maximum boron concentration of 270 µg/L.

Fluoride

The following review of health effects from oral exposure to fluoride is derived from the ATSDR toxicological profile for fluorides, hydrogen fluoride, and fluorine (ATSDR 2003). Fluoride salts, generically referred to as fluorides, are naturally occurring components of rocks, soil, and groundwater. One of the more commonly used fluoride salt is sodium fluoride; its principal use is prevention of dental caries. Sodium fluoride and other fluoride compounds, such as fluorosilicic acid and sodium hexafluorisilicate, are used in the fluoridation of public water.

Sodium monofluorophosphate and stanneous fluoride are commonly used in dentifrices such as toothpaste.

The general population can be exposed to fluoride through the consumption of fluoridated drinking water, food, and dentifrices. The average dietary intake (including water) of fluoride ranges between 1.4 and 3.4 mg/day (0.02–0.048 mg/kg/day) for adults living in areas with 1.0 mg/L fluoride in the water. In areas with <0.3 mg/L fluoride in water, the adult dietary intakes ranged from 0.3 to 1.0 mg/day (0.004–0.014 mg/kg/day). In children, the dietary intakes ranged from 0.03 to 0.06 mg/kg/day in areas with fluoridated water and from 0.01 to 0.04 mg/kg/day in areas without fluoridated water.

The main health concern regarding fluoride is likely to be from excessive chronic oral exposure via drinking water. Due to the deposition of large amounts of fluoride in bone, the primary target system for intermediate and chronic exposures of both humans and several laboratory animal species is the skeletal system (including teeth). Both beneficial and detrimental dental and skeletal effects have been observed in humans. Fluoride has been shown to decrease the prevalence of dental caries and, under certain conditions, has been used for the treatment of osteoporosis. But excess fluoride can also result in dental fluorosis and can result in an increased prevalence of bone fractures (skeletal fluorosis) in the elderly. Both the beneficial and detrimental effects of fluoride appear to be related to fluoride-induced alterations in tooth and bone mineralization.

Studies have been conducted to determine if fluoride causes cancer in people who live in areas with fluoridated water or naturally high levels of fluoride in drinking water, or people who may be exposed to fluorides at work. The studies have not found an association between fluoride and cancer in people (ATSDR 2003).

The estimated fluoride dose from ingesting Mason Valley groundwater (maximum concentration 870 µg/L) is 0.054 mg/kg/day. The Food and Nutrition Board of the Institute of Medicine has developed adequate intakes (AIs) for fluoride. The AI is the "estimated fluoride intake that has been shown to reduce the occurrence of dental caries maximally in a population without causing unwanted side effects including moderate dental fluorosis." The Mason Valley fluoride dose (from well water ingestion) is essentially equal to the AI for children (ATSDR 2003). No adverse health effects are expected from ingestion of fluoride in well water at the maximum measured fluoride concentration of 870 µg/L.

Uranium and Other Gross Alpha Emitters (Radium, Radon, and Thorium)

The following review of health effects from oral exposure to uranium and gross alpha radiation is derived from the ATSDR toxicological profiles for uranium and ionizing radiation (ATSDR 1999a and b) Uranium is a radioactive metal, which is naturally present in rocks, soil, groundwater, surface water, air, plants, and animals in small amounts. It contributes to a natural level of radiation in our environment, called background radiation. The amount of uranium in drinking water in the United States is generally less than 1 picocurie per liter (or approximately 1.5 µg/L; ATSDR 1999a).

Uranium can harm people in two ways: as a chemical toxin and as a radioactive substance. That is, its chemical and radioactive properties can both be harmful, and these two aspects are evaluated separately. Because natural uranium produces very little radioactivity, the chemical effects of uranium are generally more harmful than the radioactive effects. But due to the

combined effects of chemical and radioactive properties, more radioactive mixtures such as enriched uranium can harm the kidney or skeletal system more than natural uranium.

The kidney is the primary target organ for the chemical effects of ingested and inhaled uranium (Kurttio et al. 2002). Uranium also accumulates in bone and may increase the urinary excretion of calcium and phosphorus (Kurttio et al. 2005). The extent of toxicity is determined primarily by exposure route, type of uranium compound, and solubility of that compound. Ingested uranium compounds are generally less toxic to the kidneys than inhaled uranium compounds, partly because uranium is poorly absorbed from the intestinal tract. Highly soluble uranium compounds are generally more toxic to the kidneys than less-soluble compounds via ingestion, because the more soluble compounds are more readily absorbed (i.e., they pose a greater potential dose to the kidney). It is also important to note that in the absence of excessive kidney damage, uranium-induced changes in kidney function are generally reversible (ATSDR 1999a). Absorption of uranium is low (less than 5% of the total) by all exposure routes (inhalation, ingestion, and dermal).

The estimated daily uranium dose for a 16-kg child ingesting (l liter/day) Mason Valley groundwater (maximum concentration 107 µg/L) is 0.0067 mg/kg/day. This dose is lower than any that have caused adverse health effects in laboratory animals. Similar doses, however, have been shown to produce changes in kidney tubular function (Kurttio et al. 2002). Whether these changes in kidney function result in adverse health effects is unknown (Kurttio et al. 2002). Human and laboratory animal exposures and dose responses are not directly comparable and must be interpreted with caution. Also, due to sampling data limitations, whether higher uranium concentrations could be present, or whether concentrations are increasing or decreasing over time is unknown.

Several elements are radioactive and may occur in groundwater in Nevada: uranium, thorium, radium, radon, and their decay products. They emit alpha particles—a type of ionizing radiation—and are believed to be carcinogenic. The gross alpha test is a “total” measurement of alpha emitting particles, including radium and uranium. The MCL for gross alpha is 15 pCi/L. There is a unique protocol for interpreting samples above the MCL. The uranium alpha particle activity is subtracted from the gross alpha activity to determine whether the MCL has been met. If the gross alpha activity after subtraction exceeds 15 pCi/L, further analysis is required. Although no uranium activity measurements have been conducted, the total uranium chemical concentrations indicate that the gross alpha activities are predominantly due to uranium alpha decays.

A separate MCL is also available for the element radium. If the gross alpha result exceeds 5 pCi/L, further analysis should be done to identify the presence of radium. Radium 226 is a naturally occurring radioactive contaminant found primarily in groundwater. It can cause bone cancer in humans at high exposure levels, and possibly other cancers as well. In none of the domestic well samples do levels of Radium 226 and 228 approach the 5-pCi/LMCL .

Radon, a decay product of radium, is a naturally occurring radioactive contaminant. It is a gas released into the air during water use. At high exposure levels radon can cause lung cancer in humans. A radon water concentration of 10,000 pCi/L could add 1 pCi/L of radon to a home air level. EPA's recommended airborne action level is 4 pCi/L. Although radon was not measured in these water samples, based on the low radium and thorium activities, concentrations approaching 10,000 pCi/L are very unlikely.

Thorium 232 is a radioactive substance that occurs naturally in the environment. It has been shown to cause an increase in cancers of the lung, pancreas, and blood in workers exposed to high levels in the air. At the YAM site, thorium was not detected above the detection limit of 0.081 ppb. Note that thorium was analyzed as a metal for total thorium, rather than an isotope-specific radiological activity. Although no detectable concentrations of thorium appear to be present in these wells, thorium is included in this analysis because it is an alpha-producing radionuclide and the gross alpha activity exceeded the CV. Given the lack of detectable concentrations, thorium does not appear to be a significant component of the measured gross alpha activities.

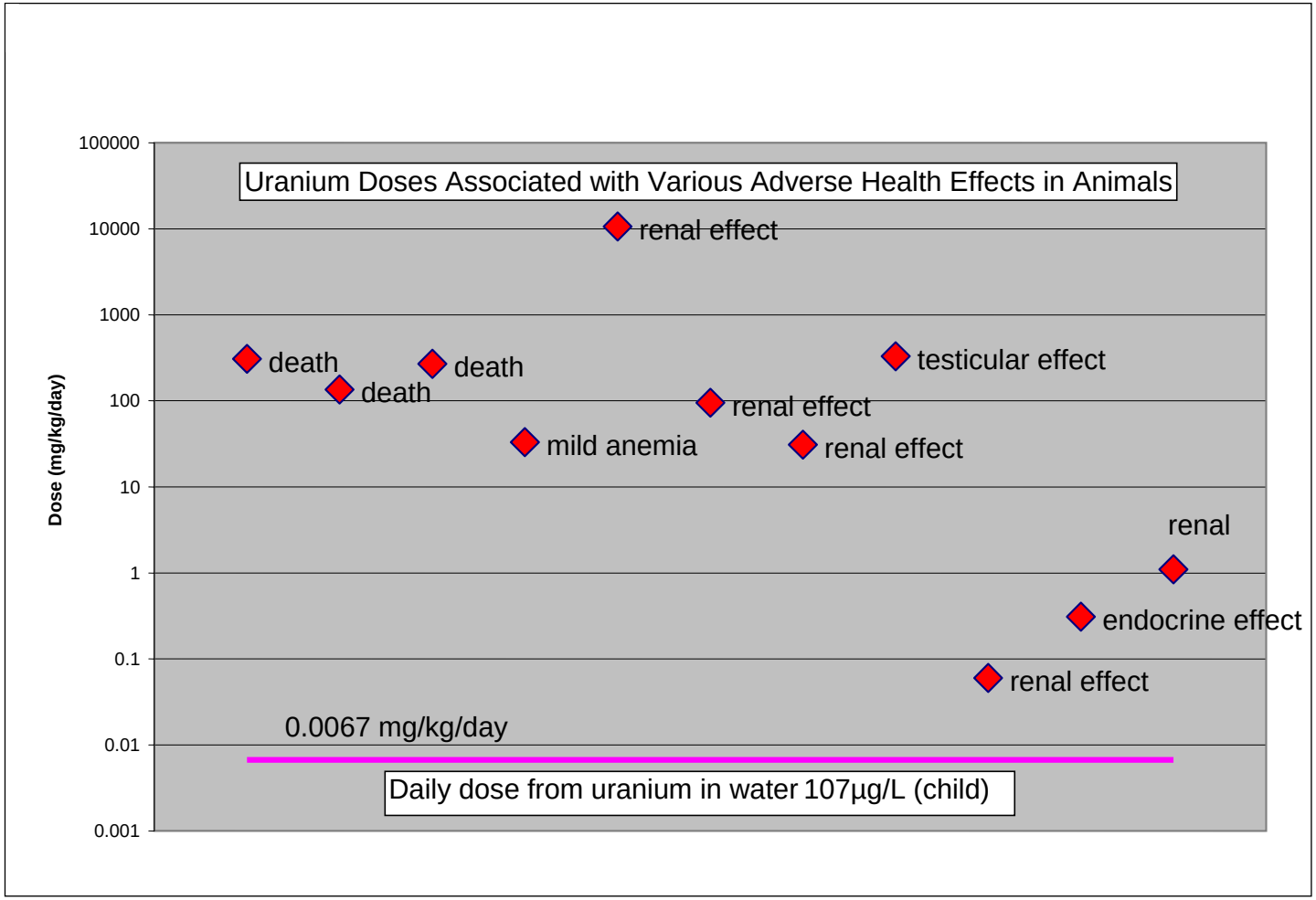

Figure 5. Uranium ingestion doses associated with various adverse health effects from different studies (ATSDR 1999a). Note that doses from ingesting Mason Valley well water (107 µg/L uranium) are lower than the dose response levels for all studies involving lab animals. Results from animal exposures are not, however, directly applicable to humans and must be interpreted with caution

Airborne Dust/Soil Contamination

Members of the Yerington community voiced a common concern that peak wind events carried dust from the mine site to the neighborhoods to the north (downwind) of the facility. Respiratory irritation, allergic reactions, and asthma were common health complaints associated with these dust events. Community members also had questions about whether mine-related contaminant concentrations in the deposited dust might be present in their homes and yards at levels of health concern.

To address these concerns both the ARC and the YPT have established air monitoring networks in the vicinity of the mine site and in the downwind community. ATSDR has received three reports describing the results of these monitoring programs. Although neither sampling program has a sampling scheme designed adequately to capture peak events, both provide some contaminant concentration data that can partially address community health concerns about the concentrations of air-borne contaminants from the YAM site.

The Wabuska monitoring location of the YPT air program (Figure 6) is about 2 miles northeast of the northern boundary of the YAM site (YPT 2003). Particulate matter (with mean diameters less than 10 microns–PM-10, and mean diameters less than 2.5 microns–PM-2.5, are measured every third day. Chemical analyses of 39 elements were analyzed for a limited number of samples. Specific daily (24 hour) results are not presented in the YPT (2003) report but are presented as statistical summaries and annual and 24 hour averages. Similarly, ARC collects PM-10 air samples at 6 locations around the YAM site boundary (some locations are also analyzed for mercury; Figure 6) on every sixth day (ARC 2005a/b). Results are presented for each sample event (~24 hour sample period; ARC 2005a/b)

Table 3 presents some of the average and maximum measured contaminant concentrations from each monitoring program (YPT 2003; ARC, 2005a/b) along with the representative health comparison (or screening) values for each contaminant. Note that these sample results represent different sampling times and are not directly comparable but are presented as representative values only. None of the measured contaminant concentrations exceeded their respective short term screening values. Thirty-four additional contaminants were analyzed in the YPT 2003 report. All of the measured contaminants except particulate matter were at least 100 times lower than their respective screening value.

In addition to average vs. peak condition limitations of the ongoing monitoring of airborne dust emissions from the YAM site, a more important factor may be that current dust constituents may have a considerably lower concentration of site-related contaminants relative to historic emissions. Based on discussions with site and EPA personnel, the largest on-site dust sources were covered with coarse-grained tailings materials when mining operations were terminated *circa* 1978–79 (Jim Sickles, personal communication, 2005). As fine-grained dust materials created by the mining and ore processing procedures have been removed by peak wind events over the last 25 years, the remaining materials may contain much lower contaminant concentrations. Consequently, current air sampling may not reflect historic conditions.

None of the measured air contaminant concentrations represent a short term health hazard. Also, because the dust events result from relatively short term wind storms, it is very unlikely that dust from the YAM site represents a long-term or annual air hazard. Air samples collected every third or sixth day do not, however, adequately represent the short term conditions of peak wind events.

Meteorological data collected by these two sampling programs indicate that wind events with speeds greater than 20 mph make up 5–7% of the total wind regime. Future air sampling should be focused on documenting dust concentrations and compositions during peak events. If peak event data are collected in the future, ATSDR will re-evaluate the potential for adverse health effects from air-borne dust and associated contaminants.

Although large quantities of sulfur were used in processing the copper ore and deposited in the various evaporation and tailings ponds, there has been little evaluation of the potential sulfur composition of the dust (or particulates). According to data in the Fugitive Dust and Tailings Areas and Evaporation Ponds Work Plans (ARC 2002 and ARC 2003a, respectively) sulfur concentrations have not been measured in these potential dust source areas and are not proposed for future analyses. The YPT air program has included limited analyses of total sulfur (Table 3). Specific health comparison values for sulfur/sulfate air particulates are not available. Consequently, these substances are included in the total particulate load, which are evaluated as PM-10 or PM-2.5.

Table 3. Representative average and maximum measured air contaminant concentrations at YAM perimeter and downwind locations and appropriate screening values.

Contaminant	***Wabuska Loc.**** ***Avg—Max µg/m³***	***AM-4†*** ***Avg—Max µg/m³***	***AM-5 †*** ***Avg—Max µg/m³***	***Screening Value µg/m³***
PM-10	16—88.8‡	7—18.7	8.4—60.4	150 (24 hour)§
PM-2.5	7—30.8 [3]	N/A	N/A	65 (24 hour)§
Arsenic	1.2e-3—3.5e-3	<1.1e-3	<1.1e-3	1.9e-1 (4 hour)¶
Mercury	8e-4—2.5e-3	2e-5—2.2e-5	2e-5—2.5e-5	1.8 (1 hour)¶
Copper	3.9e-3—2.0e-2	9.4e-2	5.5e-2	100 (1 hour)¶
Uranium	1.0e-4—6.0e-4	N/A	N/A	8 (1-365 days)**
Sulfur (total)††	0.15—0.62	N/A	N/A	N/A

Notes:

* From: Aerometric Data Analysis Report, Yerington Paiute Tribe, prepared by Sierra Nevada Air Quality Group, LLC, Reno NV, November 5, 2003. Values are in µg/m³ for 24 hour sample events.

† From: Air Quality Monitoring Summary Report for the Yerington Mine Site, First Quarter 2005, Atlantic Richfield Company, prepared by Brown and Caldwell, Carson City, NV May 10, 2005 or Air Quality Monitoring Summary Report for the Yerington Mine Site, Second Quarter 2005, Atlantic Richfield Company, prepared by Brown and Caldwell, Carson City, NV November 1, 2005. Values are in µg/m³ for 24 hour sample events.

‡ "Expected 24-hour maximum concentrations if sampling had been done every day" are 115 µg/m³ for PM-10 and 41 µg/m³ for PM-2.5.

§ National Ambient Air Quality Standards, http://epa.gov/air/criteria.html

¶ Office of Environmental Health Hazard Assessment (State of California) Acute Reference Exposure Level, http://www.oehha.ca.gov/air/acute_rels/allAcRELs.html.

** ATSDR intermediate (1 to 365 days) inhalation environmental media evaluation guide for insoluble uranium compounds.

†† The sulfur particulates may be present as sulfides, sulfates, or as sulfuric acid aerosols. There are no health comparison values for specific sulfur particulates and evaluation is limited to total particulate load (PM-10 or PM-2.5).

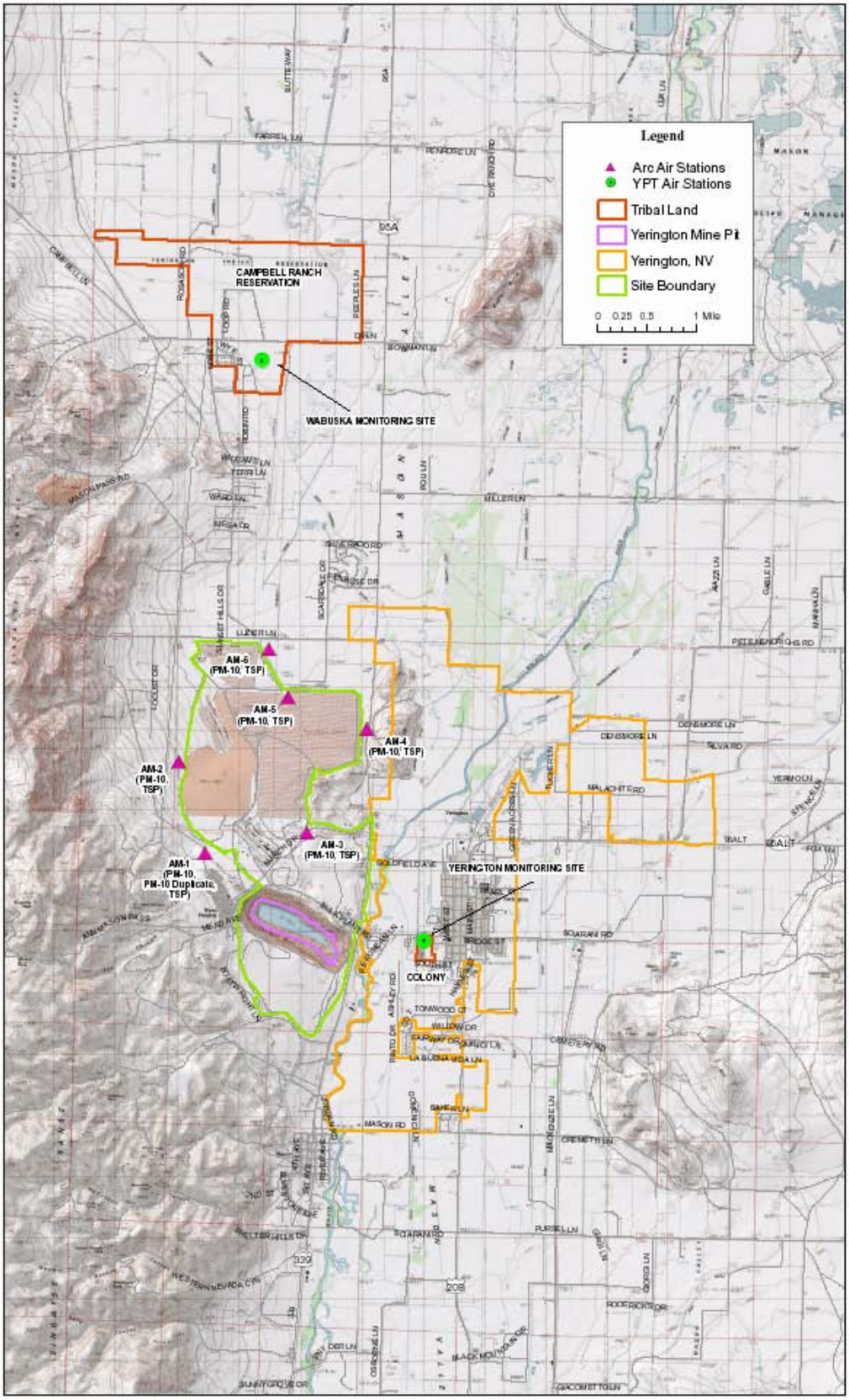

Figure 6. Locations of air monitoring stations around the YAM site

Conclusions

1. Former copper mining and ore processing operations at the YAM site have created on-site sources of contamination for various metals and metal compounds and for particulate matter. The YPT and Yerington community have voiced numerous public health concerns related to this site. Given the prevailing wind and groundwater flow directions, concerns about potential off-site exposure to site related contaminants are plausible, however, the available environmental monitoring data are insufficient for specific conclusions regarding sources of off-site contaminants .
2. On the other hand, some site-related contaminants may occur naturally. In downgradient locations, the mining and ore processing operations have increased these contaminants' concentrations, mobility, or both. Historic surface and groundwater monitoring indicates that these contaminants have migrated to off-site waterways and wells.
3. The mine and ore processing facilities also present significant physical hazards. This site represents an attractive nuisance for area children. As a result of numerous complaints by community members, improvements to site fencing and warning signs are currently in progress. Although this site represents a potential public health hazard for on-site physical hazards, improved access restrictions should limit future exposures to the surrounding community.
4. Recent analyses of off-site drinking water wells indicate that arsenic, boron, fluoride, uranium, and gross alpha concentrations (or activities) are above applicable health comparison values. A review of the toxicological literature for each of these contaminants indicates that except for uranium, past consumption of drinking water—even at the highest measured concentrations—is unlikely to create adverse health effects. If any adverse health effects from drinking uranium at measured Mason Valley concentrations do occur, they are most likely to occur as kidney disease. Due to very limited dermal absorption, plant uptake, and volatilization of these contaminants, ongoing noningestible uses of well water at the currently measured concentrations are unlikely to produce any adverse health effects.
5. Due to limitations in the monitoring data, whether any wells could have had higher concentrations in the past or if other, currently unmonitored wells may currently have higher concentrations, is unknown. Also, the available monitoring data are not sufficient to prove that releases from the YAM site are the source of contaminants in the downgradient drinking water wells. Using the estimated maximum doses and limitations of the currently available groundwater data, past exposure to well water downgradient of the YAM site is considered a public health hazard.
6. Former mining and ore processing operations also resulted in several on-site areas of disturbed and contaminated surface soils. These areas are sources of contaminated dust, which during peak wind events can be blown to off-site areas. A review of concentrations of airborne contaminants from recent air monitoring studies shows that off-site exposure to airborne contaminants is not likely to cause adverse health effects. Ongoing air monitoring programs do not, however, adequately assess contaminant concentrations in peak wind events. Given the limitations of the currently available air monitoring data, short term exposure to air-borne contaminants downwind of the YAM site is considered an indeterminate public health hazard.

Recommendations

With regard to the above public health findings, ATSDR makes the following recommendations:

- Continue to supply bottled water to people who are currently receiving bottled water for drinking and cooking purposes. The measured contaminant concentrations show that nonpotable uses such as bathing, cleaning, and irrigation do not represent a public health hazard and may continue.
- Collect additional off-site groundwater monitoring data to assess the spatial and temporal distribution of site-related contaminants.
- Improve ongoing off-site domestic well sampling by developing an agency-approved sampling and analysis plan. Ongoing monitoring activities may include speciation of metals to discriminate naturally occurring and site-related contaminants.
- Investigate the potential for groundwater pH alterations from site discharges that could mobilize naturally occurring metals. And in future groundwater evaluations consider the role of surficial discharges to the Wabuska Drain as an off-site source for site-related groundwater contamination.
- Test the private well water in Mason Valley to ensure that uranium and arsenic concentrations are below appropriate health comparison values.
- Modify ongoing air monitoring programs to target contaminant loads in peak wind events.

Public Health Action Plan

This Public Health Action Plan for the YAM site describes the completed or planned public health actions undertaken by ATSDR, EPA, YPT, or other entities in the Yerington community. Its purpose is to ensure a specific plan of action to prevent or mitigate adverse human health effects resulting from exposure to hazardous substances in the environment.

Public Health Actions Completed or Ongoing

ARC and YPT, with oversight by the EPA and the Nevada Department of Environmental Protection (NDEP), currently monitor air, groundwater, surface water, and soil on and adjacent to the site. Although this health consultation finds existing monitoring data inadequate for assessing off-site exposures to site-related contaminants, improvements to the monitoring programs are ongoing. This health consultation provides general recommendations for monitoring program improvement.

Limited site fencing and access restrictions are currently in place. An agreement to improve site fencing and warning signs has been completed and work is underway (as of mid-May 2006).

ATSDR has conducted substance-specific medical training for Yerington area health care providers. This training is designed to help provide doctors and other health professionals with information about the health effects of hazardous substances present in the Yerington area.

The EPA has initiated an effort to reduce the on-site sources of airborne dust. Capping of potential airborne dust source areas is currently underway.

Public Health Actions Planned

As data become available, ATSDR will continue its review of environmental monitoring data related to this site and reevaluate potential off-site exposures to groundwater and airborne

contaminants. As specified in Appendix A, ATSDR will also provide specific comments and recommendations on the environmental monitoring programs. ATSDR will also review the pending survey of former mine workers to determine if additional health activities are warranted.

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Appendix A. Environmental Data Needed for More Comprehensive Exposure Assessment

Groundwater Data Needs

This health consultation has identified several questions—or issues of uncertainty—regarding the distribution of groundwater contaminants downgradient of the YAM site. These issues, which are specific to past or ongoing exposures are

- Do we know of any untested wells that have high contaminant concentrations?
- In the past did any wells have higher contaminant concentrations than they have today?
- Does available monitoring data accurately reflect contaminant concentrations?
- Are arsenic and uranium the only contaminants of public health concern?

To address these questions and to conduct a more specific assessment of off-site exposure to groundwater contaminants adjacent to the YAM site, we need a better understanding of the spatial and temporal distribution of groundwater contaminants in the area downgradient of the YAM site. The spatial dimension of contaminant concentrations means how the contaminants are distributed both horizontally throughout the downgradient area, as well as vertically in the geologic strata. The temporal dimension means how the contaminant concentrations have changed over time.

The first step in developing a better groundwater data set is to ensure that the measured values accurately reflect what may be present in the water samples. To do this we need to follow a consistent and appropriate sampling and analysis protocol. Such a protocol will specify where, when, and how samples are collected, and will observe appropriate field and laboratory quality control procedures. This protocol will also indicate which analytes (i.e., potential contaminants) should be measured. Note that a sampling and analysis work plan is in process for the "Initial Groundwater Conditions Study" (ARC 2005c). On the other hand, no analogous work plan or sampling protocol for the offsite domestic well sampling is currently available.

Initially, all on-site groundwater contaminants—including arsenic, calcium, sulfate, zinc, copper, fluoride, cadmium, chromium, lead, mercury, selenium, manganese, uranium, and pH—should be measured at a large number of off-site wells with known depths and screen openings. It may not be necessary, however, to repeat collections at all wells, especially of those analytes that cannot be determined until an initial comprehensive set of samples has been analyzed.

Obtaining direct measurements of past conditions is not possible. Still, knowledge about contaminant sources and about the groundwater flow system can be used to estimate past concentrations. The ongoing "Initial Groundwater Conditions Study" will provide much of the necessary information (assuming that the data obtained are representative of current hydrogeologic conditions). groundwater modeling studies can estimate past conditions. That is, insofar as the data from this study and ongoing well monitoring provide reliable trend analyses (or contaminant concentrations over time) and an understanding of the source of the contaminants in the drinking water wells. Because the YAM site may not be the source of off-site contaminants, ATSDR recommends uranium and arsenic testing in all Mason Valley private drinking water wells. ATSDR will continue to evaluate groundwater data as it becomes available and will reassess the conclusions of this health consultation as appropriate.

Air Monitoring Data Needs

Atlantic Richfield is currently developing an air monitoring work plan with review and oversight by EPA and NDEP (ARC 2005d). Sampling under this plan will provide limited assessment of peak wind events. This plan should be modified to ensure that peak wind events are specifically sampled and reported as short term (24 hour) averages.

Appendix B. Public Comments and ATSDR Responses

ATSDR received four sets of comments from various reviewers. This appendix includes all of the comments specific to this health consultation document together with the ATSDR responses to those comments. The comments have resulted in a number of minor revisions to the health consultation and have improved the technical accuracy and readability of this document. The ATSDR responses specify how the document was revised relative to each comment or indicate why no change was made. Note that to avoid redundant responses, we have grouped comments for which similar responses are appropriate.

Comment Group 1

a. *…These documents prove conclusively that uranium is a natural component in Mason Valley's groundwater, and yet, without any explanation of how or why the Strachan studies could be in error, Evans et al (2006) has concluded that more testing is necessary to determine if groundwater-dissolved uranium is natural and not coming from the mine….*

b. *…Evans et al (2006) have chosen to ignore that the naturally-anomalous uranium in all three of these areas is hydrologically removed from the mine site…*

c. *… Asserts that the contaminants alleged to have been discharged to evaporation ponds "have migrated into the underlying groundwater system…." This assertion is contradicted on page 21, paragraph 5, sentence 2, which states that, "Also available monitoring data are not sufficient to prove that releases from the YAM site are the source of contaminants in the down-gradient drinking water wells."*

d. *This table (Table 1) identifies health concerns that members of the Yerington community have linked to the mine site. ATSDR asserts groundwater has …probably migrated off-site…No evidence is provided, however, to substantiate this assertion….*

e. *There is a reference to contamination entering the shallow aquifer from the tailings piles and evaporation ponds; the shallow aquifer is obviously the most vulnerable to contamination from all sources – including the sewage ponds, septic tanks, agricultural irrigation, fuel spills, etc. The recharge of the aquifer is primarily from the Walker River, but no mention is made of the quality of the Walker River water. As mentioned earlier, there could be different isotopic or chemical signatures for the different water sources that could be used as tracers to determine where most of the water in a given well came from. It is not right to assume that all contaminants are coming from the YAM site. In fact, some of the "contaminants" are likely from naturally occurring minerals.*

ATSDR response:

We agree, and in the health consultation we clearly stated that all of the contaminants detected in Mason Valley drinking water wells are (at least originally) naturally occurring. Nevertheless, several reports as referenced in the consultation (USGS 1982; Anaconda Minerals Co. 1983) and the Strachan report (May 25, 2004) also clearly state that groundwater contaminants from the mine site have migrated to off-site wells north of the mine property. In both surface and

subsurface releases that have migrated away from the mine site, mine operations have clearly concentrated and mobilized a number of "naturally occurring" metals. The lateral and vertical extent of this off-site migration is unknown; our consultation clearly and in several instances states that we cannot and do not attribute downgradient private well contaminant concentrations to releases from the mine.

Regardless of where the off-site drinking water well contaminants originated, ATSDR must evaluate the public health significance of the measured contaminant concentrations. Using the measured contaminant concentrations in residential water wells and the potential for higher concentrations in other areas of Mason Valley, prudent public health practice requires the determination of a public health hazard. Because the source of the measured contaminants has not been ascertained, additional monitoring is warranted.

Strachan (May 25, 2004) has proposed that the source of uranium in Sunset Hills, Locust, and Campbell Lane residential wells is due to eastward groundwater flow from the "MacArthur oxide copper deposit." Groundwater flow data do not support this hypothesis, which in any event posits a flow direction different from the south to north (or northwest) regional flow direction reported by the USGS (1982) and Applied Hydrology Associates (1983). Additional hydrogeologic data will be required to either support or refute this hypothesis.

Comment Group 2

a. *…For instance, only non-hazardous levels of arsenic (As) have been found in all drinking water tested to date (ibid, page 12, Figure 4 and page 13, para.1), yet ATSDR recommends actions to "prevent or mitigate…health effects" (ibid, page 22, para. 6). The actions recommended are in clear contradiction to their own non-hazardous findings and conclusions.*

ATSDR response:

We agree that long term ingestion of measured concentrations of arsenic is unlikely to produce adverse health effects. The results for uranium exposure are however less clear-cut and more difficult to interpret. Additionally, because of inadequate sampling and analytical protocols in the residential well sampling program, prudent public health policy requires the public health hazard determination.

Comment Group 3

a. *The report incorrectly describes uranium and arsenic in groundwater as "contaminants"; this is misleading unless the compounds are derived from industrial activities.*

ATSDR response:

The definition of a contaminant as used in this consultation is not dependent on the source of the substance; rather, it is relative to the health-based concentrations of the substance in an environmental media. In this case, substances with environmental concentrations greater than the health comparison values are considered contaminants regardless of whether they originate from a "natural" or an "industrial" source.

Comment Group 4

a. *The water quality database is inadequate at this time for discussing the health implications of uranium and other elements present in one or more samples at*

concentrations allegedly exceeding a "comparison value…The report states that there is not enough information to draw clear conclusions, but it implies that the groundwater poses a public health hazard; this statement is unsupported by the cited data.

b. *The "recent groundwater monitoring data evaluated in this health consultation are not adequate to determine how far northward (down-gradient) mine-related contaminants have migrated." Although it is not referenced in this report, the Brown and Caldwell report to ARC shows a plan for a number of monitoring wells, included background wells, at shallow, intermediate and deep intervals, in order to characterize the groundwater around the YAM site. This would be much more scientific than the use of random sampling of private wells, with no quality assurance samples, and no scientifically consistent laboratory analysis.*

c. *The data from the residential well sampling "contain little sample documentation and quality control / assurance information. Consequently, it is difficult to determine if these data are accurate and representative of groundwater contaminant concentrations."*

ATSDR response:

The available groundwater data have significant limitations for assessing temporal exposures at all downgradient residential wells (as well as unsampled locations) and for attributing contaminant sources. The consultation includes the defining assumption that the "…collective data are representative of groundwater contaminant concentrations in the YAM site area…". ATSDR is cognizant of the limitations of the available data and has ensured that our conclusions and recommendations do not overreach the underlying data. The presence of measured contaminant concentrations in residential drinking water wells is an adequate basis for assessing the public health implications of drinking that water. Note also that the measured residential wells are the only means of assessing the water that people drink or use for cooking their food. The recently completed monitoring wells have no direct relation to actual exposures.

Comment Group 5

a. *No context for the 1- and 3-mile radii. Have these areas been identified for public health reasons based on morbidity, mortality, presence of chemicals of concern, or some other reason?*

b. *Smaller figures showing locations of certain age/sex groups are misleading because it is not clear where within a given census tract or block the individuals of concern may reside. For some census tract or blocks, the individuals of concern may not reside within the 1- or 3-mile radii, although their tract or block is highlighted.*

c. *There is no explanation for choosing the one-mile and three-mile areas, but that would be similar to the local area affected by PM10. Agricultural fields, dirt roads and housing developments are located west, north and east of the mine (north is downwind of the mine based on prevailing wind direction, between the mine and the reservation); all of these activities are sources of PM10.*

d. *These are probably standard types of maps and population characteristics that are used by ATSDR. Air quality effects are generally related to children and older adults; water quality would also affect females of childbearing age.*

e. *Page 1 and Figure 1. The population estimates use 2000 census information. This area has seen substantial growth including residential construction in both the 1 and 5 mile radius around the mine. Although updated population figures may not be available, the issues regarding this should be included in the discussion in the document.*

ATSDR response

These radii (and the enclosed areas) are arbitrary distances from the YAM boundary. They are only used to characterize the demographic makeup of residents living adjacent to the mine site. The subpopulations from the enclosed areas are defined on an area-proportional basis. For example, if the enclosed area includes 50% of the area of a census block, this process assumes that it includes 50% of the block population. The discussion of demographic information on page 1 notes that "residential development is currently taking place north of the mine."

Comment Group 6

a. *ATSDR asserts that "Some of the specific disease concerns communicated to, or observed by ATSDR staff, are plausible health outcomes for the contaminants present in the YAM site area." There are several problems with this statement:…ATSDR provides no support for this statement…No problem-specific medical monitoring programs are underway…YAM site area must be defined…*

b. *Some of the concerns "are plausible health outcomes for the contaminants present in the YAM site area." There is no evidence of direct relationship. Those health outcomes and concerns could also be related to family medical history, exposure to cigarette smoke (both active and passive), and many other exposures.*

ATSDR response:

Plausible means "appearing worthy of belief." Specifically, community complaints about asthma and respiratory irritation are consistent with complaints about dust blowing from the mine site. Likewise, observations of skin discoloration are consistent with ingestion of high concentrations of arsenic. At this time we have not attempted to substantiate those complaints with estimated doses nor assumed causality between the contaminants and the observed health conditions. We have clearly stated that we do not believe that adverse health effects are likely based on exposure to the measured contaminant concentrations. We also believe, however, that prudent public health practice requires further evaluation of those health complaints that are consistent with known health outcomes for contaminants (whether site-related or background).

Comment Group 7

a. *ATSDR states that they have, "…initiated health education training for the Yerington medical community to improve medical diagnoses of potential contaminant exposures." Did the medical community find itself unable to evaluate exposure to chemicals naturally found in their neighborhood? Did they ask for such training? If not, what sort of evaluation did ATSDR perform*

to support the conclusion that the medical community needed "health education training"?

b. *The YCAG is concerned that the medical training the ATSDR did here in November was not attended by the county/community health professionals. We request another training session be done with the health professionals who deal with the residents in the community. All of the health professionals need to be informed about the health effects of the hazardous substances present in the Yerington area.*

ATSDR Response

Many health care providers have had limited training in the exposure and assessment of environmental contaminants. In response to requests, ATSDR has created certified training modules in this area and provided them to members of the Yerington medical community. ATSDR does not currently have the resources to repeat the medical education training. We are, however, attempting to determine whether the Association of Occupational and Environmental Health Clinics can provide a similar educational session for the Yerington medical community.

Comment Group 8

a. *ATSDR states that, "Further evaluation of potential contaminant-specific exposures will be conducted in the air and groundwater health consultations." What constitutes "air and groundwater health consultations"? These must be defined. How will this "further evaluation" be performed and what does it involve?*

ATSDR Response:

Health consultations are defined as 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.

The specific focus of any of these proposed health consultations will depend on the data provided by proposed site monitoring studies.

Comment Group 9

a. *This map is too vague to be helpful. No definitions for the symbols appearing in the legend are provided. What is the source of information for the locations identified? If self-reporting of various symptoms is the source, then the map is not representative of the potentially affected population.*

b. *Symbols on map should be linked to specific health complaints or environmental information (e.g., groundwater concentrations or air concentrations of the chemicals of concern.). A table that relates each symbol to a specific health complaint, for example, would be helpful.*

ATSDR Response

As stated in the figure caption and legend, these map symbols represent approximate locations of health concerns. These concerns are described in the text section labeled "Community Health Concerns." The specific concerns are summarized as Table 1.

Comment Group 10

a. *A reference should be provided to document the assertion that "there must still be a localized southward flow of groundwater into the pit lake."*

ATSDR Response:

The ARC draft document on the "Yerington Pit Lake Work Plan" has been added as suggested.

Comment Group 11

a. *The assertion that "mine-related groundwater contaminants" were present in wells immediately north of the mine boundary in the early 1980s should be documented. Evidence should be provided to support the conclusion that chemicals detected in groundwater to the north of the mine boundary are mine-related. As noted elsewhere by the report authors, data are not sufficient to attribute chemicals in groundwater to a specific source whether natural or anthropogenic.*

b. *An "on-going monitoring program" is noted, however, an "on-going monitoring program" does not exist based on information provided in this report.*

c. *Asserts that the largest source of groundwater contaminants is subsurface leachate. This statement is hearsay because no evidence was cited in the report to document the source of any chemical detected in groundwater; in fact, it is not even clear that off-site groundwater contains chemical concentrations that exceed natural background. Thus, nothing in the groundwater can rightly be identified as contamination.*

ATSDR Response

Hydrogeologic studies by both the USGS (1982) and Anaconda Minerals Co. (1983) used detailed water quality data (including stable isotopes) to assess groundwater under and north of the mine site and are so referenced. Both of these studies conclude that water from the evaporation ponds had contaminated the wells directly north of the mine site. Although the health consultation does not include the details or methods of these reports, the underlying conclusions are referenced appropriately.

Comment Group 12

a. *Admission that available groundwater monitoring data are not adequate to identify the source of "contaminants" in groundwater north of the mine site.*

b. *Asserts that adequate data are available to provide an initial assessment of public health implications. It is not clear how the "adequacy" of the data was assessed or how it could be adequate for one purpose but not another.*

c. *Admission that the accuracy and representativeness of groundwater concentration data is difficult to determine.*

d. *Premature and possibly misleading to the potentially affected public to discuss health implications of chemicals present in one or more samples at a concentration allegedly exceeding a "comparison value" (CV) especially when the authors have already acknowledged that the accuracy and representativeness of the available data is difficult to determine.*

e. *Asserts that prior to the provision of bottled water people were consuming water containing the concentrations of chemicals listed in Table 2. Prior statements about the quality of the data available do not support this assertion – the concentrations to which people may have been exposed cannot be known.*

f. *The first concern is related to groundwater, and ATSDR comments, "contaminated on-site groundwater … has probably migrated off-site." But they go on to admit, "past groundwater monitoring data are not adequate to evaluate whether exposure at the off-site wells has or may occur." Throughout this report there is no mention of the depth of the wells that were monitored, on-site or off-site, nor mention of the subsurface lithology tapped by the wells. This is important information, necessary to do any scientific analysis of potential contaminant migration. In a report for ARC by Brown and Caldwell there is a list of residential wells with depths, and some of them are extremely shallow. Shallow residential wells are most vulnerable to contamination from multiple sources. Deep water wells and water treatment and distribution infrastructure could effectively reduce potential exposure to contaminated groundwater.*

g. *"Table 2 lists seven contaminants detected in the drinking water, the range of concentrations measured, and the …health comparison values …(CVs)." The report states that "the seven listed contaminants were measured at concentrations above their respective comparison values" but that is not what the table shows. Since these data may be highly inaccurate, it is irresponsible to assume that any of the seven contaminants listed are actually present in concentrations above the CV; indeed, even with their admittedly questionable data, two of the seven compounds were not reported above the CV (radium and thorium). Without field blanks and lab blanks, and the probability that most of these samples were collected by untrained homeowners, not to mention there is no information on the laboratories that analyzed the samples or the methods used, Table 2 is unscientific.*

h. *There should be a disclaimer on this figure (3) relating to the questionable data.*

ATSDR Response

We agree that the sampling and analytical protocols under which groundwater is sampled and analyzed should be improved (and have made such recommendations), but with the caveat "assuming that these collective data are representative…" The measured contaminant data do appear to have sufficient internal consistency to be representative of conditions at each measured location. Multiple, time-sequential analyses produce similar results for each location, indicating that measured contaminant concentrations are, at the least, a useful estimate of true concentrations. Consequently, the measured concentrations in each well are a useful basis for evaluating the health implications of drinking water from each respective well.

Comment Group 13

a. *Attempt to establish a link between onsite groundwater concentrations and offsite groundwater concentrations without a technically defensible basis. While it is true that any sort of assumption can be made, the technical basis*

must be sound for that assumption to be useful in making predictions about a site.

b. *"The available environmental monitoring data do not allow specific conclusions about the source of the off-site contaminants." This is true.*

ATSDR Response

We have made no linkage between on-site and off-site groundwater conditions at the downgradient residential wells. While it is true that the off-site drinking water wells are downgradient of the mine site, we clearly state in several places that the hydrogeologic data are not sufficient to attribute contamination in those wells to site activities or site releases.

Comment Group 14

a. *The details of the bottled water program should be provided. Who manages the program, how is it funded, on what basis are households accepted into the program?*

b. *This is ARC's issue, but it is not a long-term solution. I would look at community water systems instead of private wells, and deeper wells instead of letting private wells pump from the shallow aquifer (highly vulnerable to all kinds of contamination).*

ATSDR Response

The bottled water program is managed by Atlantic Richfield (or its subcontractors). They have not provided ATSDR with any details on how this program is managed. We agree that the bottled water program is an interim solution. Local representatives have indicated that extension of the public water system to the affected area is currently under discussion. Progress on this issue may await a determination of who will pay for those hook-ups.

Comment Group 15

a. *Use of larger dots for wells containing uranium is misleading as it indicates a spatially larger problem than may actually exist. Based on the map scale, these uranium well circles are approximately 0.25 miles across. Several different well types apparently are shown on this map – it would be useful to identify well type and if a drinking water well, how many people it serves.*

b. *Figure 3. A number of site and near-site wells have U concentrations well above 0.03 mg/L but are shown as not analyzed on this figure. It is apparent that ATSDR may not have successfully acquired all the needed groundwater monitoring data including one of the earliest assessments for radionuclides, a 1984 study by the mine operator. This situation also highlights a more serious issue; the PRPs have failed to compile the groundwater data in a format useable by agencies and stakeholders.*

ATSDR Response

The larger circles discriminate visually the wells with detected uranium concentrations. Although no spatial context is inferred from the size of the circles, the symbol size has been reduced. The data base does not explicitly distinguish well type or household size. As indicated in the second comment, Figure 3 did not show all drinking water wells that have been tested for uranium. Although, as indicated, ATSDR did have the data, it was not in a consistent data format. We have reformatted the available data and revised Figure 3 to include all of the available uranium analyses.

Comment Group 16

a. *(Table 2) Presentation of data is not very useful. No information is provided to address the range of detected concentrations, temporal trends, sampling dates, locations of exceedances. No information is provided with which to evaluate current exposures if any. No information to evaluate these concentrations against natural background concentrations. Not clear why thorium and the radium isotopes are included since these chemicals do not exceed CVs. Not clear if the chemicals presented in Table 2 are the only chemicals detected, analyzed for, etc. As noted in the report, the quality of these data is questionable at best.*

ATSDR Response

The ranges of detected concentrations are included in the table. If this comment refers to the frequency distributions of the detected concentrations, those distributions are not included because the limited frequency of sampling and non-spatial representation of the sampling program would render such statistical descriptors as meaningless. Also, whether these measured contaminant concentrations represent background or anthropogenically enhanced conditions does not matter for determining whether they represent a public health hazard. We will revise our public health conclusions if more specific data become available. As explained in the text, thorium and radium are included because the evaluation process for gross alpha requires that evaluation when the gross alpha comparison value is exceeded.

Comment Group 17

a. *Except as part of a thorough baseline human health risk assessment, these toxicology summaries are not particularly useful and can be misleading to the public. Although some attempt is made to relate the toxicology summaries to data from the site, most of the toxicology information is not useful without more extensive groundwater monitoring and human exposure data.*

ATSDR Response

We believe these toxicological summaries are useful in providing basic information to the Yerington community regarding the health effects of potentially widespread groundwater contaminants. Further, an additional purpose of these summaries is to place measured contaminant concentrations within the realm of observed adverse health effects (e.g. site-specific doses, as shown in Figure 4 and 5).

Comment Group 18

a. *No source is cited for the data presented. Species studied is not identified. Data point that falls below the dose related to a groundwater concentration of 24 μg/L is misleading as the study from which this point was derived was not adjusted to account for socioeconomic or behavioral (smoking) factors – when those factors were accounted for there was not a statistically significant increase in cancer rates. The data points should be linked to a specific study, however, so that the reader can evaluate this information independently.*

ATSDR Response

This figure is based on information in the ATSDR Toxicological Profile for Arsenic. This reference has been added to the caption. The text describing the Ferreccio et al. study (2000) includes language discussing the socioeconomic and behavioral corrections.

Comment Group 19

a. *"…the highest measured arsenic concentration of 24 μg/L" was used to estimate an arsenic dose for comparison to the studies presented on Figure 4. Later in the same paragraph, however, concentrations higher than 24 μg/L are cited from an EPA (2005) report. If other data were available why were they not considered in this report?*

b. *The report mentions residential well arsenic concentrations that are not included in the data sets obtained by ATSDR. Why aren't they included? How were they sampled? Who sampled those wells? What was the screening depth on those wells (shallow aquifer)? What laboratory performed the analysis, and are they certified?*

ATSDR Response

The higher arsenic values are referred to in the EPA Unilateral Administrative Order for the Yerington site (EPA 2005) and as such are part of the official administrative record for this site. Because of the absence of accompanying information such as sample date, location, or methods, we have not included these results in our evaluation.

Comment Group 20

a. *Estimated maximum dose of arsenic in this paragraph does not agree with Table 2.*

ATSDR Response

This has been revised to the correct value of 0.0015 mg/kg/day (as in Table 2).

Comment Group 21

a. *If the estimated dose of fluoride is being compared to the adequate intake (AI), then the AI for fluoride should be presented here.*

ATSDR Response

The fluoride "AIs" from the Institute of Medicine are not weight-adjusted. To compare them directly with estimated doses, a body weight must be assumed. For example, assuming that a 4- to 8-year old child weighs 16 kg, his or her weight-adjusted AI would be 1 mg/day divided by 16 kg, which equals 0.0625 mg/kg/day. This value is essentially equal to the estimated dose of 0.054 mg/kg/day from drinking Mason Valley water with a fluoride concentration of 870 μg/L.

Age Range Adequate Intake Level	mg/day
0–6 months	**0.01**
6–12 months	**0.5**
1–3 years	**0.7**
4–8 years	**1**
9–13 years (males and females)	**2**
14–18 years (males and females)	**3**
>18 years (males)	**4**
>18 years (females)	**3**

Adequate Intake of fluoride for various ages, Institute of Medicine 1997 from ATSDR 2003.

Comment Group 22

a. *Admission that sampling data are inadequate to identify the maximum uranium groundwater concentration or whether uranium concentrations are increasing or decreasing over time.*

b. *Last sentence of this paragraph rightly states that the available data do not allow specific conclusions about the source of chemicals found in groundwater in offsite wells.*

ATSDR Response

The maximum *measured* concentration is necessarily the maximum concentration *detected*. This sentence has been reworded to indicate that due to uncertainties in sampling data, higher concentrations may be present in the area. Regardless, however, of whether higher concentrations may be present or of the temporal trends in the measurements, it is incumbent on ATSDR to make a public health determination based on the data that are available.

Comment Group 23

a. *It is helpful to know that the study results used to create this figure are from studies of laboratory animals. The data points should be linked to a specific study, however, so that the reader can evaluate this information independently (Figure 5).*

ATSDR Response

The data underlying this figure are from numerous studies as summarized in the ATSDR Toxicological Profile on Uranium. This reference has been added to the figure caption.

Comment Group 24

a. *First sentence indicates that gross alpha concentrations exceed CVs, however, a CV for gross alpha was not provided.*

ATSDR Response

The gross alpha comparison value of 15 pCi/L is provided in Table 2.

Comment Group 25

a. *Why is only uranium mentioned in connection with a specific health effect? Other chemicals allegedly were detected at concentrations exceeding their CV. In addition, this statement is misleading to the public, which is unlikely to perform a rigorous review of the dose-response information to assess the likelihood of kidney effects from uranium ingestion.*

b. *This paragraph is completely misleading and faulty in logic. The estimated maximum doses (emphasis added) do not support the conclusion that a public health hazard exists; see for example figures 4 and 5. Maximum concentrations may exceed a CV but that is not sufficient to declare a public health hazard given the weak groundwater monitoring database. This paragraph seems to be saying, "we don't have enough information to draw any conclusions, nonetheless we conclude that the groundwater poses a public health hazard."*

c. *"…Past consumption of drinking water at the highest measured concentrations (is) unlikely to create adverse health effects for all contaminants except uranium." There is no evidence that the uranium reported in the drinking water is directly related to the YAM site, and there is no QA data to show that the highest measured concentration was accurate or reliable. "The available monitoring data are not sufficient to prove that releases from the YAM site are the source of contaminants in the down-gradient drinking water wells. Based on the estimated maximum doses and limitations of the currently available groundwater data, past exposure to well water down-gradient of the YAM site is considered to be a public health hazard." This statement is pure conjecture and is not based on the available data, especially considering the questionable data that it is apparently based on. And "all well water down-gradient of the Yam site" is a huge area, and the data do not support it. This blanket statement apparently refers to all down-gradient well water at any depth, at any distance down gradient, at any concentration, by any exposure type (ingestion or dermal) and for any length of exposure.*

d. *ATSDR states that "Based on the estimated maximum doses and limitations of the currently available groundwater data, past exposure to well water down-gradient of the site is considered to be a public health hazard". ATSDR provides no scientific foundation for this statement. ATSDR should provide the basis for this statement, as it contradicts the above. If this statement is simply referring to the uncertainties around the source of the off-site contaminants, a clarifying statement should be added by ATSDR.*

ATSDR Response

Potential adverse health effects for all contaminants exceeding their respective comparison values are presented in the preceding sections. This review of estimated doses and potential adverse health effects indicates that such health effects are unlikely for any of the groundwater contaminants. Uranium ingestion at the estimated doses may, however, produce a reversible renal effect (kidney tubular function, Kurttio et al. 2002; 2005). Whether this effect on kidney function will ultimately result in an adverse health effect is uncertain. In the face of this uncertainty, as well as that associated with sampling limitations, prudent public health practice

requires the determination that long-term ingestion of water at these contaminant concentrations is a public health hazard. These clarifying sentences have been added to the appropriate sections.

Comment Group 26

a. *The recommendations seem reasonable to address the many data gaps. It is not clear who will do this work or when it will be performed. Without these details it is not possible to draw any conclusions about the quality of the work that may be performed.*

b. *Private wells in Mason Valley probably should be tested, but since they are privately owned, you can't require the owner to test them. Where will the coordination and funding come from?*

c. *There is a need to inform all residents with domestic wells, living down-gradient from the YAMS, they should not be drinking their water, but use bottled water instead. There are residents in this area who are not aware the water they are drinking could cause a potential health threat. Some residents think if they do not have Uranium levels exceeding the MCL, the water is safe to drink. Many of the domestic wells do not exceed the MCL for Uranium, but do exceed the MCL for Arsenic which is also a Health risk.*

d. *The YCAG agrees there is a need to make sure that all residents with domestic wells are informed they need to have their wells tested to ensure the water is safe to drink. There are many residents who have not had their wells tested in the past for Uranium and some who have not tested them at all.*

e. *Having the domestic well sampling improved by the development of an agency-approved sampling and analysis plan will alleviate the residents concerns about the way the sampling has been done in the past.*

f. *The YCAG would like to request an addition to the Public Health Actions planned. We would like the ATSDR to send out a fact sheet that would give needed information to residents in the community on how/where to get their domestic wells tested (Listing what analytes they should ask to have checked), and also giving the facts about Radon and giving information on how/where to get their homes checked for Radon. (The YCAG has sent the ATSDR the statistics for the Yerington area on Radon levels in homes checked by the State Health Dept., one out of three homes tested by them had Radon levels exceeding the EPA's MCL.)*

g. *This report strongly supports the need for continued expansion of air and water monitoring and improved security at the site. It also begins the first steps toward characterizing risk by identifying uranium and arsenic as potentially significant factors for area groundwater. As can be expected, the report states that limited data for the site resulted in limited conclusions but that significant health issues were identified and should be further explored. Their review also indicated that residents with elevated levels in their water should continue to use bottled water for drinking and cooking but other exposure routes occurring through use of the water for bathing and cleaning is limited. In other words, bathing and other uses do not represent significant hazards.*

h. *The monitoring recommendations include providing air sampling during dust storms, more domestic well sampling and better site security. All of these activities have been reduced and/or downplayed by BP. Stakeholders and regulatory agencies should use this report to reverse that trend.*

ATSDR Response

As indicated in the Public Health Action Plan, most of the recommendations are being addressed by the appropriate regulatory agency or other responsible parties. ATSDR is continuing to interact with those groups concerning specific aspects of monitoring data and assessment of off-site exposure. Individual homeowners are responsible for assuring the safety of their own drinking water wells. Specific information on well testing has been added to this health consultation, and we have initiated discussions with the Nevada Extension Service concerning development of a fact sheet addressing the need for the testing of residential water wells. Several fact sheets addressing well and radon testing are currently available (see Attachment 3 and the EPA radon homepage http://www.epa.gov/radon/).

Comment Group 27

a. *In order to determine if the contaminants are from the mine site, there would have to be background data for comparison, from areas with similar geology, upwind (for air) or up gradient (for water) from the mine site. There would also have to be in-depth health assessments of individuals for other environmental risk factors, such as cigarette smoking or second-hand smoke exposure.*

b. *"Although this health consultation does evaluate the potential for adverse health effects from exposure to groundwater and airborne contaminants from the YAM site, the monitoring data currently available for making these determinations appear to have significant limitations." They are only evaluating the potential for adverse health effects of specific contaminants, but they have no evidence that those contaminants in the air and groundwater actually came directly from the YAM site; there are other potential sources. They also admit that their data are not reliable, so this report is apparently based on their best guess.*

c. *One way to more accurately determine if specific contaminants are coming from the YAM site is to look for chemical or isotopic tracers, where the dust directly related to the YAM site has different characteristics from the dust at other sites (e.g. construction) and the water at the YAM site has different characteristics from surface water or the deep groundwater. For example, isotopic ratios of hydrogen (H) and oxygen (O) will vary in different water sources. There are other specific chemicals or isotopes that might be used to distinguish between different sources of dust.*

d. *Before collecting additional groundwater monitoring data, an approved plan needs to be in place, dealing with all the scientifically questionable issues about the data used in this report. Again, there is no mention of using isotopic or chemical tracers, or using geochemical modeling to look at the aquifer as a whole.*

ATSDR Response

We agree that additional information on background conditions will allow ATSDR to improve the public health assessment of this site. However, site boundary monitoring data for both air and groundwater conducted by ARC and other entities have indicated that site specific contaminants are migrating to off-site areas. It is also important to note that the public health assessment of the surrounding community must evaluate contaminant exposures and potential health effects regardless of where the contaminants originate. Additional studies documenting contaminant sources via geochemical signatures are ongoing. Note that Attachment 1 contains some general ATSDR recommendations concerning additional data needs and sampling protocols.

Comment Group 28

a. *"The leach heaps / tailings piles continue to produce acidic fluids (EPA, 2005)." Are the piles "producing fluids?" Do they really mean that when it rains on the piles, the runoff is acidic? If so, how does that compare to runoff of other disturbed areas (e.g. construction sites)?*

ATSDR Response

This sentence has been revised to "…continue to produce acidic leachate."

Comment Group 29

a. *The prevailing wind direction is generally from the south to north at the YAM site (apparently they have at least one meteorological monitoring station at YAM). There is no question that dust is blowing off of the mine site, as it is off of the adjacent roads, the construction sites, other disturbed land and the surrounding agricultural fields. They mention the tailings piles and evaporation ponds as sources of sulfates and sulfides, apparently related to the processing that was done with sulfuric acid. "These particles are only likely to become airborne during peak wind events. Current air monitoring programs designed to assess long-term average conditions are not adequate to evaluate short term conditions." This is not correct – the PM monitors are run for 24-hours, midnight to midnight, based on EPA air monitoring requirements and the fact that the PM health-based standards (NAAQS) are for 24-hours. The EPA considers the 24-hour sample "short-term." The 24-hour concentrations collected for the entire calendar year are used to determine the annual average concentration, also a health based standard (NAAQS). There are no standards for particulates based on a collection period of less than 24-hours. In addition, the EPA can classify high wind events as "natural exceptional events," and these data are not used to determine whether or not an area is in attainment of the NAAQS.*

b. *The concern about peak wind events, and that the sampling frequency (every third day at one site) is not designed to capture peak wind events, is misguided. Peak wind events are not likely to be sustained over a 24-hour period, and this is the shortest time frame for the NAAQS health-based standards. My understanding is that either ARC or YPT has installed a TEOM monitor. The TEOM collects continuous PM data (either PM10 or PM2.5, depending on configuration), but this instrument can only give you mass data (cannot be chemically speciated), and is only considered a federal equivalent method (FEM) for PM10, not PM2.5. Even if the mass concentrations exceeded the NAAQS 24-hour value on peak wind event days, these days could fall under the EPA's natural exceptional events rule, and would not count towards exceedance of the NAAQS. High wind events certainly increase the particulate matter in the air from all sources; the ATSDR should recommend that Lyon County or the NDEP issue health advisories on extremely windy days (this is done in many areas of the western US).*

c. *The recommendation to have an air monitoring program targeting the contaminant loads in peak wind events goes along with the YCAG requests and we believe this is a needed addition to the air monitoring for the safety of*

residents in the community. The YCAG concurs with ATSDR's recommendation to add total sulfur to the list of measured chemicals.

d. *The YCAG appreciates the additional comments that the current materials, migrating off-site, may contain much lower contaminant concentrations that do not reflect historic conditions. The residents are concerned that historically what blew off site may have had higher contaminant concentrations that what is blowing off-site now. The ATSDR's comments regarding this area of concern give us hope that the past dust events will be considered and studied.*

ATSDR Response

While particulate entrainment is dependent on several variables including particle size, wind speed, soil moisture, and topography (near-surface turbulence), wind speed plays a singularly important role. Wind speeds of greater than 15 mph are usually necessary for entraining silt and clay-sized particles (White ID, Mottershead DN, Harrison SJ. 1992. Environmental systems: an introductory text. 2nd ed. Toronto, Canada: Chapman Hall). Using on-site wind measurements, in the Yerington area such wind velocities occur about 5–7 percent of the time. Current air sampling of 24 hours every sixth day provides a 17 percent sampling frequency.

Considering that the 24-hour sampling period is very unlikely to correspond with the onset and end of a wind event, sampling 17 percent of the time for events that occur about 5 percent of the time is very unlikely to capture adequately those events. Continuous 24 hour sampling will mask particulate loads during peak events with longer periods of quiescence. Additionally, NAAQS are National Ambient Air Quality Standards and are for assessing and evaluating ambient conditions—not site-related events or releases. Although ATSDR uses the NAAQS standards for health comparison values, the specific monitoring criteria are not relevant for site specific monitoring or evaluation.

Comment Group 30

a. *I agree that the current air and groundwater monitoring programs, as described in this report, are not adequate. This report is supposed to contain "specific recommendations for exposure-specific monitoring activities." However, regardless of what type of air monitoring equipment is installed, and what type of sampling and analysis is done, it can't be used to reliably and accurately assess past exposures, and can only be used to estimate past exposures.*

ATSDR Response

We agree that evaluating past exposures based on current conditions and monitoring data may not be definitive. A number of modeling and analytical methods can, however, be used to produce reliable estimates of past and future exposure.

Comment Group 31

a. *The fourth concern related to site access restrictions only concerns ARC & BLM.*

b. *Site fencing and signage: probably a good idea for "high hazard former processing areas"*

c. *The site fencing needs to be improved to restrict public access (especially for the children living in the community). The site needs to have fencing around the entire perimeter of the site to restrict easy access to the hazardous site, as well as fencing within the YAMS where there are high-hazards (such as the processing areas and evaporation ponds). The signage needs to be improved as well. The current warning signs around the site boundary are inadequate. They do not state the dangers and hazards on the site. The signs should be spaced appropriately along the fencing around the whole perimeter of the site. The appropriate warning signs are long overdue and should be put up as soon as possible.*

d. *ATSDR indicates that this site presents a public health hazard for on-site physical hazards. Atlantic Richfield's security plan addresses this statement and these recommendations. It is recommended that ATSDR include a statement that indicates on-site physical hazards are being addressed in discussions between Atlantic Richfield and EPA.*

ATSDR Response

ATSDR has received numerous comments and documentation that unauthorized access to the facility by community members is ongoing. This site contains many chemical and physical hazards for which access should be restricted. The Public Health Action Plan states that discussions to improve site security are ongoing

Comment Group 32

a. *The last paragraph on page 8 changes the Table 2 reference to "five listed contaminants."*

ATSDR Response

This sentence has been revised to read "…five contaminants with concentrations greater than their respective CVs."

Comment Group 33

a. *Note that Maximum Contaminant Level (MCL) applies to water delivered to any user of a public system (not to private wells).*

ATSDR Response

Whether the water is from a public system or private well is irrelevant. The health assessment process underlying the establishment of the MCLs makes them useful as health comparison or screening values.

Comment Group 34

a. *This report talks about inhaled uranium compounds, and relates them to kidney problems. But there is no mention of the report prepared by Foxfire Scientific, Inc. (September 19, 2004) for the Nevada Department of Environmental Protection (NDEP), entitled "Yerington Mine Site Fugitive Dust Radiological Dose Assessment." This report concluded "potential exposure to fugitive dusts from the evaporation ponds and tailings study area are miniscule." The doses calculated from all radiological compounds were more than a factor of 200,000 lower than natural background radiation doses for a person living in Nevada.*

ATSDR Response

The inhaled radiological dose from uranium is not relevant to the chemical toxicity or dose of uranium from either ingestion or inhalation. We agree that the inhaled radiological dose from uranium is negligible and consequently we have not considered this a significant site-related contaminant.

Comment Group 35

a. *The health concerns reported (respiratory irritation, allergic reactions, and asthma) could be related to many environmental factors that have no direct relationship to the YAM site. The report is based on the ARC and YPT air quality monitoring network data, but we have no information on the type of monitors, how they were operated, who operated them, how the data were collected / calculated / analyzed, whether there were approved Quality Assurance Project Plans (QAPPs), what laboratory weighed and / or analyzed the filters, whether the laboratory was approved, what methods were used for analysis, etc.*

b. *Both ARC and YPT have vested interests; if ATSDR is really interested in quality assured data they need to pay for a study by an independent third party, and the air monitoring would have to be conducted for a significant time period (typically 3 years or more) using approved air monitoring methods and laboratory analysis methods with QA/QC protocols.*

ATSDR Response

Please refer to the referenced documents for those details. This health consultation is not the appropriate source for the details of those respective sampling programs. Both the ARC and YPT sampling programs are overseen by appropriate regulatory authorities and follow approved sampling and analytical protocols.

Comment Group 36

a. *The concern that contaminated dust from the mine is only blowing during peak wind events indicates that ATSDR is aware that there is no evidence of any ongoing problem with PM concentrations or contaminants from the YAM site. Some of the PM filters from the YPT site were analyzed for 39 elements (but we don't know if these filters were PM10 or PM2.5). The report states: "None of the measured contaminant concentrations exceeded their respective short term screening values. Thirty-four additional contaminants were analyzed in the YPT 2003 report. All of the measured contaminants except particulate matter (assume mass concentration) were* ***at least 100 times lower*** *than their respective screening value." (Emphasis added)*

b. *The statement that "current air sampling may not reflect historic conditions" is obvious; there is no way to go back 30 years and sample the air quality, or even make an educated guess based on current conditions. The bottom line is that "None of the measured air contaminant concentrations represent a short term health hazard. Also, because the dust events result from relatively short term wind storms, it is very unlikely that dust from the YAM site represents a long-term or annual air hazard."*

c. *Certainly the YAM site has areas of disturbed soil, but many of these areas have been modified to minimize the amount of fugitive dust that will blow off in the wind. There are likely many other areas of disturbed soil (construction sites, dirt roads and agricultural fields) that contribute a significant amount of the particulate matter collected by the air monitors. The closer the disturbed soil is to the monitor (or receptor), the more likely it is to contribute to the PM10 fraction of the mass. "Based on concentrations of airborne contaminants from recent air monitoring studies, off-site exposure to airborne contaminants (is) not likely to cause adverse health effects." Short-term exposure to particulates during peak wind events "is an indeterminate public health hazard." However, the report does not make any recommendations related to issuing health – related warnings to "sensitive populations" to stay indoors during high wind events, something that is routine in many areas of the western US.*

d. *Page 22, 5th subbullet: While it would be interesting to get data on high wind events, ATSDR provides no criteria as to how to determine whether there is contribution from site contaminants. Atlantic Richfield requests that ATSDR provide any analytical data from high wind events in any other parts of the county (or state) that could be used to draw conclusions.*

ATSDR Response

We agree that any significant wind-borne transport of site contaminants to off-site areas during most weather conditions is unlikely. Still, documentation of off-site transport during peak events has been extensively photographed. As previously discussed, however, existing sampling methods may not be adequate to assess ongoing but relatively infrequent wind events.

Fugitive dust monitoring is a common practice at various industrial and hazardous waste sites. A wide variety of literature is available on this practice and on the related sampling and analytical techniques. Numerous references are also available to event sampling and to a number of sampling instruments that capture samples during specified meteorological conditions.

Note too that interim remedial action to limit dust sources (capping) is currently underway. The Public Health Action Plan references this action, which may significantly reduce the on-site sources of airborne sulfates and alleviate the need for additional dust-event monitoring.

Comment Group 37

a. *The sulfur dioxide concentrations are "estimated by doubling measured sulfur weight concentration and assume all sulfur is present as sulfur dioxide." This is totally unscientific and unreasonable, and should not even be part of this report. The estimated concentrations are very low compared to the NAAQS; if there were any real concerns about SO_2 concentrations, there are SO_2 monitors approved by the EPA that are operated continuously in many areas of the US, and could be operated in Mason Valley.*

b. *Page 22, 5th subbullet: "Sulfur should be added..." Atlantic Richfield requests that ATSDR modify this sentence to indicate why they are recommending the addition of sulfate to the analog list.*

ATSDR Response

The SO_2 estimate is both scientific and reasonable. The measured parameter is elemental sulfur with an atomic mass of 32. Oxygen has an atomic mass of 16, and with two oxygen atoms per SO_2 molecule, also has a total mass of 32 per molecule. Therefore doubling the sulfur mass equates exactly with the SO_2 molecular mass. While this assumes all of the sulfur is present as SO_2, it is health-protective. If we had found the SO_2 to be a public health hazard using this health protective estimate, we would have indicated the health protective bias in this estimation process.

We have removed our recommendation for specific monitoring of airborne sulfur/sulfate. Specific health comparison values for sulfur particulates are unavailable; they are instead evaluated as part of the total suspended load (PM-10 or PM-2.5).

Comment Group 38

a. *"The site-related contaminants are naturally occurring…" The most likely YAM related air contaminants are sulfates, related to the sulfuric acid processing that occurred. Naturally occurring sulfates are very common and constitute the dominant dissolved salt in Walker Lake and therefore must occur in upstream sediments along Walker River.*

ATSDR Response

We agree that sulfate-rich sediments are a naturally occurring component of background sediments in Mason Valley. Planning is currently underway to establish a "background" sampling program. But Walker River sediments, which are present either subaqueously or in vegetated floodplains, are unlikely a significant component of airborne dust emanating from the YAM site.

Comment Group 39

a. *"Ongoing air monitoring programs should target contaminant loads in peak wind events. Sulfate (or total sulfur) should be added to the list of measured parameters." We don't even have information on how the particulate filters were speciated for the previous study. What type of monitor will be used, and where will the funding come from to speciate the filters? If you want filters speciated for sulfate, you need a specific type of filter that is not routinely used for PM mass measurements. There are no standards for particulate sulfate concentrations, only SO_2 (gaseous). There is no evidence that any of the particulates are related to health effects, so why spend all the time and money to measure this? Unless they want to have the monitoring program designed and implemented by a disinterested third party, there will be no resolution to the questions.*

ATSDR Response

ARC air monitoring is currently conducted using sampling and analytical protocols in the referenced document (ARC 2005d) with oversight by the EPA. Discussions are currently under way to extend or modify this work plan. Although the proposed revisions have included some discussion of sulfur/sulfate analyses, ATSDR has not made any specific recommendations concerning the analytical methods for these parameters and has also removed the recommendation for sulfur specific air analysis.

Comment Group 40

a. *This is the first mention of NDEP monitoring, and it seems to indicate that they are monitoring air, groundwater, surface water and soil on and adjacent to the site. Where are these data, and why aren't they included in this report? Where are all of the air quality monitors, who is responsible for them, what type of monitors are they (exact type, and whether or not they are federal reference methods FRMs or federal equivalent methods FEMs), are there approved quality assurance project plans (QAPPs), have the monitoring agencies been audited, are the filters processed / weighed in approved laboratories, who decides which particulate filters are speciated, how are they speciated, what laboratories are used and are they approved laboratories, what method are they using to speciated the filters, etc? If the ATSDR thinks the monitoring programs need to be improved, what is the EPA or NDEP response to this? If all the currently collected data are "inadequate" or questionable, then it doesn't make sense to add more air monitors and conduct additional analyses if the whole system needs to be changed. Perhaps the ATSDR position that the data are inadequate reflects the fact that no real, conclusive health hazards were found, so they can just keep recommending more monitors, more data, more money spent, hoping to find something.*

ATSDR Response

The health consultation makes no reference to NDEP monitoring, only NDEP oversight of ARC monitoring. EPA currently has primary regulatory oversight for monitoring activities at this site. Current and pending monitoring activities, with the exception of the residential well sampling program, do have adequate oversight and are conducted using appropriate sampling and analytical protocols. We expect that planned improvements in the ongoing monitoring programs, as required via EPA oversight, will correct the major limitations of the past monitoring practices.

Comment Group 41

a. *Why is there no mention of NDEP initiating public health advisories or warnings for high wind events? If these high wind events are really a concern, this should be standard operating procedure, as it is in many western areas. The report states that ATSDR will "provide specific comments and recommendations on the environmental monitoring programs (attachment 1)."*

ATSDR Response

The health consultation does not mention any NDEP public health advisories because we are not aware that any have been issued. We cannot comment on why such an advisory has or has not been issued by another agency.

Comment Group 42

a. *The ATSDR failed to review the use of mine waste contaminated irrigation water. Irrigation wells adjacent to the site contain elevated uranium levels and are used to irrigate onions. The use of this water on food crops plus the use in home gardens is also a question brought to the attention of ATSDR in public meetings.*

ATSDR Response

The Recommendations include the following sentence: "The measured contaminant concentrations show that nonpotable uses such as bathing, cleaning, and irrigation do not represent a public health hazard and may continue." As the uptake of metals by food crops is limited, use of well water for irrigation does not present a health hazard. It may be of interest to note that in particular, onions require high sulfate concentrations..

Comment Group 43

a. *Groundwater data needs: There are certainly questions about the accuracy and completeness of some of the available monitoring data. The discussion in this part of the report finally recognized that the vertical distribution of contaminants is important, and nothing in this report tells us any information about the depth of the wells that were sampled. The discussion about "developing a better groundwater data set" is appropriate, and similar steps would apply to developing a better air quality data set. ATSDR recognizes that ARC has developed a sampling and analysis plan for groundwater, but there seems to be no plan for an area-wide, third party sampling and analysis plan. There is also a discussion about estimating past concentrations, referring to groundwater modeling studies, but the type of modeling is not specified. The report also finally recognizes that "the YAM may not be the source of off-site contaminants…"*

b. *ARC is developing an air monitoring work plan with EPA, but there seems to be no plan for an area-wide, third party sampling and analysis plan for air monitoring. The ATSDR statement that the plan should be modified "to ensure that peak wind events are specifically sampled and reported as short term averages…" is unrealistic and unscientific. Anything less than a 24-hour sampling period would not be acceptable under the NAAQS, and the data collected would not correlate to any recognized health effects. Besides, that type of monitoring would essentially require an operator to be on-site at all times, ready to turn on the monitor with little notice when the wind speed reached some defined threshold, and turn off the monitor when the wind speed went below that threshold for some period of time. The ATSDR assertion that there needs to be regular monitoring for airborne sulfate is not supported by any of their data. The statement that sulfate "is a common contaminant at the YAM site…" does not correlate with the estimated sulfate concentrations from the reported air monitoring data.*

c. *The YCAG concurs with your opinion the current monitoring of air, groundwater, surface water and soil are inadequate for assessing off-site exposures to site related contaminants. We would like to see the programs improved in the ways you recommend.*

ATSDR Response

In the United States, site specific monitoring data are typically obtained by the responsible party with oversight by appropriate state or federal agencies. Independent third-party sampling is rare and unlikely to occur at this site without an infusion of external funds. ATSDR is hopeful that planned improvements to the sampling programs will result in the collection of reliable and accurate environmental data. We have nonetheless removed the recommendation for assessment of airborne sulfates or sulfur particles.

Comment Group 44

a. *Atlantic Richfield concurs with ATSDRs conclusion that the site does not pose an immediate health risk.*

b. *Atlantic Richfield concurs with ATSDR that based on the available data that there does not appear to be any health effects noted from long term exposures.*

c. *ATSDR indicates that short term exposure downwind of the site is considered to be an indeterminate public health hazard. Atlantic Richfield's subsequent data analysis by Brown and Caldwell on wind direction negates this and will be forwarded to ATSDR for inclusion into the report.*

d. *The ATSDR makes recommendations that include expanding the domestic well monitoring program and improved quality control for these studies. It should be noted that BP has sharply reduced domestic well monitoring and, despite repeated request, provided no comprehensive SAPs or even plans to develop SAPs for the program.*

e. *The ATSDR recommends that peak wind events be monitored. BP has refused to do this type of monitoring despite repeated request in recent meetings.*

f. *The ATSDR recommends improved security at the site that includes better fencing. In Table 1 on page 5, it is stated that "access restrictions (4-strand barbwire) are inadequate". It should be noted that BP has recently refused to provide even a perimeter fence.*

g. *The ATSDR recommends metal speciation and improved assessment of the Wabuska Drain. Both issues have been consistently been downplayed by BP. Metal speciation is not included in recent or planned data.*

h. *This is the first mention that EPA has initiated an effort to reduce the on-site sources of airborne dust.*

ATSDR Response

Comments noted.

Comment Group 45

a. *ATSDR indicates that they evaluated both Atlantic Richfield and tribe air data. Atlantic Richfield noted that all 34 contaminants the tribe analyzed for were below any level that might cause adverse effects and "were at least 100 times lower than their respective screening values". Atlantic Richfield contends that this information should be made available to the general public and Atlantic Richfield to facilitate future reviews related to the ongoing air monitoring program.*

b. *Table 3. The Tribe provided data on two monitoring stations for PM-10, only one set is presented. In addition, a statement regarding AM-4 and AM-5 to describe the very small data set associated with these monitoring stations would clarify this data. In addition, the only available data is from the winter when high moisture limited dust.*

ATSDR Response

ATSDR has made numerous requests for the YPT air data, which have not as yet been provided. We have not included data from the second YPT location (Yerington station) because it is crosswind to prevailing dominant winds relative to primary sources of on-site dust (i.e., the YAM process area and evaporation ponds). As such, it is unlikely to receive a significant contribution of airborne contaminants from the YAM site.

Comment Group 46

a. *ATSDR indicates that groundwater data isn't adequate to determine contamination source however an initial basis for public health determination of exposure to groundwater down-gradient of the site is provided. No health risks were found with exposure to Ra 226, Ra 228, Thorium 232, Boron, Fluoride and Arsenic. It is stated that Uranium is unlikely to cause health effects at the concentrations seen. Atlantic Richfield recommends that additional investigations of spatial and temporal distributions of site-related contaminants focus on Uranium.*

ATSDR Response

The health determinations in this consultation are based on currently available data. As these data have considerable spatial and temporal uncertainty, future analyses restricted to the assessment of uranium may well overlook contaminants of potential health concern. Additionally, limiting future analyses would greatly restrict the ability to determine the hydrogeological and geochemical migration of site related contaminants.

Comment Group 47

a. *Page 1 – Background Section, 1st paragraph: delete the phrase "low-grade". This modifier is not necessary, as it is a value judgment not based on fact.*

b. *Page 5, Table 1, 1st concern: Groundwater Flow Direction, flow is not simply to the north in the area of the mine site; it also includes a northwest component and is greatly influenced by irrigation activities immediately north of the site. Atlantic Richfield requests that ATSDR modify the text accordingly. More detailed information can be found in the 2003 Final Draft Groundwater Conditions Work Plan, which was prepared by Brown and Caldwell for Atlantic Richfield.*

c. *Page 8, last paragraph (first sentence): Atlantic Richfield requests that ATSDR modify the statement to indicate that "people with well water uranium concentrations greater than **25** µg/L are currently being provided bottled water". As a precautionary measure, Atlantic Richfield is providing bottled water to residents with concentrations below the current MCL for Uranium,*

d. *Page 3. In addition to vat leach operations, Anaconda also operated heap leach at a site marked as "W-3". Later operations expanded on the heap leaching.*

e. *Page 3. Anaconda is misspelled in the last paragraph.*

f. *Figure 2. The southernmost physical hazard marked on the map is well outside the mine boundary. Please clarify this location and/or hazard.*

g. *Page 21. The conclusions state that "site-related contaminants are naturally occurring". This has yet to be determined. Mine waste included imported material such as sulfur, a known source of selenium and suspected source of arsenic, and ore from other nearby mines including the McCarthur mine. In addition, historical documents suggest that the surface signature of the ore at the mine may have been limited. This creates a case were contaminants were either from off-site or previously inaccessible for exposure. A more accurate description is "some site-related contaminants may also be naturally occurring".*

ATSDR Response

Revised as suggested.

Comment Group 48

a. *Page 4 – last paragraph: Statement indicates "this health consultation should be considered preliminary and additional evaluations will be conducted as more reliable data becomes available" due to data with significant limitations. This appears contradictory with the statement on the cover page indicating that "This concludes the health consultation process for this site, unless additional information is obtained by ATSDR." Clarification from ATSDR is requested.*

ATSDR Response

As we expect additional data collection at this site, both statements are correct, though somewhat misleading. It should be noted that the conclusions will be revised based on evaluation of future information.

Comment Group 49

a. *Page 5, Table 1, 2nd concern: The wind direction is **not** predominantly to the north, as indicated in Table 1. It is highly variable, but the most frequent direction with high wind speeds is to the northeast. Short-term and long-term fugitive dust and potential health-related issues are currently addressed by the monitoring system in place – the short-term issues are incorporated into the current monitoring data. ATSDR should modify the text accordingly to reflect the available data or clarify its source for this statement as it is inconsistent with current findings. For example, ATSDR may review the 2005 Air Quality Monitoring Reports prepared by Brown and Caldwell for reference to observed wind directions.*

ATSDR Response

As stated in this comment, because the strongest winds are towards the north and northeast, the text is revised accordingly. See the response to comment 29 concerning the adequacy of peak event air sampling.

Comment Group 50

a. *While Atlantic Richfield recognizes that part of the ATSDR process involves mapping "health concerns" on a map, it gives the impression that these are high risk locations when they are really residential locations of people who voiced a health concern to ATSDR. This is different from a disease "hot spot".*

ATSDR indicates that the "specific disease concerns ….observed by ATSDR staff, are plausible outcomes for the contaminants present in the YAM site area." Atlantic Richfield contends that this may mislead the lay person to believe that ATSDR has made a conclusion that diseases have been caused by site contaminants - when they have not. This statement pertains to the hazard potential of the material and does not address the dose response relationships and subsequent risk assessment. Atlantic Richfield requests that ATSDR reword this section to indicate that the concerns were voiced by residents down gradient of the YAM site to avoid confusion by the public.

ATSDR Response

The following clause has been added to the table, "ATSDR has not determined that any specific health outcomes are related to releases from the YAM facility."

Comment Group 51

a. *Page 7 – Groundwater Contamination, 1st paragraph (second sentence): the phrase that "the sedimentary deposits consist of generally permeable sand and gravel alluvial deposits along the west margin of the valley" is too general given the information provided in the Data Summary Report for Process Areas Groundwater Conditions, which was available to ATSDR for this report. Atlantic Richfield requests that ATSDR re-clarify this, based on the process area report.*

ATSDR Response

We agree that the referenced phrase is a very general description of the site geology. that phrase and associated text are, however, both technically correct and sufficient for the purposes of this document. For more detailed descriptions of the local geology we have included an additional sentence referring readers to other sources.

Comment Group 52

a. *Pages 11-16: Information on several selected contaminants is presented, but not put in perspective from either a toxicology or geochemical perspective (especially for the Western U.S.) The acute effects discussed would never occur at these environmental levels. By presenting the data in this manner, it implies that these must all be mine-contributed site contaminants, but for several, no evidence is provided that this is the case. High levels of arsenic, boron and fluoride in the water and soil, are not unusual for Nevada or other parts of the arid West and should be given appropriate consideration for this report.*

ATSDR Response

As previously stated, we have made no attempt to link contaminant concentrations in Mason Valley wells with releases from the YAM site. We also believe it is necessary to relate the potential health effects from exposure to these contaminants to the measured concentrations in Mason Valley wells. We clearly state that we expect no adverse health effects from most of the exposures, which does seem to be an appropriate toxicological perspective. Also, the contaminant-specific summaries indicate that all of these substances may be naturally occurring

in rocks and soils. To improve the geochemical perspective we have added phrases to indicate they also naturally occur in groundwater.

Comment Group 53

a. *Page 12, Figure 4: As presented, this information has the potential to be taken out of context. According to the text, the data point for the study reporting lung cancer (which is below the dose lines) represents the combined effects of arsenic ingestion and smoking. The text states that the data point is above the line for lung cancer when the confounding factor of smoking is removed. This latter point should be used for the graph especially since ATSDR is comparing the daily dose for children. If ASTDR still wants to include the original point, the label should make it clear that the data point represents the dose of ingested arsenic in smokers.*

ATSDR Response

The figure caption has been revised to indicate that 1) when corrected for age, smoking, and other factors, all estimated Mason Valley arsenic doses are below the dose responses, and 2) the maximum child arsenic doses are not comparable with the lung cancer dose response.

Comment Group 54

a. *ATSDR should reconsider the present format of the conclusions addressed in the report. On one hand, ATSDR recognizes that current data does not allow specific conclusions to be drawn. Notwithstanding the disclosure of this reasonable limitation, ATSDR subsequently outlines a myriad of "specific conclusions" which it has drawn without proper foundation or scientific merit. Atlantic Richfield requests that ATSDR recognize the inconsistency of the statements and clarify the scientific foundation for the conclusions rendered in this Section.*

ATSDR Response

ATSDR believes specific conclusions can be drawn from the data presented in this health consultation. Although sources of uncertainty are associated with the data sets underlying this report, we have acknowledged those uncertainties and have appropriately restricted our conclusions. The recommendations are logically based on the appropriately restricted conclusions.

Comment Group 55

a. *ATSDR'S assertion that the site be considered a public health hazard lacks any verifiable evidence that residents that have lived near the YAM site and / or relied upon local groundwater have exhibited any higher level of notable adverse health effects than similar persons living elsewhere within the State.*

b. *Due to lack of associated adverse health effects in the community and the limitations in the monitoring data, Atlantic Richfield requests that ATSDR include additional information to indicate how past exposure is considered to be a public health hazard.*

ATSDR Response

ATSDR is unaware of any quantitative health studies conducted in the Yerington area which would document specific adverse health effects. Additionally, any large scale epidemiological reviews of health effects are unlikely to provide enough spatial resolution to document such localized health effects.

To reiterate, we do not believe that the estimated doses from measured contaminant concentrations have produced any adverse health effects. Nevertheless, given the uncertainty associated with groundwater sampling and dose estimation, combined with variation in the toxicological dose response of long term exposure, prudent public health policy requires a public health hazard determination. Currently available data are not sufficient to determine whether the YAM site is the source of contaminants in the residential drinking water wells. If, however, future information confirms that the YAM site is not the source of these contaminants, we will revise our conclusions accordingly.

Comment Group 56

a. *Table 2. The concentrations range for Radium 226 and 228 should be presented as a sum to match the stated comparison value.*

ATSDR Response

As the radium isotopes were individually analyzed, it is more appropriate to present the results separately. Also, it should be noted that even summed, the maximum radium activities are lower than the comparison value. The radium activities are included only because the gross alpha activity exceeds its comparison value.

Comment Group 57

a. *Figure 4. IRIS (http://cfpub.epa.gov/iris/quickview.cfm?substance_nmbr=0278) lists a NOAEL for arsenic at 0.0008 mg/kg/d, a value lower than either of those presented. Critical effect for this dose is listed as hyerpigmentation, keratosis and possible vascular complications, based on an oral RfD described as medium confidence. This value should be included in the arsenic exposure discussions.*

ATSDR Response

All of the dose-response values shown in Figure 4 are cancer effect levels and represent doses for which cancer effects have been observed or estimated. By contrast and by definition a NOAEL is a value without "observed adverse effects." Combining dose levels which have caused adverse health effects with other, lower doses for which no adverse effects have been observed could be confusing. Note also that a dose of 0.0008 mg/kg/day is essentially the same as dose of 0.001 mg/kg/day.

Comment Group 58

a. *Page 16. The report states that "there are not data available assessing the health effects of uranium ingestion on humans". Contrary to the appearance of this statement, there are a number of studies related to the health effects of uranium ingestion through drinking water that may need to be discussed in this section. There is an excellent summary of several of these studies in the Recommendations for a Uranium Health-Based Ground Water Standard*

prepared for the New Mexico Environmental Department by Malczewska et al. in 2003 (copy provided under separate cover). Studies such as Limson-Zamora et al (1998) and Novikov et al. (1968), cited in the document indicate responses to uranium intake in drinking water at rates of 0.001 mg/kg/d or lower. Several other studies such as one done by Health Canada (1998) in a First Nations community and Mao et al (1995) showed measurable responses in residents using drinking water with uranium concentrations in the range of values found in Yerington.

ATSDR Response

The referenced quotation is from the ATSDR Toxicological Profile on Uranium. Both the ATSDR Uranium document (ATSDR 1999a) and the above referenced Malczewska-Toth, et al. (2003) report review a number of studies that evaluate subclinical biological effects of uranium ingestion. Neither of these reviews nor the reviewed studies link those subclinical biological effects with any adverse health effects. Still, because this may be a misleading distinction, we have deleted the referenced sentence.

Comment Group 59

a. *Page 18. The report states that "it is very unlikely that dust from the YAM site represents a long-term or annual air hazard". Since dust events happen regularly with a season of greater intensity (snow cover is limited to days with exceptional spells lasting less than two weeks) would this constitute a chronic, not short term, exposure? It should be added that additional exposure occurs when the dust is present in homes near the mine. This section may require reconsideration or additional clarification.*

ATSDR Response

We agree that meteorological conditions leading to off-site dust transport may be regularly occurring events. Even though such events may occur regularly, they are nonetheless relatively rare in comparison with calmer conditions with little or no dust entrainment and off-site transport. Consequently, air parameters such as PM-10, averaged over long-term or annual conditions, are unlikely to exceed annual comparison values. Similarly, the cumulative dust deposited in off-site soils represents a long-term average of settling from all meteorological conditions, with only a small fraction contributed by dust from the mine site. Specifically, long-term conditions are reflected in the average PM-10 concentrations collected by YPT (2003). Average PM-10 concentrations at both monitoring locations (Yerington and Wabuska) are less than 16 $\mu g/m^3$. These concentrations are also less than ⅓ of the NAAQS annual standard and are therefore unlikely to cause any adverse health effects.

Additionally, the currently available air monitoring data do not indicate site-related contaminant concentrations that would be high enough to affect long-term average conditions. ATSDR will reevaluate the potential off-site exposures via air-borne dust when additional data become available.

Comment Group 60

a. *Page 19. It should be noted that the California Ambient Air Quality Standard for PM-10 is 50 $\mu g/m^3$, which is exceeded on several occasions at both Tribal monitoring stations. Although these standards are of limited enforcement value, they are based on best available health studies. In other words, the*

elevated dust levels around the mine do represent a health issue according to these measures. Adding to this, these measures were taken up to two miles from the mine. The over 2,000 people living closer to the mine were most likely exposed to much higher levels.

b. *Page 21. Air quality discussions should be reviewed in light of the above comment (number 6). With 24 hour measurements exceeding some standards for PM-10, it must be concluded that there is a higher probability of associated health risk. This becomes more evident when the locations of those measures, up to 2 miles from the mine, are considered.*

ATSDR Response

Several health-based standards are available for ambient particulate matter, including the referenced California standard and the proposed EPA national standard for PM 2.5-10 (65 μg/m3). Note however that virtually the entire State of California is a nonattainment area relative to its PM 10 standard. Also note the following quote from the EPA fact sheet on the proposed PM 10 revision. Although the health basis for this statement is not referenced, it is notable that dust events in rural and mining settings are exempt.

> The proposed standard would exclude any ambient mix of PM10-2.5 where the majority of coarse particles are rural windblown dust and soils and PM generated by agricultural and mining sources. Evidence to date does not support a national air quality standard for these kinds of situations. (http://www.epa.gov/oar/particlepollution/fs20051220pm.html)

We agree that meteorological conditions in the Yerington area will occasionally produce very dusty conditions that could in turn produce reversible adverse health effects in people with respiratory conditions such as asthma. ATSDR recommends that such persons exercise caution during these times by avoiding prolonged outdoor activity. Although during these meteorological conditions the YAM site may increase the dust available for entrainment, whether a commensurate increase in site-specific contaminants in that dust occurs, or whether dust from the YAM site is more toxic than dust from other Mason Valley sources, is unknown.

Appendix C. Appendix C. Information Resources for Water Quality Testing of Private Wells

As a general rule, water testing for private well owners is recommended annually since private wells are not monitored by any government agency. Therefore, it is the responsibility of homeowners to test drinking water to ensure that your water is safe. Further, water quality results can vary greatly from site to site so that a neighbor's test results may not reflect the quality of the water next door. To summarize the importance and details for why and how private well owners should have their water quality tested:

WHY: Elevated concentrations of uranium, arsenic, and other metals have been detected in drinking water wells in Mason Valley. Drinking high concentrations of these contaminants can make you sick.

WHERE: The Nevada State Health Laboratory has a certified water quality laboratory. Contact them directly at (775) 688-1335. They will provide you with the information and procedures on how to get your water tested.

COST: A routine domestic water quality analysis (that includes 23 different contaminants) costs approximately $100, uranium analysis costs an additional $90, and a test of bacterial contamination an additional $12.

The Atlantic Richfield Company is providing free water quality tests for wells located down-gradient (north) of the Yerington Anaconda Mine Site. Well owners should contact *Stacey J. Waterman, Ph.D.* (714) 228-6791 phone, watesj@bp.com (e-mail) for information on this program.

Additional information that may clarify private well water testing may be found in the following Fact Sheets published by the University of Nevada, College of Cooperative Extension (UNCE). All may be accessed online and free of charge from the UNCE publications website.

Donaldson, Courtois, Walker	Drinking Water Quality in Nevada: Common Problems for the Well Owner http://www.unce.unr.edu/publications/FS00/FS0046.pdf	FS-00-46
Donaldson,	Drinking Water Testing for Private Well Owners	FS-99-24

Cobourn, S. Lewis	http://www.unce.unr.edu/publications/FS99/FS9924.pdf	
Donaldson, Johnson, Hammond, S. Lewis	How to Test Your Well Water and Understand the Results http://www.unce.unr.edu/publications/FS99/FS9923.pdf	FS-99-23
Donaldson, Courtois, Walker	Matching Drinking Water Quality Problems to Treatment Methods http://www.unce.unr.edu/publications/SP00/SP0019.pdf	SP-00-19
Donaldson, Cobourn	Protect Your Well Water http://www.unce.unr.edu/publications/FS99/FS9925.pdf	FS-99-25
Fisher, Reisig, Powell, Walker	Reverse Osmosis: Installing and Maintaining a Reverse Osmosis Unit http://www.unce.unr.edu/publications/FS05/FS0510.pdf	FS-05-1