Health Consultation

TRAVERSE MOUNTAIN: THALLIUM IN DRINKING WATER

LEHI, UTAH COUNTY, UTAH

Prepared by
Utah Department of Health

DECEMBER 3, 2014

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners 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 or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

You May Contact ATSDR Toll Free at
1-800-CDC-INFO
or
Visit our Home Page at: http://www.atsdr.cdc.gov

HEALTH CONSULTATION

TRAVERSE MOUNTAIN: THALLIUM IN DRINKING WATER

LEHI, UTAH COUNTY, UTAH

Prepared By:

Environmental Epidemiology Program
Office of Epidemiology
Utah Department of Health
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

TABLE OF CONTENTS

SUMMARY 4
PURPOSE 8
BACKGROUND 8
Site History 8
Land Use and Demographics 8
Remediation 10
DISCUSSION 11
Nature and Extent of Contamination 11
Exposure Pathways Analysis 11
Completed Pathways 11
Eliminated Pathways 12
Potential Pathways 12
Public Health Implications 13
Evaluation Process 13
Exposure Dose Estimates and Toxicological Evaluation 14
Thallium Evaluation 16
DATA LIMITATIONS 23
CHILD'S HEALTH CONSIDERATIONS 23
COMMUNITY HEALTH CONCERNS 24
CONCLUSIONS 24
RECOMMENDATIONS 26
PUBLIC HEALTH ACTION PLAN 26
REPORT PREPARATION 28
AUTHORS 28
REFERENCES 30
APPENDICES 34
APPENDIX A – TABLES AND FIGURES 35
APPENDIX B – SITUATION ANALYSIS 40
APPENDIX C – LEHI CITY PUBLIC NOTICES 64
APPENDIX D – EXPOSURE DOSE CALCULATIONS 69
APPENDIX E – ACRONYMS AND TERM DEFINITIONS 77
APPENDIX F – PUBLIC COMMENTS 81

TABLES

Table 1. Health guideline values considered for chronic oral exposure reference dose to thallium based on hierarchy of human health toxicity values (highest ranked at top) (EPA, 2012d) 16
Table 2. Potential exposure doses to thallium contaminated drinking water from October 21, 2010 to February 16, 2012. Lehi, UT. 17
Table 3. Potential exposure doses to thallium contaminated drinking water from February 22, 2012 to April 9, 2012 and from July 16, 2012 to August 30, 2012. Lehi, UT. 19
Table 4. Potential incidental exposure doses to thallium contaminated drinking water from outdoor home spigots February 22, 2012 to August 30, 2012. Lehi, UT. 19

Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT. 21

Table A1. Oak Hollow Well and Traverse Mountain Water System Timeline, 2001 to 2012, Lehi City Water Department, Utah. 37
Table A2. Thallium concentrations in residential soil samples collected on June 12, 2012, Traverse Mountain, Lehi, Utah. 38
Table A3. Thallium concentrations in drinking water samples exceeding EPA MCL collected after separation of the Oak Hollows Well from the drinking water distribution system on February 16, 2012 to August 16, 2012. Traverse Mountain, Lehi, Utah. 39

FIGURES

Map 1. Traverse Mountain, Lehi, Utah 2012. (Lighter Spot in Inset Map) 36

SUMMARY

INTRODUCTION

The Environmental Epidemiology Program (EEP) at the Utah Department of Health (UDOH), as part of a co-operative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared this health consultation (HC) to evaluate the human health risks arising from thallium exposures in Traverse Mountain, Lehi, Utah.

In October 2010, thallium concentrations in the Traverse Mountain Well (known as the Oak Hollow Well when it was drilled in 2001; see **Map 1** for the location of the well in the mountains above the Traverse Mountain community) were detected at levels above the U.S. Environmental Protection Agency's (EPA) maximum contaminant level (MCL). In February 2012, Lehi City removed the Traverse Mountain Well from the drinking water system and replaced it with two different sources containing non-detectable thallium concentrations (Lehi City, 2012a).

In the first week of March 2012, Lehi City began sampling the water from residential faucets and continued to detect thallium levels exceeding MCL. Lehi City immediately began flushing the drinking water distribution system and notified Traverse Mountain residents of the contamination. System flushing was performed from March 8, 2012 through March 23, 2012 when thallium concentrations fell to non-detectable levels (Lehi City, 2012a).

In April 2012, residents expressed concerns regarding the potential health effects from exposure to contaminated drinking water, secondary water, soil, and garden grown vegetables. In May 2012, ATSDR received a request from a Traverse Mountain resident to conduct a health assessment of the community's thallium exposure.

After careful consideration of the available water and soil data, the EEP concludes that the past exposures to the Traverse Mountain Well are not expected to harm the health of the Traverse Mountain community. Current thallium exposures from the Traverse Mountain Well are not expected to harm the health of the Traverse Mountain community since drinking water sample testing shows non-detectable levels of thallium.

CONCLUSION 1	The EEP concludes ingestion and skin contact with drinking water from October 21, 2010 to February 16, 2012 is not expected to harm people's health.
BASIS FOR DECISION	The EEP supports EPA's maximum contaminant level (MCL) for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL and calculated potential child and adult exposure doses exceeded the EPA Provisional Peer Reviewed Toxicity Values (PPRTV) reference dose (RfD). Although exposures to thallium levels exceeded MCL and PPRTV chronic exposure RfD (greater than 365 days), the levels are less than those associated with adverse health effects from thallium exposure. The EEP acknowledges reports of residents visiting their physicians for symptoms similar to thallium exposure. However, the EEP cannot conclude on the cause of these symptoms, which may be caused by exposures other than to thallium.
NEXT STEPS	The Lehi City Water Department will continue to monitor drinking water and the EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 2	The EEP concludes ingestion and skin contact with contaminated drinking water from February 22, 2012 to August 30, 2012 is not expected to harm people's health.
BASIS FOR DECISION	The EEP supports EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the no-observed-adverse-effect-level (NOAEL [highest exposure level at which no significant increase in adverse health effects occur]) for intermediate thallium exposure.
NEXT STEPS	The Lehi City Water Department will continue to monitor drinking water and the EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 3	The EEP concludes ingestion and skin contact with contaminated drinking water from outdoor home spigots from February 22, 2012

	to August 30, 2012 is not expected to harm people's health.
BASIS FOR DECISION	The EEP supports the EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the NOAEL for intermediate thallium exposure.
NEXT STEPS	The Lehi City Water Department will continue to monitor drinking water and the EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 4	The EEP concludes ingestion and skin contact with drinking water after August 30, 2012 is not expected to harm people's health.
BASIS FOR DECISION	Drinking water thallium levels have remained below EPA MCL (below detectable levels) since August 30, 2012.
NEXT STEPS	The Lehi City Water Department will continue to monitor drinking water and the EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 5	The EEP concludes that incidental ingestion and skin contact with thallium in secondary water (non-potable water) is not expected to harm people's health.
BASIS FOR DECISION	Although secondary water is not regulated by drinking water standards, the EEP applied the EPA MCL for thallium in its evaluation. The EEP supports the MCL as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated incidental child and adult exposure doses did not exceed the EPA PPRTV chronic exposure RfD.
NEXT STEPS	The EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 6	The EEP concludes that incidental ingestion and skin contact with thallium in soil is not expected to harm people's health.

BASIS FOR DECISION	Incidental exposure calculations based on soil sample data and ATSDR oral and dermal exposure equations result in potential thallium exposure doses below EPA PPRTV chronic exposure RfD.
NEXT STEPS	The EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
CONCLUSION 7	The EEP concludes that ingestion of vegetables grown in gardens where soil sampling occurred is not expected to harm people's health.
BASIS FOR DECISION	Without data to indicate how much thallium is taken up by plants grown in Traverse Mountain residential soil, potential exposure dose calculations are based on incidental soil exposures. Average soil thallium concentrations are well below the level at which the most thallium-concentrating vegetables may be considered potentially hazardous for human consumption (700 parts per billion [ppb]).
NEXT STEPS	The EEP will continue to provide residents with information regarding the health effects associated with exposures to thallium upon request. The EEP will review new information as it becomes available and revise this assessment if necessary.
FOR MORE INFORMATION	You may contact the EEP at (801) 538-6191 or eep@utah.gov for additional information about this health consultation.

PURPOSE

The Environmental Epidemiology Program (EEP) at the Utah Department of Health (UDOH) prepared this health consultation to evaluate the human health risks from potential exposure to thallium from drinking water, secondary water, soil, and garden vegetables in Traverse Mountain, Lehi, Utah. The EEP evaluates the human health risks of exposure to environmental contaminants in Utah through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

The mission of ATSDR is to serve the public by applying the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures related to toxic substances. The ATSDR has requested that the EEP conduct this health consultation to identify public health hazards posed by the contaminants to the surrounding area. The assessment process serves as a mechanism to help ATSDR and state health departments determine where public health actions should be addressed and for whom.

In April 2012, residents of the Traverse Mountain community in Lehi, Utah expressed concerns regarding the potential health effects from exposure to thallium-contaminated drinking water, secondary water, soil, and garden vegetables. In May 2012, ATSDR received a request from a Traverse Mountain resident to conduct a health assessment of the community's thallium exposure. The primary objective of this health consultation is to determine if thallium concentrations in drinking water, secondary water, soil, and garden vegetables pose a health hazard to the residents of the Traverse Mountain community in Lehi, Utah.

BACKGROUND

Site History

The community of Traverse Mountain is located in Lehi, Utah County, Utah, about 12 miles north of Provo and 23 miles south of Salt Lake City (see **Appendix A, Map 1**). Lehi was originally settled by the Mormon pioneers in 1850. Historical names for the city have included Sulfur Springs, Snow's Springs, Dry Creek, and Evansville. The city's name was changed to Lehi and incorporated in 1852. Lehi is Utah's sixth oldest town, and the northernmost community in Utah Valley. Lehi has more than doubled in population since 2000 to 46,000 residents in 2010 (Census, 2012).

Land Use and Demographics

Development of Traverse Mountain, a master planned community on the northernmost border of Lehi, began in 2001. The master plan includes 5,812 dwelling units along with plans for open space, retail, offices, restaurants, schools, and civic buildings. Currently there are 1,900 residential units within Traverse Mountain (Lehi City, 2012c). Prior to development, the Traverse Mountain area was used for agriculture, primarily winter wheat.

Land and Resource Use

Traverse Mountain is a residential and commercial development area.

History of Contamination

Thallium occurs naturally in the earth's crust and is often found in the vicinity of metallic ore deposits (EPA, 2009a). In 2001, the Traverse Mountain Well (then known as the Oak Hollow Well) was drilled to service the water needs (drinking and secondary) of the Traverse Mountain area (see **Map 1** for the location of the well in the mountains above the Traverse Mountain community). At that time, naturally occurring thallium was detected at 1.4 parts per billion (ppb) in the supply well; a value below the Environmental Protection Agency (EPA) maximum contaminant level (MCL) of 2 ppb. Sampling reports in 2004 indicated a thallium concentration of 1.7 ppb, and a concentration of 1.9 ppb in 2007. In October 2010, thallium concentrations at the well were reported at 2.6 ppb, exceeding the MCL. In October 2011, the Lehi City Water Department began quarterly thallium sampling and detected concentrations between 2.5 and 2.9 ppb. On February 16, 2012, the Traverse Mountain Well was removed from the drinking water system and the Lehi City Water Department introduced water from two different sources with non-detectable thallium concentrations (Lehi City, 2012a). The Lehi City Water Department tested the drinking water distribution system with the new sources and detected thallium levels exceeding the MCL (see timeline in **Appendix A, Table A1**).

The Lehi City Water Department hypothesized that the water pipes in the drinking water distribution system collected thallium (a process called "scaling") until February 16, 2012, when the Traverse Mountain Well was separated from the distribution system. Afterwards, built-up thallium was released into the drinking water system due to the differential water chemistry of the new water sources. The flushing that occurred from March 8, 2012 to March 23, 2012 reduced drinking water thallium levels to below MCL.

On July 16, 2012, investigative sampling of outside home spigots by the Lehi City Water Department resulted in thallium concentrations above MCL. The Lehi City Water Department hypothesized that piping at the ends of the drinking water distribution system tested above MCL due to these areas holding older water and experiencing less use. The Lehi City Water Department flushed and resampled until August 20, 2012, when levels returned to below MCL (Lehi City, 2012b).

Traverse Mountain properties also have access to secondary water with detectable levels of naturally occurring thallium. The secondary water distribution system is separate from the drinking water distribution system. Secondary water taps often are located away from housing structures and near the edge of properties. During a community meeting in April 2012, residents described using secondary water for watering gardens, yards, and recreational purposes. Some residents reported that children played in secondary water sprinkler systems.

Basis for Taking Action

In October 2010, the Lehi City Water Department detected thallium concentrations in drinking water that exceeded the MCL. These data were submitted at the end of October 2010 to the Utah Division of Drinking Water (DDW). The DDW reviewed the data in January 2011 and instructed the Lehi City Water Department to begin a quarterly monitoring requirement at the end of October 2011 (DDW, personal communication, July 18, 2012). Quarterly sampling began in November 2011 and is still ongoing at the present time. Additional sampling also occurred in January, February, and March of 2012. The Lehi City Water Department received orders from

DDW to issue a public notice on March 7, 2012 and began flushing on March 8, 2012 (**Appendix A, Table A1**).

In April 2012, the Lehi City Water Department requested the EEP attend a community meeting and discuss the health effects expected from thallium exposure. Representatives from the Lehi City Water Department, Lehi City Administration, Mayor of Lehi, Utah County Health Department, DDW and the EEP were present. Residents expressed concerns regarding the potential health effects from contaminated drinking water, secondary water, soil, and garden grown vegetables. In May 2012, ATSDR received a request by a Traverse Mountain resident to conduct a health assessment of the community's thallium exposure.

Remediation

On February 16, 2012, the Traverse Mountain Well was isolated from the drinking water system for Traverse Mountain, and the Lehi City Water Department introduced drinking water from different sources with non-detectable thallium concentrations. On March 8, 2012, the Lehi City Water Department began flushing the Traverse Mountain drinking water distribution system with non-detectable thallium concentration water. Sample results from distribution system blow-offs (endpoints in the water lines) detected thallium levels ranging from non-detect to 54.9 ppb. Drinking water distribution system flushing continued until March 23, 2012, when thallium concentrations were non-detectable (Lehi City, 2012a). Public notifications were sent by the Lehi City Water Department on March 8, 2012 to Traverse Mountain residents regarding thallium levels exceeding MCL in their drinking water. The notice indicated that residents did not need to use an alternative drinking water supply (Lehi, 2012c; **Appendix C**).

On August 16, 2012, the Lehi City Water Department took investigative samples from outdoor drinking water spigots and discovered that two homes sampled above the thallium MCL. A public notice was distributed to the area on August 18, 2012 explaining how outdoor spigots may have retained thallium build-up due to infrequent use. After these taps were flushed and re-sampled, the Lehi City Water Department received results indicating thallium concentration levels were below MCL on August 20, 2012. A second letter was sent to the community on August 21, 2012 explaining the results as well as recommending residents flush any outdoor spigots or piping connected to homes that were not frequently used to remove residual thallium in the piping (Lehi City, 2012b; **Appendix C**).

Drinking Water

The Lehi City Water Department continues to conduct post-remediation quarterly sampling of the source well according to regulations set by DDW. Thallium concentrations in the drinking water system currently remain at non-detectable levels.

Secondary Water

Sampling of secondary water sources is not required or regulated by DDW. Consideration should be given to the fact that secondary water is non-potable and should not be used in ways similar to drinking water. The July 2012 sampling result for the Traverse Mountain Well was 2.8 ppb. The Lehi City Water Department will continue to sample the Traverse Mountain Well as needed.

Soil
During the week of June 11, 2012 the EEP collected soil samples from 15 residential locations in the Traverse Mountain area (**Appendix A, Table A2**). Samples were analyzed for thallium by the Utah State Department of Health Division of Laboratory Services.

DISCUSSION

Nature and Extent of Contamination

This health consultation addresses the potential for health effects based on exposure to drinking water, secondary water, soil, and garden vegetables contaminated with thallium.

Exposure Pathways Analysis

To determine if residents, visitors, and workers are exposed to contaminants related to a site, ATSDR evaluates the environmental and human components that lead to human exposure. An exposure pathway consists of five elements (ATSDR, 2005):

(1) A source of contamination;
(2) Transport through an environmental medium;
(3) A point of exposure;
(4) A route of human exposure; and
(5) A receptor population.

ATSDR categorizes an exposure pathway as either *completed*, *potential, or eliminated*. In a *completed* exposure pathway, all five elements exist and indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. In a *potential* exposure pathway, at least one of the five elements has not been confirmed, but it may exist. Exposure to a contaminant may have occurred in the past, may be occurring, or may occur in the future. An exposure pathway can be *eliminated* if at least one of the five elements is missing and will never be present (ATSDR, 2005).

When an exposure pathway is identified, comparison values (CVs) for air, soil, or drinking water are used as guidelines for selecting contaminants that require further evaluation (ATSDR, 2005). To protect susceptible populations, the CVs for children are used when available.

Inhalation of aerosolized water droplets during activities like showering is expected to be no more than a negligible contributor to thallium exposure. Moreover, there are no comparison values for inhalation exposure to thallium due to a lack of data on this pathway. Therefore, the EEP cannot assess this route of exposure.

Completed Pathways
Past drinking water exposure pathway
Traverse Mountain's drinking water contamination resulted in ingestion and dermal route exposures. Thallium concentrations in drinking water samples exceeded the EPA MCL of 2 ppb from October 21, 2010 through February 16, 2012, February 22, 2012 through April 9, 2012, and from July 16, 2012 through August 30, 2012. Health effects are described in the section

"Exposure Dose Estimates and Toxicological Evaluation." The exposure pathway can be detailed as:

Exposure element	Contaminated Drinking Water
1) A source of contamination…….....	Naturally occurring in Traverse Mountain Well
2) Transport through environmental medium...	Drinking water system (distribution pipes)
3) A point of exposure……..	Contact with contaminated drinking water
4) A route of human exposure…….….	Ingestion and dermal exposure (e.g., bathing)
5) A receptor population……...	Residents in contaminated area

Past, present, and future secondary water exposure pathway
Secondary water is designated as non-potable; therefore, potential exposure lies in incidental ingestion and dermal absorption. Peer-reviewed scientific literature addressing the amount and effects of dermal exposure to thallium from contaminated water is limited. Most studies of dermal thallium absorption are based on studies performed in industrial settings.

Traverse Mountain's secondary water contamination resulted in ingestion and dermal route exposures. The most recent (July 16, 2012) secondary water thallium concentration is 2.8 ppb and exceeds the EPA MCL of 2 ppb. Health effects are described in the section: "Exposure Dose Estimates and Toxicological Evaluation." The secondary water exposure pathway can be detailed as:

Exposure element	Contaminated Secondary Water
1) A source of contamination…….....	Naturally occurring in Traverse Mountain Well
2) Transport through environmental medium...	Secondary water system
3) A point of exposure……..	Contact with contaminated secondary water directly or indirectly (i.e., playing in secondary water, gardening)
4) A route of human exposure…….….	Incidental ingestion or dermal exposure
5) A receptor population……...	Residents in contaminated area

Eliminated Pathways
Present drinking water exposure pathway
Thallium concentration levels in drinking water are currently below the MCL and therefore are not deemed as harmful to health.

Potential Pathways
Soil exposure pathway
Exposure to thallium can also occur through incidental ingestion and dermal absorption of contaminated soils. Peer-reviewed scientific literature addressing the amount and effects of dermal exposure to thallium from contaminated soil is limited. Most studies of dermal thallium absorption address exposures in industrial workplaces. The soil exposure pathway can be detailed as:

Exposure element	Contaminated Soil
1) A source of contamination…….....	Naturally occurring in Traverse Mountain Well
2) Transport through environmental medium...	Irrigation of soil
3) A point of exposure……..	Contact with soil directly or indirectly (i.e., playing in soil, gardening)
4) A route of human exposure…….….	Incidental ingestion or dermal exposure
5) A receptor population……...	Residents in contaminated area

Food chain exposure pathway
Concerns from the Traverse Mountain community include thallium exposure through ingesting garden vegetables grown in contaminated soil. Although actual sampling of food did not occur, the possibility of this exposure pathway exists. The food chain exposure pathway can be detailed as:

Exposure element	Contaminated Garden Vegetables
1) A source of contamination…….....	Naturally occurring in Traverse Mountain Well
2) Transport through environmental medium...	Plant uptake of thallium from contaminated soil
3) A point of exposure……..	Garden vegetables
4) A route of human exposure…….….	Ingestion of garden vegetables
5) A receptor population……...	Residents in contaminated area

Public Health Implications

Levels of contaminants that exceed the CV will not necessarily cause adverse health effects upon exposure. The potential for exposed persons to experience adverse health effects depends on many factors, including:

(1) The amount of each chemical to which a person is or has been exposed;
(2) The length of time that a person is exposed;
(3) The route by which a person is exposed (inhalation, ingestion, or dermal absorption);
(4) The health condition of the person;
(5) The nutritional status of the person; and
(6) Exposure to other chemicals (such as cigarette smoke or chemicals in the work place).

Evaluation Process

The EEP examined the concentrations of thallium for each media type (drinking water, secondary water, and soil). The CVs were used to screen media types that would warrant further evaluation for a possible risk to human health. CVs are media-specific concentrations of contaminants that can be reasonably assumed to be harmless under default conditions of exposure. These values are generally conservative concentrations used to ensure the protection of sensitive populations, most notably pregnant women and growing children. Values of

contaminants that exceed the CVs do not necessarily indicate that a health risk exists; however, it does indicate that further evaluation is required for these chemicals.

Exposure Dose Estimates and Toxicological Evaluation

The contaminant of concern for this health consultation is thallium. The ingestion of contaminated drinking water was the most likely pathway of contaminant exposure prior to remediation. Currently, the most likely pathways of contaminant exposure are incidental ingestion and dermal exposures to soil and secondary water.

The exposure pathways (described previously) were assessed using doses calculated from the highest concentration levels of thallium associated with each pathway. Exposure doses were then compared with health guidelines. These guidelines are conservative health-protective values that have been developed using human exposure data where available. When human data are not available, animal exposure data are used.

It is important to note that a health guideline value is not an absolute value at which health effects from exposure will occur. These are values at which action should be taken and are not necessarily harmful to all people if exceeded (ATSDR, 2005).

Health guidelines used in this report include EPA's Maximum Contaminant Levels (MCLs) and Reference Doses (RfDs). The MCL for thallium is 2.0 ppb (EPA, 2009a). MCLs are derived from Maximum Contaminant Levels Goals (MCLGs), which are non-enforceable health benchmark goals where no adverse health effects are expected to occur (EPA, 2012). The MCLG for thallium is 0.5 ppb (EPA, 2012b). The MCL is a legally enforceable standard that sets the highest level of a contaminant that EPA allows in drinking water. MCLs are set as close to MCLGs as feasible by evaluating studies on health effects, the occurrence of the contaminant in water, and using the best available analytical and treatment technologies while taking cost into consideration (CDPH, 2011; EPA, 2012a; EPA, 2013). Evaluations of the adverse effects and doses related to these effects result in the RfD, which is further applied to calculate the MCL. The enforceable MCL of 2.0 ppb for thallium was derived from the Integrated Risk Information System (IRIS) RfD of 8.0E-05 (i.e., 8.0×10^{-5}) milligrams per kilogram of bodyweight per day (mg/kg/day) (EPA, 2009a).

The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive populations) that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA, 1993).

The RfD is useful as a reference point from which to gauge the potential effects of the chemical at other doses. Usually, doses less than the RfD are not likely to be associated with adverse health risks, and are therefore less likely to be of regulatory concern. As the frequency and/or magnitude of the exposures exceeding the RfD increase, the probability of adverse effects in a human population increases. However, it should not be categorically concluded that all doses below the RfD are "acceptable" (or will be risk-free) and that all doses in excess of the RfD are "unacceptable" (or will result in adverse effects) (EPA, 1993).

The EPA establishes RfD values based on available scientific studies estimating the daily lifetime dose of a substance that is unlikely to cause harm in humans. Since human studies on frequent chronic exposures to thallium are not available, effects from long-term exposures are based on animal studies (rats). The RfD derived from these studies are based on the lowest dose that caused hair loss in animals. This lowest dose is further divided by a composite uncertainty factor (UF) of 3,000 (10 to extrapolate from subchronic to chronic data, 10 to extrapolate from variation within the same animal species, 10 to account for animal to human variability, and 3 to account for lack of reproductive and chronic toxicity data). The resulting value is the RfD for thallium (EPA, 1993). **Table 1** describes health guideline RfDs considered for this HC.

The EPA and literature recommend using the hierarchy of human health toxicity values (**Table 1**) to evaluate exposures (EPA, 2012d; Effio et al., 2012). Currently, the EPA IRIS is determining an official chronic RfD for thallium. Until 2009, the official EPA chronic RfD for soluble thallium was 8.0E-05 mg/kg/day. Since then, the EPA has proposed candidate chronic RfD values of 1.0E-05 and 3.0E-06 mg/kg/day; however, the available toxicity database for thallium contains studies that are generally of poor quality (EPA, 2009a).

Another chronic RfD value of 7.0E-05 mg/kg/day resulted from a 2009 EPA risk reassessment for thallium (EPA, 2009d). The EPA will consider this new assessment in the next review cycle (post-2009) since it was not completed by the cutoff date for the *Six-Year Review 2 Health Effects Assessment* on March 1, 2009 (EPA, 2009b). The EPA lists the Provisional Peer Reviewed Toxicity Values (PPRTV) chronic RfD value of 1.0E-05 mg/kg/day in a regional screening level table (EPA, 2012c). This RfD is used to evaluate exposures in this HC since it is the highest ranked official health guideline value in the absence of an official IRIS RfD value for thallium (EPA, 2012d; Effio et al., 2012).

Conclusions from the following section, "Thallium Evaluation", are based on the EPA PPRTV chronic RfD value of 1.0E-05 mg/kg/day with the acknowledgement that an observable adverse effect (hair loss) in rats was first detected at a dose 3,000 times greater when exposed for 90-days (EPA, 2009a). Other acknowledgements to consider include conclusions in 2009 by EPA that "short-term" exposures to thallium are considered "safe" for a 10-kg (22 lb.) child consuming one liter of water per day for up to 7 years of exposure to 7.0 ppb (EPA, 2009c). Presently, this changed to 10 days of exposure to 7.0 ppb after the pre-2009 EPA RfD was removed from official status (EPA, 2012a).

In addition, conclusions by the EEP are based on the no-observed-adverse-effect-level (NOAEL [highest exposure level at which no significant increase in adverse health effects occur]) intermediate exposure in rats from Stoltz et al., cited by ATSDR (Stoltz et al., 1986). The EEP divided the NOAEL (0.2 mg/kg/day) by a composite uncertainty factor of 3,000 (10 to extrapolate from subchronic to chronic data, 10 to extrapolate from variation within the same animal species, 10 to account for animal to human variability, and 3 to account for lack of reproductive and chronic toxicity data) to extrapolate an intermediate human exposure reference dose of 6.67E-05 mg/kg/day (Stoltz et al., 1986).

Exposure doses that are lower than the MCL or RfD are considered to be without appreciable risk to human health. If a calculated exposure dose exceeds the health guidelines, the dose is then

compared to values from individual studies documented in the scientific literature that have reported health effects. These values may be the NOAEL level or the lowest-observable-adverse-effect-level (LOAEL [lowest exposure level that produces a significant increase in frequency or severity of adverse effects]). If a contaminant has been determined by the scientific literature to be cancer causing (carcinogenic), a cancer risk is also estimated (ATSDR, 2005). No current studies provide conclusive evidence that thallium can cause cancer in humans or animals (ATSDR, 1992a). The calculations for determining exposure doses for oral ingestion and dermal absorption can be found in **Appendix D**.

Values that exceed CVs (e.g., EPA MCL and PPRTV RfD) do not necessarily indicate a health risk exists; however, it does indicate that further evaluation is required for the chemical of concern (ATSDR, 2005). It is also important to note that reviewing the basis for health guidelines as part of this evaluation in no way diminishes the importance of the health guideline; rather, it serves as a means of gaining perspective on how strongly the supporting toxicological data suggests that harmful exposures have occurred or might occur (ATSDR, 2005).

Table 1. Health guideline values considered for chronic oral exposure reference dose to thallium based on hierarchy of human health toxicity values (highest ranked at top) (EPA, 2012d).

Health Guideline	Hierarchy Toxicity Values Source	Value	Reference
Provisional/Candidate RfD	IRIS (unofficial)	1.0E-05 and 3.0E-06 mg/kg/day (soluble salts)	EPA. (2009). Integrated Risk Information System, Thallium (I), Soluble Salts; CASRN various.
Pre-2009 RfD	IRIS (expired)	8.0E-05 mg/kg/day (soluble salts)	EPA. (2009). Integrated Risk Information System, Thallium (I), Soluble Salts; CASRN various.
RfD	PPRTV	1.0E-05 mg/kg/day (soluble salts)	EPA. (2012). Mid-Atlantic Risk Assessment: Generic Tables: Regional Screening Level (RSL) Summary Table, November 2012
MRL	ATSDR	Not derived	ATSDR. (1992). Toxicological profile for thallium. Atlanta: U.S. Department of Health and Human Services.
RfD	Cal/EPA	8.0E-05 mg/kg/day	California EPA OEHHA. (1996). Appendix B, Comparison of Cal/EPA and US EPA Toxicity Values.
RfD	Health Effects Summary	7.0E-05 mg/kg/day (soluble salts)	EPA. (2009). Six-year Review 2 Health Effects Assessment: Summary Report. Page 64.

Notes: RfD= Reference Dose; IRIS = Integrated Risk Information System; mg/kg/day = milligram per kilogram per day; EPA = Environmental Protection Agency; PPRTV = Provisional Peer Reviewed Toxicity Values; MRL = Minimal Risk Level; ATSDR = Agency for Toxic Substances and Disease Registry; Cal/EPA = California Environmental Protection Agency; OEHHA = Cal/EPA Office of Environmental Health Hazard Assessment

Thallium Evaluation

Drinking Water

The EEP performed exposure dose calculations using the ATSDR equations for drinking water ingestion and dermal exposure (ATSDR, 2005). Both equations are based on contaminant concentration, amount of contaminant consumed per body area contacted, duration of exposure,

and body weight of the exposed individual. Body weight used for ingestion for adults is 70 kilograms (kg) (155 pounds [lbs.]) and 16 kg (35 lbs.) for children. Body weight used for dermal exposure for children ages 1-11 years is 30 kg.

Ingestion exposure calculations used standard water ingestion intake rates of one liter per day for children and two liters per day for adults, for 365 days a year. Incidental ingestion rates used 50 milliliters (ml) per day. The ATSDR Dose Calculator (2008a) assigned a permeability coefficient of 1.0×10^{-3} centimeters (cm) per hour for thallium. Although thallium is reported to absorb through the skin from dermal exposure (Guy, 1999; Stellman, 1998; Vincoli 1997), no specific studies are identified regarding health effects in humans or animals after dermal exposure to thallium (ATSDR, 1992b). The calculations for determining exposure doses for oral ingestion and dermal absorption can be found in **Appendix D**.

Drinking water results were divided into two groups: samples exceeding the MCL before isolation of the Traverse Mountain Well on February 16, 2012, and samples exceeding the MCL from February 22, 2012 through August 30, 2012.

Drinking Water Potential Exposure Dose Estimates, October 21, 2010 to February 16, 2012. Four samples collected from quarterly testing before February 16, 2012 exceeded the MCL: October 21, 2010 (2.6 ppb), November 3, 2011 (2.9 ppb), January 11, 2012 (2.5 ppb), and February 14, 2012 (3.0 ppb). Potential exposure doses based on the ATSDR equations used the maximum thallium concentration (3.0 ppb) detected from the four samples. Calculations applied an exposure factor of 1.0 representing daily exposure to contaminated drinking water. Potential exposure doses are presented in **Table 2**.

The calculated potential exposure doses for children and adults during this time period exceeded the EPA PPRTV RfD. A review of ATSDR and EPA literature concludes that the sample thallium concentrations in **Table 2** do not typically result in symptoms related to thallium exposure (CEPA, 1999; ATSDR, 2002; ATSDR, 2004; ATSDR 2005; ATSDR, 2006; ATSDR, 2007; ATSDR, 2008b; ATSDR, 2009; EPA, 2009a; ATSDR, 2010).

Table 2. Potential exposure doses to thallium contaminated drinking water from October 21, 2010 to February 16, 2012. Lehi, UT.

Date	Sample Thallium Concentration (ppb)	Duration (days)	Route of Exposure	Potential Child Exposure Dose (mg/kg/day)	Potential Adult Exposure Dose (mg/kg/day)	EPA PPRTV RfD (mg/kg/day)
10/21/2010 to 2/16/12	3.0	484	Dermal	8.75E-07	8.31E-07	1.0E-05
			Ingestion	**1.88E-04**	**8.57E-05**	
			Total	**1.89E-04**	**8.65E-05**	

Notes: ppb = parts per billion; mg/kg/day = milligram per kilogram bodyweight per day; EPA = Environmental Protection Agency; PPRTV = Provisional Peer Reviewed Toxicity Values; RfD = Reference Dose; bolded values are greater than EPA PPRTV RfD.

The lowest known single dose of thallium reported in the literature associated with adverse effects in humans was 0.31 grams (g) of thallium acetate (3.4 mg/kg thallium [3400 ppb], assuming 70 kg body weight) (Cavanagh et al., 1974). This dose caused neurological symptoms, weakness, vomiting, and hair-loss in a 26-year-old male. A complete recovery occurred following treatment approximately one month after the onset of symptoms (Cavanagh et al., 1974). The highest drinking water sample thallium concentration from the drinking water distribution system at Traverse Mountain was 54.9 ppb collected on March 11, 2012. No current literature discusses health effects observed in humans from frequent and chronic exposures (daily exposures for over 365 days) to thallium concentrations similar to levels at Traverse Mountain.

Furthermore, an observable adverse effect (hair loss) in studies involving animal models (rats) was first detected at a dose of 0.04 mg/kg/day (NOAEL), which was 3,000 times greater than the EPA PPRTV RfD value of 1.0E-05 mg/kg/day (MRI, 1988; EPA, 2009a). In 1986, Stoltz et al. observed hair loss in rats fed with thallium at a dose of 0.2 mg/kg/day. The pre-2009 EPA RfD value originated from this dose. The authors indicated that hair-loss observed in rats was attributed to the normal cyclic pattern of hair growth and rat barbering behavior (Stoltz et al., 1986). Another factor to consider is the conclusion by EPA that short-term exposures to thallium are considered "safe" for a 10-kg (22 lbs.) child consuming one liter of water per day, up to 7-years of exposure at 7.0 ppb (EPA, 2009c). This changed to 10-days of exposure to 7.0 ppb after the pre-2009 EPA RfD was removed from official status (EPA, 2012a).

That said, 26 of 36 Traverse Mountain residents reported to their physician symptoms similar to thallium exposure (e.g., hair loss, gastrointestinal irritation) before the community meeting held in April 2012. Two of the 26 reported testing and detecting thallium levels in urine. February 2012 was the most recent reported date for onset of symptoms. The EEP did not receive reports of residents visiting their physicians for symptoms similar to thallium exposure after February 2012. The EEP did not review official medical documentation.

Upon thorough evaluation of the completed contaminated drinking water exposure pathway from October 21, 2010 to February 16, 2012, the EEP concludes ingestion and skin contact with thallium in drinking water during this time period is not expected to harm people's health. The EEP supports EPA's maximum contaminant level (MCL) for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL and calculated potential child and adult exposure doses exceeded the EPA PPRTV reference dose. Although exposures to thallium levels exceeded MCL, the levels are less than those associated with experiencing negative health effects from thallium exposure. The EEP acknowledges reports of residents visiting their physicians for symptoms similar to thallium exposure. However, the EEP cannot conclude on the cause of these symptoms, which may be caused by exposures other than to thallium.

Drinking Water Potential Exposure Dose Estimates, February 22, 2012 to August 30, 2012
After February 16, 2012, 157 samples were collected, 29 of which exceeded the MCL (**Appendix A, Table A3**).

The potential intermediate (15 to 365 days) exposure doses from the samples collected after February 16, 2012 were further separated into two groups. Samples from the first group were

from February 22, 2012 to April 9, 2012. Samples from the second group were from July 16, 2012 to August 30, 2012. These two groups were separated by a time period (March 27, 2012 to July 15, 2012) when thallium concentrations were non-detectable. The end date of August 30, 2012 for the second group was selected to account for attenuation of exposure from the most recent exceedance of MCL (August 16, 2012).

Similar to previous potential exposure dose calculations, calculations after February 16, 2012 used the maximum thallium concentration, but for each day samples were taken due to less-consistent sampling (as opposed to quarterly sampling prior to well separation). Potential intermediate dose calculations utilized the geometric mean of the maximum concentrations detected per day (**Appendix A, Table A3**). A geometric mean was appropriate due to unevenly distributed sampling locations and infrequent sampling (ATSDR, 2005). Potential intermediate exposure doses after the Traverse Mountain Well separation are presented in **Tables 3 and 4**.

Table 3. Potential exposure doses to thallium contaminated drinking water from February 22, 2012 to April 9, 2012 and from July 16, 2012 to August 30, 2012. Lehi, UT.

Date	Sample Thallium Concentration Geometric Mean (ppb)	Duration (days)	Route of Exposure	Potential Child Exposure Dose (mg/kg/day)	Potential Adult Exposure Dose (mg/kg/day)	Incidental Intermediate RfD (mg/kg/day)
2/22/12 to 4/9/12	8.39	48	Dermal	3.22E-07	3.06E-07	6.67E-05
			Ingestion	6.09E-05	3.15E-05	
			Total	6.12E-05	3.18E-05	
7/16/12 to 8/30/12	6.59	46	Dermal	2.42E-07	2.30E-07	
			Ingestion	5.19E-05	2.37E-05	
			Total	5.21E-05	2.39E-05	

Notes: ppb = parts per billion; mg/kg/day = milligram per kilogram bodyweight per day; EPA = Environmental Protection Agency; PPRTV = Provisional Peer Reviewed Toxicity Values; RfD = Reference Dose; bolded values are greater than EPA PPRTV RfD; no samples taken March 27, 2012 to July 15, 2012 had detectable thallium levels; intermediate RfD extrapolated from Stoltz et al., 1986 NOAEL of 0.2 mg/kg/day divided by composite uncertainty factor of 3000.

Table 4. Potential incidental exposure doses to thallium contaminated drinking water from outdoor home spigots February 22, 2012 to August 30, 2012. Lehi, UT.

Date	Sample Thallium Concentration Geometric Mean (ppb)	Duration (days)	Route of Exposure	Potential Child Exposure Dose (mg/kg/day)	Potential Adult Exposure Dose (mg/kg/day)	Incidental Intermediate RfD (mg/kg/day)
2/22/12 to 8/30/12	7.94	191	Dermal	2.32E-06	1.27E-06	6.67E-05
			Ingestion	1.30E-05	2.97E-06	
			Total	1.53E-05	4.24E-06	

Notes: ppb = parts per billion; mg/kg/day = milligram per kilogram bodyweight per day; EPA = Environmental Protection Agency; PPRTV = Provisional Peer Reviewed Toxicity Values; RfD = Reference Dose; bolded values are greater than EPA PPRTV RfD; no samples taken March 27, 2012 to July 15, 2012 had detectable thallium levels; intermediate RfD extrapolated from Stoltz et al., 1986 NOAEL of 0.2 mg/kg/day divided by composite uncertainty factor of 3000.

The EEP concludes ingestion and skin contact with contaminated drinking water from February 22, 2012 to August 30, 2012 (**Table 3**) is not expected to harm people's health. The EEP supports EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the NOAEL for intermediate thallium exposure.

Drinking water samples collected after August 16, 2012 have thallium concentrations below MCL and are not expected to harm people's health.

Drinking Water from Outdoor Home Spigots
On August 16, 2012, the Lehi City Water Department took investigative samples from outdoor drinking water spigots and discovered that two homes sampled above the thallium MCL. A public notice was distributed to the area on August 18, 2012, explaining how outdoor spigots may have retained thallium build-up due to infrequent use. After these taps were flushed and re-sampled, the Lehi City Water Department received results indicating thallium concentration levels were below MCL on August 20, 2012.

The EEP applied the same methods described in "Drinking Water Potential Exposure Dose Estimates, February 22, 2012 to August 30, 2012" to calculate potential intermediate exposure doses (**Table 4**). The EEP concludes ingestion and skin contact with contaminated drinking water from outdoor home spigots from February 22, 2012 to August 30, 2012 is not expected to harm people's health. The EEP supports EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the NOAEL for intermediate thallium exposure.

Soil and Secondary Water
Soil samples were collected by the EEP during the week of June 11, 2012 from 15 residential locations in the Traverse Mountain area. Sampling locations were based on permission to access properties. Samples were analyzed for thallium by the Utah State Department of Health Division of Laboratory Services. Secondary water samples were collected on July 16, 2012 by the Lehi City Water Department from the secondary water well head. Secondary water samples were analyzed for thallium by ChemTech-Ford Laboratories.

The EEP performed exposure dose calculations using the ATSDR equations for soil and secondary water incidental ingestion and dermal contact exposures (ATSDR, 2005). Equations were based on contaminant concentration, amount of contaminant consumed/body area contacted, duration of exposure, and body weight of the exposed individual. Body weight used for adults was 70 kg (155 lbs.) and 16 kg (35 lbs.) for children. Standard incidental soil ingestion rates were 200 mg/day (child) and 100 mg/day (adult). Standard incidental water ingestion rates were 50 ml per day for children and adults. The ATSDR Dose Calculator (2008a) assigned a default permeability coefficient of 1.0×10^{-3} cm per hour for thallium.

Soil exposure calculations utilized the highest thallium soil concentration in the samples, 965 ppb. The most recent (July 16, 2012) secondary water thallium concentration, 2.8 ppb, was used

for calculating incidental secondary water ingestion exposures. The exposure duration assumes 180 days a year of incidental soil and secondary water exposure. The EPA PPRTV RfD of 1.0E-05 milligrams per kilogram per day (mg/kg/day) of thallium was compared with calculated potential exposure doses (EPA, 2009a). Potential exposure doses for incidental soil and secondary water exposures are presented in **Table 5**.

Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT.

Source	Thallium Concentration (ppb)	Route of Exposure	Potential Child Exposure Dose (mg/kg/day)	Potential Adult Exposure Dose (mg/kg/day)	EPA PPRTV RfD (mg/kg/day)
Soil	965	Dermal	2.01E-06	6.32E-07	1.0E-05
		Ingestion	4.30E-06	4.91E-07	
		Total	6.31E-06	1.12E-06	
Secondary Water	2.8	Dermal	4.09E-07	3.88E-07	
		Ingestion	3.12E-06	7.12E-07	
		Total	3.53E-06	1.10E-06	

Notes: ppb = parts per billion; mg/kg/day = milligram per kilogram bodyweight per day; EPA = Environmental Protection Agency; PPRTV = Provisional Peer Reviewed Toxicity Values; RfD= Reference Dose; bolded values are greater than EPA PPRTV RfD

The EEP concludes that the potential exposure pathways for soil and incidental ingestion of secondary water are not expected to harm people's health since potential exposure doses were below EPA PPRTV RfD. Consideration should be given to the fact that secondary water is non-potable and should not be used in ways similar to drinking water.

Food Chain

Without sampling garden grown food to estimate how much thallium was absorbed by plants grown in residential soil, the EEP examined soil samples collected in June 2012. Assuming the plants would absorb thallium in concentrations equal to the soil after one growing season, potential exposure dose calculations for vegetables were extrapolated from soil samples. This involved reviewing literature on thallium absorption in vegetables described in the following section, "Thallium".

The EEP concludes that the potential exposure pathway for ingestion of thallium in vegetables is not expected to harm people's health since extrapolated potential exposure doses were below EPA PPRTV RfD.

Thallium

Thallium is widely distributed in trace amounts in the earth's crust and is a soft, bluish-white metal. Thallium is naturally found in soil at levels between 300 ppb to 700 ppb. Thallium is odorless and tasteless in its pure form and can be found in a pure state, mixed with other metals, or combined with other substances such as chlorine and fluorine to form salts. Thallium does not breakdown and therefore remains in the environment. Thallium is naturally present in the air,

water, and soil. Research has not determined how much time thallium takes to move from one medium to another (ATSDR, 1992a; ATSDR, 2013).

Thallium is used to make electronics, and is a diagnostic component in certain medical procedures involving heart function. Until 1972, thallium sulfate was used as a rat poison, but was banned because of its potential harm to people. Even though rat poison containing thallium was banned, incidental poisonings from old rat poison still occur, especially in children. Thallium is no longer produced in the U.S. Since 1984, all the thallium used in the U.S. has been obtained from imports and thallium reserves (ATSDR, 1992a).

Plants and vegetables may accumulate thallium when grown in soils containing high contaminant concentrations (LaCoste et al., 2001). Different vegetables accumulate thallium at different rates and in different areas of the plant. Roots of plants are the best accumulators of thallium, and concentrations are higher in the roots than in the leaves of vegetables (Queirolo et al., 2009). Not all plants uptake thallium at the same rate; potatoes, turnips, radishes, and brassicaceous plants (cabbage family) have been found to have higher concentrations of thallium than other vegetables (Pavlickova et al., 2005; Queirolo et al., 2009). Vegetables with lower thallium uptake include green beans and tomatoes. It has been shown that vegetables in field/garden conditions have a lower thallium uptake than plants grown in pots, due to a lower root density (LaCoste et al., 2001).

Vegetables grown in soils with a thallium concentration below 700 ppb are not considered to pose any health risk (LaCoste et al., 2001). Concerns are raised when certain vegetables with higher thallium uptakes (potatoes, turnips, cabbage) are grown in soils greater than 700 ppb. Vegetables with a lower thallium uptake (green beans, tomatoes, onion, peas) are not expected to pose a potential health risk until the soil is above 3,500 ppb (LaCoste et al., 2001).

When thallium is swallowed, most of it is absorbed and rapidly goes to various parts of the body, especially the kidney and liver. Thallium can affect the nervous system, lung, heart, liver, and kidney if large amounts are eaten or drunk for short periods of time. Temporary hair loss, vomiting, diarrhea, burning/tingling sensations on the skin, and death may result after exposure to large amounts of thallium for short periods. Thallium can be fatal from a dose as low as one gram. Based on the literature, it is unknown what long term health effects would result from low level thallium exposure (ATSDR, 1992a; ATSDR, 2013).

Reliable and accurate ways to measure thallium in the body are available. The average amount of thallium in human urine is less than 1 ppm. Human hair will generally contain 5–10 ppb thallium. The presence of higher amounts of thallium in urine and hair can indicate harmful exposure. Although thallium can be measured in blood, this tissue is not a good indicator of exposure since it only remains in the blood for a short period of time. It is not known yet whether thallium levels measured in the body can be used to predict possible health effects. Generally, thallium leaves the body through urine and, to a lesser extent, in feces. It can be found in urine within one hour after exposure. After 24 hours, increasing amounts are found in feces. About half of the thallium that enters the body is excreted within three days (ATSDR, 1992a).

Currently there are no reliable quantitative studies regarding absorption of thallium in humans or animals after dermal exposure. Furthermore, acute, intermediate, and chronic duration dermal minimal risk levels (MRLs) have not been derived for thallium due to the lack of an appropriate methodology for developing dermal MRLs (ATSDR, 1992b).

No current studies provide conclusive evidence on the developmental toxicity of thallium in humans. Study animals drinking water contaminated with thallium in excess of 0.7 mg/kg/day for two months showed damaged reproductive organs, especially the testes. No current studies in the literature give conclusions describing the reproductive effects in humans after oral exposure to thallium. No information currently describes the effects in animals after exposure to small amounts of thallium for longer periods of time. No current studies provide conclusive evidence that thallium causes cancer in humans or animals (ATSDR, 1992a).

DATA LIMITATIONS

Several limitations and uncertainties exist with regard to the conclusions of this health consultation. Plants are able to accumulate thallium by absorption from soil through their root systems, and it is known that some plants accumulate more thallium than others. However, consumption of vegetables grown in soil with thallium concentrations below 700 ppb is not expected to pose a health risk (LaCoste et al., 2001). As no information about the types of vegetables grown in gardens irrigated with thallium-containing water is available and no sampling occurred, direct assessment of this potential exposure pathway is not possible. In the absence of these data, the EEP estimated exposure doses for this pathway by assuming that vegetables would absorb thallium in concentrations equal to the soil after one growing season. The average thallium concentration in residential soil based on the 15 samples collected on June 12, 2012 (218.5 ppb) is well below the level at which thallium-concentrating vegetables may be considered potentially hazardous for human consumption (700 ppb).

Additionally, there is very little data available on the health effects of long term (>1 year) exposure to thallium. Chronic exposure to thallium is relevant to this health consultation as residents of Traverse Mountain were exposed to contaminated drinking water from at least October 2010 to August 2012, when concentrations dropped below the MCL. In preparing the toxicological profile on thallium, ATSDR was unable to identify any studies on the effects of chronic oral or dermal in humans. No studies were available on the health effects of chronic thallium exposure in animals by any route of exposure (ATSDR, 1992b; ATSDR, 2013). Nevertheless, although the RfD comparison value utilized in this document is based on subchronic data, the uncertainty factor used in its derivation accounts for this lack of chronic exposure data and is conservative and health protective.

CHILD'S HEALTH CONSIDERATIONS

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at a greater risk than adults from certain kinds of exposures to hazardous substances. Children are more likely to be exposed because they play outdoors and because they often bring food into contaminated areas. They are more likely to come into contact with dust, soil, and heavy vapors close to the ground. Due to their larger surface area to body weight ratio, children are more

vulnerable to toxicants absorbed through the skin. Furthermore, the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages.

In the Traverse Mountain area, children were generally at higher risk of exposure to thallium in drinking water, secondary water, and soil than adults. Recommendations for action are therefore focused first on children and aimed at reducing overall chronic exposure to these contaminants.

COMMUNITY HEALTH CONCERNS

In keeping with ATSDR's commitment to better respond to community concerns, a situation analysis was conducted for the Traverse Mountain site (**Appendix B**). A situation analysis defines and interprets the state of the environment of a community within a specific point in time. It identifies and analyzes social or economic problems, the community's indigenous assets, and quality-of-life.

Key informants were interviewed to determine relevant aspects of the social structure and needs of the community. The interviewees were a combination of community members and representatives from local business, industry, non-profit organizations, faith-based organizations, and other community-based organizations. These interviews were used to build a general assessment of the Traverse Mountain community as a whole and establish resources for coordinating and collaborating health promotion and community engagement activities. Demographics and characteristics, community health issues/needs, and challenges and activities within the community were also identified. The EEP staff conducted telephone interviews in July 2012 and a total of nine residents of Traverse Mountain were interviewed.

Overall, key informant interviews indicated that general drinking water contamination was the most important issue to the community. Key informants also indicated that the community was interested in learning more about thallium contamination and the history behind the contamination. A summary of key findings is located in **Appendix B: Situation Analysis, Part VII**.

CONCLUSIONS

Drinking Water Ingestion and Dermal Pathway: October 21, 2010 to February 16, 2012
Upon thorough evaluation of the completed contaminated drinking water exposure pathway from October 21, 2010 to February 16, 2012, the EEP concludes that exposure to thallium levels is not expected to harm people's health. The EEP supports the EPA MCL for thallium as a conservative health value. Sample concentrations during this time period exceeded the MCL and calculated potential child and adult exposure doses exceeded the EPA Provisional Peer Reviewed Toxicity Values (PPRTV) reference dose (RfD). Although exposures to thallium levels exceeded MCL and PPRTV RfD, the levels are less than those associated with experiencing health effects from thallium exposure in the current literature. The EEP acknowledges reports of residents visiting their physicians for symptoms similar to thallium exposure. However, the EEP cannot conclude on the cause of these symptoms, which may be caused by exposures other than to thallium.

Drinking Water Ingestion and Dermal Pathway: February 22, 2012 to August 30, 2012
The EEP concludes ingestion and skin contact with contaminated drinking water from February 22, 2012 to August 30, 2012 is not expected to harm people's health. The EEP supports EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the NOAEL for intermediate thallium exposure.

Drinking Water from Outdoor Home Spigots Exposure Pathway: February 22, 2012 to August 30, 2012
The EEP concludes ingestion and skin contact with contaminated drinking water from outdoor home spigots from February 22, 2012 to August 30, 2012 is not expected to harm people's health. The EEP supports EPA MCL for thallium in drinking water as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated potential child and adult exposure doses did not exceed the intermediate (15 - 365 days) RfD calculated from the NOAEL for intermediate thallium exposure.

Drinking Water Ingestion and Dermal Pathway: August 30, 2012 to Present
The EEP concludes that based on drinking water sample data after August 30, 2012, thallium levels in the drinking water distribution system are not expected to harm people's health since levels have remained below MCL.

Secondary Water Ingestion and Dermal Pathway
The EEP concludes that incidental ingestion and skin contact with thallium in secondary water (non-potable water) is not expected to harm people's health. Although secondary water is not regulated by drinking water standards, the EEP applied the EPA MCL for thallium in its evaluation. The EEP supports the MCL as a conservative health value. Sample concentrations during this time period exceeded the MCL, but calculated incidental child and adult exposure doses did not exceed the EPA PPRTV RfD. Secondary water is non-potable and can contain other contaminants that are hazardous to health. Secondary water should not be used in ways similar to drinking water.

Soil Ingestion and Dermal Pathway
The EEP concludes incidental ingestion and skin contact with thallium in soil is not expected to harm people's health since potential exposure doses are below EPA PPRTV RfD.

Food Chain Exposure Pathway
The EEP concludes ingestion of vegetables grown in gardens where soil sampling occurred is not expected to harm people's health since potential exposure doses were less than the EPA PPRTV RfD. Potential exposure doses were estimated by assuming thallium concentrations in the soil were equivalent to levels in garden grown food since sampling of food did not occur. Average soil thallium concentrations are well below the level at which the most thallium-concentrating vegetables may be considered potentially hazardous for human consumption (700 parts per billion (ppb)).

RECOMMENDATIONS

Based upon the EEP's review of the Traverse Mountain drinking water, secondary water, soil data, and the concerns expressed by community members, the following recommendations are appropriate and protective of the health of residents in the community.

- Residents are recommended to contact poison control or their physician with health problems and concerns regarding thallium exposure.
- The Lehi City Water Department superintendents are recommended to review MCLs for contaminants common to their water systems.
- The Lehi City Water Department superintendents are recommended to collaborate with local health departments and the DDW to review standard protocols when MCLs are exceeded.
- The Lehi City Water Department and the DDW are recommended to emphasize to Traverse Mountain residents that secondary water is non-potable and should not be used for activities that could lead to possible incidental ingestion and dermal exposure (i.e., in swimming pools, playing in sprinklers, bathing).
- The Lehi City Water Department and the DDW are recommended to continue to provide health educational materials regarding drinking water and secondary water to the community.

PUBLIC HEALTH ACTION PLAN

The public health action plan for the site contains a description of actions that have been or will be taken by the EEP and other government agencies at Traverse Mountain. The purpose of the public health action plan is to ensure that this HC both identifies public health hazards and provides a plan of action designed to mitigate and prevent harmful human health effects resulting from breathing, drinking, or touching hazardous substances in the environment. Included is a commitment on the part of the EEP to follow up on this plan to ensure that it is implemented.

Public health actions that have been taken at the site include:

- In November 2011, the Lehi City Water Department moved from annual to quarterly testing of the Traverse Mountain Well as instructed by DDW.
- In February 2012, the Lehi City Water Department isolated the Traverse Mountain Well from the drinking water system and Lehi City introduced water from different sources with non-detectable thallium concentrations.
- In March 2012, the Lehi City Water Department flushed the drinking water distribution system with non-detectable thallium concentration water and notified all Traverse Mountain residents. System flushing continued until thallium concentration levels were non-detectable.
- In April 2012, the EEP gave a presentation on thallium and the health effects from exposure to residents at a community meeting at Traverse Mountain.
- In May 2012, the EEP created a website addressing community concerns following the community meeting at Traverse Mountain. (http://www.health.utah.gov/enviroepi/appletree/Lehi/traversemtn.htm)

- In June 2012, the Lehi City Water Department mailed their *2011 Annual Water Quality Report* to all Lehi residents. This included a detailed explanation of actions Lehi City Water Department made to address thallium in Traverse Mountain drinking water.
- In June 2012, the EEP sampled residential soil for thallium concentrations. Samples were analyzed by the Utah State Department of Health Division of Laboratory Services.
- In July 2012, the EEP developed and administered a telephone questionnaire among key informants living at Traverse Mountain. Results were incorporated and used to draft a Situation Analysis of Traverse Mountain in accordance with ATSDR guidelines.
- On August 18, 2012, the Lehi City Water Department received investigative sample results that detected thallium levels above MCL from two residential outside taps and distributed a public notice letter to homes in the impacted area.
- On August 21, 2012, the Lehi City Water Department issued another public notice letter indicating that thallium levels in previously sampled outside taps were below MCL after flushing taps.

Public health actions that are ongoing or will be implemented at the site include:

- The Lehi City Water Department will continue to monitor drinking water quarterly for thallium concentrations according to regulations set by DDW.
- The Lehi City Water Department continues to test secondary water. The most recent test was conducted on July 16, 2012 (2.8 ppb). Regular testing of secondary water is not required due to non-potable purposes.
- The EEP will provide continued health education (in the form of fact sheets, flyers and pamphlets) to the community regarding chronic health effects related to exposures to thallium. Health education information will be available through the EEP's website: http://www.health.utah.gov/enviroepi/appletree/Lehi/traversemtn.htm.
- The EEP will remain available to address any public health questions or concerns regarding this issue for residents, visitors, and the general public following this report's final release.
- The EEP will provide continued support to both city and county agencies on interpreting sampling data and adverse health outcomes, as well as participating in all community and public health meetings.

REPORT PREPARATION

This Public Health Consultation for Traverse Mountain, Lehi, Utah, was prepared by the Environmental Epidemiology Program at the Utah Department of Health under a cooperative agreement with ATSDR. It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented. ATSDR's approval of this document has been captured in an electronic database, and the approving agency reviewers are listed below.

AUTHORS

Report Prepared By:
Alexander Wu, MPH
Epidemiologist
Environmental Epidemiology Program
Bureau of Epidemiology
Utah Department of Health

Nathan LaCross, Ph.D., MPH
Epidemiologist
Environmental Epidemiology Program
Bureau of Epidemiology
Utah Department of Health

Contact Author:
Craig J. Dietrich, Ph.D.
Toxicologist
Environmental Health Hazard Assessment Manager
Environmental Epidemiology Program
Bureau of Epidemiology
Utah Department of Health

Certifying Reviewers:
Sam LeFevre
Program Manager
Environmental Epidemiology Program
Utah Department of Health

Jennifer Brown, JD, MS
Bureau Director
Bureau of Epidemiology
Utah Department of Health

Barry Nangle, Ph.D.
Director
Center for Health Data
Utah Department of Health

Allyn Nakashima, MD
State Epidemiologist
Bureau of Epidemiology
Utah Department of Health

ATSDR Reviewers
Gregory V. Ulirsch, Ph.D.
Environmental Health Science Advisor
Associate Director for Science, Eastern Branch

Charisse J. Walcott, M.S.
Technical Project Officer, Western Branch
Division of Community Health Investigations

Cassandra V. Smith, M.S.
Branch Chief, Western Branch
Division of Community Health Investigations

Kai Elgethun, Ph.D., MPH
Associate Director for Science, Western Branch
Division of Community Health Investigations

Lynn Wilder, Ph.D., CIH
Associate Director for Science
Division of Community Health Investigations

Tina Forrester, Ph.D.
Division Director (Acting)
Division of Community Health Investigations

Alan Yarbrough, MS
Deputy Director (Acting)
Division of Community Health Investigations

REFERENCES

Agency for Toxic Substances and Disease Registry [ATSDR]. (1992a). *Public health statement for thallium*. Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/PHS/PHS.asp?id=307&tid=49

Agency for Toxic Substances and Disease Registry [ATSDR]. (1992b). *Toxicological profile for thallium*. Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/toxprofiles/TP.asp?id=309&tid=49

Agency for Toxic Substances and Disease Registry [ATSDR]. (2002). *ATSDR Health Consultation: Social Circle Cotton Mill, Social Circle, Walton County, Georgia.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/HAC/pha/PHA.asp?docid=1026&pg=0

Agency for Toxic Substances and Disease Registry [ATSDR]. (2004). *ATSDR Health Consultation: Evaluation of private drinking water well samples, Plant City, Hillsborough County, Florida.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/hac/PHA/CoronetIndustires030804/CoronetIndustries030804.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2005). *ATSDR Health Consultation: Wright groundwater contamination site, Wright, Kansas.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/HAC/pha/WrightGroundwaterContamination/WrightGroundwaterFinalHC082605.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2006). *ATSDR Health Consultation: Fuller Heights community, private well results, Mulberry, Polk County, Florida.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/HAC/pha/Fuller_Heights_Community/FullerHeightsCommunityHC030906.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2007). *ATSDR Health Consultation: Fruit and vegetable testing, the former Hernando County Department of Public Works Site, Brooksville, Hernando County, Florida.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/hac/pha/FormerHernandoCountyDepartmentofPublicWorksSite/FormerHernandoCountyDeptHC%208.17.07.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2008a). *ATSDR dose calculator* Atlanta: U.S. Department of Health and Human Services.

Agency for Toxic Substances and Disease Registry [ATSDR]. (2008b). *ATSDR Health Consultation: Analysis of nitrate and metals sampling data, East 67th street groundwater*

plume, Odessa, Ector County, Texas. Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/HAC/pha/East67thStreetHC/East67thStreetHC030608.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2009). *ATSDR Health Consultation: Nelson Tunnel-Commodore waste rock pile Superfund Site, Creede, Mineral County, Colorado.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/HAC/pha/NelsonTunnel/NelsonTunnelCommodoreWasteRockPileHC3-13-2009.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2010). *ATSDR Health Consultation: Evaluation of contaminants in private residential well water, Pavillion, Wyoming, Fremont county.* Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/hac/PHA/Pavillion/Pavillion_HC_Well_Water_08312010.pdf

Agency for Toxic Substances and Disease Registry [ATSDR]. (2013). *ToxFAQs for thallium*. Atlanta: U.S. Department of Health and Human Services. Retrieved from: http://www.atsdr.cdc.gov/toxfaqs/TF.asp?id=308&tid=49

California Department of Public Health [CDPH]. (2011). *Drinking water monitoring and regulation.* California Environmental Health Tracking Program. Retrieved from: http://www.ehib.org/page.jsp?page_key=152

California Environmental Protection Agency [CEPA]. (1999). *Public health goal for thallium in drinking water.* Office of Environmental Health Hazard Assessment. Retrieved from: http://www.oehha.ca.gov/water/phg/pdf/thal_f.pdf

Cavanagh, J.B., Fuller, N.H., Johnson, H.R.M., et al. (1974). *The effects of thallium salts, with particular reference to the nervous system changes*. Q J Med 43:293-319.

Effio, D.G., Kroner, O., Maier, A., Hayes, W., Willis, A. and Strawson, J. (2012). *A look at state-level risk assessment in the United States: Making decisions in the absence of federal risk values.* Society for Risk Analysis. Volume 33.

Guy, R. H. (1999). *Metals and the skin: topical effects and systemic absorption*. Published by Informa Healthcare, ISBN: 978-0-8247-9385-2.

Lacoste, Robinson, & Brooks, 2001. (2001). *Uptake of thallium by vegetables: its significance for human health, phytoremediation, and phytomining.* Journal of Plant Nutrition. 24(8).

Lehi City. (2012a). *2011 Annual water quality report.* Lehi City Water Department.

Lehi City. (2012b). *Important information about your drinking water.* Lehi City Water Department. Distributed August, 21, 2012.

Lehi City. (2012c). *Important information about your drinking water.* Lehi City Water Department. Distributed March 8, 2012. Retrieved from http://www.lehi-ut.gov/wp-content/uploads/2012/03/Lehi-City-Water-Notice.pdf

Lehi City. (2012c). *Traverse Mountain: land use.* Retrieved from http://www.lehi-ut.gov/wp-content/uploads/2011/11/land-use.pdf

Midwest Research Institute [MRI]. (1988). *Toxicity of thallium (I) sulfate (CAS No. 7446-18-6) in Sprague-Dawley rats. Vol. 2. Subchronic (90-day) study [revised final report].* Prepared by Dynamac Corporation, Rockville, MD, for the Office of Solid Waste, Washington, DC; Project No. 8702-L(18); Work Assignment No. 111148-008.

Pavlickova, J., Zbiral, J. Smatanova, M., Habarta, P., Houserova, P., & Kuban, V. (2006). *Uptake of thallium from naturally-contaminated soils into vegetables.* Food Additives and Contaminants. 23(5).

Queirolo, F., Stegen, S., Contreras-Ortega, C., Ostapczuk, P., Queirolo, A., Paredes, B. (2009). *Thallium levels and bioaccumulation in environmental samples of Northern Chile: human health risks.* Journal of the Chilean Chemical Society. 54,4.

Stellman, J. M. (1998). *Encyclopaedia of occupational health and safety: Volume 3*. Published by International Labour Organization. Geneva, Switzerland. ISBN 978-9-2210-9203-2.

Stoltz, M.L., Stedham, M.A., Brown, L.K., Laber, L., El-Hawari, A.M. (1986). *Subchronic (90-day) toxicity of thallium (I) sulfate (CAS No. 744-18-6) in Sprague-Dawley rats. Final Report. Project no. 8702-L(18).* Prepared for the U.S. Environmental Protection Agency by Midwest Research Institute.

U.S. Census Bureau. (2012). *State and county quick facts: Utah.* Retrieved from: http://quickfacts.census.gov/qfd/states/49000.html

U.S. Environmental Protection Agency [EPA]. (1993). *Reference dose (RfD): description and use in health risk assessments: background document 1a.* Retrieved from: http://epa.gov/iris/rfd.htm

U.S. Environmental Protection Agency [EPA]. (2009a). *Integrated risk information system, thallium (I), soluble salts; CASRN various.* Retrieved from: http://www.epa.gov/iris/subst/1012.htm

U.S. Environmental Protection Agency [EPA]. (2009b). *Six-year review 2 health effects assessment: summary report.* Retrieved from: http://water.epa.gov/lawsregs/rulesregs/regulatingcontaminants/sixyearreview/second_review/upload/Six-Year-Review-2-Health-Effects-Assessment-Summary-Report.pdf

U.S. Environmental Protection Agency [EPA]. (2009c). *Technical factsheet on thallium.* Retrieved from: http://www.epa.gov/safewater/pdfs/factsheets/ioc/tech/thallium.pdf

U.S. Environmental Protection Agency [EPA]. (2009d). *Toxicological review of thallium and compounds. In support of summary information on the integrated risk information system (IRIS).* Cited in U.S. Environmental Protection Agency [EPA]. (2009b). *Six-year review 2 health effects assessment: summary report.*

U.S. Environmental Protection Agency [EPA]. (2012a). *2012 Edition of the drinking water standards and health advisories.* Retrieved from: http://water.epa.gov/action/advisories/drinking/upload/dwstandards2012.pdf

U.S. Environmental Protection Agency [EPA]. (2012b). *Basic information about thallium in drinking water.* Retrieved from: http://water.epa.gov/drink/contaminants/basicinformation/thallium.cfm

U.S. Environmental Protection Agency [EPA]. (2012c). *Mid-Atlantic risk assessment: generic tables: regional screening level (rsl) summary table November 2012.* Retrieved from: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/Generic_Tables/pdf/master_sl_table_run_NOV2012.pdf

U.S. Environmental Protection Agency [EPA]. (2012d). *Mid-Atlantic risk assessment: user's guide (November 2012).* Retrieved from: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/usersguide.htm

U.S. Environmental Protection Agency [EPA]. (2013). *Terminology services: vocabulary catalog list detail – drinking water glossary: maximum contaminant level.* Retrieved from: http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do

Vincoli, J. F. (1997). *Risk management for hazardous chemicals: Volume 1*. Published by CRC Press. Boca Raton, FL. ISBN: 978-1-5667-0200-3.

APPENDICES

APPENDIX A – TABLES AND FIGURES

Map 1. Traverse Mountain, Lehi, Utah 2012. (Lighter Spot in Inset Map)

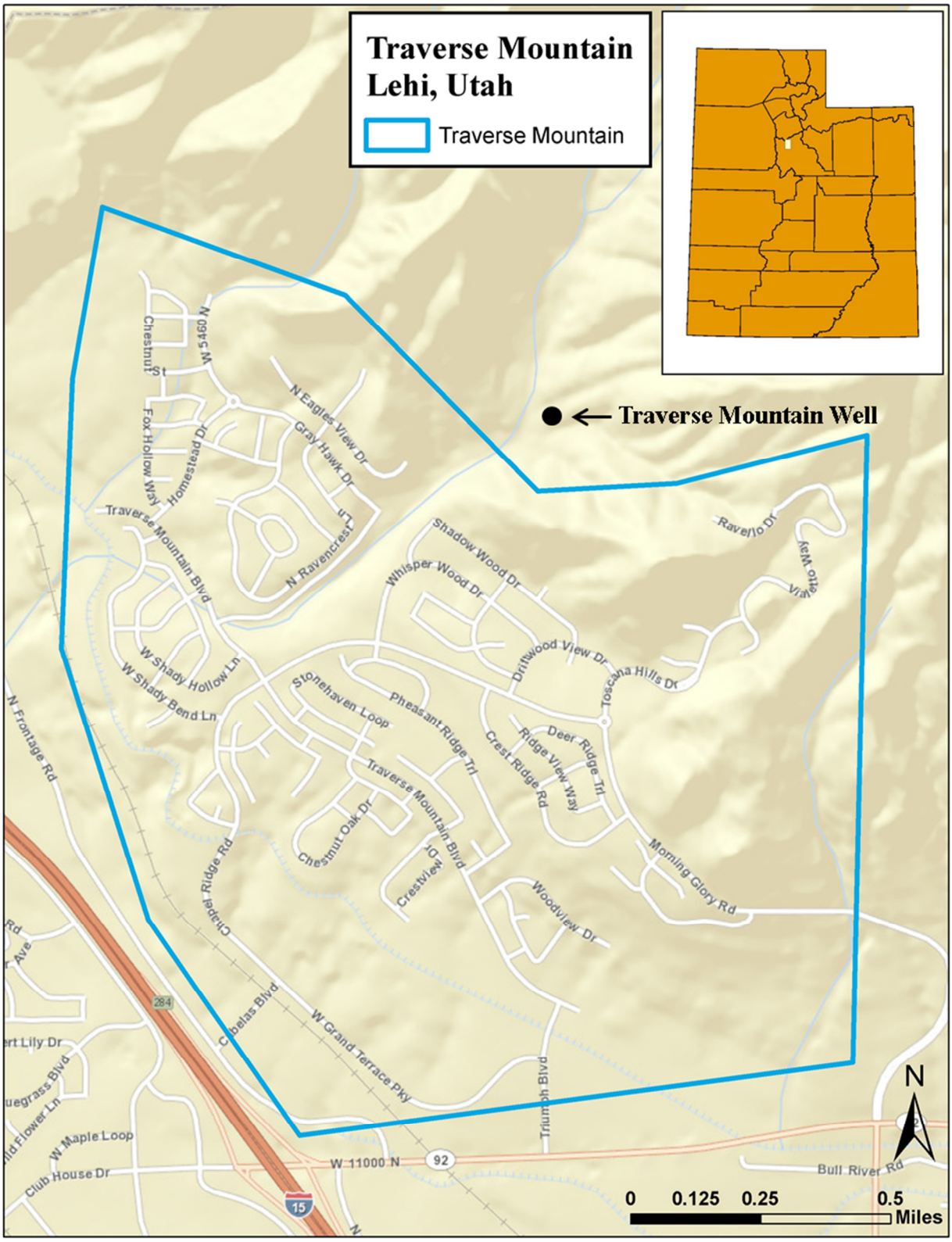

Table A1. Traverse Mountain Well and Traverse Mountain Water System Timeline, 2001 to 2012, Lehi City Water Department, Utah.

Date	Activity
2001	Drilled Traverse Mountain Well
2001	Thallium level was 1.4 ppb - acceptable
2002	Equipped Traverse Mountain Well
2004	Thallium level was 1.7 ppb – acceptable (below MCL)
2005	Installed booster pump
2007	Thallium level was 1.9 ppb – acceptable (below MCL)
Oct. 2010	Thallium level was 2.6 ppb – exceeded 2 ppb standard
End of 2010	Data submitted to Division of Drinking Water
Oct. 26, 2011	Division of Drinking Water set up a Quarterly Monitoring Requirement
Nov. 2011	Thallium test results were 2.9 ppb- exceeded 2 ppb standard
Jan. 2012	Thallium test results were 2.5 ppb – exceeded 2 ppb standard
Feb. 14, 2012/Tues.	Thallium test results were 3.0 ppb – exceeded 2 ppb standard
Feb. 16, 2012/Thurs. 2:05 a.m.	Last water from Traverse Mountain Well entered the system – stopped using in the drinking system
Feb. 22, 2012/Wed.	Six random samples taken from the system
March 2, 2012/Fri. 4:33 p.m.	Received thallium results from random sampling ranging from 2.1 ppb to 6.0 ppb – exceeded 2 ppb / one approached the 7.0 ppb short term limit
March 5, 2012/Mon.	Sent information to Division of Drinking Water
March 5, 2012/Mon.	Flushed parts of the system and resampled
March 6, 2012/Tues.	Meeting with Lehi City and Division of Drinking Water personnel
March 7, 2012/Wed.	Received results from second random testing with the following results (in ppb): non-detect, 1.0, 2.1, 2.0, 0.6, 5.2 (only two still exceeded 2 ppb)
March 7, 2012/Wed.	Flushed parts of the system and resampled
March 8, 2012/Thurs.	Flushed parts of the system and resampled
March 8, 2012/Thurs.	Distributed notification of thallium exceeding MCL to citizens

Table A2. Thallium concentrations in residential soil samples collected on June 12, 2012, Traverse Mountain, Lehi, Utah.

Sample #	Thallium (ppb)
201203209	93
201203210	73
201203211	365
201203212	127
201203213	263
201203214	965
201203215	196
201203216	160
201203217	156
201203218	134
201203219	119
201203220	76
201203221	174
201203222	159
201203223	217
Mean	218.5
Geometric Mean	169.9

Notes: ppb = parts per billion

Table A3. Thallium concentrations in drinking water samples exceeding EPA MCL collected after separation of the Traverse Mountain Well from the drinking water distribution system on February 16, 2012 to August 16, 2012. Traverse Mountain, Lehi, Utah.

Date Sampled	Thallium Concentration (ppb)
02/22/12	**6.0**
03/07/12	2.5
03/07/12	3.5
03/07/12	3.8
03/07/12	**4.4**
03/10/12	**2.1**
03/11/12	**54.9**
03/15/12	**18.4**
03/16/12	**17.8**
03/16/12	2.1
03/16/12	3.3
03/16/12	3.3
03/16/12	5.8
03/16/12	7.0
03/17/12	**12.2**
03/17/12	2.4
03/17/12	2.6
03/17/12	3.5
03/18/12	**5.7**
03/21/12	**10.0**
03/21/12	7.7
03/23/12	**2.5**
03/27/12	**3.1**
07/16/12	**2.8**
07/26/12	**3.8**
08/16/12	8.9
08/16/12	3.8
08/16/12	3.3
08/16/12	**26.9**

Notes: EPA = Environmental Protection Agency
MCL = maximum contaminant level
ppb = parts per billion

Bolded values are samples with the highest concentration per day

APPENDIX B – SITUATION ANALYSIS

UTAH APPLETREE

ATSDR's Partnership to Promote Localized Efforts to Reduce Environmental Exposures

Situation Analysis

Traverse Mountain, Lehi, Utah

Developed by:

Utah Department of Health Environmental Epidemiology Program
Division of Disease Control and Prevention

Contents

I. Overview……..43

II. Public Health Issue……..43

III. Public Health Concern…….43

IV. History/Background of Community ….……..44

V. Site History……..44

VI. Demographics……..45

VII. Findings from Key Informant Interviews……45

VIII. Recommendations……...48

IX. Community Profile…….. ……...49

I. Overview

In keeping with Agency for Toxic Substances and Disease Registry's (ATSDR) commitment to better respond to community concerns, a situation analysis was conducted for the Traverse Mountain site. A situation analysis defines and interprets the state of the environment of a community within a specific point in time. It identifies and analyzes the social or economic problems, the community's indigenous assets, and quality-of-life.

Key informants were interviewed to determine relevant aspects of the social structure and needs of the community. Within the community, demographics, characteristics, community health issues/needs, challenges, and activities were identified through the interviews. The Environmental Epidemiology program (EEP) staff conducted telephone interviews in July, 2012. A total of nine residents of Traverse Mountain were interviewed.

The interviewees were a combination of community members and representatives of local business, industry, non-profit organizations, faith-based organizations, and other community-based organizations. Key informant interviews were used to build a general assessment of the Traverse Mountain community as a whole and establish resources for coordinating and collaborating health promotion and community engagement activities.

Overall, key informant interviews indicated that general drinking water contamination was the most important issue to the community. Key informants also indicated that the community was interested in learning more about thallium contamination and the history behind the contamination. A summary of key findings is located in Part VII.

II. Public Health Issue

Thallium concentrations exceeding the Environmental Protection Agency's (EPA) MCL were detected in residential drinking water in the Traverse Mountain area of Lehi from October 2010 to August 2012. The secondary water source used for irrigation currently has detectable amounts of thallium. The contaminated source was taken off line in February 2012 and Lehi City Water Department introduced two different water sources with non-detectable thallium concentrations.

III. Public Health Concern

Residents are primarily concerned with thallium in the secondary water, the potential transfer of thallium to garden vegetables, and health effects from past exposure through their drinking water. Potential risks to health exist through exposure to secondary water and contaminated soil, by incidental exposure and dermal contact, and through the consumption of vegetables grown in contaminated soil.

The Utah Department of Health (UDOH), EEP under a cooperative agreement with ATSDR, has a mandate to prepare a health consultation (HC) to determine if thallium at the site poses any health risks to residents, and to define any follow-up activities needed to protect public health.

IV. History / Background of Community

The community of Traverse Mountain is located in Lehi, Utah County, Utah, about 12 miles north of Provo and 23 miles south of Salt Lake City. Lehi was originally settled by the Mormon Pioneers in 1850. Historical names for the City have included: Sulphur Springs, Snow's Springs, Dry Creek, and Evansville. The City's name was changed to Lehi City and incorporated in 1852. Lehi is Utah's sixth oldest town, and the northernmost community in the Utah Valley. Lehi experienced a monetary boom in 1858 as a result of the Utah Expeditionary Force at nearby Camp Floyd, the largest military establishment in the United States at that time. The local economy skyrocketed again in the 1890s with the establishment of the Utah Sugar Company's first factory. Lehi has increased in size by over 142 percent since the year 2000, from a population of 19,000 to over 46,000 today,[1] driven by a boom in high-tech development and manufacturing and by commuters seeking more affordable housing.

On the northern most border of Lehi, a master planned community by the name of Traverse Mountain actively began developing in 2001. The master plan includes 5,812 dwelling units along with plans for open space, retail, offices, restaurants, schools and civic buildings. Currently there are 1,900 existing or platted dwelling units within Traverse Mountain. Prior to development, the Traverse Mountain area was used for agriculture, primarily winter wheat.

V. Site History

The Traverse Mountain Well was drilled in 2001 to service the Traverse Mountain area. At the time of installation, the well had a thallium concentration of 1.4 parts per billion (ppb), below the EPA MCL (2 ppb). In October 2010, the thallium concentration was reported at 2.6 ppb, exceeding MCL. In October 2011, the Lehi City Water Department increased thallium sampling to quarterly testing and detected concentrations between 2.5 and 2.9 ppb. On February 16, 2012, the Traverse Mountain Well was isolated from the drinking water system and the Lehi City Water Department introduced water from two different sources with non-detectable concentrations.

In March 2012, the Lehi City Water Department began sampling the water distribution system and detected thallium levels up to 6 ppb. The Lehi City Water Department flushed the system and notified all Traverse Mountain residents. System flushing began in March 2012 and continued until April 2012, when thallium concentration levels were non-detectable.

The EEP became involved in April 2012 after numerous residents contacted the Centers for Disease Control and Prevention (CDC) with health questions and concerns. Under the direction of Lehi City, the EEP presented at a community meeting held on April 27, 2012. During the meeting, residents expressed numerous concerns regarding the health effects they were experiencing or had experienced from apparent thallium poisoning. Residents also expressed a concern over their gardens and the health effects associated with eating home grown vegetables watered with a thallium contaminated source. A factsheet and website were put together to educate the community about health risks related to thallium after the meeting to address some of

[1] US Census. (2012). Retrieved from http://factfinder.census.gov/gfd/states/49/4944320.html

the concerns.

In June 2012, the EEP collected 15 soil samples from various residents to establish a thallium concentration baseline. Samples were analyzed by the Utah State Department of Health Division of Laboratory Services. For the 15 samples, the average thallium result was 218.5 ppb and the highest result was 965 ppb of thallium. Exposure dose estimates for dermal and ingestion exposures were calculated, and a toxicological evaluation was conducted by EEP based on the soil sampling results. Based on the summer soil sampling results, EEP determined there is no apparent health risk to adults and children from incidental soil ingestion and soil exposure. It was also determined that all vegetables grown in soil below 700 ppb are not considered to pose a health risk. Because not all plants uptake thallium at the same rate, concerns are raised when certain vegetables (potatoes, turnips, cabbage) are grown in soils with thallium greater than 700 ppb.

VI. Demographics

Demographics are based on the City of Lehi, Lehi Utah.

Population: The total population of Utah as of the 2010 census was 2,763,885. Utah is a predominantly white community (86%), with Lehi being slightly less diverse (92.7% white) than the State as a whole. The total population of Lehi, Utah as of the 2010 census was 47,407. Lehi is 93% white, less than 1% African-American, less than 1% American Indian, 1% Asian, 2% other and mixed race, and 6% Hispanic[1].
Economic Status: Median owner-occupied home values are higher in Lehi ($248,200) than across the state ($218,100). Lehi also has a higher percentage of owner-occupied housing (82.8%) than the state of Utah (71.2%)[1]. The unemployment rate in Utah has fallen from 8% in July 2010 to 6% in July 2012[2].
Education Level: The percentage of residents with high school diplomas is slightly higher in Lehi than across the state of Utah (94.3% v. 90.6%). This is also true for the percentage of individuals with bachelor's degrees and higher (36.3% v. 29.4%) [1].

VII. Findings from Key Informant Interviews

Interviews were conducted with a combination of community members and representatives of local business, industry, non-profit organizations, faith-based organizations, and other community-based organizations. Key informant interviews were used to build a general assessment of the Traverse Mountain community as a whole and establish resources for coordinating and collaborating health promotion and community engagement activities.

Community Concerns

Growth and water were the two main community concerns listed for the Traverse Mountain area. Growth was referred to mainly as "commercial" growth. Interviewees were worried about the additional traffic and how the commercial industry would integrate with the "family" feel

[2] US Bureau of Labor Statistics. (2012). Retrieved from http://www.bls.gov/lau/

currently experienced throughout the community.

Water was a concern to the community, specifically the thallium in the water. A resident stated they were aware the city moved the contaminated water source to their secondary system. They still have concerns regarding their gardens, kids running through the sprinklers, and dust. The residents were not happy about the idea of "diluting" the contaminated water, blending the contaminated water with water with non-detectable levels of thallium. As one resident stated,
"We pay for our water the same as everyone else within Lehi City, however we don't get clean water, and we want to be treated like everyone else, what's fair is fair."

Financial burdens were also expressed by a number of informants. Many residents have experienced frustration paying costly medical bills in an attempt to figure out what was making their families sick. One resident stated,
"We have spent thousands and thousands of dollars on medical. We had no idea what was making our family sick, come to find out it was the water we were drinking, bathing in and cooking with."

Another resident expressed the incurred cost their family experienced from installing a water purification system to ensure their family's safety, the resident stated:
"We had to take it upon ourselves to ensure safety to our family, we spent $1,500 on a water purification system on top of medical expenses, and we can't handle any more."

These concerns were followed by a decrease in owner occupied housing and an increase in negative perception toward the home owners association (HOA). Many interviewees felt the decrease was due to the recession and the weak real estate market forcing owners to rent in lieu of selling. One resident noted that one specific family was forced to rent their home and leave the community due to poor health. The entire family was ill due to the thallium, and they could not keep up with the home and medical bills any longer. They moved in hopes of better health.

The community was expecting a new park to be built. They felt it would not happen without a fight. They felt that the HOA and specifically the builders have let them down. They did not receive all of the amenities they were promised before moving into the Traverse Mountain area.

One representative expressed concern about dust control during any future building, and requested additional information regarding the thallium concentrations in the soil. This person stated that the wind blows constantly, possibly creating a public health hazard. However all of the health effects, financial burdens and concerns have come at the cost of fatigue. As one resident stated,
"People are just sick of it; we just want answers and solutions."

Levels of Cohesiveness and Concern

The biggest schism identified in the community was between the residents and the city. The residents felt the city had misled them, by initially telling them they only had thallium exceeding the MCL in their water for two weeks. Upon investigation residents discovered they could have

potentially been exposed for up to five years. They also felt the health concern regarding the thallium contamination would be a much higher priority among community members if they had all the facts. One resident stated;
"The only reason I know so much about the health effects of thallium is because I did my own research."

All the literature and information provided by Lehi City to the community only addressed a two week exposure, when the exposure potentially could have been up to five years.

One resident stated that their constant environmental battles have left them tired. Based on the interviews, most residents did not feel the thallium concern was representative of the majority of the community and that they did not see it as an immediate threat. Many residents were anxious to learn what was there and what was going to be done about it.

As previously stated, some residents attributed their health concerns to thallium.

Community Values and Priorities

When asked, "What do you feel your community values most?" 100% of respondents reported "family", not only their immediate families, but also their community family.

The EEP were asked by many residents to "treat the community as your family", and the expectation was put forth that organizations working in the community be good stewards to the community.

Historical Anecdotes

Traverse Mountain is a relatively new community; the community actively began developing in 2001. Interviewees mentioned that when the development first began the economy was much better and the houses were of a better quality. They also stated that with the economic slowdown, the community has begun developing at a slower pace and the quality of houses has declined. Renter occupied homes were also mentioned as a concern for the community, with regards to maintaining the "family" feel. Historically the community has been described as a "very close knit family". Interviewees worried that with time the community would lose that feel due to high renter turnover.

Community Readiness

All community representatives interviewed initially found out about the thallium concern through a door flier distributed by the city water department. Residents expressed great appreciation to Lehi City and felt they did a good job getting the word out. They expressed the need for Lehi City to lead their community during an emergency. They felt the Lehi City was more prepared than the County, State or Federal agencies. One resident said,
"Lehi has a great Mayor and an excellent fire/police department."

The community consistently identified local leaders and organizations as the primary contacts for

environmental concerns. Interviewees felt effective communication occurred between neighborhood leaders and the HOA. This and the support from community decision-makers (i.e., mayor, police, and fire department) contributed to community readiness and stability according to the interviewees.

Community Leadership

The following organizations were listed by interviewees as leaders in the community that should participate in the discussion of the site: Lehi City Mayor, faith-based leaders (mainly of the Latter-day Saint [LDS] faith), HOA, and neighborhood representatives (the community is organized in "neighborhoods," and each neighborhood has an assigned representative). Identified sources for community outreach included: social media (the community has a website, a Facebook page, and an email list serve), churches (specifically LDS), the home owners association, and neighborhood representatives.

Community Assets

The community assets included:

- Long-term residents
- Family friendly atmosphere
- Active faith-based organizations
- Active community organizations
- Easy freeway access to both Salt Lake and Provo

Communication Preferences

Community members stated that mailers or door fliers were the most effective way to notify the community, and prior notification of actions by the City was preferred. Other popular forms of communication included social media via the internet (use is prevalent for younger residents but not the elderly or the LDS church). One faith-based representative mentioned that the LDS church includes everyone in the community regardless of their faith as part of a "community readiness plan" and would be an excellent resource to ensure every home was notified.

Interviewees advised that multiple approaches should be utilized to communicate with the community.

VIII. Recommendations

Based on the key informant interviews, the following are recommendations for Traverse Mountain, Lehi, Utah:

1. There is a need for additional Community Engagement or Health Education interventions at this time. The community indicated distrust and outrage toward Lehi City. They felt the true extent of the contamination and health effects were not properly communicated to the community. Health education materials should be given to each member of the

community in the form a factsheet or flier. Factsheets should include health effects along with information about ATSDR and the HC process.

2. Upon completion of the HC, Lehi City, Utah Department of Drinking Water (DDW), and EEP staff should provide meeting support for the release of the document.

3. The HC and fact sheets should be in English; no cultural issues were identified that need to be taken into consideration at this time.

IX. Community Profile

UTAH APPLETREE
ATSDR's Partnership to Promote Localized Efforts to Reduce Environmental Exposures

Traverse Mountain, Lehi

Lehi, Utah 84043

TABLE OF CONTENTS

SECTION	PAGE
Site Information	50
ATSDR Site Involvement & Focus	50
Community, Stakeholders and Interested Parties	50
Community Resources	51
Community Work-Life	53
Community Demographics and Socioeconomic Characteristics	55
Additional Community Resources	56
Media Reports	58

SECTION 1: SITE INFORMATION

See page 44 for detailed information on this site.

SECTION 2: ATSDR SITE INVOLVEMENT & FOCUS

Site brought to ATSDR's attention by:
Resident petition to CDC's Agency for Toxic Substances and Disease Registry (ATSDR)
What are the contaminants of concern and exposure pathways?
Thallium. Air, water, soil, and food.

According to site documents, do people live, work, play or go to school on the site?
Yes, this is a residential community. The contaminated source was removed from the drinking water system and a second source was introduced until further action can be taken. The current level of thallium in the community distribution system is non-detect.

SECTION 3: COMMUNITY, STAKEHOLDERS AND OTHER INTERESTED PARTIES

Federal Environmental Public Health and Federal Environmental Protection Agencies

ATSDR
Regional Lead Assigned to Site:
Chris Poulet, cpoulet@cdc.gov (303) 312-7013
David Dorian, dorian.david@epa.gov (303) 312-7011
ATSDR - Region 8 Denver office, 1595 Wynkoop Street, Denver, CO 80202; (303) 312-7013
Other ATSDR Staff:
Charisse Walcott, cpw8@cdc.gov (770) 488-3730
Candice Mayweather, hlb8@cdc.gov

State Health Department

Utah Department of Health, Environmental Epidemiology Program
288 North 1460 West, Salt Lake City, Utah 84114, (801) 538-6191, www.health.utah.gov
Environmental Epidemiology Program Manager:
Sam LeFevre, (801)538-6191, slefevre@utah.gov
APPLETREE Program Manager:
Dr. Craig Dietrich, (801) 538- 6832, dietrich@utah.gov
Health Education, Community Involvement Coordinator:
McKell Drury, (801) 538-9342, mdrury@utah.gov
Epidemiologist:
Alex Wu, (801) 538-6705, awu@utah.gov

State Environmental Quality Department

Utah Department of Environmental Quality, Division of Drinking Water
195 North 1950 West, Salt Lake City, Utah 84116 (801) 536-4200, www.drinkingwater.utah.gov
Director:
Kenneth Bousfield, (801) 536-4207, kbousfield@utah.gov

Local Government Officials

Name of Municipality: Lehi City
Lehi City Hall, 153 North 100 East, Lehi, Utah 84043, http://www.lehi-ut.gov
Mayor:
Bert Wilson, (801) 768-7100, bwilson@lehi-ut.gov
Assistant City Administrator:
Ron Foggin, (801) 768-7100 ext 2253, rfoggin@lehi-ut.gov
City Council Persons:
Kaye Collins, Stephen Holbrook, Michael Southwick, Mark Johnson, Johnny Revill
City Council Website:
http://www.lehi-ut.gov/government/elected-officials
Water District Superintendent:
Lee Barnes, (801) 768-7102 ext 2421, lbarnes@lehi-ut.gov

Other County, State, and Federal Elected Officials

Governor:
Gary Herbert, 350 North Stat Street, Suite 200, P.O. Box 142220, Salt Lake City, UT 84114-2220, (801) 538-1000 http://www.utah.gov/governor
VA General Assembly Website: http://le.utah.gov/

Community Organizations

Lehi Area Chamber of Commerce:
P.O. Box 154, Lehi, Utah, 84043, (801) 768-9657
Senior Citizens Organizations:
Jan Jonsson, 123 North Center Street, Lehi, UT 84043, (801) 768-7102 ext 4
Lehi Community Council:
Lehi's Community Council plan events and activities, offer family resources, and provide access to programs aimed at strengthening families in the Lehi area.
Traverse Mountain community: http://traversemountain.org/

SECTION 4: COMMUNITY RESOURCES

Local Library

Lehi Library, 120 North Center Street, Lehi Utah 84043, (801) 768-7150
The Lehi Library offers many services including computer access, wireless access, a copy center, inter-library loans, tours, and events
Rippy Literacy Center, 120 North Center Street, Lehi, Utah 84043, (801) 407-1025
The award winning Rippy Literacy Center provides free year-round tutoring in a number of different subjects and levels including Math and English.

EPA/DEP Field Office

U.S. EPA Region, 1595 Wynkoop Street, Denver, Co 80202-1129, (303) 312-6473.
http://www.epa.gov/libraries

Local Religious Centers

Baptist

Living Word, 2540 North 1200 West, Lehi, UT 84043, (801) 885-8719, www.livingwordbcutah.com
Timpanogos, 55 W. Main St. Lehi, UT (801) 221-7937, www.timpbaptistchurch.org
First Baptist Church, 344 E Center St, Pleasant Grove, UT, (801) 785-3295
Salt Lake Baptist Assoc, 12401 S 450 E # G2, Draper, UT, (801) 619-0574
Utah-Idaho Southern Baptist, 12401 S 450 E # G1, Draper, UT, (801) 572-5350

Catholic

St. Peters Catholic Church, 634 N 600 E, American Fork, UT, (801) 756-7771
St. Francis of Assisi Catholic Church, 65 East 500 North, Orem, UT, (801) 221-0750

Christian (General)

Draper Friends Church, Draper, UT, (801) 523-1622
Compassion Christian Fellowship, 684 E Union Sq, Draper, UT, (801) 495-1322

The Church of Jesus Christ of Latter-day Saints (LDS)

LDS Church Locator http://www.lds.org/rcmaps/?lang=eng

Lutheran

Tree of Life Lutheran Church, 1080 N 470 W, Orem, UT, (801) 802-8733
Grace Lutheran Church-Sandy, 1815 E 9800 S, Sandy, UT, (801) 572-6375
St Mark's Lutheran Church, 464 W 3700 N, Provo, UT, (801) 225-5777

Good Shepherd Lutheran Church, 8575 S 700 E, Sandy, UT, 801-255-8181
Hope Lutheran Church-W Jordan, 2930 W 9000 S, West Jordan, UT, 801-569-1111

Methodist

Hilltop United Methodist Church, 985 E 10600 S, Sandy, UT, (801) 571-5777
United Methodist Church, 1044 N Geneva Rd, Provo, UT, (801) 370-9668
Mountain Vista United Methodist Church, 8931 S 3200 W, West Jordan, UT, (801) 280-4148

Mosques

Islamic Society of Salt Lake City, 740 S. 700 E, Salt Lake City, UT, (801) 364-7822

Presbyterian

Community Presbyterian Church, 75 N 100 E, American Fork, UT, (801) 756-2621
Hidden Valley Presbyterian Church, 12883 S 1300 E, Draper, UT, (801) 553-7144

Synagogues

Synagogue Congregation Kol Ami. 2425 Heritage Way, Salt Lake City, UT, (801) 484-0337

Public Safety

Lehi Police Department, 580 West State St, Lehi, UT 84043, (801)768-7100
Lehi Fire Department, 176 North Center St, Lehi Utah 84043, (801) 343-7130
Lehi Emergency Preparedness, http://www.lehi-ut.gov/residents/emergency-prepardness

Lehi Public Safety, http://www.lehi-ut.gov/residents/public-safety

Local Post Offices

US Post Office, 400 East Main Street, Lehi, UT 84043, (801) 768-1562

Local Day Care Center

Lehi Legacy Center- 123 North Center Street, Lehi, Utah 84043, (801) 768-7124

Local Schools

Alpine School District – 575 North 100 East, American Fork, Utah 84003, (801) 756-8400
http://alpineschools.org/

Grades 10-12
Lehi High School, 180 North 500 East, Lehi, Utah 84043, (801) 768-7000

Grades 7-9
Lehi Junior High School, 700 East Cedar Hollow Road, Lehi, Utah 84043, (801) 768-7010
Willowcreek Middle School, 2275 West 300 North, Lehi, Utah 84043, (801) 766-5273

Grades K-6
Eaglecrest Elementary, 2760 North 300 West, Lehi, Utah 84043, (801) 768-7035
Fox Hallow Elementary, 1450 W. 3200 N., Lehi, Utah 84043, (801) 768-2499
Lehi Elementary, 765 North Center St., Lehi, Utah 84043, (801) 768-7020
Meadow Elementary, 176 South 500 West, Lehi, Utah 84043, (801) 768-7025
Sego Lily Elementary, 550 East 900 North, Lehi, Utah 84043, (801) 768-7030
Snow Springs Elementary, 850 South 1700 West, Lehi, Utah 84043, (801) 768-7045

Local Hospitals/Clinics

American Fork Hospital, 170 North 1100 East, American Fork, Utah 84003,
http://intermountainhealthcare.org/hospitals/americanfork/Pages/home.aspx

SECTION 5: COMMUNITY WORK-LIFE

Description of Major Local Industries

Top Employers in Lehi, UT
Construction - 18%
Professional, scientific, and technical services – 10%
Retail Trade - 12%
Manufacturing - 14%
Educational Services - 5%
Health Care and Social Assistance - 5%
Finance and insurance - 5%

Source: http://www.city-data.com/city/lehi-Utah.html

Transportation Mode(s) Available to Community

Lehi, UT has a public transportation system including buses, trains and express buses. Fare, route and schedule information available at: http://www.rideuta.com/

Crime Statistics

Source: http://www.city-data.com/city/lehi-Utah.html

	Lehi, Utah - # of crimes per year					
	2000	2001	2002	2003	2004	2005
Murder/Manslaughter	0	1	0	0	1	0
Forcible Rape	0	12	2	3	9	10
Robbery	2	2	3	1	1	1
Aggravated Assault	10	8	14	9	11	17
Arson	2	0	1	3	0	2
Burglary	83	114	186	202	211	243
Larceny-Theft	189	189	319	330	345	408
Motor Vehicle Theft	27	24	36	44	40	55

SECTION 6: COMMUNITY DEMOGRAPHICS AND SOCIOECONOMIC CHARACTERISTICS

	Lehi, Utah	**Utah**
Population Size		
Total Population	47,407	2,763,885
Males	50.2%	50.2%
Females	49.8%	49.8%
Race/Ethnicity		
White	92.7%	86.1%
Black/African-American	0.4%	1.1%
Asian	1.4%	2.0%
American Indian/Alaskan Native	.4%	1.2%
Hispanic/Latino (Of Any Race)	6.4%	13.0%
Other Race/Two or More Races	2.5%	2.7%
Age Distribution		
Persons under 5 years old	15.8%	9.5%
Persons under 18 years	43.3%	31.5%
Persons 65 years and over	4.6%	9.0%
Languages Spoken in the Area*	**(2006-2010 data)***	**(2006-2010 data)***
Language other than English	9.1%	14.2%
Socioeconomic Characteristics		
High school graduate or higher (25 years and over)	94.3%	90.6%
Bachelor's degree or higher (25 years and over)	35.3%	29.4%
Individuals below the Poverty Level	4.6%	10.8%
Median household income	$67,999	$56,330
Per capita income	$21,315	$23,139
Median value, owner-occupied homes	$248,200	$218,100
Homeownership rate	82.8%	71.2%

*Source: 2010 US Census: http://factfinder.census.gov/gfd/states/49/4944320.html

SECTION 7: ADDITIONAL COMMUNITY RESOURCES

Community Media Resources

Local Print Media:
Herald Extra, http://www.heraldextra.com/
Salt Lake Tribune, http://www.sltrib.com/

News Stories about the Site:

Date	Headline	Outlet
3/9/2012	Lehi cautions TM residents about drinking water	heraldextra.com
3/20/2012	Lehi still flushing thallium from water system	heraldextra.com
3/30/2012	Lehi well should be operational by Monday	heraldextra.com
4/3/2012	Lehi gets all clear on drinking water supply	heraldextra.com

(Full articles available in appendix)

Local Radio Stations:

AM radio stations in Lehi:

- KIQN (1010 AM; 50 kW; TOOELE, UT)
- KALL (700 AM; 50 kW; NORTH SALT LAKE CITY, UT; Owner: CITICASTERS LICENSES, L.P.)
- KSL (1160 AM; 50 kW; SALT LAKE CITY, UT; Owner: BONNEVILLE HOLDING COMPANY)
- KLLB (1510 AM; daytime; 10 kW; WEST JORDAN, UT; Owner: UNITED SECURITY FINANCIAL, INC.)
- KWDZ (910 AM; 5 kW; SALT LAKE CITY, UT; Owner: ABC, INC.)
- KKDS (1060 AM; 10 kW; SOUTH SALT LAKE, UT; Owner: HOLIDAY BROADCASTING COMPANY)
- KTKK (630 AM; 10 kW; SANDY, UT; Owner: UNITED BROADCASTING COMPANY)
- KBEE (860 AM; 10 kW; SALT LAKE CITY, UT; Owner: CITADEL BROADCASTING COMPANY)
- KOVO (960 AM; 5 kW; PROVO, UT; Owner: MILLCREEK BROADCASTING LLC)
- KFNZ (1320 AM; 5 kW; SALT LAKE CITY, UT; Owner: CITADEL BROADCASTING COMPANY)
- KBJA (1640 AM; 10 kW; SANDY, UT; Owner: UNITED BROADCASTING COMPANY, INC)

FM radio stations in Lehi:

- KXRK (96.3 FM; PROVO, UT; Owner: SIMMONS-SLC, LS, LLC)
- KQMB (102.7 FM; MIDVALE, UT; Owner: SIMMONS-SLC, LS, LLC)
- KZHT (94.9 FM; PROVO, UT; Owner: CITICASTERS LICENSES, L.P.)
- KENZ (107.5 FM; OREM, UT; Owner: CITADEL BROADCASTING COMPANY)
- K217CL (91.3 FM; PROVO, UT; Owner: STOCKTON CHRISTIAN LIFE COLLEGE, INC)

- KSOP-FM (104.3 FM; SALT LAKE CITY, UT; Owner: KSOP, INC.)
- K272DP (102.3 FM; TOOELE, UT; Owner: FAMILY STATIONS, INC.)
- KODJ (94.1 FM; SALT LAKE CITY, UT; Owner: CITICASTERS LICENSES, L.P.)
- KUER-FM (90.1 FM; SALT LAKE CITY, UT; Owner: UNIVERSITY OF UTAH)
- KRCL (90.9 FM; SALT LAKE CITY, UT; Owner: LISTENERS COMMUNITY RADIO OF UTAH)
- KBZN (97.9 FM; OGDEN, UT; Owner: CAPITOL BROADCASTING, INC.)
- KBYU-FM (89.1 FM; PROVO, UT; Owner: BRIGHAM YOUNG UNIVERSITY)
- KOSY-FM (106.5 FM; SPANISH FORK, UT; Owner: MERCURY BROADCASTING COMPANY, INC.)
- KRSP-FM (103.5 FM; SALT LAKE CITY, UT; Owner: SIMMONS-SLC, LS, LLC)
- KBER (101.1 FM; OGDEN, UT; Owner: CITADEL BROADCASTING COMPANY)
- KISN-FM (97.1 FM; SALT LAKE CITY, UT; Owner: CLEAR CHANNEL BROADCASTING, INC.)
- KKAT (101.9 FM; OGDEN, UT; Owner: CITICASTERS LICENSES, L.P.)
- KSFI (100.3 FM; SALT LAKE CITY, UT; Owner: SIMMONS-SLC, LS, LLC)
- KUBL-FM (93.3 FM; SALT LAKE CITY, UT; Owner: CITADEL BROADCASTING COMPANY)
- KURR (99.5 FM; BOUNTIFUL, UT; Owner: CITICASTERS LICENSES, L.P.)

Local TV Broadcast Stations:

- KUTV (Channel 2; SALT LAKE CITY, UT; Owner: KUTV HOLDINGS, INC.)
- KCBU (Channel 32; PROVO, UT; Owner: GARY M. COCOLA FAMILY TRUST, GARY M. COCOLA TRUSTEE)
- KUPX (Channel 16; PROVO, UT; Owner: PAXSON SALT LAKE CITY LICENSE, INC.)
- KULC (Channel 9; OGDEN, UT; Owner: UTAH STATE BOARD OF REGENTS)
- KUED (Channel 7; SALT LAKE CITY, UT; Owner: UNIVERSITY OF UTAH)
- KEJT-LP (Channel 48; SALT LAKE CITY, UT; Owner: TELEMUNDO OF NORTHERN CALIFORNIA LICENSE CORP.)
- K59GS (Channel 59; SALT LAKE CITY, UT; Owner: ALPHA & OMEGA COMMUNICATIONS, LLC)
- KBYU-TV (Channel 11; PROVO, UT; Owner: BRIGHAM YOUNG UNIVERSITY)
- KUWB (Channel 30; OGDEN, UT; Owner: ACME TV LICENSES OF UTAH, LLC)
- KTVX (Channel 4; SALT LAKE CITY, UT; Owner: CLEAR CHANNEL BROADCASTING , INC.)
- K49GD (Channel 49; SPANISH FORK, UT; Owner: ALPHA & OMEGA COMMUNICATIONS, L.L.C.)
- K55IT (Channel 55; PROVO, UT; Owner: ALPHA & OMEGA COMMUNICATIONS, L.L.C.)

Community Medical & Academic Resources

Nearby Colleges/Universities:

- Utah Valley University (about 12 miles; Orem, UT; Full-time enrollment: 15,072)
- Brigham Young University (about 16 miles; Provo, UT; FT enrollment: 30,109)
- University of Phoenix-Utah Campus (about 18 miles; Salt Lake City, UT; FT enrollment: 3,097)
- Salt Lake Community College (about 20 miles; Salt Lake City, UT; FT enrollment: 11,080)
- Western Governors University (about 20 miles; Salt Lake City, UT; FT enrollment: 15,870)
- Westminster College (about 23 miles; Salt Lake City, UT; FT enrollment: 2,451)
- University of Utah (about 26 miles; Salt Lake City, UT; FT enrollment: 20,534)

SECTION 8: MEDIA REPORTS

Full-length news articles cited in this report:

Lehi cautions Traverse Mountain residents about drinking water

3/9/2012

LEHI -- Lehi city has notified Traverse Mountain residents that it has shut down the planned community's culinary water well because of a minute increase in thallium found in routine testing. A flier has been distributed telling residents about the situation, and the city again flushed and tested the well on Thursday.

"We are doing flushing and testing and we're going to take care of this problem," Lehi water superintendent Lee Barnes said.

The situation does not place the people in the area at risk according to Ron Foggin, Lehi assistant city administrator.

"If there were dangerous levels, the notice in the flier would have said do not drink the water," Foggin said.

The city got test results on Feb. 22 and again on March 3, which showed continued higher than average concentrations. Thallium is a chemical element that is naturally found in most water sources but causes harm to the body when taken in high doses over an extended period of time. Based on the test's thallium concentration level, the chemical would take several years to adversely affect someone.

Park City had a more extensive problem in 2010 when tests discovered unacceptable levels of thallium, manganese, arsenic and mercury, according to director of the state Division of Drinking Water Ken Bousfield.

"It is based on our experience with Park City that has helped us with Lehi city," Bousfield said. "We knew it wasn't spontaneous generation of this stuff and that it had to be coming from somewhere. Our best guess is that it came from the Traverse Mountain well and accumulated in the pipeline."

Lehi uses a redundant system called looping so while the problem well is shut down and being flushed, its 500 West well is feeding water to affected residents.

"The city has done something absolutely brilliant. We insisted on looping our system," Foggin said. "The benefit of what we have now is when we have situations like this, we can use other water sources."

He said a few years ago, a Traverse Mountain developer didn't want the city to loop the system and wanted the area well dedicated to only the planned community.

"He didn't want the city to access his well," Foggin said. "Isn't it a good thing that the city insisted on looping that system? That's just a side note. Boy, I'm glad we have a looped system now."

Water department staff discovered the increased thallium when required routine tests were taken six months ago showed concentration at two parts per billion. At that time, testing on that particular well was moved from once every three years to quarterly.

The second quarter test showed the concentration level hadn't decreased and was still in violation of the drinking water standard, so city staff decided to discontinue using the well for Traverse Mountain on Feb. 22. After they turned the well off, they began seeing thallium levels rise to three parts per billion, according to Bousfield. The Environmental Protection Agency sets a level of seven parts per billion over the short term, two to three weeks, before thallium adversely affects humans.

"So really strange," Bousfield said. "In the theory we are working on, the pumping of the Traverse Mountain well laid down some of the thallium in the pipe and introducing the water from a new well changed the chemistry in the system and broke down the layer of thallium in the pipe."

He said they are optimistic that the process the city is following will resolve the issue in a short amount of time. The thallium concentrations are a chronic containment.

"That means people need to drink that water for years in order to see a health effect," Bousfield said.

Side effects after inordinate exposure to thallium are gastrointestinal irritation; peripheral neuropathy; blood chemistry changes; liver, kidney, intestinal and testicular tissue damage; and hair loss.

Since Lehi city is using a redundant system for culinary water, residents do not need to use an alternative water supply. The city flier tells residents that if there are specific health concerns to consult a doctor.

"All of this is precautionary but it is advised to be on the safe side," Bousfield said. "This should resolve the problem in a matter of days."

Bousfield said based on the Park City experience, they were able to advise Lehi staff to purge the pipelines scouring the inside with fast flushing water to break down the thallium buildup. Purging began and a March 5 test showed much lower levels but with some tests remaining at two parts per billion.

"Which is why it was decided to put out the notice," Foggin said. Flushing began again on the system and the city is waiting for test results to come in this afternoon.

Lehi still flushing thallium from water system

3/20/2012

LEHI -- Water samples taken from the Traverse Mountain culinary water system main lines came back March 16 under 2 parts per billion for thallium, a metal found at levels of 3 parts per billion in a previous test of the Lehi Oak Hollow Well. At the current rate of flushing, the water department expects to have the entire system clear and the thallium lever even lower by March 23.

"This is great news and proves that the flushing works to remove thallium buildup in the system," said Ron Foggin, Lehi assistant city administrator. "The bad news is the water department has just under half the culinary water system left to flush."

The assumption made that the Oak Hollow Well deposited thallium within the main culinary lines appears correct and flushing the mains is removing those deposits. After Lehi City turned the well off, staff began seeing thallium levels rise to 3 parts per billion, according to Ken Bousfield of the Utah State Division of Drinking Water. The Environmental Protection Agency sets a level of 7 parts per billion over the short term, two to three weeks, before thallium adversely affects humans.

"The pumping of the Traverse Mountain well laid down some of the thallium in the pipe and introducing the water from a new well changed the chemistry in the system and broke down the layer of thallium in the pipe," Bousfield said.

The Lehi Water Department continued flushing the culinary water system mains at Traverse Mountain last week with the offending well remaining shut down. On Friday, just under 50 percent of the system remained to be scoured by high pressure flushing.

As of Monday, 90 percent of the flushing had been completed, according to Lehi Water Superintendent Lee Barnes.

"The flushing is moving it. We are making good progress with cleaning the system," Barnes said. "We have a few areas needing to be re-flushed and retested."

Foggin said because of the high water velocity needed to scour flush the system the process must be done in parts so water pressure isn't lost for the residents.

"We're doing it right," Foggin said. "If we did a bunch of flushing at the amount we are putting out for this water project, people would be upset."

He said that in other words, if the water staff flushed the system too aggressively, homes and businesses would experience a dramatic reduction in water pressure. Because of the pressure issue, they are taking a little longer to flush the entire system.

"The water department is pushing as hard as they possibility can to get this problem solved," Foggin said.

Lehi city had notified its Traverse Mountain residents in early March that the municipality shut down the planned community's culinary water well because of a minute increase in thallium found in routine testing. Thallium is a chemical element that is naturally found in most water sources but causes harm to the body when taken in high doses over an extended period of time. Based on the test's thallium concentration level, the chemical would take several years to adversely affect someone. Water department staff discovered the thallium concentration rise when required routine tests were taken six months ago showing concentration at 2 parts per billion.

More on the required report and its standards can be found at water.epa.gov.

Lehi well should be operational by Monday

3/30/2012

LEHI -- Lehi public works director Jim Hewitson said he hopes to have the Oak Hollow well back online next week, following several days of work to flush elevated levels of the base metal thallium from culinary water lines.

"It's going very well, we should have an all clear next week," Hewitson said.

The city issued a drinking water alert March 8 after test results showed unsafe levels of the metal in a well that serves the Traverse Mountain area. Those levels are determined by the Environmental Protection Agency.

Lehi water superintendent Lee Barnes said he used other water sources within the municipal culinary network to supply the area with drinking water while Lehi crews flushed water lines and brought the supply network back into compliance.

He said all but one segment tested Wednesday were in compliance. He expected test results Thursday to show all segments were ready to be put back online.

"We have one sample left being tested right now and if it comes back below the two ppb we'll be able pass out fliers to people and let them know," Hewitson said.

The Drinking Water Division of the state Department of Environmental Quality must give its OK before the water system goes back online. The EPA has found that elevated levels of thallium can cause gastrointestinal irritation and peripheral neuropathy, a nerve function disorder. EPA and state standards for acceptable thallium levels in culinary water is two parts per billion for long-term exposure and seven parts per billion for exposures of one to 10 days.

Tests from the Oak Hollow Well tested in the two to six parts per billion range as recently as March 2, Barnes said. He will send Traverse Mountain residents a letter, likely Monday he said, with word the system is safe and that thallium levels are below two parts per billion.

The city is considering blending water from the well that had elevated levels of thallium with water from other sources to maintain compliance levels.

"To make sure we don't have an increase in thallium again," Hewitson said. "Apparently there is something in the well that is increasing the thallium. We just want to make sure we don't go over again."

Lehi gets all-clear on culinary water supply

4/3/2012

LEHI -- Lehi city staff hand delivered the all-clear notice on the Oak Hollow well water this afternoon to every home and business in the Traverse Mountain area.

"I am happy to report that thallium levels in the culinary water system are under two ppb," Lehi city assistant administrator Ron Foggin said.

The notice was printed with the headline of "Thallium Levels are Below Drinking Water Standards," meaning that the base metal levels were in compliance with the Environmental Protection Agency and state permissible levels and actually at a higher level of compliance than the standard of two parts of thallium per billion. The well, however, is still not online.

"It's not really all over right yet. We will be pulling some random samples during the month to make sure that the levels are still stable," Lehi water superintendent Lee Barnes said.

Lehi city issued a drinking water alert March 8 after test results showed unsafe levels of the metal in a well that serves the Traverse Mountain area. Those levels are determined by the Environmental Protection Agency. Tests from the Oak Hollow Well tested in the two to six parts per billion range as recently as March 2, Barnes said.

Lehi flushed the Traverse Mountain area culinary water distribution system and sampled from more than 45 sites within that system. Sample results confirmed that all areas are now below the thallium standard of two ppb as of Monday. Each sample site was required to have two consecutive results at or below the required 2 ppb.

Foggin said state employees are working with the Lehi water department and an engineering firm to create a culinary water blending plan for the Traverse Mountain area. The blending plan will combine culinary water sources, thus reducing thallium levels.

Until the blending plan is approved by the Utah State Division of Drinking Water, the Lehi water department will continue to supply the Traverse Mountain area with culinary water from the 500 West well.

"That is what we are proposing, is we are looking at that option to blend the water if it's acceptable," Barnes said. "We are not using it yet. We have a blending plan being reviewed by the state."

Foggin said that the city had no need to use the alternate supply of drinking water but did so from the 500 North well while flushing the Cedar Hollow well and the Traverse Mountain water system.

"Of course Lehi water will continue to monitor thallium levels to ensure the best possible drinking water for our citizens and businesses," Foggin said.

Those who would like to see all of the thallium sample results, including dates and locations, can check the Lehi city website at www.lehi-ut.gov or "Lehi City" on Facebook.

APPENDIX C – LEHI CITY PUBLIC NOTICES

Screen-shot of Lehi-UT.gov of Public Notice, March 8, 2012
(http://www.lehi-ut.gov/updates/drinking-water-update)

LEHI

facebook twitter

Report An Issue | Contact Us | Pay Your Utility Bill

What can we help you find?

What's New – News, Updates & Notices | Residents – Community Information | Business – Business Information | Discover – Programs & Attractions | Government – Leadership & Planning | City Services – Utility & Public Works

Lehi News & Updates

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

Traverse Mountain Area Has Levels of Thallium Above Drinking Water Standards

Thallium has recently been discovered in the Oak Hollow Well resulting in a violation of the drinking water standard. Although this is not an emergency, as our customers, you have a right to know what happened, what you should do, and what we are doing to correct this situation.

Lehi City Water routinely monitors for the presence of drinking water contaminants. Testing results we received on February 22, 2012, show that our system exceeds the standard, or maximum contaminant level (MCL), for Thallium. The standard for Thallium is 2 parts per billion for long term exposure, and 7 parts per billion for short term (1 to10 days).

What should I do?

You do not need to use an alternative (e.g., bottled) water supply.

However, if you have specific health concerns, consult your doctor.

What does this mean?

The EPA has found thallium to potentially cause the following health effects from acute exposures at levels above the MCL: gastrointestinal irritation; peripheral neuropathy.

Thallium has the potential to cause the following health effects from long-term exposures at levels above the MCL: changes in blood chemistry; damage to liver, kidney, intestinal and testicular tissues; hair loss.

There is no evidence that thallium has the potential to cause cancer from lifetime exposures in drinking water.

What is being done?

The Lehi Water Dept. is currently using a different source of culinary water not containing Thallium to provide water to the Traverse Mountain area. We are flushing the pipes and aggressively sampling to assure the purity of your drinking water.

Lehi City Water Department is preparing a blending plan which will be implemented upon approval of the Division of Drinking Water. This plan will comply with the regulations of the State.

For more information, please contact Lehi City Water Dept. at 801-768-7102, ext. 3, or after hours at 801-836-1045

We are located at 2538 North 300 West, Lehi, UT

For further information contact The Division of Drinking Water at 801-536-4200

This notice is being sent to you by Lehi City. State Water System ID#: UTAH 25015.

Date distributed: March 8, 2012.

Categories

- Board of Adjustments
- City Council
- Events
- Library
- Museum
- Planning Commission
- Public Hearing Notices
- Road Closures and Construction
- Round-Up Week

Screen-shot of Lehi-UT.gov of Public Notice, April 2, 2012
(http://www.lehi-ut.gov/updates/thallium-levels-are-below-drinking-water-standards)

LEHI

facebook twitter

Report An Issue | Contact Us | Pay Your Utility Bill

What can we help you find?

What's New — News, Updates & Notices | Residents — Community Information | Business — Business Information | Discover — Programs & Attractions | Government — Leadership & Planning | City Services — Utility & Public Works

Lehi News & Updates

THALLIUM LEVELS ARE BELOW DRINKING WATER STANDARDS

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

Thallium Levels are Below Drinking Water Standards

The Traverse Mountain area of our water system has been flushed and sample results confirm that all areas are now below the
thallium standard of 2 parts per billion (ppb). Lehi flushed the distribution system and sampled from over 45 sites. Each sample site was required to have two consecutive results at or below the 2ppb. As of April 2, 2012, this requirement has been met.

As you know from the original notice there was no need to use an alternate supply of drinking water and with the completed
lushing process conducted by the Lehi Water Department the residents in the Traverse Mountain area can be confident in the quality of their culinary water. If you would like to see all of the thallium sample results, including dates and locations, please check the Lehi City website at www.lehi-ut.gov or Lehi City on Facebook and Twitter.

What will Lehi do to avoid the high thallium levels in the future?

The Utah State Division of Drinking Water is working closely with The Lehi Water Department and a third party engineering firm to create a culinary water blending plan for the Traverse Mountain area. The blending plan will combine
culinary water sources reducing Thallium levels. This procedure will require monitoring and testing to ensure Thallium levels stay below the State and EPA standards. Until the blending plan is officially approved by the Utah State Division of Drinking Water, the Lehi Water Department will continue to supply the Traverse Mountain area with culinary water from the 500 West Well.

For more information please contact the Lehi City Water Dept. at 801-768-7102, ext. 3, or after hours at 801-836-1045. The Water Department is located at 2538 North 300 West, Lehi, UT.

This notice is being sent to you by Lehi City / State Water System ID# UTAH25015.

Date distributed: April 2, 2012

Categories

- Board of Adjustments
- City Council
- Events
- Library
- Museum
- Planning Commission
- Public Hearing Notices
- Road Closures and Construction
- Round-Up Week

Public Notice, August 18, 2012

LEHI

PIONEERING UTAH'S FUTURE

IMPORTANT INFORMATION ABOUT

YOUR DRINKING WATER

Lehi Has Levels of Thallium Above Drinking Water Standards in Your Area
Investigative samples were taken in the area from 2249 Whisper Wood to 2079 Whisper Wood

During our regular flushing and sampling Lehi City recently found thallium levels above the standard in your area. Although this is not an emergency, as our customers, you have a right to know what happened, what you should do, and what we are doing to correct this situation.

Since the high levels of thallium that occurred in our system in March of this year we have continued to test regularly to make sure the thallium remains below the drinking water standard of 2ppb. Testing results on 3 homes in your area that we received on August 18, 2012, show 2 homes exceeded the standard or maximum contaminant level (MCL), for thallium. The standard for thallium is 2ppb.

Thallium was found at 3ppb, with one resident outside tap over 7ppb.

What should I do?

You do not need to use an alternative (e.g., bottled) water supply. However, if you have specific health concerns, consult your doctor.

What is Thallium? Where did it come from?

Thallium is a metal found in natural deposits such as ores containing other elements. It is naturally occurring. The Traverse Mountain Well had detectable levels of thallium, but that well was turned off in February of 2012. The water being delivered to Lehi City comes from wells that have no detections of thallium.

What happened? What is being done?

We pulled investigative samples in your area and found 2 samples that exceeded the MCL. Both of these samples were taken from an outside tap, which may indicate a buildup of thallium in those taps due to infrequent use. The lab advised that a rush sample can be analyzed on Monday, the 20th and results will be available on Tuesday, Aug. 21, 2012. You will be notified when the levels reduce back below the drinking water standard of 2ppb.

For more information, please contact Lehi City Water Dept. at 801-768-7103, ext. 8, or after hours at 801-836-1065
We are located at 2538 North 300 West, Lehi , UT
For further information contact the Division of Drinking Water, Rachael Cassidy, at 801-536-4467 or 801-674-9572
This notice is being sent to you by Lehi City - State Water System ID #: UTAH 25015
Date distributed: July 18, 2012

Distributed with incorrect date
Actual date was Aug. 18, 2012

Public Notice, August 21, 2012

LEHI

PIONEERING UTAH'S FUTURE

IMPORTANT INFORMATION ABOUT YOUR DRINKING WATER

2549 Whisper Wood to 2570 Whisper Wood

Thallium Levels are Below Drinking Water Standards

The Whisper Wood area of the Traverse system has been sampled from inside the home and at the meter. These repeat samples confirm that this area is now below the thallium standard of 2 parts per billion (ppb).

On August 16, 2012, we pulled 2 investigative samples from the outside taps of 2 homes and found the presence of thallium. We re-sampled in the home and at the meter on August 20, 2012, and sample results received from the lab today confirm that these areas are now below the thallium standard of 2 parts per billion (ppb).

It is recommended by the Lehi Water Dept. that any outside taps or piping connected to the house that are not frequently used be flushed to remove any residual thallium in the piping.

For more information, please contact Lehi City Water Dept. at 801-768-7102, ext. 3, or after hours at 801-836-1045
We are located at 2538 North 300 West, Lehi, UT
For further information contact the Division of Drinking Water, Rachael Cassidy, at 801-536-4467 or 801-674-9572
This notice is being sent to you by Lehi City - State Water System ID #: UTAH 25015
Date distributed: August 21, 2012

APPENDIX D – EXPOSURE DOSE CALCULATIONS

Exposure Dose (ED) calculation for ingestion of water [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x IR x EF) / BW

Where:
C = Contaminant concentration (milligrams per liter (mg/L))

IR = Intake rate of contaminated water (liters per day (L/day))
= 2 L/day for an adult
= 1 L/day for a child

EF = Exposure Factor (unitless); 1.0 = daily exposure to the contaminant for 365 days per year

BW = Body Weight (kg)
= 70 kg for an adult
= 16 kg for a child

Example from *Table 2. Potential exposure doses to thallium contaminated drinking water from October 21, 2010 to February 16, 2012. Lehi, UT*. Calculating potential child exposure dose for ingesting contaminated drinking water:

Where:
C = 3.0 ppb thallium or 0.003 mg/L (milligrams per liter (mg/L))

IR = 1 L/day for a child

EF = 1.0 for daily exposure to thallium

BW = 16 kg for a child

ED = (C x IR x EF) / BW
ED = (0.003 mg/L x 1.0 L/day x 1.0) / 16 kg
ED = **1.88×10^{-4} mg/kg/day**

Exposure Dose (ED) calculation for incidental ingestion of water [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x IR x EF) / BW

Where:
C = Contaminant concentration (milligrams per liter (mg/L))

IR = Intake rate of contaminated water (liters per day (L/day))
= 0.05 L/hour, or 0.05 L/swimming event for an adult
= 0.05 L/hour, or 0.05 L/swimming event for a child

EF = Exposure Factor (unitless); 1.0 = daily exposure to the contaminant for 365 days per year

BW = Body Weight (kg)
= 70 kg for an adult
= 16 kg for a child

Example from *Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT.* Calculating potential child exposure dose for incidental ingestion of contaminated secondary water:

Where:
C = 2.8 ppb thallium or 0.0028 mg/L (milligrams per liter (mg/L))

IR = 0.05 L/day for a child (50 milliliters)

EF = [(5 days/week x 26 weeks/year) x 1 year] / (1 year x 365 days/year)
= 0.35616

BW = 16 kg for a child

ED = (C x IR x EF) / BW
ED = (0.0028 mg/L x 0.05 L/day x 0.35616) / 16 kg
ED = **3.12×10^{-6} mg/kg/day**

Exposure Dose (ED) calculation for dermal contact with water [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x P x SA x ET x CF) / BW

Where:
C = Contaminant concentration (milligrams per liter (mg/L))

P = permeability coefficient (centimeters per hour (cm/hr))

SA = exposed body surface area (centimeters squared (cm^2))

ET = exposure time (hours/day)

CF = conversion factor (one liter per one thousand square centimeters ($1L/cm^2$))

BW = Body Weight (kg)
= 70 kg for an adult
= 30 kg for a child ages 1 – 11 years

Example from *Table 2. Potential exposure doses to thallium contaminated drinking water from October 21, 2010 to February 16, 2012. Lehi, UT.* Calculating potential child exposure dose for dermal contact with contaminated drinking water:

Where:
C = 3.0 ppb thallium or 0.003 mg/L

P = 0.001 cm/hr, default permeability coefficient (ATSDR Dose Calculator, 2008a)

SA = 8750 cm^2

ET = 1.0 hours/day

CF = 0.001 $1L/cm^2$

BW = 30 kg for a child

ED = (C x P x SA x ET x CF) / BW
ED = (0.003 mg/L x 0.001cm/hr x 8750 cm^2 x 1.0 hrs/day x 0.001 $1L/cm^2$) / 30 kg
ED = 8.75×10^{-7} mg/kg/day

Exposure Dose (ED) calculation for incidental dermal contact with secondary water [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x P x SA x ET x CF) / BW

Where:
C = Contaminant concentration (milligrams per liter (mg/L))

P = permeability coefficient (centimeters per hour (cm/hr))

SA = exposed body surface area (centimeters squared (cm^2))

ET = exposure time (hours/day)

CF = conversion factor (one liter per one thousand square centimeters ($1L/cm^2$))

BW = Body Weight (kg)
= 70 kg for an adult
= 30 kg for a child ages 1 – 11 years

Example from *Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT.* Calculating potential child exposure dose for incidental dermal contact with secondary water:

Where:
C = 2.8 ppb thallium or 0.0028 mg/L

P = 0.001 cm/hr, default permeability coefficient (ATSDR Dose Calculator, 2008a)

SA = 8750 cm^2

ET = 0.5 hours/day

CF = 0.001 $1L/cm^2$

BW = 30 kg for a child

ED = (C x P x SA x ET x CF) / BW
ED = (0.0028 mg/L x 0.001cm/hr x 8750 cm^2 x 0.5 hrs/day x 0.001 $1L/cm^2$) / 30 kg
ED = 4.09×10^{-7} mg/kg/day

Exposure Dose (ED) calculation for soil ingestion [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x IR x EF x CF) / BW

Where:
C = Contaminant concentration (milligrams per kilogram (mg/kg))

IR = Intake rate of contaminated soil (milligrams per day (mg/day))
= 100 mg/day for an adult
= 200 mg/day for a child

EF = Exposure Factor (unitless); 1.0 = daily exposure to the contaminant for 365 days per year

CF = Conversion Factor (10^{-6} kg/mg)

BW = Body Weight (kg)
= 70 kg for an adult
= 16 kg for a child

Example from *Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT.* Calculating potential child exposure dose for ingesting soil:

Where:
C = 965 ppb thallium or 0.965 mg/kg

IR = 200 mg/day for a child

EF = [(5 days/week x 26 weeks/year) x 1 year] / (1 year x 365 days/year)
= 0.35616

CF = 0.000001 kg/mg

BW = 16 kg for a child

ED = (C x IR x EF x CF) / BW
ED = (0.965 mg/kg x 200 mg/day x 0.35616 x 0.000001kg/mg) / 16 kg
ED = **4.30×10^{-6} mg/kg/day**

Exposure Dose (ED) calculation for soil dermal contact [ATSDR, 2005]:

ED = exposure dose (milligrams per kilogram per day (mg/kg/day))
ED = (C x IR x EF x CF) / BW

Where:
C = Contaminant concentration (milligrams per kilogram (mg/kg))

A = exposed area (cm^2) x adherence concentration (mg/cm^2)
= total soil adhered (mg)

AF = bioavailability factor (unitless)

EF = exposure factor (unitless)

CF = conversion factor (10^{-6} kg/mg)

BW = Body Weight (kg)
= 70 kg for an adult
= 30 kg for a child

Example from *Table 5. Potential incidental exposure doses to thallium contaminated soil and secondary water. Lehi, UT.* Calculating potential child exposure dose for soil dermal contact:

Where:
C = 965 ppb or 0.965 mg/kg

A = 8750 cm^2 x 0.2 mg/cm^2 (default soil adherence concentration for children)
= 1750 mg

AF = 1.0 default value (ATSDR Dose Calculator, 2008a)

EF = [(5 days/week x 26 weeks/year) x 1 year] / (1 year x 365 days/year)
= 0.35616

CF = 0.000001 kg/mg

BW = 30 kg for a child

ED = (C x A x AF x EF x CF) / BW
ED = (0.965 mg/kg x 1750 mg x 1.0 x 0.35616 x 0.000001 1L/cm^2) / 30 kg
ED = 2.01 x 10^{-6} mg/kg/day

Exposure Dose (ED) calculation for soil dermal contact [ATSDR, 2005] (continued):

Default Dermal Exposure Values

Age (yrs)	Body Weight (kg)	Total Surface (cm^2)	Area Exposed (%)	Exposed Area (cm^2)	Total Soil Adhered (mg)
0-1	10	3,500	30	1,050	210
1-11	30	8,750	30	2,625	525
12-17	50	15,235	28	4,266	299
18-70	70	19,400	24	4,656	326

Total soil adhered (A) is estimated by multiplying the exposed area by the default soil adherence concentration of 0.07 mg/cm^2 for adults and 0.2 mg/cm^2 for children.

Notes:
cm^2 – square centimeters
kg - kilogram
mg - milligram
yrs - years

APPENDIX E - ACRONYMS AND TERM DEFINITIONS

ATSDR	Agency for Toxic Substances and Disease Registry
Completed Exposure Pathway	A way in which humans can be exposed to a contaminant associated with a site. An exposure pathway is a description of the way a chemical moves from a source to where people can come into contact with it. A completed exposure pathway has all of the 5 following elements: 1) A source of contamination 2) Transport through environmental medium 3) A point of exposure 4) A route of human exposure 5) An exposed population
CDC	Centers for Disease Control and Prevention
COC	**Contaminant of Concern**: A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.
CV	A **comparison value** is a calculated concentration by ATSDR or EPA of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. Examples include MCL, MRL, and RfD.
DDW	Utah Department of Environmental Quality, **Division of Drinking Water**
EEP	Environmental Epidemiology Program at the Utah Department of Health
EPA	The **U.S**. **Environmental Protection Agency** is the federal agency that develops and enforces environmental laws to protect the environmental and public health.
Exposure Dose	The measured or calculated dose to which humans are likely to be exposed considering all sources and routes of exposure.
HC	A **Health Consultation** is a way for ATSDR to respond quickly to a need for health information on toxic substances and to make recommendations for actions to protect the public's health. ATSDR staff evaluate information available about toxic material at the site, determine whether people might be exposed to it, and report what harm exposure might cause.
HOA	Home Owner’s Association
kg	kilogram
lbs	pounds

LDS	The Church of Jesus Christ of **Latter-day Saints**
LOAEL	The **Lowest Observable Adverse Effect Level** is the lowest exposure level of a chemical that produces significant increases in frequency or severity of adverse effects.
MCL	A **Maximum Contaminant Level** is an EPA estimate of the threshold concentration of a contaminant above which water is not suitable for drinking. See the National Primary Drinking Water Standards web page http://www.epa.gov/safewater/mcl.html for more information. In the Safe Drinking Water act, an MCL is defined as "the maximum permissible level of a contaminant in water which is delivered to any user of a public water system."
mg	milligram
ml	milliliter
MRL	A **Minimal Risk Level** is an ATSDR estimate of daily human exposure to a chemical that is likely to be without an appreciable risk of deleterious non-cancer health effects over a specified duration of exposure. Thus, MRLs provide a measure of the toxicity of a chemical.
ND	Chemicals that are **not detected** in a sample above a certain limit, usually the quantitation limit for the chemical in the sample.
NOAEL	The **No Observable Adverse Effect Level** is the exposure level of chemical that produces no significant increases in frequency or severity of adverse effects. Effects may be produced at this dose, but they are not considered to be adverse.
Potential Exposure Pathway	A possible way in which people can be exposed to a contaminant associated with a site. An Exposure pathway is a description of the way a chemical moves from a source to where people can come into contact with it. A potential exposure pathway has 4 of the 5 following elements: 1) a source of contamination 2) transport through environmental medium 3) a point of exposure 4) a route of human exposure 5) a receptor population
ppb	Parts per billion
ppm	Parts per million

PPRTV	EPA **Provisional Peer Reviewed Toxicity Values** derived by EPA Superfund Health Risk Technical Support Center for the EPA Superfund Program.
RfD	A **Reference Dose** is an EPA estimate, with uncertainty of safety factors built-in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.
UDOH	Utah Department of Health

APPENDIX F – PUBLIC COMMENTS

No comments were received for this document.