

# **Public Health Assessment**

Red Butte Creek Oil Spill

Salt Lake City, Salt Lake County, Utah

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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

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## SUMMARY

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### INTRODUCTION

On Saturday, June 12, 2010, a high-voltage electrical arc, from a parallel above ground power line followed a fence pole into the ground and to a Chevron crude oil transfer pipeline, creating a small hole approximately one-half inch in diameter in the pipeline. This resulted in a crude oil leak that spilled directly into Red Butte Creek in Salt Lake City, Utah. The leak was not detected until mid-morning Saturday, June 12. The pipeline was shut down once the leak was detected. It is estimated that approximately 33,600 gallons of crude oil spilled into Red Butte Creek. Red Butte Creek travels through residential and business properties in Salt Lake City, Utah, and many of the properties along the path of the Red Butte Creek were directly impacted by the spill. These include neighborhoods from the University of Utah southwest through Liberty Park. One neighborhood, Yalecrest, contains several properties bordered or traversed by Red Butte Creek. Yalecrest has been registered as a historic community due to its architectural home design and small business districts.

Although remediation of the oil and restoration of the creek has occurred, many area residents are concerned about acute and chronic health effects resulting from exposure to crude oil. Their concerns include exposures to contaminants in the water as well as volatile organic compounds (VOCs) in the air during and after the spill. After addressing these concerns with the Salt Lake Valley Health Department (SLVHD), the health officer asked the Environmental Epidemiology Program (EEP) in the Utah Department of Health (UDOH) to evaluate the data and create a public health assessment (PHA).

This PHA addresses the crude oil contaminants and the environmental compartments that were impacted during the spill, specifically focusing on water and air. It also addresses the potential for long-term health impacts in the community from exposure to components of crude oil.

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### CONCLUSION 1

Based on review of the sampling data, the EEP concludes that although surface water samples were detected above comparison values for benzene, dose exposure calculations were not above Minimal Risk Levels (MRL), and therefore do not present a health hazard to the community from ingestion or dermal absorption.

BASIS FOR DECISION	Water from Red Butte Creek is not used as drinking water by area residents; therefore, chronic ingestion is not of concern. In addition, the risk of exposure during recreational use of the creek was not determined to exceed the Agency for Toxic Substance and Disease Registry's (ATSDR) MRL for benzene.
NEXT STEPS	The EEP will continue to provide residents with information about the contaminants of concern and health effects for acute and chronic exposures.
CONCLUSION 2	Analysis of the ambient outdoor air pathway showed that levels of VOCs (including benzene and naphthalene) were not elevated above ATSDR's MRL and thus do not have the potential to harm human health through inhalation of contaminated air.
BASIS FOR DECISION	The highest levels of contamination were measured at areas along the creek where clean-up crews were working. Elevated concentrations of benzene were also detected in indoor and outdoor residential samples in July and August, 2010. However, exposure dose calculations determined that doses obtained during this time did not exceed MRL values.
NEXT STEPS	The EEP will continue to provide residents with information about the contaminants of concern and health effects for acute and chronic exposures.
CONCLUSION 3	Risk to human health from inhalation of VOCs during the hours immediately following the spill cannot be determined.
BASIS FOR DECISION	Air samples for the hours immediately following the spill were not documented, although first responders did not detect elevated levels of VOCs upon discovery of the spill. While it is possible to estimate concentrations and exposure during this time, the actual risk may vary.
NEXT STEPS	The EEP will conduct a baseline study of chronic diseases to monitor for any changes that may occur over time.

**FOR MORE  
INFORMATION**

If you have concerns about your health or the health of your children, you should contact your health care provider and tell them that you were exposed to contaminants related to the Red Butte Creek oil spill. You may call UDOH at (801) 538-6191 and ask for additional information about the Chevron Red Butte Creek Oil Spill Health Consultation.

**PURPOSE AND HEALTH ISSUES**

The Environmental Epidemiology Program (EEP) at the Utah Department of Health (UDOH) prepared this Public Health Assessment (PHA) to evaluate the human health risks from potential exposure to crude oil during a pipeline release into Red Butte Creek. Residents and visitors to the area are concerned about the movement of contaminants into the water column, sediments and air, as well as any adverse health effects that can be correlated to exposure. 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 and disease(s) related to toxic substances. The health officer at Salt Lake Valley Health Department (SLVHD) has requested that the EEP conduct this assessment to identify public health hazards posed by the oil spill to the surrounding area. The PHA process serves as a mechanism to help ATSDR and state health departments determine where public health actions should be addressed and for whom. The primary objective of this assessment is to determine if the residents living in close proximity to Red Butte Creek in Salt Lake City, Utah, were exposed to crude oil contaminants through any environmental pathway resulting from the Chevron oil spill, and if so, to develop appropriate public health interventions.

The Chevron oil spill was brought to the attention of the EEP in late summer of 2010. Community residents concerned about the short and long-term health effects associated with residing near an oil spill voiced their concerns to the SLVHD. Having limited resources to address the community's concerns, the EEP was then asked to examine data related to the spill and evaluate potential acute and chronic health effects following exposure.

Red Butte Creek originates in the Wasatch Mountains and flows southwest into the Jordan River, which drains into the Great Salt Lake. There are several areas along this route where the creek flows underground in culverts. However, the majority of the spill was contained at the retention pond in Liberty Park. There are approximately 600 residences in this area and it is estimated that approximately 1,800 residents may have been impacted by the oil spill.

**BACKGROUND**

This PHA provides a response to community concerns surrounding the Chevron oil spill in Red Butte Creek. The EEP was asked by the SLVHD health officer to conduct this assessment to

determine the potential health hazards to the residents from exposure to the contaminants associated with crude oil.

## **Oil Spill**

Evidence suggests that in the early morning hours of Saturday June 12, 2010, an electrical arc created a one-half inch hole in the top of a steel crude oil pipe. As a result, approximately 800 barrels (33,600 gallons) of crude oil were released, traveling down Red Butte Creek and collecting in Liberty Park Pond with some sheen escaping into the Jordan River. At approximately 6:55 a.m. on Saturday, June 12, 2010, Salt Lake City Police/Fire was dispatched on a complaint of petroleum odors on the grounds of the Veteran's Administration (VA) facility at 500 Foothill Drive. This led to the discovery of significant amounts of crude oil in Red Butte Creek, which runs through the VA property.

At approximately 7:45 a.m., Chevron was alerted to the problem by the Salt Lake City Fire Department (SLCFD). After reviewing the logs for the pipeline, Chevron noticed unusual changes in the pipe-flow monitoring data for about 10:00 p.m. on Friday, June 11, 2010.

Once the scope of the problem was assessed, the SLCFD called in its own Hazardous Materials (Hazmat) Team to assist in the early mitigation phase. A construction company with excavating equipment that was on scene at a nearby project was asked to assist. Construction workers used a large backhoe to dig several temporary containment ponds. Chevron sent a truck to the site of the spill to pump oil from the ponds and transport the crude to the local Chevron refinery just north of Salt Lake City.

By evening on June 12, the leak had been effectively stopped and the focus had turned to remediation efforts, including controlling shoreline residue and riverbed damage as well as wildlife assistance and treatment. Absorbent booms were placed at the outlets of two culverts to contain the oil leak and prevent its migration into the Great Salt Lake. Hogle Zoo became the receiving point for all distressed wildlife and waterfowl. The zoo staff, with assistance from volunteers, treated and cleaned over 200 waterfowl and held them for observation. Additional oil-covered birds were collected by Salt Lake City teams and brought to an offsite location to be cleaned.

SLVHD and the Utah Department of Environmental Quality (UDEQ) conducted ongoing surface and air sampling on and near Red Butte Creek and the Jordan River to quantify the extent of the spill as well as the expected concentrations of exposure for communities residing in close proximity to the spill.

The affected waterways were not part of Salt Lake City's domestic water supply. Salt Lake City utility officials determined after appropriate sampling and monitoring that the spill had not impacted municipal drinking water. Although the city did not expect drinking water to be affected, it was regularly monitored during remediation for crude oil contaminant encroachment.

Of the oil spilled into Red Butte Creek, Chevron officials confirmed that approximately 600

barrels of crude oil, the equivalent of 25,200 gallons, was collected and taken back to the refinery during the initial remediation phase of the spill. An estimated 100 barrels (4,200 gallons) evaporated into the atmosphere from the water's surface, leaving approximately 85 barrels (3,570 gallons) for further remediation.

## Red Butte Creek and Canyon

Red Butte Creek is a perennial third-order<sup>1</sup> stream that flows southwest into the Jordan River, which eventually drains into the Great Salt Lake. The basin sharing the same name is located in the middle Rocky Mountains in the western foothills of the Wasatch Mountain range. The creek is without upstream regulation (dams, flow control gates, etc.) or diversion until the flow is collected by a reservoir at the base of the canyon. The creek has created a narrow canyon with steep sides rising at an average slope of 35 degrees on the north side and 40 degrees on the south side (Ehleringer *et al.* 1992). Immediately upstream of the reservoir is a U.S. Geological Survey Hydrologic Bench Mark Station, which has monitored monthly flow rate and discharge since January 1942.

The average monthly discharge rate recorded between 1964 and 1988 was approximately 4.7 ft<sup>3</sup>/sec as it entered the reservoir at an elevation of 5400 feet (ReMillard *et al.* 1996). Stream flow exhibits a straightforward annual pattern characteristic of this region, with high flows in the spring during snowmelt followed by reduced flows in the summer and early fall.

The climate along Red Butte Creek is characterized by hot, dry summer and long, cold winters. The majority of precipitation falls in the winter and spring, with the summer being less predictable due to monsoonal systems which sweep across northern Utah. Mean annual precipitation ranges from about 20 inches at the lower elevations to approximately 35 inches at the higher elevations (Hely *et al.* 1971).

Soils in the basin are classified as mollisols<sup>2</sup>, consisting of well-drained soils that are formed from mixed sedimentary rocks (Woodward 1974). There is not much diversity among soils in the basin; most consist of a layer of dark- to reddish-brown, cobbly, loamy sand on top of bedrock. The depths of soils vary from 50 to 150 cm depending on which way the slope faces (south or north, respectively). Soils are neutral to slightly alkaline, with a pH range between 6.1 and 8.4, and the more alkaline soils are coated with lime (Woodward 1974).

## Land Use and Demographics

### ***Impacted Area***

The residential area surrounding Red Butte Creek is part of metropolitan Salt Lake City; therefore, demographic information is based on data at the census block group level. The impacted area includes properties along Red Butte Creek from the spill site to Liberty Park.

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<sup>1</sup> Streams are categorized by order; a first-order stream has not intersected with any other streams. A second-order stream results from the intersection of two first-order streams. A perennial third-order stream is simply a stream that was created by the intersection of two second-order streams, and runs year-round.

<sup>2</sup> Mollisols form in semi-arid to semi-humid environments, under a grassland cover usually in savannahs or mountain valleys. The defining characteristic of mollisols is the deep layer of organic matter in the surface soil.

Census block groups<sup>3</sup> corresponding to this area are: 101400.1-2, 103000.1, 103500.1-3, 103600.1-2, 104100.1-2, and 104200.3. The 2000 Census data estimates the population of this area is 16,550. The following is a description of one of several neighborhoods that make up the area.

### ***Yalecrest neighborhood***

Yalecrest is bordered by Sunnyside Avenue to the north, 1900 East and 1300 East to the east and west, respectively and 1300 South to the south in Salt Lake City. This area is comprised of older, historic homes and three large recreational parks. Yalecrest was listed on the National Register of Historic Places in 2007. Red Butte Creek runs through many properties in the Yalecrest community and the creek's health and continued success have been a priority in the community for many years.

The community contains residential, commercial and recreational areas, including a theater and a small shopping area. The majority of the area is residential with homes and yards. Yalecrest also has a well established neighborhood council to provide input and information to all Salt Lake City departments. It is led by a board of five volunteer officers that serve a one year term.

With three large parks within the Yalecrest community, several types of outdoor recreational activities including hiking, biking, walking, jogging, football, tennis, baseball, soccer and picnicking are common in the surrounding areas. The community is on a public water system and does not receive its drinking water from Red Butte Creek, although children have been observed playing in the creek during the warm summer months.

Because the area affected by the spill is considered a community within Salt Lake City, there is no accurate or current census data for the community available. However, it was estimated that approximately 600 homes and 1,800 residents were impacted by the oil spill. These estimates include the areas outside of Yalecrest that also border Red Butte Creek's path.

## **Site History**

Red Butte Creek water was first utilized by Utah pioneers who diverted its waters, along with those of Emigration Creek, to City Creek for use as the city's main water supply. This use ended in 1862 when the Army constructed two reservoirs east of Fort Douglas and diverted Red Butte Creek to fill them for their use. In 1890, Congress gave the creek protected status and prevented future development along the watershed in response to concerns about water quality resulting from quarrying of red sandstone. Red Butte Canyon is currently managed by the United States Forest Service and the watershed is considered one of the best of the Wasatch Front. The area has been considered a Research Natural Area since 1969 and was described as "a living museum and biological library of a size that exists nowhere else in the Great Basin. . . an invaluable benchmark in ecological time." (Ehleringer, 1992) As a result of this designation, the area is well studied and has a large diversity of plant and animal life.

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<sup>3</sup> A census block group is the smallest grouping of geographical data that is used by the U.S. Census Bureau. Census block groups usually contain 600-3,000 people. There are 211,267 census block groups in the United States.



Presently, Red Butte Creek flows west out of Red Butte Canyon and through several areas of Salt Lake City, including Red Butte Garden and Arboretum, The University of Utah and Liberty Park. The creek borders and/or runs through many properties along its course, but also runs underground in culverts in several areas before emptying into the Jordan River. The creek's underground path does not impact area aquifers.

### ***Surface water sampling***

Samples of water from various locations along Red Butte Creek were collected on June 14, 2010 and analyzed for inorganic and organic content by American West Analytical Laboratories. The locations of each sample and analytical results are found in Tables 1 and 2 (Appendix B).

### ***Air sampling***

Sampling data for the hours and days initially following the spill were not documented. Therefore the actual extent of initial contamination is not known. However, first responders to the scene using photoionization detectors (PID) specific for volatile organic compounds (VOCs) (including benzene) determined that the area right up to the creek was below screening levels at that time.

Independent air sampling was conducted by IHI Environmental, Inc. from June 18–August 10, 2010. Samples were taken via two methods: passive dosimeters (June 18–24 and July 1-9) and summa canisters (July 7–26 and August 4-10). Five passive dosimeters containing charcoal tubes were left out for a 24 hour period before lab analysis. Summa canister sampling is more sensitive than passive dosimetry. Summa canister data collection occurred at six residences and one creek location for two hours prior to lab analysis. Sample locations and results are found in Tables 3 and 4 (Appendix B).

## **DISCUSSION**

### **Nature and Extent of Contamination**

Sampling data revealed that VOCs were present in both air and creek water following the oil spill as well as during the remediation process. However VOCs by nature are highly volatile and the majority of the chemicals would likely have dissipated into the air shortly after the spill.

There have been seven oil spills that have been studied regarding health effects from exposure to crude oil components. (Aguilera, 2010; Janjua, 2006; Lyons, 1999; Campbell, 1993) All studies focused on acute effects and only a few extended studies beyond one year. In addition, most epidemiological analyses of chronic effects from crude oil exposures are occupational studies where exposures have occurred for many years. (Kirkeleit, 2008) As a result, chronic effects of acute exposures to crude oil are not well understood.

This PHA addresses the potential for health effects based on a short term exposure to components of crude oil. In addition, recent exposure events in the United States, specifically the Gulf Oil Spill and the Enbridge Oil Spill in Michigan, may provide future insight into health

effects following acute or intermediate exposures.

## Exposure Pathways Analysis

To determine if nearby 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.

The main routes of exposure identified during the Red Butte Creek oil Spill were the water pathway (residential and non-residential) and the ambient air pathway (indoor and outdoor). Samples were collected in both of these environmental compartments in order to evaluate the potential health impacts on the community.

### ***Completed Exposure Pathways***

#### *Ambient Air (Indoor and Outdoor): past, present and future exposure*

Many of the contaminants associated with the spill were volatile, and indoor and outdoor air quality was of highest concern in the community. Although an exposure likely occurred, especially immediately after the spill and prior to it being reported, long-term adverse health effects resulting from exposure to the contaminants related to the oil spill are unlikely.

Crude oil is a complex mixture of different kinds of hydrocarbons and other compounds. The types and relative quantities of different hydrocarbon in crude oil vary among different sources and even through time from the same source. Hydrocarbons with fewer carbon atoms are termed light hydrocarbons. Light hydrocarbons tend to be more volatile than those with many carbon atoms (termed heavy hydrocarbons). When crude oil is exposed to the environment, it undergoes a process known as weathering. In the weathering process, the composition of the crude oil

changes because the lighter hydrocarbons such as the BTEX components discussed in this PHA break-down or disperse at a more rapid rate than the heavier hydrocarbons. Some of the heaviest hydrocarbons will not volatilize at ambient conditions. These may remain, and in high concentrations, can form a residual sludge.

The rate that hydrocarbons volatilize from surface water into the atmosphere is primarily dependent on the specific hydrocarbon, air and water temperatures, atmospheric humidity, atmospheric chemistry, the wind and the turbulence, and mixing of the water surface. Once volatilized, the fate transport of hydrocarbons to the breathing space of persons is primarily dependent on wind and turbulence.

Air monitoring data specific for BTEX was first collected on June 13, 2010 (see Table 3). Since detectable odor was reported in the early morning of June 12, 2010, it is likely that exposure to oil vapors for residents along Red Butte Creek occurred for at least a day before air monitoring was initiated. No air samples were collected the first day, partly because of lack of awareness of the leak and partly because the immediate concerns of responders were to stop the leak and limit the contamination. The EEP, in collaboration with UDEQ staff investigated the feasibility of estimating the range of exposures that could have occurred to residents living along the Red Butte Creek during the first day of exposure based on sampling data that occurred later on. The estimation would have employed fate and transport modeling techniques. With the assistance of UDEQ, the EEP has concluded that it is not possible to model the early exposures with any reliability (David Prey, UDEQ, personal communication, 2011).

Residents and persons in the area of the Red Butte Creek during the first 24 hours after the spill were likely exposed to levels of BTEX higher than the levels measured through air sampling in subsequent days. However, it is not possible to determine how high that exposure would have been. It can be determined that the exposures were acute, most likely hours to a day in duration.

<u>Exposure element</u>	<u>Red Butte Creek oil spill</u>
1) A source of contamination.....	Red Butte Creek oil spill
2) Transport through environmental medium...	volatilization of crude oil contaminants into ambient air; movement into homes
3) A point of exposure.....	contact with contaminated VOCs in air
4) A route of human exposure.....	inhalation of contaminants
5) A receptor population.....	residents living in close proximity to spill

#### *Creek Water: present and future exposure*

Red Butte Creek is accessible to those who reside near the creek as well as to those who were involved in remediation. In addition, there are several areas where public access is likely (i.e., parks). All five elements of exposure exist in the surrounding community and other neighborhoods directly adjacent to the creek.

<u>Exposure element</u>	<u>Red Butte Creek oil spill</u>
1) A source of contamination.....	Red Butte Creek oil spill
2) Transport through environmental medium...	leak directly into creek water
3) A point of exposure.....	contact with contaminated waters directly or indirectly (i.e., playing in the creek, remediating the creek)
4) A route of human exposure.....	ingestion of creek water
5) A receptor population.....	residents in contaminated area

Current and future exposure to petroleum hydrocarbons and its constituents may have also occurred in an unknown number of areas with direct access to the creek. The entire length of the creek was sampled and was evaluated as to the risks to residents living within close proximity to the spill and its resulting contamination.

Estimated exposure doses and the health effects associated with exposure to crude oil contaminants will be discussed in the “Exposure Dose Estimates and Toxicological Evaluation” section of this document.

### **Public Health Implications**

Levels of contaminants that exceed 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).

The public health implications of the crude oil contamination at the site will be better understood following a thorough toxicological evaluation of the sampling data.

### **Evaluation Process**

The EEP examined the types and concentrations of each chemical of concern for each media type (soil, groundwater, air, etc.) in which the chemical was measured. ATSDR and EPA comparison values (CVs) were then used to screen for chemicals of concern 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 when assuming 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 indicate that a health risk exists; it merely indicates that further evaluation is required for these chemicals.

## Exposure Dose Estimates and Toxicological Evaluation

The primary chemicals of concern for the Red Butte Creek oil spill site were VOCs, specifically benzene, toluene, ethylbenzene and xylene (referred to as BTEX), naphthalene, and other compounds volatilizing into the air. Heavy metals were an additional concern of the community and were sampled in surface waters collected from the creek. Exposure doses for children and adults were calculated and reported below.

For present and future exposure, inhalation of VOCs immediately after the spill is the most likely exposure pathway. Another potential exposure pathway is the accidental ingestion of surface water from Red Butte Creek.

As there was no documented air data from the hours immediately following the spill, the potential for inhalation exposures cannot be eliminated. Therefore, the exposure pathways described above were assessed using doses calculated from the highest contaminant levels found 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 when it is available from scientific literature. When human data is not available, animal exposure data is used. Health guidelines used in this report include ATSDR's Minimal Risk Levels (MRLs) and EPA's Reference Doses (RfDs). Exposure doses that are lower than the MRL 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 No Observable Adverse Effect Levels (NOAEL) or Lowest Observable Adverse Effect Levels (LOAEL). If a contaminant has been determined by the scientific literature to be cancer causing (carcinogenic), a cancer risk is also estimated (ATSDR 2005). The calculations for determining exposure dose for oral ingestion and inhalation can be found in Appendix C.

### ***Benzene***

Benzene is a colorless liquid with a sweet odor. It evaporates quickly into air and does not readily dissolve in water. Benzene is highly flammable and is formed from both natural and anthropogenic activities. Benzene is widely manufactured and used in the United States to make plastics, resins, nylon and other synthetic fibers. It is also a component of crude oil and is found in high concentrations in cigarette smoke.

Because industrial processes are the primary source of benzene exposure, it can be found in all environmental compartments; it can volatilize into the air from soil and water. In air, it reacts with other chemicals and degrades within a few days. It can also attach to rain drops or snow pellets and be carried back to the ground. Due to its volatility, there is no evidence to suggest that benzene accumulates in plants and animals (ATSDR 2007).

Benzene exposure can come from a variety of places, including tobacco smoke, automobile exhaust and service stations, forest fires and industrial emissions. Household items that have benzene vapors include glues, paints, furniture wax and some detergents. Higher concentrations

of benzene can be found in and around hazardous waste sites and near gas stations. Studies have documented a benzene exposure of 1 part per million (ppm) associated with filling a car up with gasoline (Vainiotalo et. al. 1998, Wallace 1989). The threshold odor, or lowest concentration that can be detected by the human sense of smell, is 1.5 ppm (1500 ppb) for benzene.

Breathing very high levels of benzene can result in death, while chronic high level exposure can cause drowsiness, dizziness, rapid heart rate, headaches, tremors, confusion and unconsciousness. Eating or drinking foods that contain high levels of benzene can lead to vomiting, stomach irritation, sleepiness, convulsions, rapid heart rate and even death. Chronic exposures to benzene affect the blood and bone marrow, resulting in effects such as irregular menstrual bleeding in women, anemia, and weakening of the immune system. (ATSDR, 2007)

Exposure doses were calculated for both children and adults and compared to ATSDR's MRL. The MRL is considered an estimate of the daily human oral exposure to benzene that is likely to be without appreciable risk or adverse non-cancer health effects.

Surface water samples determined a maximum concentration of benzene in the creek to be 27.6 ppb. This was above both the CV for chronic exposure as well as the Cancer Risk Evaluation Guide (CREG) value for benzene. As the water from Red Butte Creek is not used as a drinking water source for the area, it is assumed that ingestion of this water did not occur and therefore exposure doses for this pathway were not calculated. However, an incidental exposure resulting from playing in the creek was possible, especially given the number of households near the creek with children. Therefore, exposure doses for the incidental ingestion of creek water were calculated based on the above maximum detected concentration. For this calculation, the intake rate was determined to be 45 milliliters (mL) and the exposure frequency was estimated to simulate occasional recreational use of the creek (2 hours per day over 20 days). Based on these estimates, the exposure dose estimate for children was  $3.54 \times 10^{-7}$  mg/kg/day, which is well below the MRL for ingestion of benzene.

According to air sampling data, the highest concentration of benzene for indoor air at residential properties was 0.60 ppb. Intake rates were calculated for children, adult males, and adult females. Based on this, exposure dose estimates for inhalation of benzene were  $3.75 \times 10^{-4}$  mg/kg/day for children,  $9.68 \times 10^{-5}$  mg/kg/day for adult females, and  $1.3 \times 10^{-4}$  mg/kg/day for adult males. These exposures are all below the MRL for chronic, intermediate and acute exposures to benzene.

Outdoor air sampling revealed a maximum concentration of benzene of 0.53 ppb. Exposure doses calculated based on this concentration were  $3.31 \times 10^{-4}$  mg/kg/day,  $8.55 \times 10^{-5}$  mg/kg/day, and  $1.15 \times 10^{-4}$  mg/kg/day for children, adult females, and adult males, respectively. These values were all below MRL as well.

In areas in proximity to where clean-up crews were working along the creek, a maximum of 1.4 ppb was measured during summa canister monitoring. Exposure doses calculated based on this concentration were  $8.75 \times 10^{-4}$ ,  $2.26 \times 10^{-4}$ , and  $3.04 \times 10^{-4}$  for children, adult females, and adult males, respectively. These values were all below MRL.

The excess risk of cancer from exposure to a chemical is described in terms of the chance that an exposed individual will develop cancer because of that exposure by age 70 (EPA 2011). For each contaminant of concern, excess cancer risk is calculated from the daily exposure dose of the chemical from the site averaged over a lifetime (ED) and the slope factor (SF) for the chemical, as follows:

$$\text{Excess Cancer Risk} = \text{ED} \times \text{SF}$$

In general, excess cancer risks that are below about 1 chance in 1,000,000 ( $1 \times 10^{-6}$ ) are considered so small that they are negligible, and risks above 1 chance in 10,000 ( $1 \times 10^{-4}$ ) are sufficiently large that some sort of remediation is desirable. Excess cancer risks that range between  $1 \times 10^{-6}$  and  $1 \times 10^{-4}$  are generally considered to be acceptable. For example, a theoretical cancer risk of  $2 \times 10^{-6}$  indicates the possibility of an excess of two cancer cases in a population of one million due to an exposure.

Levels of benzene were above CREG values; therefore an excess cancer risk from exposure to benzene by inhalation was also quantified. The theoretical cancer risk for children and adults in this study (based on one month of exposure) was  $4.0 \times 10^{-6}$  and  $1.39 \times 10^{-6}$ , respectively. Therefore, the risk of developing cancer due to exposure to benzene is negligible for this population.

### ***Toluene***

Toluene is a colorless gas that occurs naturally in crude oil and has a distinctive smell. It is a byproduct of the gasoline production process as well as from the production of coke from coal (ATSDR 2005). Several other products utilize toluene in their production; including paint, paint thinner, lacquers, adhesives, nail polish and rubber. Toluene is also used in some printing and leather tanning processes.

Toluene can get into surface water and groundwater from spills of solvents and petroleum products or from leaking underground storage tanks. Toluene can also enter the soil or water in areas when it is disposed in landfills.

Human exposure to toluene occurs mainly through breathing in fumes in the workplace, from automobile exhaust, use of gasoline, kerosene, heating oil, paints and lacquers, and drinking contaminated well water. Exposure to toluene at low to moderate levels can result in tiredness, confusion, weakness, memory loss, nausea, loss of appetite, and loss of hearing and/or color vision. At high levels of exposure, toluene can cause kidney damage, unconsciousness or death.

Studies of animals and humans have determined that exposure to toluene does not cause cancer. In addition, the EPA has not classified toluene as a carcinogen.

The results of air sampling data determined that levels of toluene were not above CV; therefore, exposure doses were not calculated and no adverse health effects are likely.

**Ethylbenzene**

Ethylbenzene is a colorless yet flammable liquid with a gasoline-like smell. It occurs naturally in coal and petroleum and can also be found in insecticides, inks and paints. Ethylbenzene is typically used to produce styrene. It is also used as a solvent and in fuels. (ATSDR, 2007)

Ethylbenzene moves from soil and water to air or from soil to water. It takes approximately three days to break down into other chemicals. In water, ethylbenzene reacts with other chemicals and in soil it is broken down by bacteria. Humans that reside in a city or near factories or highways are exposed to ethylbenzene via inhalation. Other means of exposure include handling and use of products containing ethylbenzene such as gasoline, varnish, carpet glue, and paint.

Health effects from acute exposures to ethylbenzene include eye and throat irritation and dizziness. Chronic low level exposures have been found to cause inner ear damage and hearing loss, as well as kidney damage in animal studies. The EPA has set the Maximum Contaminant Level (MCL) for ethylbenzene in drinking water at 700 ppm. The International Agency for Research on Cancer (IARC) has classified ethylbenzene as a possible human carcinogen.

The results of air sampling data determined that levels of ethylbenzene were not above CV; therefore, exposure doses were not calculated and no adverse health effects are likely.

**Xylene**

Xylene is a colorless flammable gas with a distinctly sweet smell. It has three isomeric forms and occurs in petroleum and coal tar. Xylene is used as a solvent in the printing, rubber and leather industries. It is also used as a cleaning agent, paint thinner and is found in paints and varnish. Xylene is also found in small quantities in gasoline. (ATSDR 2007)

Xylene moves from soil and surface water to air quickly and breaks down into less harmful chemical in a matter of days. In soil and water, xylene is decomposed by bacteria. Small amounts of xylene can be found in the food chain, specifically fish, shellfish and plants that reside in contaminated water.

Human exposure to xylene occurs through the respiratory tract and dermal absorption. This can occur by use of paints, varnish, or shellac, or from cigarette smoke. Exposure to very small quantities of xylene can occur through ingestion of contaminated plants or water. Occupational exposure can occur from industries that use xylene, including biochemical laboratories, auto repair garages, metal workers, and furniture refinishers.

Health affects resulting from exposure to high levels xylene include headache, lack of muscle control, dizziness, confusion and a change in balance. Acute high levels of xylene can cause irritation of the skin, eyes, nose and throat, difficulty breathing, stomach irritation, memory problems. Liver and kidney damage are also possible. At very high concentrations, exposure can lead to unconsciousness and death.

The results of air sampling data determined that levels of xylene were not above CV; therefore, exposure doses were not calculated and no adverse health effects are likely.



***Naphthalene***

Naphthalene is a volatile white solid and can be found in fuels such as coal and petroleum, as well as moth balls and moth flakes. Naphthalene is also a by-product of burning wood or tobacco. It is used in the production of polyvinyl chloride (PVC) plastics as well as moth repellent and toilet deodorants. (ATSDR 2005)

Naphthalene is found in several different environmental compartments, and usually enters the environment from industrial use or spills. Naphthalene has been found to be present in drinking water in areas close hazardous waste sites and landfills. It can migrate from soil into groundwater. In addition, naphthalene in the air will break down within twenty four hours. Naphthalene does not bioaccumulate in the food chain.

Humans can be exposed to naphthalene by inhalation of low levels found in outdoor air, drinking water from contaminated wells, or touching clothing that has been treated with moth repellent. Occupational exposures can occur in places that produce coal tar products, dyes, inks or moth repellents. Humans also can be exposed from breathing in air that contains naphthalene from industrial discharges, wood burning, or cigarette smoking.

Health effects from exposures of large quantities of naphthalene include damage to red blood cells, called hemolytic anemia. Other health effects include nausea, vomiting, diarrhea, blood in the urine, and jaundice. Animal studies have demonstrated long term effects in the nose and lung resulting from daily exposures to naphthalene. Animal studies also suggest that naphthalene may cause tumors in the nose and lungs. The Department of Health and Humans Services (DHHS) concluded that naphthalene is reasonably anticipated to be a human carcinogen. The IARC as well as the EPA concluded that naphthalene is possibly carcinogenic to humans.

Results of air sampling data determined that maximum concentrations of naphthalene near the creek to be 0.84 and 3.4 ppb, representing outdoor residential air and the area where clean-up crews were working, respectively. These values were above CV for chronic exposure. Therefore, exposure doses for the inhalation of naphthalene in proximity to Red Butte Creek were calculated. Intake rates were calculated for children, and adult males and females. Based on this determination, exposure dose estimates for inhalation of benzene (outdoor residential air) were  $2.8 \times 10^{-3}$  mg/kg/day for children,  $7.1 \times 10^{-4}$  mg/kg/day for adult females, and  $9.5 \times 10^{-4}$  mg/kg/day for adult males. For exposures closer to the creek where clean-up crews were located, the exposures were determined to be  $1.1 \times 10^{-2}$  mg/kg/day for children,  $2.9 \times 10^{-3}$  mg/kg/day for adult females, and  $3.9 \times 10^{-3}$  mg/kg/day for adult males. These exposures are all below the MRL for acute exposures to naphthalene.

***Multiple Chemical Exposure Evaluation***

The potential for the toxic effects from the chemical mixture interactions of the contaminants at Red Butte Creek were evaluated. The health impact of exposure to chemical mixtures and the potential for combined action of chemicals is a concern and was evaluated using the Hazard Index (HI), which is a summation of the hazard quotients for all chemicals to which an individual has been exposed. To obtain a hazard quotient, calculated exposure doses for individual

chemicals are divided by respective MRL or comparison values. If the HI is less than 1.0, it is highly unlikely that significant additive or toxic interactions would occur. If the HI is greater than 1.0, further evaluation is necessary (ATSDR 2005).

If the HI for the chemical mixture at this site is greater than 1.0, the estimated doses for each individual chemical will then be compared to their NOAELs or comparable values. Doses of chemicals that are less than one-tenth of their respective NOAELs are unlikely to contribute to significant additive or interactive effects with other chemicals in the mixture.

Calculations were completed using air sampling data gathered from June through August of 2010 and MRL for intermediate exposure (15-364 days). A summation of hazard quotients for inhalation of VOCs, specifically benzene and naphthalene, in proximity to the creek resulted in a combined HI of 0.164. Based on this HI, a chemical hazard does not exist for humans who lived or worked near Red Butte Creek during the weeks following the spill.

## Cancer Incidence

Exposures to components of crude oil, namely BTEX, naphthalene, and other polycyclic aromatic hydrocarbons (PAH), have been linked to several cancer types, including leukemia, multiple myeloma, Hodgkin's disease and non-Hodgkin's lymphoma, skin, esophageal, stomach, pharyngeal and lung cancers (Adami, 2008). With the exception of benzene, the associations are not causal and are based on occupational exposures (i.e., chronic, low-level) and animal studies (Kirkeleit, 2008). While there have been a few studies that document health effects of acute exposures (Janjua, 2006; Lyons, 1999; Campbell, 1993), there are no studies that examine a potential link between acute exposures to crude oil and later development of cancer.

As a result, the EEP conducted a baseline analysis of cancer incidence rates for the areas of Salt Lake City affected by the oil spill and compared the rates to the statewide incidence rates for Utah. The study area included census block groups that surround the creek from the point of release (POR) to Liberty Park (101400.1-2, 10300.1, 103500.1-3, 103600.1-2104100.1-2, 104200.3). The coordinates of the POR are 40.766307, -111.826487. Maps corresponding to the area of analysis are located in Appendix A at the end of this document. For this investigation, data were analyzed for both genders in all age groups for the following cancer types that have been linked to exposure to components of crude oil:

Melanoma	Hodgkin's Disease
Pharyngeal	Non-Hodgkin's Lymphoma (NHL)
Laryngeal	Acute Lymphoblastic Leukemia (ALL)
Esophageal	Chronic Lymphoblastic Leukemia (CLL)
Stomach	Acute Myelogenous Leukemia (AML)
Lung	Chronic Myelogenous Leukemia (CML)
Multiple Myeloma	

Age-adjusted rates were analyzed in five-year increments for from 1973 to 2007. The results of this study suggest that there is no evidence of clustering of cancer types linked to crude oil exposure. However, latent periods for cancers associated with crude oil exposure are not well established and may be longer than ten years. Given these considerations, this analysis provides a baseline of rates to compare with results of future analyses.

## **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 emitted from waste sites and emergency events. 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 communities surrounding Red Butte Creek, children were generally at higher risk of exposure to contaminants related to crude oil in both the waters of the creek and the ambient air. Not only will children ingest, inhale and absorb a higher dosage of these contaminants from the environment as a result of their daily activities, but they are also more susceptible to the adverse health effects resulting from such exposure. Recommendations for action are therefore focused first on children and aimed at reducing overall chronic exposure to these contaminants.

## **COMMUNITY HEALTH CONCERNS**

The EEP conducted a Community Needs Assessment in 2010 to evaluate the public health concern associated with potential exposures to components of crude oil that resulted from the June 12, 2010 spill into Red Butte Creek in Salt Lake City, Utah. As part of the process, the EEP staff conducted a site visit, attended town meetings, and distributed a survey. The goal of this needs assessment was to document and respond accordingly to community questions and concerns regarding the spill.

The results of the community needs assessment have been compiled and are presented in this document (see Appendix E). The community will have another opportunity to express concerns during any educational activities held in the community (i.e., public forums and meetings) as well as during the public release of this document, which requires a public comment period.

## **CONCLUSIONS**

UDOH's purpose is to serve the public by using the best science, taking responsive public health actions and providing trusted health information to the public to prevent people from residing in

close proximity to hazards and coming into contact with harmful toxic substances.

### ***Surface Water***

The EEP concludes that the accidental ingestion that occurs when playing and swimming in Red Butte Creek will not harm children's health. Concentrations of VOCs in the surface water of the creek were below CV; therefore no long-term effects could result from this exposure.

### ***Indoor Air Pathway***

The residential indoor air pathway had the potential to adversely affect the health of residents or visitors exposed at the time the oil spill occurred. The highest concentrations of benzene and naphthalene in indoor air were above CV, and calculated exposure doses determined that no appreciable harm would occur due to this exposure.

### ***Outdoor Air Pathway***

The outdoor air pathway also had the potential to adversely affect the health of residents, visitors or clean-up crews exposed at the time the oil spill occurred. The highest concentrations of benzene and naphthalene in the outdoor air, specifically in areas along the creek where clean-up was occurring, were above CV. Calculated exposure doses determined, however, that no appreciable harm would occur due to this exposure.

Because levels of benzene were above the CREG value, a theoretical cancer risk was calculated for benzene exposure. The EEP concludes that based on available data, the risk of cancer due to this exposure is very low for both children and adults. However, as these calculations were based on sampling data that occurred six days after the spill, the EEP cannot completely eliminate the risk. As a result, a baseline cancer study was conducted that will serve as a comparison in future studies.

## **RECOMMENDATIONS**

Based upon the EEP's review of the Red Butte Creek surface water and air data and the concerns expressed by community members, the following recommendations are appropriate and protective of the health of residents in the community. Based on the conclusions of this report, the following general public health recommendations will be implemented by the EEP:

- The EEP recommends that the cancer incidence study specific for cancer types linked to crude oil exposure is re-evaluated every five years, as additional data becomes finalized.
- Coordinate with UDEQ to assess future sampling data during the remediation process, including flush events.

## **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 the site. The purpose of the public health action plan is to ensure that this public health assessment 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:

- A community health group has been established to work with state and local agencies to determine the adverse health impact to the community from the oil spill.
- Public meeting held with county, state and local authorities on action items to pursue regarding the spill and remediation activities.
- The EEP created and conducted a Needs Assessment survey in the community to determine resident concerns and create targeted health education strategies to address concerns.
- The EEP completed the ATSDR Public Health Assessment document, evaluating potential for adverse health effects from exposure to contaminants of crude oil.

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

- The EEP will participate in a public meeting with other stakeholders and the community to explain the results of the PHA and address any community or individual resident health concerns.
- The EEP will make copies of the finalized PHA available to both Salt Lake County and interested residents through various public buildings. Upon finalization, the document will also be able to be accessed electronically through both the EEP website at <http://health.utah.gov/enviroepi/activities/hha/hhamain.htm> and the Salt Lake County environmental health website at <http://www.slvhealth.org/programs/environmentalHealth>.
- The EEP will provide continued health education (in the form of fact sheets, flyers and pamphlets) to the community regarding acute and chronic health effects related to exposure to crude oil, including VOCs, BTEX, naphthalene, and petroleum hydrocarbons. Fact sheets will focus on odor thresholds for VOCs, signs and symptoms related to exposure and questions for exposed residents to discuss with their physicians for continued medical surveillance.
- 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 conduct a study of adverse health outcomes related to crude oil exposure in the neighborhoods surrounding Red Butte. This will allow a historical baseline for these health effects in the community. As new data become available, additional analyses will be conducted to determine if any increases in specific illnesses are occurring that could be correlated to exposure to contaminants related to the spill. These updated studies will be made available to the community upon peer review and finalization.

- 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.

## **AUTHORS**

### ***Report Prepared By:***

Stacey Anderson, MPH  
Epidemiologist  
Environmental Epidemiology Program  
Bureau of Epidemiology  
Utah Department of Health

Christina R. McNaughton, Ph.D.  
Health Hazard Assessment Manager  
Environmental Epidemiology Program  
Bureau of Epidemiology  
Utah Department of Health

### ***Contact Author:***

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

### ***Designated Reviewers:***

Jennifer Brown, M.S., J.D.  
Director, Bureau of Epidemiology  
Utah Department of Health

Gary Edwards, M.S., CHES  
Executive Director  
Salt Lake Valley Health Department

## CERTIFICATION

## CERTIFICATION


This Health Consultation, **Chevron Oil Spill in Red Butte Creek, Salt Lake County, Utah**, was prepared by the Utah Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun. Editorial review was completed by the Cooperative Agreement partner.



Sam LeFevre

Utah Department of Health, Environmental Epidemiology Program Manager

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Jennifer Brown, JD, MS

Utah Department of Health, Bureau Director Bureau of Epidemiology





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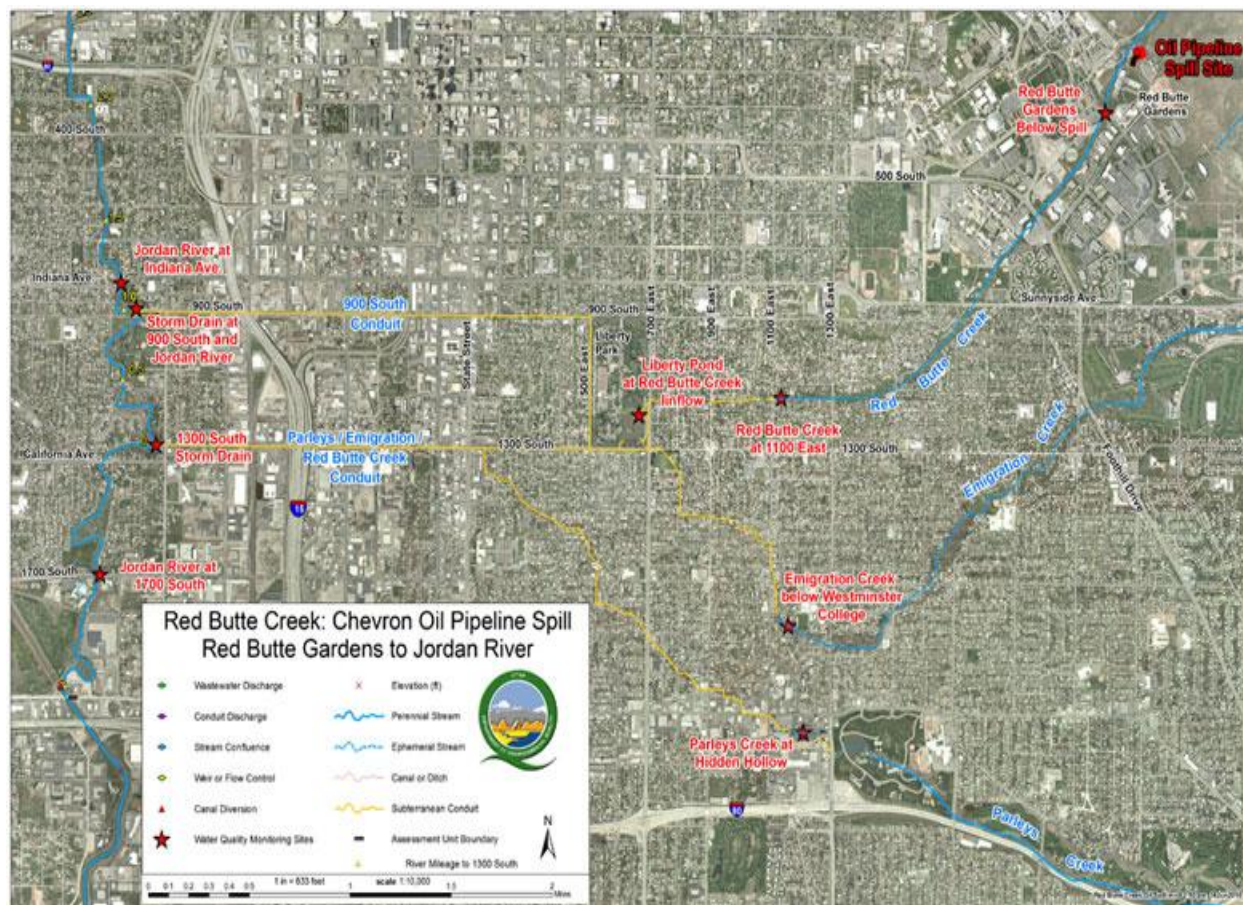
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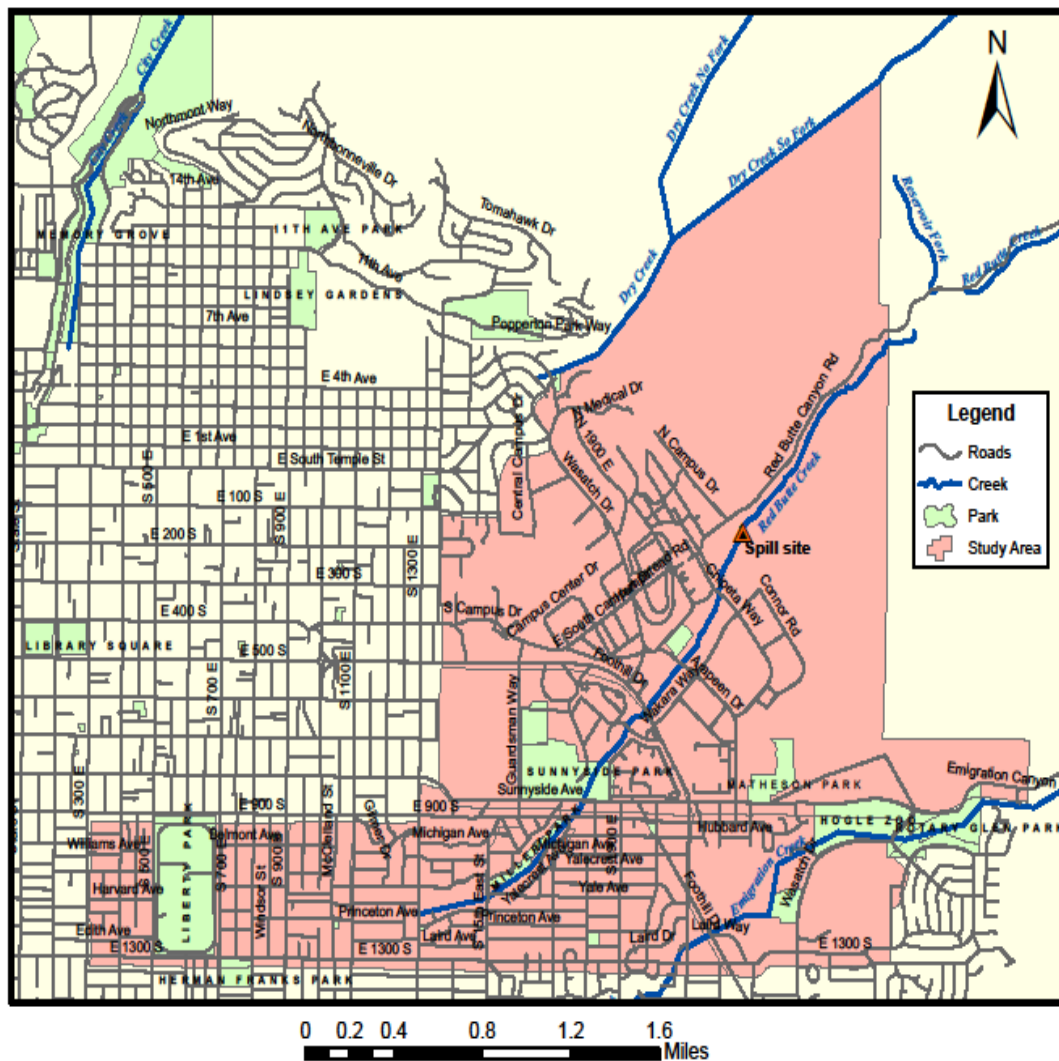
## **APPENDICES**

## **APPENDIX A – MAPS OF STUDY AREA**

**Figure 1.** Sampling locations along Red Butte Creek, Salt Lake City, Utah, June 2010.



Courtesy UDEQ

**Figure 2.** Study Area for Cancer Incidence Investigation, Salt Lake City, Utah.

## **APPENDIX B – TABLES OF STUDY DATA**

**Table 1.** Inorganic sampling results from creek water at various locations along Red Butte Creek, Salt Lake City, Utah, June 14, 2010.

Sampling Locations	Analytical Results (ppm)							
	Arsenic	Barium	Cadmium	Chromium	Lead	Mercury	Selenium	Silver
Red Butte Creek below gardens	0.0011	0.060	<0.00018	<0.010	0.0026	<0.00020	<0.00080	<0.00040
Red Butte Creek @ 1100 East	0.0015	0.056	<0.00018	<0.010	0.0026	<0.00020	<0.00080	<0.00040
1300 South Strom Drain	0.0034	0.075	<0.00018	<0.010	0.0012	<0.00020	<0.00080	<0.00040
900 South Storm Drain	0.0027	0.080	<0.00018	<0.010	0.0045	<0.00020	0.00083	<0.00040
Jordan River @ Indiana Avenue	0.0050	0.064	<0.00018	<0.010	0.0067	<0.00020	<0.00080	<0.00040
New State Canal	0.0057	0.064	<0.00018	<0.010	0.011	<0.00020	<0.00080	<0.00040
Burnham Dam	0.0055	0.059	<0.00018	<0.010	0.0081	<0.00020	<0.00080	<0.00040
Jordan River @ Cudahy Lane	0.0035	0.059	<0.00018	<0.010	0.0055	<0.00020	<0.00080	<0.00040
Jordan River @ 1800 North	0.0038	0.059	<0.00018	<0.010	0.0038	<0.00020	<0.00080	<0.00040
Jordan River @ 300 North	0.0035	0.057	<0.00018	<0.010	0.0032	<0.00020	<0.00080	<0.00040
Jordan River @ 1700 South	0.0070	0.056	<0.00018	<0.010	0.012	<0.00020	0.00083	<0.00040

**Table 2.** Organic sampling results from creek water collected at various locations along Red Butte Creek, Salt Lake City, Utah, June 13-July 15, 2010.

Sampling Locations	Sampling Date	Contaminants of Concern (ppm)				
		Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene
Jordan River @ 300 North	06/13/2010	ND	0.0006	0.0005	0.0058	0.0046
	6/16/2010		0.00024			0.002
	6/22/2010		0.00021			
Jordan River @ Indiana Avenue	6/15/2010		0.00031			0.0022
Jordan River @ 800 South	6/22/2010		0.00041			
Jordan River @ 900 South	6/13/2010	ND	0.0009	0.0008	0.009	0.0118
900 South Storm Drain	6/16/2010		0.00048			0.0027
	6/21/2010		0.00029			0.002
	7/15/2010		0.00025			



Red Butte Creek @ 1100 East	6/15/2010				0.002	0.028
	6/16/2010				0.0014	0.025
	6/17/2010		0.00019	0.00047	0.0016	0.01
	6/21/2010				0.0003	0.0035
	7/15/2010		0.00024	0.00027	0.00083	0.00324
1300 South Storm Drain	6/12/2010	ND	0.00394	0.0057	0.05563	0.01591
	6/13/2010	ND	0.0009	0.0006	0.0071	0.0117
	6/16/2010		0.00019			0.0022
	6/21/2010		0.00015			0.0019
Jordan River @ Cudahy Lane	6/13/2010	ND	0.0006	0.0005	0.0051	0.0022
	6/16/2010		0.00028			0.002
	6/17/2010		0.00036			0.0019
	6/22/2010		0.00019			
Jordan River @ 1800 North	6/16/2010		0.00027			0.002
Jordan River @ Burnham Dam	6/13/2010	ND	0.0008	0.0007	0.008	0.0031
	6/16/2010		0.00017			0.0019
	6/22/2010		0.00014			
Liberty Park Pond near Inflow	6/12/2010	ND	0.0034	0.0059	0.0647	0.057
Liberty Pond Outfall	07/15/2010		0.00074			
Jordan River @ New State Canal	6/13/2010	ND	0.0014	0.0015	0.0149	0.0049
	6/16/2010					0.002
Parleys Creek @ Hidden Hollow	6/15/2010		0.00018			
Red Butte Creek below Gardens	6/12/2010	0.0276*	0.0915	0.0285	0.239	0.0916
	6/13/2010	0.001	0.006	0.0023	0.0177	0.0043

\* Value above CV

**Table 3.** Passive dosimeter air sample results in comparison to health based screening levels from residences along Red Butte Creek, Salt Lake City, Utah, June-July, 2010. (ppb)

	Hexane	Benzene	Toluene	Ethylbenzene	Xylenes	Naphthalene	Total Hydrocarbons
<b>Residence Indoor</b>							
Minimum	<63	<6.2	<59	<59	<59	<11	<53
Maximum <sup>a</sup>	<63	<7.3	<70	<70	<70	<11	810*
Mean <sup>b</sup>	<63	<6.5	<62	<62	<62	<11	202
<b>Resident Outdoor</b>							
Minimum	<63	<6.2	<59	<59	<59	<11	<53
Maximum <sup>a</sup>	<63	<8.8	<85	<85	<85	<11	110
Mean <sup>b</sup>	<63	<6.6	<63	<63	<63	<11	38
<b>Miller Park</b>	NA	<10	<100	<100	<100	NA	190
<b>ATSDR MRL<sup>c</sup></b>							
Acute	--	9	1000	10000	2000	--	--
Intermediate	--	6	--	700	600	--	--
Chronic	6000	3	80	300	50	0.7	--

**Note:** The symbol "<" indicates that the result is less than the analytical limit of detection.

-- - not available

NA - not analyzed

\*Indoor sample whose corresponding outdoor sample was non-detect, indicating that the source was likely not outdoor air

<sup>a</sup> Maximum detected value shown if available, or highest detection limit if no samples had detectable levels.

<sup>b</sup> Multiple results for indoor air or outdoor air at a residence were averaged before calculating the overall mean among residences for indoor or outdoor air data. Multiple results for a residence were generally similar. Undetected results were included at half the detection limit unless all samples were undetectable, then mean of detection limits is presented.

<sup>c</sup> Minimal risk levels by the Agency for Toxic Substances and Disease Registry (ATSDR) are protective of public health from noncancer health effects based on acute exposure (less than 14 days), intermediate exposure (14 days to 364 days), or chronic exposure (more than 1 year).

**Table 4.** Summary of Summa canister air sample results at residential properties along Red Butte Creek, Salt Lake City, Utah, July-August, 2010. (ppb)

	Hexane	Heptane	Benzene	Toluene	Ethylbenzene	Xylenes <sup>a</sup>	Naphthalene	TH
<b>Residence Indoor</b>								
Minimum	<0.13	<0.11	<0.10	0.72	<0.087	0.71	<0.50	100
Maximum <sup>b</sup>	1.4	0.71	0.60	4.7	0.78	3.9	<0.50	260
Mean <sup>c</sup>	0.60	0.30	0.41	2.5	0.30	1.6	<0.50	154
<b>Residence Outdoor</b>								
Minimum	<0.13	<0.11	<0.10	0.76	<0.087	0.30	<0.50	80
Maximum <sup>b</sup>	0.86	0.27	0.53	1.6	0.22	2.0	0.84	170
Mean <sup>c</sup>	0.45	0.082	0.27	0.93	0.088	0.81	0.40	113
<b>Creek near cleanup crews</b>	0.97	0.51	1.4	7.0	1.4	12	3.4	710
<b>Residual oil on outdoor deck</b>	0.76	0.40	1.2	1.8	<0.087	0.25	<0.50	93

<b>Residual oil on creek bank</b>	0.80	0.62	1.8	7.8	1.1	7.6	1.3	490
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**Note:** The symbol "<" indicates that the result is less than the analytical limit of detection and not detectable.

TH = Total Hydrocarbons

<sup>a</sup>Total xylenes includes results for m,p-xylene and o-xylene that were measured separately and summed. One-half of the detection limit was used for undetected results.

<sup>b</sup>Maximum detected value shown if available, or highest detection limit if no samples had detectable levels.

<sup>c</sup>Multiple results for indoor air or outdoor air at a residence were averaged before calculating the overall mean among residences for indoor or outdoor air data. Multiple results for a residence were generally similar. Undetected results were included at half the detection limit unless all samples were undetectable, then mean of detection limits is presented.

## **APPENDIX C – STATISTICAL CALCULATIONS**

**Exposure Dose (ED) Calculation for ingestion of surface water [ATSDR 2005]:**

$$ED = (C \times IR \times EF) / BW$$

Where: ED = Exposure dose (mg/kg/day)

C = Contaminant concentration (mg/L)

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

EF = Exposure Factor (unitless)  
 = 1 represents daily exposure to the contaminant, 365 days per year

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

**Exposure Dose (ED) Calculation for Water Dermal Contact [ATSDR 2005]:**

$$ED = (C \times P \times SA \times ET \times CF) / BW$$

Where: ED = Exposure dose (mg/kg/day)

C = Contaminant concentration (mg/L)

P = Permeability coefficient (cm/hr)

SA = Exposed body surface area (cm<sup>2</sup>)  
 = age 3<6 years: 7,280 (males) 7,110 (females)  
 = age 6<9 years: 9,310 (males) 9,190 (females)  
 = age 9<12 years: 11,600 (males) 11,600 (females)  
 = age 12<15 years: 14,900 (males) 14,800 (females)  
 = age 15<18 years: 17,500 (males) 16,000 (females)  
 = adults: 19,400 (males) 16,900 (females)

ET = Exposure time (hours/day)

CF = Conversion factor (1 L/1,000 cm<sup>3</sup>)

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

**Exposure Dose (ED) calculation for inhalation of contaminated air [ATSDR 2005]:**

$$ED = (C \times IR \times EF) / BW$$

Where: ED = Exposure dose (mg/kg/day)

C = Contaminant concentration (mg/L)

IR = Intake rate (m<sup>3</sup>/day)  
= 4.5 m<sup>3</sup>/day for an infant  
= 10 m<sup>3</sup>/day for a child age 6-8  
= 11.3 m<sup>3</sup>/day for adult females  
= 15.2 m<sup>3</sup>/day for adult males

EF = Exposure Factor (unitless)  
= 1 represents daily exposure to the contaminant, 365 days per year

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

## **APPENDIX D - ACRONYMS AND TERM DEFINITIONS**

<b>ALL</b>	<b>Acute Lymphocytic Leukemia</b> is a cancer of the blood and bone marrow that has a rapid onset and progression. ALL affects the white blood cells called lymphocytes. It is the most common cancer type in children, although it can occur in adults.
<b>AML</b>	<b>Acute Myelogenous Leukemia</b> is a cancer of the blood and bone marrow that affects the cells that are precursors to white blood cells. AML has a rapid onset and progression. It is one of the most common forms of leukemia in adults.
<b>ATSDR</b>	Agency for Toxic Substances and Disease Registry
<b>Background Level</b>	The amount of a chemical that occurs naturally in a specific environment.
<b>BTEX</b>	BTEX is an acronym for the four most common volatile organic compounds found in petroleum products: <b>Benzene, Toluene, Ethylbenzene</b> and <b>Xylene</b> .
<b>Cancer Classes</b>	Each health organization has a separate method of cancer classification:

Environmental Protection Agency (EPA) (Based on 1986 cancer assessment guidelines):

- A = Human Carcinogen.
- B1 = Probable Human Carcinogen (based on limited human and sufficient animal studies).
- B2 = Probable Human Carcinogen (based on inadequate human and sufficient animal studies).
- C = Possible Human Carcinogen (no human studies and limited animal studies).
- D = Unlikely to be a Human Carcinogen
- E = Evidence of non-carcinogenicity in humans

Environmental Protection Agency (EPA) (Based on 2003 cancer assessment guidelines):

- CA= Carcinogenic to humans
- LI = Likely human carcinogen (cancer potential established; but limited human data)
- SU = Suggestive evidence (human or animal data suggestive)
- IN = Inadequate (data inadequate to assess)
- NO= Robust data indicate no human carcinogen.

International Agency for Research on Cancer (IARC)

- 1 = Carcinogenic to Humans (sufficient human evidence).
- 2A = Probably Carcinogenic to Humans (limited human evidence; sufficient evidence in animals).



- 2B = Possibly Carcinogenic to Humans (limited human evidence; less than sufficient evidence in animals).
- 3 = Not Classifiable
- 4 = Probably Not Carcinogenic to Humans

National Toxicology Program (NTP)

- 1 = Known Human Carcinogen
- 2 = Reasonably anticipated to be a carcinogen
- 3 = Not Classified

**CLL**                      **Chronic Lymphocytic Leukemia** is a cancer that forms in the blood and bone marrow and affects white blood cells called lymphocytes. It has a slower onset and progression than acute forms of leukemia, and typically affects adults.

**CML**                      **Chronic Myelogenous Leukemia** is a cancer that forms in the blood and bone marrow that affects cells that are precursors to white blood cells. It has a slower onset and progression than the acute form of leukemia, and is more common in adults than in children.

**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

**CREG**                      **Cancer Risk Evaluation Guides** are based on a contaminant concentration estimated to increase the cancer risk in a population by one individual in one million people over a lifetime exposure ( $1 \times 10^{-6}$ ).

**CV**                        A **comparison value** is a calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process.

**DHHS**                      The United States Department of Health and Human Services

**EEP**                        Environmental Epidemiology Program at the Utah Department of Health

**EMEG**                      **Environmental Media Evaluation Guides** are media-specific comparison values used to select contaminants of interest at hazardous waste sites.

EMEGs are derived from Minimal Risk Levels (MRLs), developed by the Agency for Toxic Substances and Disease Registry (ATSDR), and are an estimate of human exposure to a compound that is not expected to cause noncancerous health effects at that level for a specified period. They are intended to protect the most sensitive individuals (i.e., children). MRLs are guidelines and are not used to predict adverse health effects. MRLs do not take into account carcinogenic effects, chemical interactions, or multiple routes of exposure.

<b>EPA</b>	The <b>U.S. Environmental Protection Agency</b> is the federal agency that develops and enforces environmental laws to protect the environmental and public health.
<b>EPHTN</b>	<b>Environmental Public Health Tracking Network</b> oversees the ongoing collection, integration, analysis, and interpretation of data about environmental hazards, exposure to environmental hazards, and health effects potentially related to exposure to environmental hazards
<b>Exposure Dose</b>	At some sites, the existing conditions may result in exposures that differ from those used to derive Comparison Values such as the EMEG. In these situations, the health assessor can calculate site-specific exposures more accurately using an exposure dose. The exposure dose can then be compared to the appropriate toxicity values (MRL, RfC, RfD).
<b>Hazard Index (HI)</b>	A sum of the hazard quotients for substances (in a given exposure) that affect the same organ or organ system.
<b>Hazard Quotient</b>	The ratio of the potential exposure to the MRL or specific comparison value. A Hazard Quotient of less than 1 means that no adverse health effects are expected as a result of exposure. If the Hazard Quotient is greater than 1, then adverse health effects are possible.
<b>Health-Based</b>	see “Screening values.”
<b>IARC</b>	The <b>International Agency for Research on Cancer</b> is part of the World Health Organization. The IARC studies and makes recommendations on the carcinogenicity of substances in terms of risks to human health.
<b>LOAEL</b>	The <b>Lowest Observable Adverse Effect Level</b> is the lowest exposure level of a chemical that produces significant increases in frequency or severity of adverse effects.
<b>MCL</b>	A <b>Maximum Contaminant Level</b> is an enforceable standard calculated by the United States Environmental Protection Agency. The MCL is the highest level of a contaminant that is allowed in drinking water.

<b>MRL</b>	A <b>Minimal Risk Level</b> is defined as an 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.
<b>NA</b>	Needs Assessment
<b>ND</b>	Chemicals that are <b>not detected</b> in a sample above a certain limit, usually the quantitation limit for the chemical in the sample.
<b>NIOSH</b>	National Institute for Occupational Safety and Health.
<b>NHL</b>	<b>Non Hodgkin Lymphoma</b> is a cancer of the lymphatic system, which is an important component of the human immune (disease fighting) system.
<b>NOAEL</b>	The <b>No Observable Adverse Effect Level</b> 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.
<b>NPDWR</b>	<b>National Primary Drinking Water Regulations</b> are legally enforceable standards that apply to public water systems. Primary standards are available on the web at: <a href="http://www.epa.gov/safewater/mcl.html">http://www.epa.gov/safewater/mcl.html</a>
<b>NPL site</b>	The National Priorities List is a list published by EPA ranking all the Superfund sites. Superfund is the common name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a federal law enacted in 1980. This law was preauthorized in 1986 as the Superfund Amendments and Reauthorization Act. CERCLA enables EPA to respond to hazardous waste sites that threaten public health and the environment. A site must be added to the NPL site list before remediation can begin under Superfund.
<b>NTP</b>	The <b>National Toxicology Program</b> is part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.
<b>PAH</b>	<b>Polycyclic aromatic hydrocarbons</b> are found in oil, tar and coal deposits, and are byproducts of fuel burning. They are not volatile in air or soluble in water. As a result, PAHs are often found in the soil or suspended in particulate matter in air. Health effects of PAH range from nontoxic to carcinogenic.

<b>PEL</b>	<b>Permissible Exposure Limit</b> for a hazardous substance or condition in the workplace as defined by the Occupational Safety and Health Administration (OSHA) General Industry Air Contaminants Standard (29 CFR 1910.1000).
<b>PHA</b>	<b>Public Health Assessment.</b> An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health.
<b>PHAP</b>	Public Health Action Plan
<b>PID</b>	A <b>Photoionization Detector</b> is a tool that measures the concentration of a volatile organic compounds or other gases in the air. Hazmat crews often use PID to determine if the area is safe for responders and residents to remain in an area after a spill or gas leak.
<b>Potential Exposure Pathway</b>	<p>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:</p> <ol style="list-style-type: none"> <li>1) a source of contamination</li> <li>2) transport through environmental medium</li> <li>3) a point of exposure</li> <li>4) a route of human exposure</li> <li>5) a receptor population</li> </ol>
<b>POR</b>	Point of Release
<b>PPM</b>	Parts Per Million
<b>PRG</b>	Preliminary Remediation Goals. Used for EPA Planning Purposes only.
<b>Public Health Hazard</b>	The category ATSDR assigns to sites that pose a health hazard to the public as the result of long-term exposures to hazardous substances. See “Public Health Hazard Categories”.
<b>Public Health Hazard Categories</b>	Categories defined by ATSDR and used in public health assessments that assess if people could be harmed by conditions present at a site in the past, present or future. One or more hazard categories may be assigned to a site. The five categories are:

Urgent Public Health Hazard  
 Public Health Hazard  
 Indeterminate Public Health Hazard  
 No Apparent Public Health Hazard  
 No Public Health Hazard

<b>PVC</b>	Polyvinyl chloride is a type of plastic that is commonly used in construction, as well as clothing, toys, hoses and tubing. Certain additives (plasticizers) that are used to produce PVC items have been linked to certain health risks.
<b>REL</b>	<b>Recommended Exposure Limit</b> for a hazardous substance or condition in the workplace as defined by the National Institute for Occupational Safety and Health (NIOSH).
<b>RfD</b>	A <b>Reference Dose</b> 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.
<b>RMEG</b>	<b>Reference Dose Media Evaluation Guides</b> are media-specific comparison values used to select contaminants of interest at hazardous waste sites. RMEGs are derived from reference doses (RfDs), developed by the U.S. Environmental Protection Agency (EPA), and are an estimate of human exposure to a compound that is not expected to cause noncancerous health effects at that level for a specified period. They are intended to protect the most sensitive individuals (i.e., children). RfDs are guidelines and are not used to predict adverse health effects. RfDs do not take into account carcinogenic effects, chemical interactions, or multiple routes of exposure.
<b>Screening Values</b>	Screening Values are health-based and media-specific concentrations that are used to select environmental contaminants for further evaluation in public health assessments. These values are not valid for other types of media, nor do concentrations above these values indicate that a health risk actually exists (agency that developed the value is in parenthesis for the examples below):

Examples of Comparison Values for non-cancer health effects

- EMEG-c = Environmental Media Evaluation Guide for chronic (more than 365 days) exposure (ATSDR).
- EMEG-I = Environmental Media Evaluation Guide for intermediate exposure (ATSDR).
- EMEG-u = Environmental Media Evaluation Guides that are unpublished are designated with an asterisk by the authors of this health assessment and used only in the absence of published comparison values and are calculated

using equations outlined in Appendix B.

RMEG = Reference Dose Media Evaluation Guide (ATSDR).

NPDWR = National Primary Drinking Water Regulations (EPA) accessed on web at:  
[www.epa.gov/safewater/mcl.html](http://www.epa.gov/safewater/mcl.html)

LTHA = Lifetime health advisory for drinking water (EPA).

Example of a Screening values for cancer health effects

CREG = Cancer Risk Evaluation Guide for  $1 \times 10^{-6}$  excess cancer risk (ATSDR).

<b>SDWA</b>	<b>The Safe Drinking Water Act</b> is the main federal law that ensures the quality of Americans' drinking water. SDWA was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply.
<b>SDWS</b>	<b>National Secondary Drinking Water Standards</b> or secondary standards are non-enforceable guidelines that regulate contaminants that may cause cosmetic or aesthetic effects in drinking water.
<b>SLCFD</b>	Salt Lake City Fire Department
<b>SLVHD</b>	Salt Lake Valley Health Department
<b>UCR</b>	Utah Cancer Registry
<b>UDEQ</b>	Utah Department of Environmental Quality
<b>UDOH</b>	Utah Department of Health
<b>VA</b>	Utah Department of Veterans Affairs
<b>VOCs</b>	<b>Volatile Organic Compounds</b> are a group of carbon-based chemicals that evaporate quickly at room temperature. VOCs are found in many different household items, including paint, cleaning products and vehicle exhaust. There are many different types of VOCs. Some VOCs have been linked to health effects, but the severity of effects depends on the exposure of the chemical.
<b>WHO</b>	World Health Organization
<b>ZCTA</b>	<b>Zip Code Tabulation Areas</b> are generalized area representations of U.S. Postal Service (USPS) ZIP Code service areas.

## **APPENDIX E – NEEDS ASSESSMENT**

## **Red Butte Creek Oil Spill Needs Assessment**

The Utah Department of Health (UDOH) Environmental Epidemiology Program (EEP) is currently conducting a Public Health Assessment (PHA) to evaluate the public health risk associated with contaminated water, soil and air in the area surrounding the Red Butte Creek, Salt Lake City, Utah. This PHA is being conducted under a cooperative agreement with the Agency for Toxic Substance and Disease Registry (ATSDR). As part of the process, the EEP staff has conducted various site visits and attended town meetings. The goal of this needs assessment is to document and respond accordingly to the community's questions and concerns regarding the site.

### **Social Demographics**

As this area is part of metropolitan Salt Lake City, demographic information is based on data at the census block group level. The study area includes properties along Red Butte Creek, through a residential community known as Yalecrest to Liberty Park. Census block groups corresponding to the study area are: 101400.1-2, 103000.1, 103500.1-3, 103600.1-2, 104100.1-2, and 104200.3. The 2000 Census data estimates the population of this area is 16,550.

### **Area of Concern**

Yalecrest is bordered by Sunnyside Avenue to the north, 1900 East and 1300 East to the east and west, respectively and 1300 South to the south in Salt Lake City. This area is comprised of older, historic homes and three large recreational parks. Yalecrest was listed on the National Register of Historic Places in 2007. This registration is due to the historic architectural design of homes and businesses within the community. Red Butte Creek runs through many properties in the Yalecrest community and the creek's health and continued success have been a priority in the community for many years.

The community contains residential, commercial and recreational areas, including a theater and a small shopping area. The majority of the area is residential with homes and yards. Yalecrest also has a well established neighborhood council to provide input and information to all Salt Lake City departments. It is led by a board of five volunteer officers that serve a one year term.

With three large parks within the Yalecrest community, several types of outdoor recreational activities including hiking, biking, walking, jogging, football, tennis, baseball, soccer and picnicking are common in the surrounding areas. The community is on a public water system and does not receive its drinking water from Red Butte Creek, although children have been observed playing in the creek during the warm summer months.

As Yalecrest is considered a community within Salt Lake City, there is no accurate or current census data for the community available. However, it was estimated that



approximately 600 homes were impacted by the oil spill.

### Historical Data

Evidence suggests that in the early morning hours of Saturday, June 11, a high-voltage power outage resulted in an electrical arc jumping through a steel fence post to a buried pipeline transporting crude oil to the Chevron refinery in Salt Lake City. The electric arc melted a small hole (approximately one-half inch in diameter) in the steel crude oil pipe. This resulted in a crude oil leak that spilled directly into Red Butte Creek.

At approximately 6:55 a.m. on Saturday, June 12, 2010, Salt Lake City Police/Fire was dispatched on a complaint of petroleum odors on the grounds of the Veteran's Administration (V.A.) facility at 500 Foothill Drive. This led to the discovery of significant amounts of crude oil in Red Butte Creek, which runs through the V.A. property.

At approximately 7:45 a.m., Chevron was alerted to the problem by the Salt Lake City Fire Department. After reviewing the logs for the pipeline, Chevron noticed a peculiarity in the pipe flow monitoring data for about 10:00 p.m. on Friday, June 11, 2010.

Once the scope of the problem had been assessed, the Salt Lake Fire Department called in its own Hazmat team to assist in the early mitigation phase. The Big D Construction Company was on scene at a nearby construction project and was asked to assist. Construction workers used a large backhoe to dig several temporary containment ponds. Chevron deployed a truck to the site of the spill to pump oil from the ponds and transport the crude to the local Chevron refinery just north of Salt Lake City.

By nightfall on June 12<sup>th</sup>, the leak had been effectively stopped and the focus had turned to remediation efforts, including controlling shoreline residue and riverbed damage as well as wildlife assistance and treatment. Absorbent booms were placed at the outlets of two culverts to contain the oil leak and prevent its migration into the Great Salt Lake. Hogle Zoo became the receiving point for all distressed wildlife and waterfowl. The zoo staff with assistance from volunteers, treated and cleaned over 200 waterfowl and held them for observation. Additional oil covered birds were collected by Salt Lake City teams and transported to an offsite location to be cleaned.

The Salt Lake Valley Health Department (SLVHD) and the Utah Department of Environmental Quality (UDEQ) conducted ongoing surface and air sampling on and near Red Butte Creek and the Jordan River to quantify the extent of the spill as well as the expected concentrations of exposure for communities residing in close proximity to the spill.

The affected waterways were not part of Salt Lake City's domestic water supply.

Salt Lake City utility officials determined after appropriate sampling and monitoring that the spill had not impacted municipal drinking water. Although the city does not expect drinking water to be adversely affected, it will be regularly monitored for crude oil contaminant encroachment.

Of the oil spilled into Red Butte Creek, Chevron officials confirmed that approximately 600 barrels of crude oil, the equivalent of 25,200 gallons, was collected and taken back to the refinery from the company's vacuum truck during the remediation phase of the spill. An estimated 100 gallons evaporated into the atmosphere from the water's surface. Although remediation of the oil and restoration of the creek has occurred, many Yalecrest residents are concerned about acute and chronic health effects resulting from exposure of crude oil from both exposures to contaminants in the water as well as air contaminants following the volatilization of volatile organic compounds (VOCs) related to oil. The SLVHD asked the EEP to assist them in addressing these concerns, to evaluate any available data and to conduct a PHA.

The PHA will address the crude oil contaminants and the environmental compartments that were impacted during the spill, specifically focusing on water and air. It also addresses the potential for long-term community health impacts in the community from exposure to the components of crude oil.

### Goal

Document and respond accordingly to the community's questions and concerns regarding the site.

### Objectives

Provide SLVHD with recommendations from the health assessment by May 2011, health education will be provided to address the concerns of the residents.

### Community Concerns

The Chevron oil spill was brought to the attention of the EEP in the summer of 2010 through community concerns about the short and long-term health effects associated with residing near an oil spill. These concerns were expressed by impacted residents to the SLVHD. SLVHD has limited resources to address the community's concerns directly, and EEP was asked to evaluate data related to the spill and potential acute and chronic health effects following exposure.

Yalecrest residents are concerned about acute and chronic health effects resulting from exposure of crude oil from both exposures to contaminants in the water as well as air contaminants following the volatilization of VOCs related to oil.

The EEP, in collaboration with SLVHD developed a needs assessment tool (NAT) and distributed it by mail in November 2010 to residents within a 300 foot distance on either side of the Red Butte Creek. The NAT focused on gathering information to help estimate exposure, to understand specific community concerns, and

to document experienced adverse health effects among impacted residents.

The NAT was sent to 636 resident addresses in the community. Of the 636 NAT surveys that were mailed out, 131 were completed and returned to the EEP. The respondents were spread throughout the entire geographical area of the creek. Despite the small return rate, the NAT is assumed to reflect the overall feeling and concerns of the community. According to the needs assessment the residents expressed a number of concerns. The four major concerns the community believes they are facing today is (1) future cancer, (2) adverse impacts on the health of the environmental and wildlife associated with the creek (3) future respiratory/lung problems, and (4) persisting poor water quality.

Of the people that responded to the needs assessment, 23% of them responded that the Red Butte Creek actually runs through their yard. Forty-four percent of the households have children living in the home and more than half of those (29%) responded their children play in and or around the Red Butte Creek.

According to respondents, 73% said they smelled an unusual odor in the early days of the spill but only 7% actually evacuated their home. Of the 73% who smelled the initial odor, only 6% still smell an odor today. The majority of residents (42.9%) indicated they spent less than 2 hours, on an average day, in their yards during the week of June 11-18, 2010.

According to the survey, 94% of families in the area are covered by health insurance and 97% of them feel they have access to adequate health coverage.

The following comments are from residents in response to the 2010 UDOH needs assessment. The comments are divided into the following categories: concerns, knowledge, attitudes/beliefs, and practices/behaviors:

Concerns:

- When a disaster strikes SLC I want to be able to drink from the local creek if necessary.
- Our dogs do hike/play in water in the red butte area up by the U.
- Experienced visible decline in 3 trees and front lawn.
- What has the spill done to my "real" or "perceived" property values?
- We were anxious and concerned about the long term environmental effects of the spill. My children frequent the creek and were quite saddened about the loss of wildlife.
- My biggest concern is when my family will safely be able to swim in the creek.
- When will someone tell us it's definitely safe to go back in the water?
- Any pollution is concerning but adding tainted soil and water... there is no lesser evil.
- When will Liberty Park be cleaned up? Used to run their daily, haven't been there since June. Makes me sad ☹
- Our biggest concern is what is unknown in the long run.

- I was very unimpressed with Chevron representatives that came by our home during the week. They could not answer questions such as “about how long to clean up?” “Why did it happen?” and “why are pipes and substations built so close to the creek?”
- Both my kids are potty trained and during this week they both wet the bed.
- No concerns for us personally, worried about our neighbors.
- Concerned that the creek was only surface washed and that future off-gassing of remaining oil may affect those in close contact with the creek. I am also concerned about how the residual oil will affect the microbiology in the creek. A thriving micro-climate is essential for clean water.
- More worried about the creek/environment than our selves.
- We noticed the oil smell initially and during clean up but no one in the household appears to have been adversely affected, but we don’t know the long term effects.
- Months after the spill, the lagoon in Liberty Park is still surrounded by chain link fence and mitigation equipment. The lagoon is in a fairly discreet locale with few rocks and plants and natural features to impede cleanup efforts. If the contractors cannot clean the lagoon in this time, what’s happening to the red butte creek bed?
- The smell was very concerning but we did not notice any overwhelming symptoms and when we returned, we were more irritated by the noisy clean up vehicles than the actual spill itself.
- I continue to be concerned about the residual contamination in the stream bed on the rocks and rockwork along the banks, and in the soil behind retaining walls. I’m also concerned about the migration of contaminants into ground water.
- Secondary concern is my neighborhood was impacted by the weekly diversion of the irrigation canal. Each Friday city workers would run 2 stroke pumps for approximately 6 hours. The pumps were smelly and very loud and the city workers would sit in their vehicles idling their engines for the entire time. The effects on air quality for me and my neighbors were not good.
- I walked around the reservoir at Liberty Park the other day and it smelled bad. Should I be concerned as I live directly west of this pond?
- My kid played in that creek and they got very sick.
- Wildlife

Knowledge:

- We have smelled crude oil odor periodically during clean up (not in your time frame).
- The smell lingered for two months, which was disturbing but not sickening.
- We only smelled an odor during flushing’s.
- Since the spill our water has a distinct bleach or chlorine smell and funny taste.
- Can only smell a smell when walking through Miller Park.
- Could only smell the odor out of doors. Nothing in the house.
- Experienced asthma for the first time.
- The smell was stronger some days than others.
- I wasn’t even aware of the spill.

Attitude/Beliefs:

- Living on the creek is no longer desirable to home buyers as it was before.
- 20% or more of my properties value is due to the fact my yard backs up to the creek and park. I am afraid I have lost ½ of that value or more now.
- I have the perception that Chevron has taken ownership of this serious problem. I hope that the perception conforms to reality.
- This incident offers Chevron an opportunity to set an industry-wide example for corporate responsibility and environmental stewardship. I hope chevron makes the most of this opportunity.
- Too many to list on this page.
- I felt good about the clean up, the personnel involved and the preservation of my yard along the creek.
- We missed some opportunities to enjoy the creek and yard during summer and our garden suffered but overall believe chevron did a nice job cleaning up.
- Noise from the cleanup was more disruptive then the spill.
- My quality of life has diminished and I now have to buy water.
- It seems as citizens we all ought to be taking our stewardship of this valley a little more serious.
- We don't feel the oil spill has had any impact on us at all. We live right up against the creek and all of our family members and pets are okay and haven't experienced any affects due to the spill.
- Air pollution from motor vehicles is far greater environmental risk factor to the health of our neighborhood than anything to do with the oil spill.
- Happy with Chevron's concern and contacts by phone, email, personal visits, tv and media.
- Thank you
- I think chevron did an excellent job containing and cleaning up the spill. On a scale of 1 to 10, I would give them a 10.
- We all spent some time breathing stuff that is not good to breathe- that can't be good for us. To some extent however, we do that every day.
- Thank you for sending such a thorough survey. Although we haven't experienced any long-term ill health effects, I am sure others with more exposure have. I appreciate the concern and serious response the city and county are taking to this environmental disaster
- We live across the street from the creek. The spill was a nuisance and inconvenience but we were impressed with the swift and comprehensive cleanup efforts.
- The oil is a nuisance more than a concern at this point.
- Any one that claims they were "damaged" by this act of god is only doing so to get money. Chevron has been very professional and responsive. This is ridiculous.
- It was a sad day when a sign noting "dangerous" was found at the entrance of the gully.
- We felt this spill was handled extremely well. Through information, letters and meeting you kept all informed. Thank you

Practices/Behaviors:

- We could not go outside in the early days due to the smell.
- We were on vacation.
- We could not be outside grilling, gardening, etc until late August. Luckily our kids were away at camp.
- Out of town.
- We want independent testing done.
- I will not use water from the tap for drinking nor cooking. I must go to the store for water
- I no longer use Liberty Park for tennis, running, walking the dog.
- Asthma attacks, nausea and vomiting

**Implementation**

Members of the community feel their health is in jeopardy due to crude oil contamination. In collaboration with SLVHD, EEP is conducting a health assessment to determine if there are health-risks from the crude oil exposure. The results of the PHA report will be distributed through SLVHD to the residents upon completion.

The EEP health educator, in collaboration with SLVHD health education staff, will continue to monitor the reports and research of the findings and will conduct health education as needed. The EEP health educator will work with the SLVHD and Salt Lake City officials to ensure the messages and materials are appropriate for the community.

Upon completion of the investigation a fact sheet will be developed and distributed to the residents. The fact sheet will address resident concerns; contain information about the environmental testing/sampling process along with the results, and an outlook for the future. Information on how residents can obtain a complete copy of the health consultation will be provided.

**Recommendations**

As a result of this community needs assessment and the concerns of the local resident it is recommended that the EEP in cooperation with ATSDR (conduct a PHA.

A PHA is a way to respond quickly to a need for health information on toxic substances and to make recommendations for actions to protect the public's health in a community. Staff evaluate information available about toxic material at the site, determine whether people may be exposed and how, and report what harm exposure might cause.

Public Health Assessments may consider:

- what the levels (or "concentrations") of hazardous substances are;

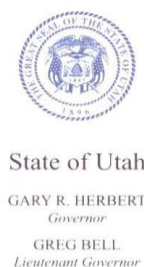
- whether people might be exposed to contamination and how (through "exposure pathways" such as breathing air, drinking or contacting water, contacting or eating soil, or eating food)
- what harm the substances might cause to people (or the contaminants' "toxicity")
- whether working or living nearby might affect people's health
- other dangers to people, such as unsafe buildings, abandoned mine shafts, or other physical hazards

What happens after the Health Assessment process?

Every health assessment includes conclusions about public health hazards and recommendations for actions to protect the public's health. Recommendations cover many activities by EPA, state environmental and health agencies, and ATSDR.

For example, Recommendations can contribute to:

- site cleanup
- keeping people away from contamination and physical dangers for example, by fencing the site
- giving residents acceptable drinking water
- relocating exposed people
- community environmental health education for residents and health care providers to inform them about site contaminants, harmful health effects, and ways to reduce or prevent health effects
- an ATSDR or state health study

**Utah Department of Health**

David N. Sundwall, M.D.  
*Executive Director*

**Disease Control and Prevention**

Robert T. Rolfs, MD, MPH  
*Division Director*  
*State Epidemiologist*

**Bureau of Epidemiology**

Jennifer G. Brown, JD, MS  
*Bureau Director*

November 8, 2010

Dear Resident:

The Utah Department of Health is partnering with the Salt Lake Valley Health Department and Salt Lake City to determine possible health issues relating to crude oil exposure after the Red Butte Creek Oil Spill in June.


Please take a moment to complete and return this needs assessment questionnaire. Your response will help us identify the health concerns and needs of your community.

In order to ensure we are collecting information from households near the Red Butte Creek a full address is required. Potential identifiers such as your name and address will also be used to build a neighborhood registry. Please be assured we will hold your information confidential.

Please feel free to pass this questionnaire on to family, friends or neighbors living in the area who may not have received it. However, only one survey per household will be counted. Duplicates or questionnaires that do not have a complete address will not be assessed. Please fill out this questionnaire in its entirety, to the best of your knowledge.

This questionnaire plus additional information can be found at [www.health.utah.gov/enviroepi](http://www.health.utah.gov/enviroepi). Also, feel free to contact me at [mdrury@utah.gov](mailto:mdrury@utah.gov) or 801-538-6191 should you need further assistance.

Sincerely



McKell Drury  
Health Program Specialist  
Utah Department of Health



288 North 1460 West • Salt Lake City, Utah  
Mailing Address: P.O. Box 142104 • Salt Lake City, Utah 84114-2104  
Telephone (801) 538-6191 • Facsimile (801) 538-9913 • [www.health.utah.gov/ehs](http://www.health.utah.gov/ehs)





**Red Butte Creek Oil Spill  
Community Needs Assessment Questionnaire**

☐ by checking this box, I certify that I am a legal head of household as it pertains to this residence and hereby giving my consent to participate. I understand that this survey, provided by the Utah Department of Health, Environmental Epidemiology Program, will be used to determine possible health issues/concerns regarding potential side effects from crude oil exposure in the community.

Name: \_\_\_\_\_

Email: \_\_\_\_\_

Phone: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

Business: ☐ Residential: ☐

Would you prefer to take this survey by phone? If yes, please provide a daytime phone number where you can be reached and return the survey in the postage paid envelope. Phone number: _____		Yes <input type="checkbox"/>	
1.	Does Red Butte Creek run through your yard? If yes, please describe the creek as it pertains to your yard. Length of the creek _____ Width of the creek _____ Distance from your home to the creek bed _____ Elevation drop from your home to the creek _____	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2.	Did you smell an unusual odor in the early days (June 11-18) of the spill?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2.a.	If yes, did you evacuate your home?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
2.b.	If yes, do you still smell an odor today?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
3.	When you now smell an odor, do you feel nauseous or experience the same health effects you did when smelling the crude oil?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4.	Do you have children living in the home?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
4.a.	If yes, what are their ages: _____		
4.b.	Do they play in or around the creek?	Yes <input type="checkbox"/>	No <input type="checkbox"/>
5.	Do you have pets?	Yes <input type="checkbox"/>	No <input type="checkbox"/>

5.a.	If Yes, please provide the following information:								
	<b>Type of Animal breed</b>	<b>Indoor</b>	<b>Outdoor</b>	Please note any changes you have noticed in your pet since the oil spill					
		<input type="checkbox"/>	<input type="checkbox"/>						
		<input type="checkbox"/>	<input type="checkbox"/>						
		<input type="checkbox"/>	<input type="checkbox"/>						
		<input type="checkbox"/>	<input type="checkbox"/>						
		<input type="checkbox"/>	<input type="checkbox"/>						
6.	Between June 11, 2010 and June 18, 2010, <b>on an average day</b> , how many hours did you spend in your yard? (Grilling, gardening, socializing, playing, etc.) 0-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> 9-11 <input type="checkbox"/> 12+ <input type="checkbox"/>								
7.	Do you or any one in your household smoke?						Yes <input type="checkbox"/>	No <input type="checkbox"/>	
8.	During the initial exposure (June 11-18) did you or anyone in your household experience any of the following symptoms? Also, please note if you are still experiencing these symptoms (see last page for each additional family members).								
	<b>Symptom</b>	<b>June 11 – 18</b>	<b>Now</b>	<b>June 11 – 18</b>	<b>Now</b>	<b>June 11 – 18</b>	<b>Now</b>	<b>June 11 – 18</b>	<b>Now</b>
	<b>Family Member 1</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____			<b>Family Member 2</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____		<b>Family Member 3</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____		<b>Family Member 4</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____	
	<b>Dizziness</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Fatigue</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Headache</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Nausea</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Confusion</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Vomiting</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Blurred vision</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Diarrhea</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Runny nose</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Irritated eyes</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Sore throat</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Cough</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Itchy skin</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Rash</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Blisters</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Shortness of breath</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Depression</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Weakness</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Anxiety</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9.	Have you visited your physician since the Red Butte Creek Oil spill for any of the symptoms mentioned above?						Yes <input type="checkbox"/>	No <input type="checkbox"/>	
10.	Do you have access to adequate health care?						Yes <input type="checkbox"/>	No <input type="checkbox"/>	
11.	Is your family covered by health insurance?						Yes <input type="checkbox"/>	No <input type="checkbox"/>	
12.	What do you feel are the greatest (long term) health concerns of the spill? 1. _____ 2. _____ 3. _____								

13.	Do you feel the spill has impacted your family? Financially <input type="checkbox"/> Physically <input type="checkbox"/> Emotionally <input type="checkbox"/>
14.	What do you consider to be the greatest environmental concern facing your community today? (Please circle just one) a. air pollution b. water pollution c. soil contamination d. other: _____

Questions/Comments/Concerns:

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- ☐ Please feel free to contact me for further questions or clarification.  
☐ Please do not contact me any further.

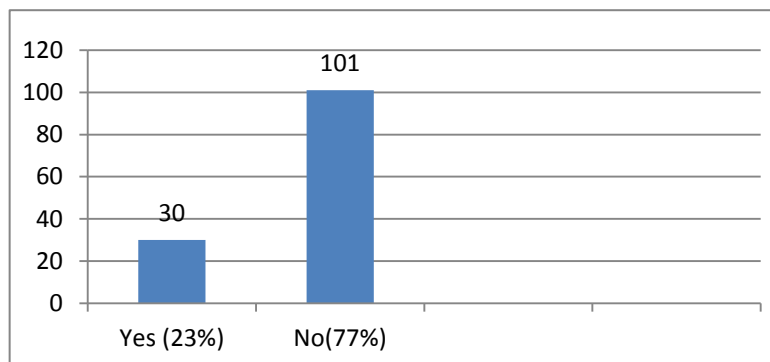
Thank you for taking the time to complete this needs assessment. Please return this form in the postage paid envelope before November 22, 2010. If you have any questions, please give me a call, Monday-Thursday 8:00 am-6:00pm at (801) 538-6191 or visit our website at [www.health.utah.gov/enviroepi](http://www.health.utah.gov/enviroepi)

McKell Drury  
Health Educator  
Environmental Epidemiology Program  
Utah Department of Health

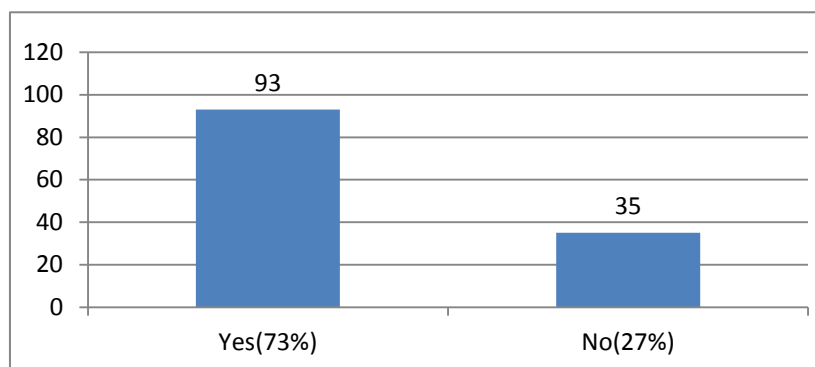
Symptom	June 11 – 18	Now	June 11 – 18	Now	June 11 – 18	Now	June 11 – 18	Now
<b>Family Member 5</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____			<b>Family Member 6</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____		<b>Family Member 7</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____		<b>Family Member 8</b> Adult <input type="checkbox"/> Child <input type="checkbox"/> Age: _____	
Dizziness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Fatigue	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Headache	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nausea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Confusion	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Vomiting	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blurred vision	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Diarrhea	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Runny nose	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Irritated eyes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sore throat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cough	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Itchy skin	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Rash	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blisters	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Shortness of breath	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Depression	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Weakness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Anxiety	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

## Red Butte Creek Oil Spill Detailed Community Needs Assessment Findings

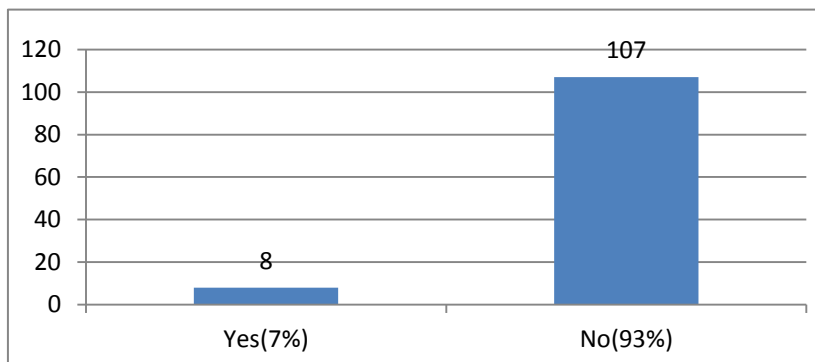
1. Does Red Butte Creek run through your yard?



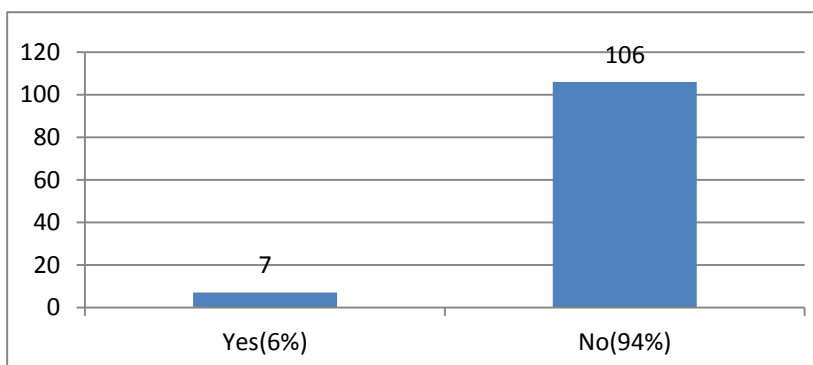
2. Did you smell an unusual odor in the early days (June 11-18) of the spill?



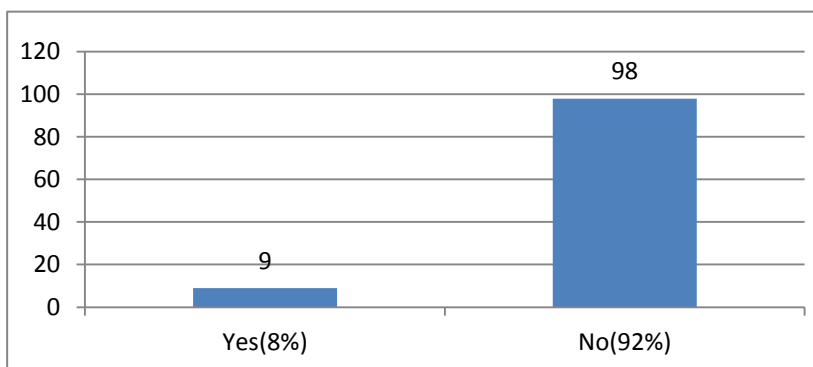
2a. If yes, did you evacuate your home?



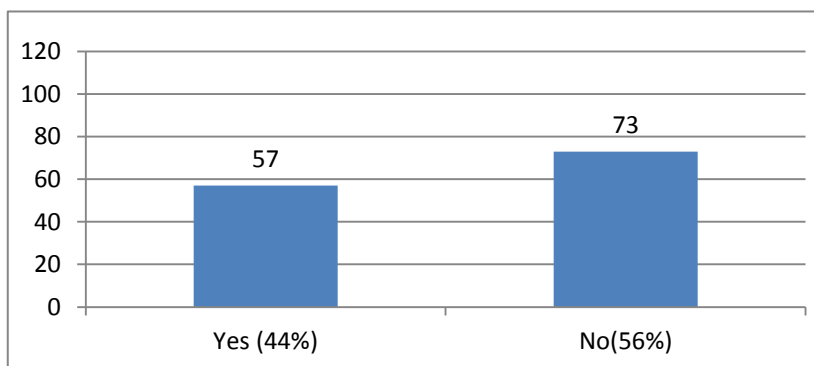
2b. Do you still smell the odor today?



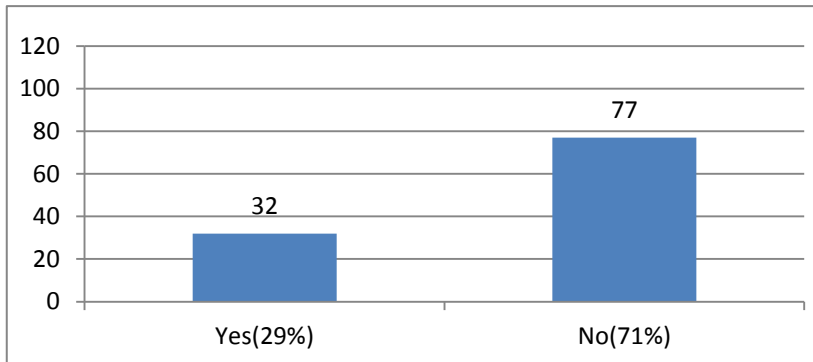
3. When you now smell an odor, do you feel nauseous or experience the same health effects you did when smelling the crude oil?



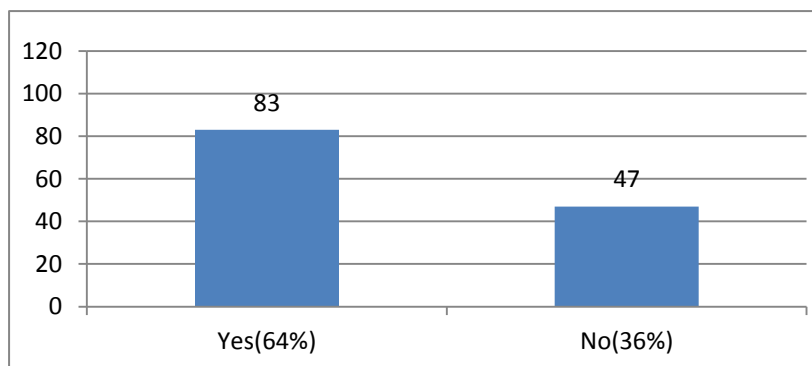
4. Do you have children living in the home?



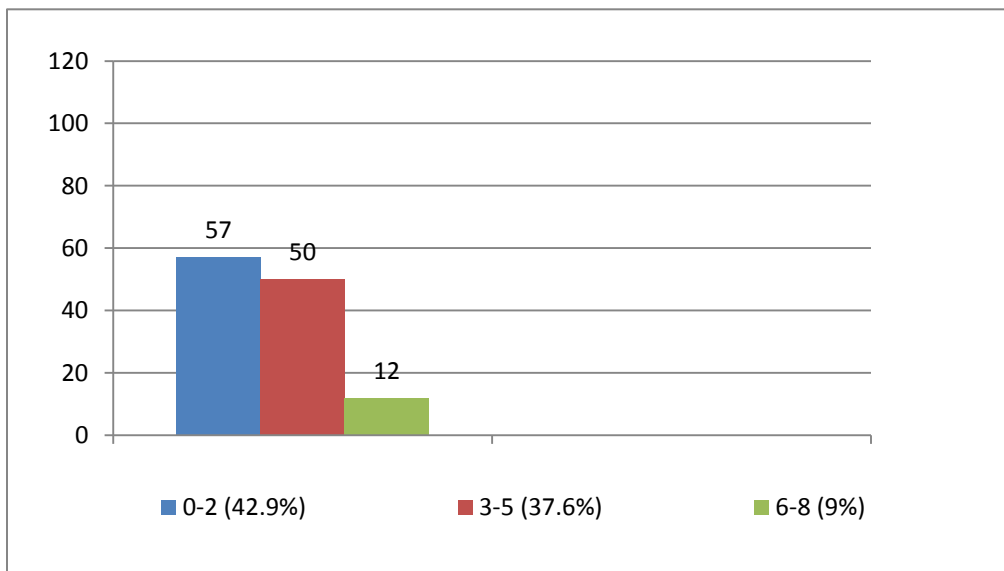
4a. If yes, do they play in or around the stream?



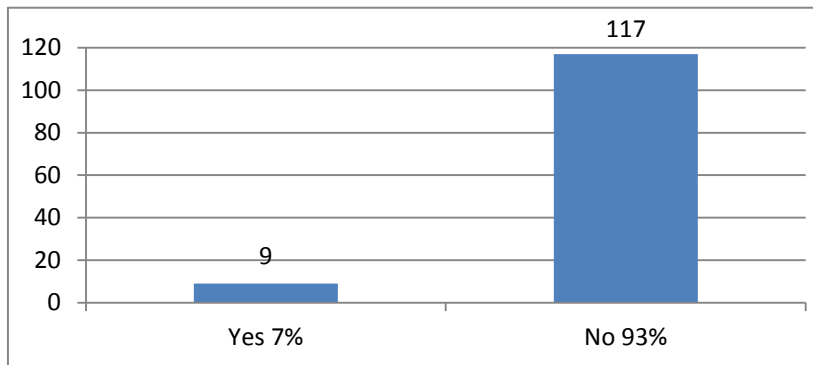
5. Do you have pets?



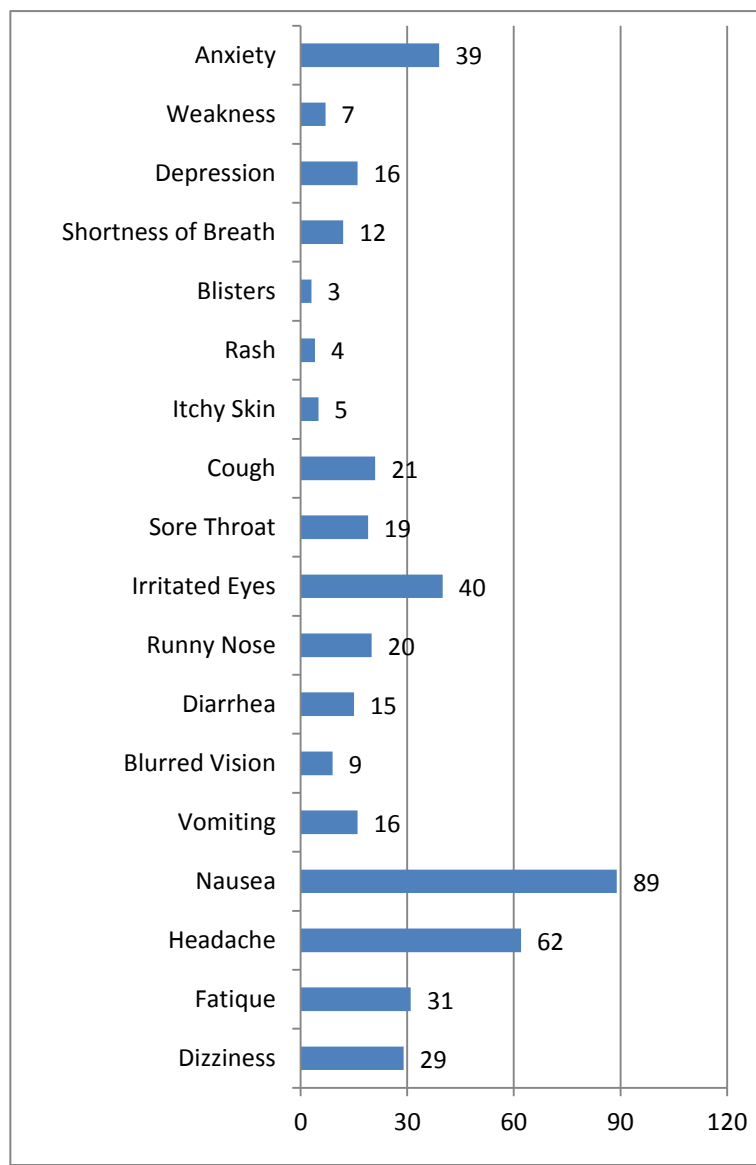
6. Between June 11, 2010 and June 18, 2010, ON AN AVERAGE DAY, how many hours did you spend in your yard?



### 7. Do you or any one in your household smoke?

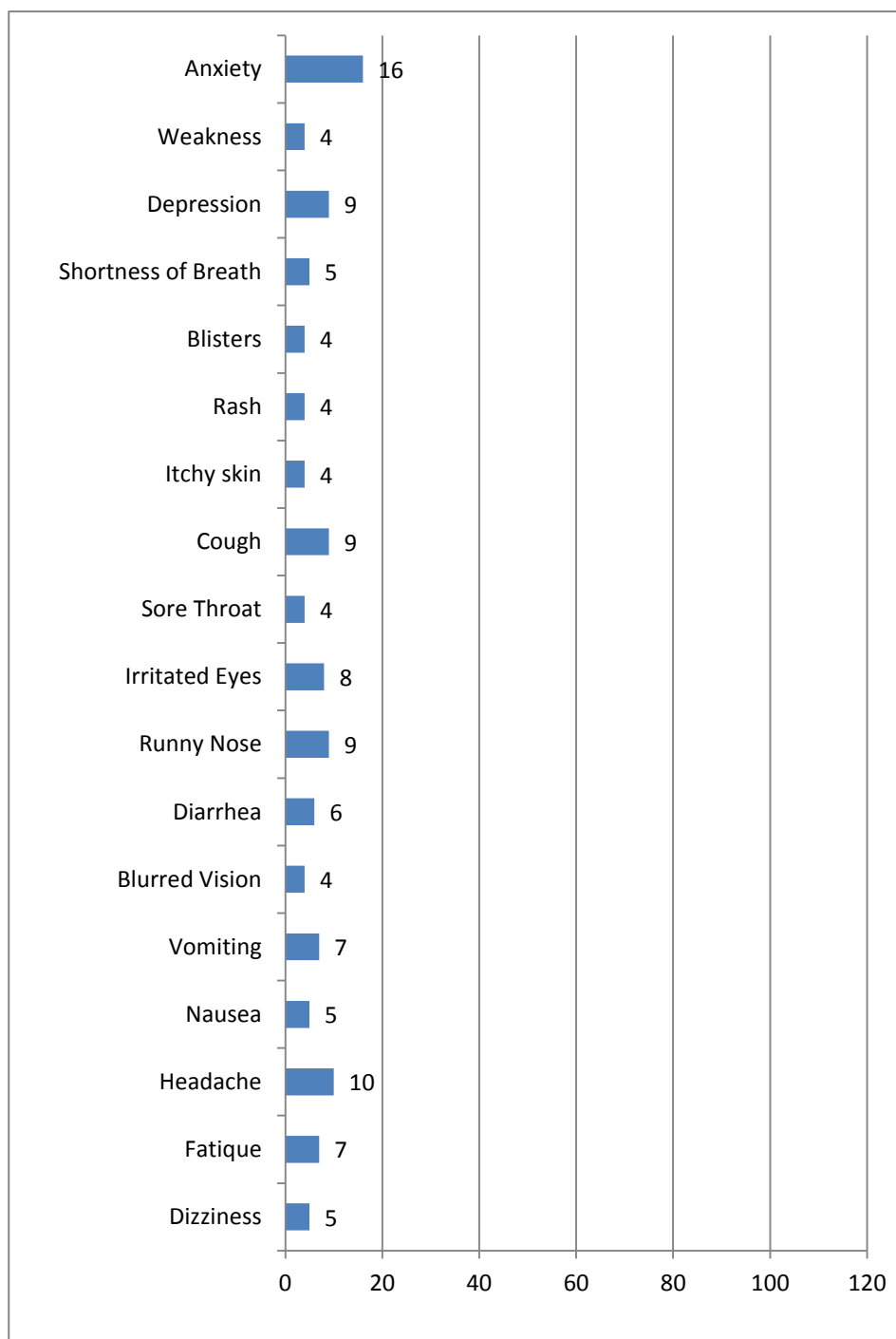


### 8. Symptoms experienced by one or more family members at onset of spill: *These are the symptoms most commonly reported in the community following an oil spill.*

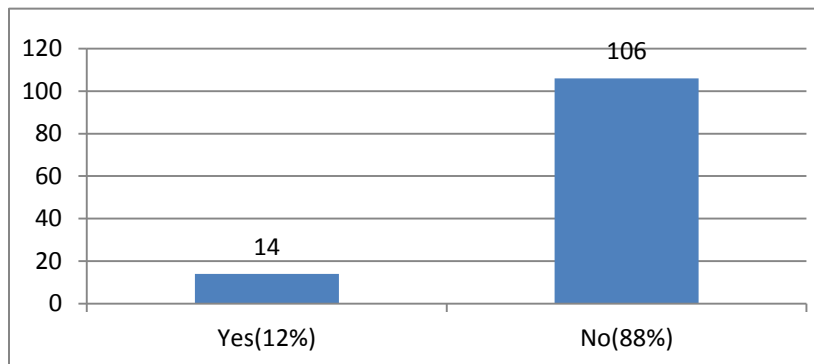




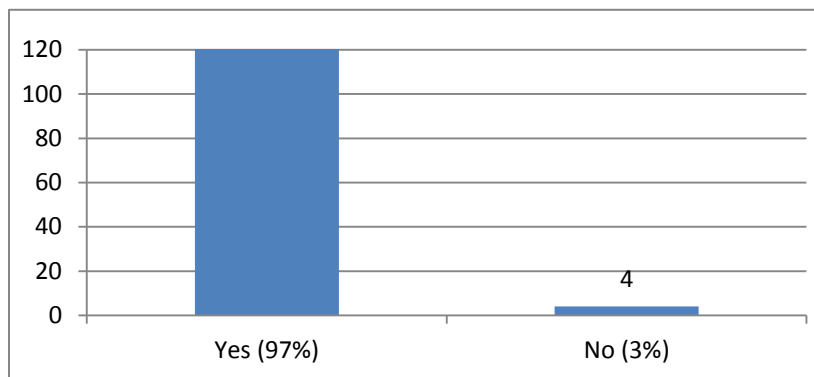
Symptoms still being experienced by one or more family members:  
*These are the symptoms most commonly reported in the community following an oil spill.*



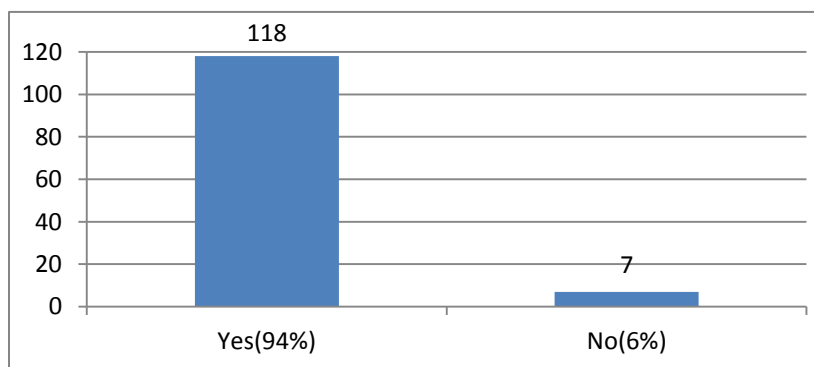
9. Have you visited your physician since the red butte creek oil spill for nay of the symptoms mentioned above?



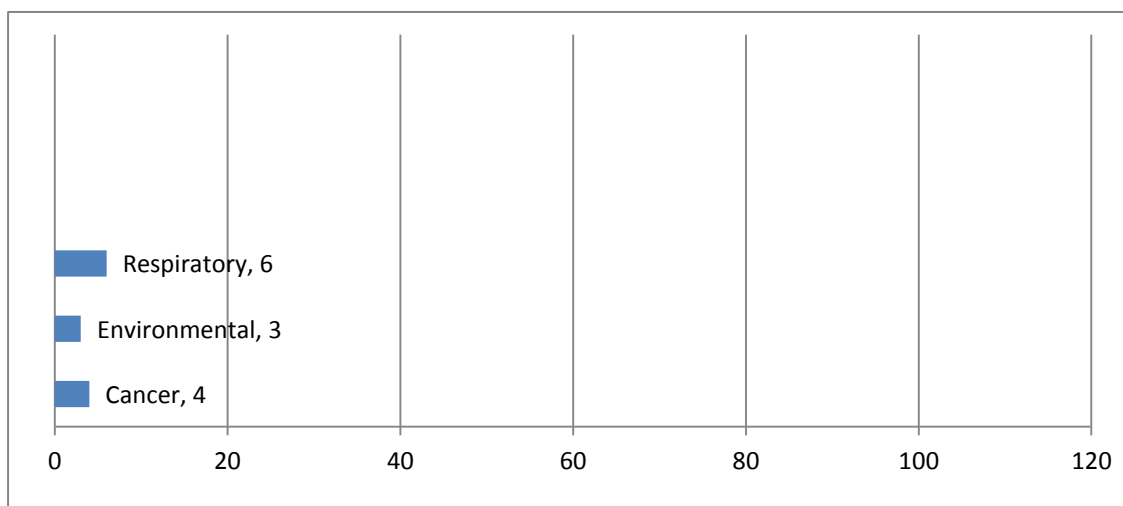
10. Do you have access to adequate health care?



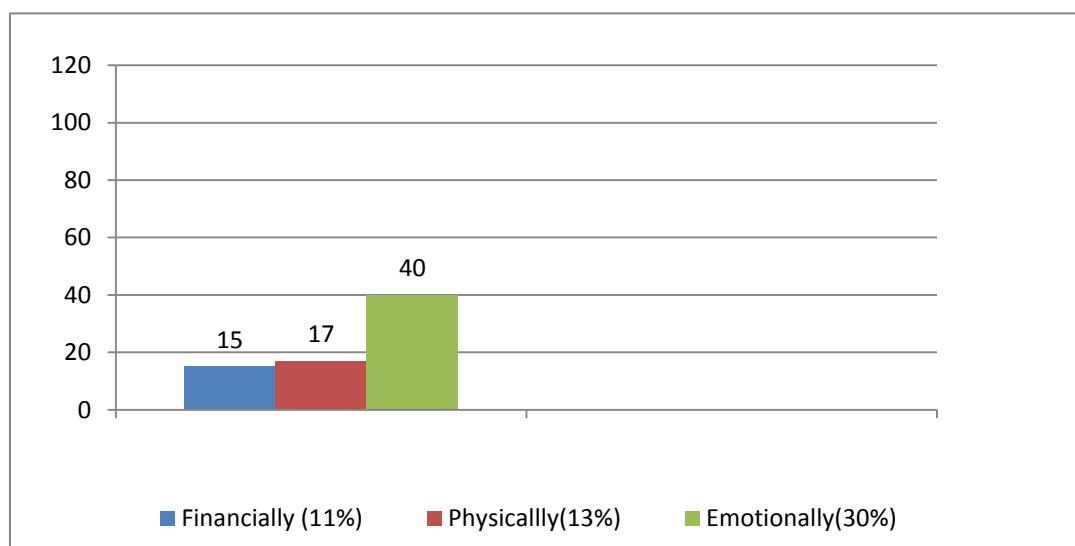
11. Is your family covered by health insurance?



12. What do you feel are the three greatest (long term) health concerns of the spill?



13. Do you feel the spill has impacted your family?



14. What do you consider to be the greatest environmental concern facing your community today?

