Health Consultation

AN INVESTIGATION OF CANCER INCIDENCE IN CENSUS TRACTS – 1101.02 AND 1110.02

SALT LAKE COUNTY, UTAH

MAY 18, 2006

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

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HEALTH CONSULTATION

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SALT LAKE COUNTY, UTAH

Prepared by:

Utah Department of Health
Office of Epidemiology
Environmental Epidemiology Program
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Summary

In March 2005, a group of residents in Cottonwood Heights contacted the Salt Lake County Mayor's office with complaints of a variety of health issues, including cancer and asthma. The community suspected that the source of these illnesses might be related to the environment. Specifically, two open gravel pits, asphalt production, and storage facility are located in the area. The residents suspect that dust and odor generated by these facilities may be contributing to the illnesses in the community. The Environmental Epidemiology Program was asked to investigate the cancer incidence in the area by Salt Lake Valley Health Department.

The gravel pits area owned by A.J. Dean and Construction Products Company (CPC) and the asphalt production, and storage facility is owned by CPC and are located about a quarter mile east of the community. The address for the gravel pit is 6990 South Wasatch Boulevard. The asphalt production and storage facility is located at 6695 South Wasatch Boulevard and are directly north of the mouth of Big Cottonwood Canyon.

Cancer data for this investigation were obtained from the Utah Cancer Registry for census tracts 1101.02 and 1110.02 and the state of Utah. The data received from the registry covered the years from 1988 – 2001. The year 2001 was the most recent/updated year for which complete data were available from the Utah Cancer Registry and from 1988 was the most reliable data available. Since the community did not identify specific cancers of concern from the perceived exposure, this investigation evaluated 41 specific cancers for statistical significance as requested by Salt Lake Valley Health Department.

Population demographics for the selected census tracts and the state of Utah were obtained from the 1990 and 2000 U.S. Census Data. The state of Utah was selected as the comparison population.

The data source used to obtain cancer incidence rates is the Utah Indicator-Based Information System-Public Health (IBIS-PH), which is Utah's public health data resource. Standardized incidence ratios (SIR) were calculated and analyzed to determine if there is a greater risk or lower risk of developing cancer as compared to the comparison population. Ninety-five percent confidence intervals were calculated and applied to determine if the number of observed cases was statistically different compared to the number of expected cases. Incidence rates were also calculated and age-adjusted to the 2000 U.S. standard population (per 100,000 person years).

Variation of cancer incidence over time was examined using SIR and confidence intervals. Two five-year periods and one four-year period were evaluated for each cancer over a period of 14 years (1988 – 2001). The periods were calculated beginning with 1988 – 1992 and ending with 1998 – 2001. Similar time periods were also calculated for the state of Utah.

This investigation evaluated 41 cancer site/types and found cancer of the larynx as the only cancer that demonstrated a significant increase during one period, 1998-2001. The rates for

cancer of the larynx were almost identical to Utah's rate from 1988-1997. This investigation could not determine the reason why cancer of the larynx was elevated during this period.

This investigation also found significant decreases in cancer from all sites in two periods (1988-1992 and 1998-2001) and decreases in colon cancer (1998-2001) and lung and bronchus cancer (1988-1992) during one period. It was not possible to evaluate cancer rates in persons less than 18 years of age due to small sample sizes.

The Utah Division of Air Quality monitored the area near the sand and gravel pits in 2002 for particulate matter (PM_{10}), total suspended particulate (TSP), and in 2004 for TSP and volatile and semi-volatile compounds. The concentrations of TSP and respirable dust (PM_{10}) detected in ambient air samples near the sand and gravel pits pose no public health hazard to the general population. No volatile or semi-volatile compounds were detected in the air samples.

The EEP recommends that the communities living in census tracts 1101.02 and 1110.02 be provided with information about cancer and a copy of this health consultation.

The EEP also recommends that the incidence of cancer be re-evaluated when three additional years of cancer data is available if necessary.

The EEP recommends that the Division of Air Quality continue to monitor the ambient air quality near the sand and gravel pits.

Background

In March 2005, a group of residents in Cottonwood Heights contacted the Salt Lake County Mayor's office with complaints of a variety of health issues, including cancer and asthma. The community suspected that the source of these illnesses might be related to the environment, particularly the sand and gravel pits and asphalt production. They requested that the county investigate the matter.

On March 18, 2005, the Bureau of Epidemiology at the Salt Lake Valley Health Department (SLVHD) contacted one of the concerned residents by phone to obtain information about the area and more details of their complaints. This citizen provided in some detail, the geographic and historic background of the community, as well as information about some of the illnesses (primarily cancers) that had been perceived to be higher than normal in the community. No specific cancers were mentioned, only a perceived increase in the incidence of cancer.

Although the community is located within the city of Cottonwood Heights, this community is otherwise known locally as Old Mill Estate or Old Mill Valley. The zip code for the area is 84121 and the 2000 census tracts were 1101.02 and 1110.02, respectively.

The residents believe that source or exposure causing the illnesses is the sand and gravel pits and asphalt production located about a quarter mile east of the community. The gravel pits are owned by A.J. Dean and Sons and Construction Products Company (CPC), and the asphalt production

and storage facility is owned by CPC. The address for the gravel pit is 6990 South Wasatch Boulevard. The asphalt production and storage facility is located at 6695 South Wasatch Boulevard and are directly north of the mouth of Big Cottonwood Canyon. Residential complaints were primarily associated with the fugitive dust generated by the sand and gravel operations, and on occasion odor from the asphalt. The community has raised concerns with many state and local government agencies about dust that comes from the gravel pit and the smell that the asphalt plant produces. The Utah Department of Environmental Quality has found no evidence of any hazardous air pollutants at concentrations that would cause any adverse health effects.

Limited testing for volatile organic compounds (VOCs) and Polycyclic Aromatic Hydrocarbons (PAHs) was conducted but no sampling for carbon monoxide, nitrogen oxides, sulfur dioxides have not been conducted. Also, analysis of the crystalline silica (total and respirable) in the dust has not been determined.

On March 18, 2005, the SLVHD notified the Utah Department of Health about the matter and requested assistance. In response to the citizens' concerns regarding the level of cancers in the area, the Utah Department of Health, Environmental Epidemiology Program (EEP) was requested by SLVHD to evaluate the incidence of all cancers in census tracts 1101.02 and 1110.02, respectively (See Map 1 in Appendix A).

Site Description

Incorporated on January 14, 2005, the city of Cottonwood Heights is the newest city in Utah. The city is near the mouth of Big Cottonwood Canyon in the east side of Salt Lake County. Prior to becoming a city, this area was under the jurisdiction of Salt Lake County. A. J. Dean and Sons and CPC are located about a quarter mile east of the community located next to I-190 and south of the community located by Gun Club Road (Site #2). The site is directly north of the of the Mouth of Big Cottonwood Canyon. (See Map 2, Appendix A).

Operating Description

A. J. Dean and Sons and CPC have been operating in the Cottonwood area for approximately 60 years. They operate two sand and gravel pits. Raw aggregate material is mined from the quarry walls by front-end loader. Some of the material is pushed from higher elevations down into the pit area by bulldozers. The raw aggregate material is then fed into a feeder and then through a jaw crusher to a series of conveyors and screens. The screens vary on site from double to triple deck screens. The screens shake the material through various classifiers to sort the material according to size. Some finished product is conveyed out of the screens, while other materials are routed to various crushers to be crushed and re-screened. The company operates a variety of screens including jaw crushers and various forms of cone crushers. Finished product is conveyed from screens to storage piles. Front-end loaders load haul trucks with the various materials made by the aggregate processing circuits for shipment offsite. Some of the aggregate material is conveyed directly to the feed bins for the asphalt plants. Water sprays are used to control fugitive dust emissions from various crushers and conveyor drop points. Foam injection

is also used on some of the cone crushers. A small fabric filter is used on the Sandvic hydrocone crusher in addition to the foam injection. Fugitive dust emissions from haul roads and operational areas are controlled by water truck (SLVHD 2005).

CPC owns and operates two drum mix asphalt plants and supporting aggregate operations from its Walker Pit location in Salt Lake County. Processed aggregate material is stored in feeder bins at the asphalt plants. The feeders feed the main conveyor with the proper proportion of various sized aggregate and sand to the drum mixer. The aggregate is heated and dried in the mix drum by low NOX natural gas burners. Asphalt is added near the end of the drum where the material falls out to be conveyed to storage silos. The asphaltic concrete is stored in insulated storage silos for up to two days until it is loaded into haul trucks for shipment to a road project. Emissions are controlled from the asphalt plants by fabric filter baghouses and low-NOX burners on the drums (SLVHD 2005).

Demographics

The total land area for the city of Cottonwood Heights is approximately 6.8 square miles, with a total population of 27,569 (Census U.S. 2006). Nearly 92% of the population is White, non-Hispanic. The area is characterized by the U.S. Census as an upper income area. Although the city is new, most homes in the area of concern have been in existence for more than 10 years. The population for the study area (2000 census tracts) 1101.02 and 1110.02 is 10,651. The median age is 32.6. Whites account for 96% of the population.

METHODS

Cancer Data

Cancer data for this investigation were obtained from the Utah's Department of Health, Indicator-Based Information System for Public Health (IBIS-PH). IBIS-PH) provides information on the health status of Utahns, the state of the health care system, and Utah public health activities. IBIS-PH received cancer data directly from the Utah Cancer Registry. Each newly diagnosed case is assigned to the census tract of residence at the time of diagnosis. The data for the study area (2000 census tracts – 1101.02 and 1110.02) and the state of Utah were categorized by cancer site/type, sex, age group, and year of diagnosis, and covered the years from 1988 – 2001. The year 2001 was the most recent updated year for which complete data were available from the Utah Cancer Registry.

Census Data

The population demographics for the study area (2000 census tracts) 1101.02 and 1110.02 and the state of Utah were obtained from the 1990 and 2000 U.S. Census Data. The intercensal populations were estimated linearly on the basis of 1990 and 2000 populations. The populations were estimated at a constant rate of growth.

Comparison Population

A comparison population was selected to evaluate if the observed cases in the study population were statistically different from expected cases if the population had not been at any special risk. The state of Utah was used as the comparison population for this investigation. For the purpose of analysis, from this point after, census tracts 1101.02 and 1110.02 will be referred to as *Cottonwood Heights* and the state of Utah will be referred to as *Utah*, unless otherwise specified.

Statistical Analysis

A Standardized Incidence Ratio was used for the quantitative analysis of cancer incidence in the area under evaluation (Kelsey, et al 1986, Aldrich and Griffith 1993). An SIR was calculated for each period and used to determine if there is a greater risk or a lower risk of developing cancer as compared to the comparison population. The SIR was calculated by dividing the crude observed count by the expected count. The ratio of observed to expected was then used to determine if there was a greater or lower risk of developing cancer in Cottonwood Heights as compared to Utah. The expected count was calculated by multiplying the age-specific comparison rate (Utah) by the age-specific population of the study population (Cottonwood Heights), and summing the results. An SIR of one (1.0) indicates rates are equal and there is no increased risk. An SIR of greater than one (1.0) indicates an increased risk for the study group, while an SIR of less than one (1.0) indicates a decreased risk for the study group. Random fluctuations may account for some SIR deviations from 1.0. A more detailed description of the standardization of the data is presented in Appendix B.

The statistical significance of deviations from an SIR of 1.0 was evaluated using a 95 percent confidence interval. The confidence interval for the SIR is the range within which the true SIR value has a specified probability of being included. The specified probability is called the confidence level, and the endpoints of the confidence interval are called the confidence limits. By assessing the confidence interval, information about the variability of the data and the statistical significance of the SIR was obtained. The differences between the observed versus the expected (or SIR) were considered significant (not a random occurrence or due to chance alone) if the confidence interval applied to the SIR did not include one (1.0). An important note is that statistical significance does not mean causally associated. It does mean that the recognized association has stability and may need further evaluation. A more detailed description of the confidence interval calculation is presented in Appendix B.

Variation of cancer incidence over time was examined using SIR and confidence intervals. Two five-year periods (1988-1992 and 1993-1997) and one four-year period (1998-2001) were evaluated for each cancer over a period of 14 years (1988 – 2001). For comparison purposes, incidence rates were also calculated for Utah for the same interval. The five-year and four-year intervals will be referred to as *periods* unless otherwise specified.

Age-Adjusted Rates

Age-adjusted rates of morbidity (per 100,000 person-years) were calculated (by IBIS-PH) through direct standardization and adjusted to the 2000 U.S. Standard Population. This adjustment provides a basis for comparison across populations by reducing the effects of differences in the age distributions of the population being compared. It is computed by using the weighted age-specific rates in the population of interest and the proportions of the persons in the corresponding age groups within a standard population. From this point after, the age-adjusted rates will be referred to as *incidence rates* or *rates*, unless otherwise specified.

Literature Search

A literature search was conducted relative to the association between the cancers found to be elevated and the contaminant of concern in this investigation. This investigation employed the National Library of Medicine's Medical Literature Analysis and Retrieval System. The computer files of the National Library of Medicine consist of more than 30 biomedical databases. Medline contains almost 30 years of bibliographic data from more than 3,600 major medical journals.

CANCERS EVALUATED

Cancer data were obtained from IBIS-PH for the period 1988 – 2001 that occurred in the Cottonwood Heights area. Since asphalt is a mixture of numerous compounds this investigation evaluated 41 site/type cancers to determine if any cancer demonstrated a statistically significant outcome in at least one of the periods evaluated. The cancers that were evaluated are presented in Appendix C.

RESULTS

The results of this investigation found cancer of the larynx as the only cancer to demonstrate a significant increase in only one period (1998-2001). Two cancers demonstrated significant decreases during the study period. Colon cancer was significantly decreased in only one period and lung and bronchus in two periods. No other cancers demonstrated significant increases or decreases from the 41 cancers evaluated as compared to Utah.

Results for cancer from all sites, cancer of the larynx, colon cancer, and lung and bronchus cancer are listed below.

Cancer from All Sites

Cancer from all sites was significantly lower during periods 1988-1992 (SIR = 0.70, 95% CI 0.54, 0.90) and 1998-2001 (SIR = 0.81, 95% CI 0.67, 0.97). The SIRs did not exceed 1.0 during the study period. The rates for cancer from all sites did increase from 284.8 (1988-1992) to 373.1 (1993-1997) and slightly decreased to 367.5 in period 1998-2001. See Table 1, Appendix D.

Cancer of the Larynx

Cancer of the larynx was significantly increased in one time period, 1998-2001 (SIR = 2.66, 95% CI 1.44, 13.70). The confidence interval for this SIR is extremely wide and indicates that this finding is not particularly reliable and difficult to interpret. The remaining two periods contained three or fewer cases. The lack of significant findings in more than one time period suggests that the one period with elevated rates may be due normal variation in cancer rates. See Table 2, Appendix D.

Colon Cancer
Colon cancer significantly decreased period 1998-2001 compared to Utah. The SIR for this period was 0.22 (95% CI = 0.02, 0.81). The remaining periods also demonstrated SIRs lower than 1.0 but were not significant. All periods contained three or less cases. (See Table 3, Appendix D).

Lung and Bronchus Cancer

Cancer of the lung and bronchus was also significantly lower than Utah during period 1988-1992 (SIR = 0.15, 95% CI 0.00, 0.85). However, this outcome is considered a statistical aberration. The rates of lung and bronchus cancer were slightly higher than Utah's during period 1993-1997 (Rate = 34.2 vs. 32.7). See Table 4, Appendix D.

Interpretation of these results should be approached cautiously primarily due to the small number of cases diagnosed in any of the periods evaluated. A small number of cases can be deceptive or statistically problematic for drawing certain conclusions or inferences due to the large fluctuations that occur in the cancer rates during a time period.

DISCUSSION

Cancer is a single term that refers to the uncontrolled growth and spread of abnormal cells anywhere in the body. However, cancer is not a single disease; it is an umbrella term for at least 100 different types of uncontrolled cell growth. Cancers of the same type, and especially cancers of different types, can be related to many different causes, ranging from genetic predisposition, to personal habits such as smoking, to environmental exposures.

Residents of Cottonwood Heights have expressed concern that they are experiencing higher rates of cancer than would be expected in a population of their size. Potential exposure pathways for potentially cancer-causing contaminants have existed in Cottonwood Height from two sand and gravel pits and asphalt production. However, that does not indicate whether residents were actually experiencing excess cancer. The purpose of this investigation was to specifically evaluate cancer incidence in Cottonwood Heights, Utah from 1988-2001 as compared to Utah.

Census tracts 1101.02 and 1110.02 (1990 census and 2000 census) were examined to determine whether an excess of cancers was present in the Cottonwood Heights area. In examining the two five-year periods and one four-year period of cancer incidence, this investigation evaluated 41 cancer site/types and found cancer of the larynx as the only cancer that demonstrated a staistically significant increase during one period. The rates for cancer of the larynx were almost similar to Utah's rate from 1988-1997. The only increase observed for cancer of the larynx was during period 1998-2001.

This investigation also found statistically significant decreases in cancer from all sites in two period (1988-1992 and 1998-2001) and decreases in colon cancer (1998-2001) and lung and bronchus cancer (1988-1992) during one period.

Approximately 12,500 new cases of cancer of the larynx occur each year in the U.S. (Boring et al., 1994). It has an incidence pattern similar to that of cancers of the mouth and throat, occurring more often among men than women and more often among blacks than among whites.

This investigation found that the observed number of laryngeal cancer cases in Cottonwood Heights during 1998-2001 significantly exceeded the expected number of cancer cases in a single isolated time period. Through the literature search and review, no association was found that links exposures to sand and gravel pits and asphalt as a risk factor in the development of laryngeal cancer. Tobacco and alcohol are the two primary risk factors that have been established for laryngeal cancer. As with oral and esophageal tumors, tobacco and alcohol act synergistically to increase the risk of this disease. Some occupations have been associated with an increased risk of laryngeal cancer, including those that involve exposure to asbestos, nickel, wood dust, formaldehyde, mustard gas, and alcohol. However, these occupational exposures are relatively rare, and probably account for only a small percentage of all cases of laryngeal cancer (UCR 2000 and Shottenfeld and Fraumeni, 1996).

Other causes of cancer also play a role in determining cancer rates in a community. For example, smoking is, by far, the most common cause of lung cancer in the United States. This study did not specifically examine smoking rates in Cottonwood Heights. If Cottonwood Heights has higher rates of smoking than Utah as a whole, this may be a reasonable reason for the elevated rate in laryngeal cancer rather than exposures associated with the sand and gravel pits. However, lung cancer rates would also be expected to be elevated, not significantly decreased as found by this investigation.

There are many other common risk factors for cancer that were not investigated by this study. It is not possible to draw any definitive conclusion about the cause of an elevated cancer rate without also examining the risks factors mentioned above.

Cancer Incidence

Cancer rates increased nationwide until the mid-1990's when they began to decline. Despite these declines, cancer remains the second most common cause of death in the United States after heart disease. There are several major factors that have contributed to high cancer rates. Tobacco

exposure, primarily through smoking, causes most lung cancer in the U.S.; lung cancer is the leading cause of cancer death. Another factor is the longer lifespan of the modern U.S. population. In 1900, the life expectancy was 47 years compared to 77 years in 2000. Because cancer is caused by accumulated changes in our cells, it becomes more likely as we get older. Thus, longer lifespans nationwide increases the amount of cancer seen in the population (MDCH, 2000). In addition, higher rates of obesity in the U.S. probably also contributes to higher cancer rates (NCI 2003).

In addition to the decreasing rates of cancer, the survival rate once someone has been diagnosed has increased. This increase is due to improvements in the early detection and treatment of specific types of cancers such as breast, colon, and cervical cancers (NCI 2003, MDCH, 2000).

Unexplained cancer-related health disparities remain among population subgroups. For example, Blacks and people with low socioeconomic status have the highest rates of both new cancers and cancer deaths (NCI 2003).

CANCER EPIDEMIOLOGY

Cancer is a name applied to many diseases with many different causes. Cancer is very common. Nearly half of all men and one-third of all women in the U.S. population will develop cancer at some point in their lives and 22 percent of the population will eventually die of cancer (ACS 2004). Statistically, it is normal for cancer rates to fluctuate in smaller communities. Some years the rates are higher, other years lower, eventually the rates tend to balance out over time.

When a subset of the population is found to have an increased rate of cancer, there are no definitive tests to determine which of the cancer cases are due to the unique risk factors present in that population and which cases are due to the background risk factors or genetic factors present in the general population. Therefore, if the expected rate of a particular cancer in the general population is 100 cases and a particular occupational group is found to have 120 cases, no test currently can determine which 20 individuals developed the disease due to the specific risks associated with their profession (or environmental exposures) and which 100 would have occurred anyway.

Characterizing types of cancers, cancer rates, and determining causal relationships to environmental exposures without exposure measurements or data is difficult because people live and work in many environments and are exposed to complex mixtures of toxic pollutants at home, at work, and in the ambient environment. In addition, only a relatively small percentage of cancers can be attributed to environmental factors (Klaassen 1996).

The following are risk factors associated with the etiology of cancer of the larynx.

Larynx

Tobacco and alcohol are the two primary risk factors that have been established for laryngeal cancer. As with oral and esophageal tumors, tobacco and alcohol act synergistically to increase the risk of this disease beyond simply adding the separate risks from each of these exposures.

Some occupations have been associated with an increased risk, including those that involve exposure to asbestos, nickel, wood dust, formaldehyde, mustard gas, and alcohol. However, these occupational exposures are relatively rare and probably account for only a small percentage of all cases of laryngeal cancer. Recent studies suggest that consumption of fruits and vegetables may reduce the risk of laryngeal tumors. Avoidance of tobacco products and drinking alcohol in moderation are the two most important measures to prevent this disease (UCR 2000 and Shottenfeld and Fraumeni, 1996).

CONTAMINANT OF CONCERN

Potential Pathways

To determine whether nearby residents are exposed to contaminants at the site, the U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (ATSDR) and EEP evaluate the environmental and human components that make up a human exposure pathway. An exposure pathway consists of the following five elements (ATSDR 2004):

(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 2004).

When an exposure pathway is identified, ATSDR comparison values (CVs) for air, soil, or drinking water are used as guidelines for selecting contaminants that require further evaluation [ATSDR 2004). To protect the more susceptible population, CVs for children are used when available.

Completed Exposure Pathways

There is one completed exposure pathway for residents living near the sand and gravel pits in the Cottonwood Heights area: respirable dust inhalation. Elements of the completed exposure pathway are described here.

Completed Exposure: Dust

Exposure element	Gravel pits
1) A source of contamination	Dust
2) Transport through environmental medium	Airborne contaminants/dust
3) A point of exposure	Residential area
4) A route of human exposure	Inhalation
5) A receptor population	Residents and visitors near the site

A completed pathway of exposure to airborne respirable dust is found due to the proximity of residential homes to the sand, gravel and asphalt operations in the Cottonwood Heights area. Examples of this exposure pathway include children playing outside in the area and breathing in small dust particles, residents working in their yards, or visitors running in contaminated air and dust. The inhalation pathway existed in the past and continues to exist because the site exposures are residential with unrestricted access.

Air Quality Sampling

The Utah Division of Air Quality (UDAQ) conducted two surveys to monitor both respirable particulate matter (PM_{10}) and total suspension particulates (TSP) in 2002 and 2004 near the two sand and gravel pits in Cottonwood Heights. PM_{10} refers to airborne particles that are 10 microns or smaller in aerodynamic diameter. These small airborne particulates are of health concern because they can travel unimpeded through the body's respiratory tract and lodge in the lungs where they can cause respiratory damage. Because of this health concern the Environmental Protection Agency (EPA) and the UDAQ regulate these small particles. The 24-hour federal standard is set at a concentration of 155 ug/m^3 PM_{10} (EPA –NAAQS 1990)

In 2002, PM_{10} concentrations were monitored in July, and TSPs were monitored in August. Site #1 was located at the Intermountain Christian School (6515 South Lion Lane) and the second site (Site #2) was located near the intersection of Gun Club Road and Heughs Canyon Drive 3474 East 6575 South (approximate monitoring address)). The duration of the monitoring was two months.

None of the samples collected from each site demonstrated high or even moderate concentrations of PM_{10} (Table 5, Appendix E). UDAQ collected 17 24-hour PM_{10} samples during July 2002. Concentrations of PM_{10} averaged 23 and 18 ug/m^3 at Site #1 and Site #2, respectively. The highest concentration measured was 43 ug/m^3 (Site #1), a level only 28% of the EPA's National Ambient Air Quality Standard (UDAQ 2002).

Neither the EPA and UDAQ regulate TSP in the ambient air. It is left to the local government entities to establish control strategies to mitigate fugitive dust by issuing nuisance ordinances. The results of the 2002 survey suggest the dust coming from the sand and gravel pit is comprised primarily of large sized dust particles, not $PM_{10.}$ Total dust may create nuisance problems when it deposits on vehicles, patio furniture, inside the home, etc, but does not represent health hazard because the respiratory tract effectively removes these large-sized particles. As displayed in Table 6 (Appendix E), TSP concentrations averaged 61 ug/m^3 at Site #1 (n=12 samples) and 131 ug/m^3 (n=9 samples) at Site #2. Total dust levels from both sites represent a broad

concentration range from 28 to 434 ug/m^3. The sample collected on August 19, showed elevated dust levels in excess of EPA's former TSP standard of 265 ug/m^3. The surface winds measured on August 19 at UDAQ's permanent monitoring site near Cottonwood High School (5851 South 1300 East), averaged 4 miles-per-hour. There is likelihood that airborne dust from the gravel pit and surrounding area may have infiltrated the sample air filter because no other sample demonstrated such high levels. The next highest level was 221 ug/m^3 (UDAQ 2002).

In 2004 UDAQ monitored the area near the sand and gravel pits again at Site #1 and a new site (Site #3) at the Old Mill Estates (6985 South 3265 East) for TSP. The testing was conducted from April 13 to June 15, 2004.

A total of 13 runs (tests) were conducted for Site #1 and 11 runs for Site #3. The concentration range for Site #1 was 16 to 76 ug/m^3 TSP and the range for Site #3 was 2 to 118 ug/m^3 TSP. Neither site exceeded the former EPA TSP standard (265 ug/m^3) that served as the benchmark for UDAQ (Table 7, Appendix E). (UDAQ 2004a).

The UDAQ, also in 2004, conducted ambient air monitoring for volatile and semi-volatile compounds at two sites. Site #1 was located in the cul-de-sac of Canyon Creek Circle and Site #2 was located at 6790 South and 3215 East, in Cottonwood Heights near the asphalt plant. Three samples were collected from each site. None of the samples demonstrated detectible levels for any of the 68 compounds scanned by the Utah Department of Health Laboratory. Table 8 (Appendix E) presents the 68 semi-volatile compounds that were scanned via gas chromatography/mass spectrometry (GC/MS) (UDAQ, 2004b).

One Summa canister grab sample was collected by a Cottonwood Heights resident as requested by UDAQ. The whole-air sample was analyzed for VOCs by GC/MS. Low levels of VOCs characteristic of an urban environment were detected (benzene 0.72 ppbv, toluene 4.0 ppbv, ethlybenzene 0.54 ppbv, xylenes (all isomers) 4.3 ppbv (UDAQ 2004b).

The prevailing winds generally blow southeast out of Big Cottonwood Canyon and should blow the fugitive dust in a northwesterly direction towards the sites where the monitors were placed. Meteorological data was captured from the UDAQ's Cottonwood station located by Cottonwood High School.

Map (2) presenting the testing sites and gravel pits area is located in Appendix A.

CHILD'S HEALTH CONSIDERATIONS

ATSDR and EEP recognize the unique vulnerabilities of infants and children. Children are at a greater risk than adults from some environmental hazards. Children are more likely to be exposed to contaminants because they play outdoors, often bring food into contaminated areas, and are more likely to make contact with dust and soil. Because children's bodies are still developing, children can sustain permanent damage if toxic exposures to some contaminants occur during critical growth stages.

Due to small sample sizes this investigation could not evaluate the incidence of pediatric cancers in the Cottonwood Heights area among persons 0 to 17 years of age.

LIMITATIONS OF INVESTIGATION

In areas with small populations (such as Cottonwood Heights) the numbers of expected cases of a given cancer are sometimes too small to be appropriately analyzed. These types of cancer cluster investigations lack the statistical power to detect small or medium elevations in cancer rates. Therefore, the lack of detected significantly elevated cancer rates may not be truly representative of underlying cancer risk. Unfortunately, there are few statistical methods available to improve detection of elevated cancer rates in this type of situation.

Factors that must be considered in the development and etiology of most cancers, but could not be evaluated in this investigation, include latency period, population migration, personal habits, diet, occupational exposures, and familial history. The latency, or induction period, for most adult cancers ranges from 10 to 30 years after initial exposure to a carcinogen. Therefore, ascertaining the place and time of exposure to a carcinogen is difficult. Migration of people into and out of the area presents a problematic issue relative to exposure and latency. Humans live and work in many environments and are exposed to complex mixtures of toxic pollutants at home and at work. Information was not available for individual occupational exposures. Lifestyle factors such as smoking and alcohol consumption could not be examined.

Factors such as latency or induction period, population migration, personal habits, race, diet, occupational exposures, and familial history make drawing a conclusion problematic. The lack of adequate exposure information also limits one's ability to infer that a positive association between study area and health outcome was due to exposure, or to infer that the absence of an association was because exposure resulted in no adverse health effect. In most cancer incidence investigations no exposure or potential cause is ever apparent or established (MMWR 1990).

The primary objective of a cancer incidence investigation is to identify whether the number of cases that have occurred is significantly greater than what would be expected to occur by chance in the study area and to determine if there is a plausible carcinogenic association to the contaminants of concern. This investigation should not be viewed as a tool to definitively identify a cancer source (cause and effect) associated or linked to the chemical of concern. In addition, cancer incidence investigations that fail to explain why increases in specific cancers are occurring in a community should not be interpreted as supporting environmental pollution.

CONCLUSION

This investigation found only cancer of the larynx that was statistically significantly increases in Cottonwood Heights as compared to Utah from 1998 to 2001. This investigation could not determine the reason why cancer of the larynx was elevated during this period. With the

exception of cancer of the larynx, this investigation found no evidence that the incidence of cancer was occurring at a greater frequency in Cottonwood Heights as compared to Utah.

The concentrations of TSP and respirable dust (PM_{10}) detected in ambient air samples near the sand and gravel pits pose no public health hazard to the general population. In addition, no semi-volatile compounds were detected in the air samples analyzed. However, low levels of VOCs that are characteristic of an urban environment were detected by one Summa canister grab sample.

RECOMMENDATION

The EEP recommends that the communities living in census tracts 1101.02 and 1110.02 be provided with information about cancer and a copy of this health consultation.

The EEP recommends that the incidence of cancer be re-evaluated when three additional years of cancer data is available if necessary. This will allow Salt Lake Valley Health Department to monitor if cancer of the larynx continues to be significantly elevated.

The EEP recommends that the Division of Air Quality continue to monitor the ambient air quality for unsafe levels.

PUBLIC HEALTH PLAN

The EEP with coordinate with the Salt Lake Valley Health Department to provide residents living in census tracts 1101.02 and 1110.02 with information about cancer and a copy of this health consultation.

The EEP, in coordination with the Salt Lake Valley Health Department, will conduct a follow-up epidemiological investigation of cancers in the census tracts 1101.02 and 1110.02, when an additional three years of cancer data has been compiled by the Utah Cancer Registry.

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Certification

This Health Consultation, An Investigation of Cancer Incidence in Census Tracts - 1101.02 and 1110.02, in Salt Lake County, Utah, was prepared by the Utah Department of Health, Environmental Epidemiology Program 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 consultation began. Editorial review was completed by the Cooperative Agreement partner.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this health consultation and concurs with its findings.

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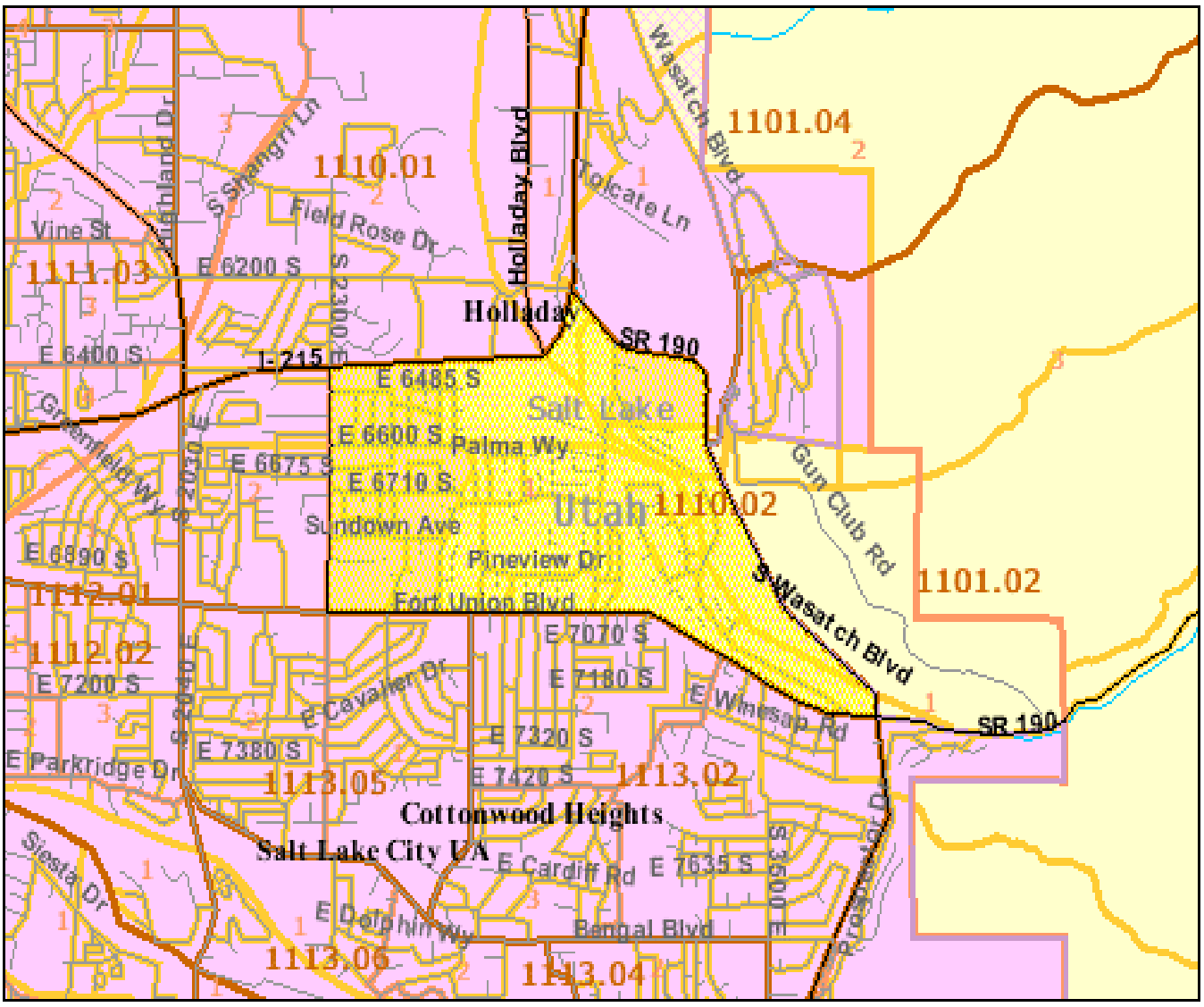
[UDAQa] Utah Division of Air Quality, 2004. Air Monitoring Data for Cottonwood Heights.

[UDAQb] Utah Division of Air Quality, 2004. Air Monitoring – VOC and Semi-Voc Scanning Data for Cottonwood Heights.

APPENDIX A – MAPS

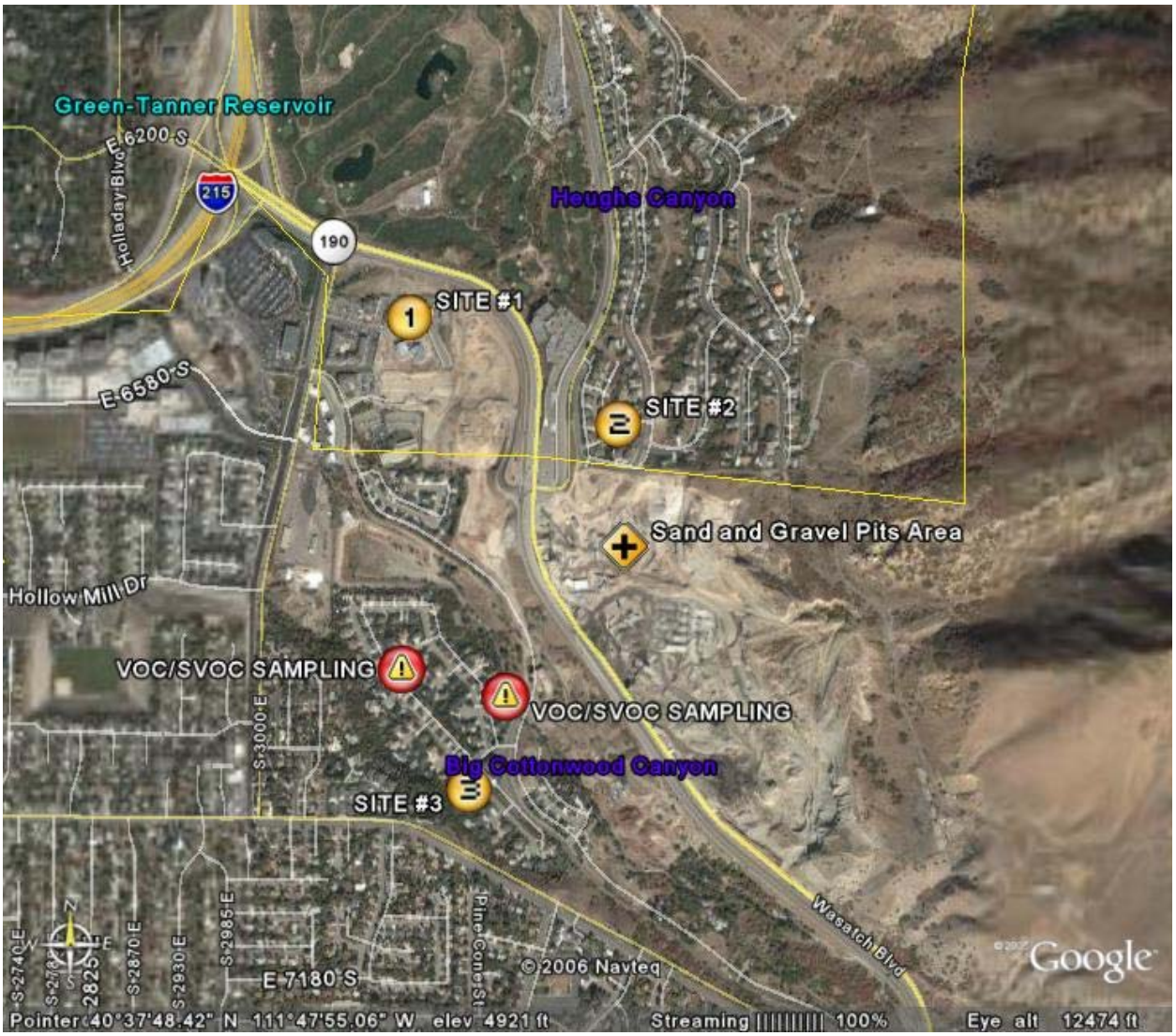
MAP 1

Map displaying area of census tracts (2000) 1110.02 and 1102.02 in Salt Lake County, Utah.



MAP 2

Map depicting sampling areas for Site #1, #2, and #3, and areas of VOC/SVOC sampling in Cottonwood Heights, Utah.



APPENDIX B– STATISTICAL CALCULATIONS

Age-Adjustment Method (Standardized Incidence Ratios)

Standardized Incidence Ratios (SIR) were calculated using a statistical method applicable to both the direct and indirect age-adjustment or standardization methods. This method uses the age distribution of each population group and the age-specific rates for the standard population (state of Utah) to calculate the expected number of cancer cases if the rates of disease were constant as in the standard population. The observed number of incidences is then compared (divided) with the expected number of incidences in the study population (census tracts - 1101.02 and 1110.02) and a ratio is derived, referred to as the SIR.
The formula for this ratio = $\Sigma p_{ia} n_{ia} / \Sigma p_{is} n_{ia}$

Where: a = area chosen as the study area (census tracts 1101.02 and 1110.02)
s = area chosen as a reference standard (state of Utah)
n_{ia} = number of individuals in ith class of study area
n_{is} = number of individuals in ith class of reference standard area
x_{ia} = number of cases in ith age class of area a (similarly for s)
$p_{ia} = x_{ia}/n_{ia}$ = incidence rate in ith age class of area a (similarly for s)

(Harold A. Kahn and Christopher T. Sempos, "Statistical Methods in Epidemiology", Oxford University Press, 1989, pp 85-136.)

The confidence interval for the SIR is the range of values for a calculated SIR with a specified probability (95%) of including the true SIR value:

$$\frac{\left[\sqrt{n} \pm (1.96 \, X \, 0.5)\right]^2}{x}$$

Where *n* is the Number of Observed.
x is the Number of Expected.

(Frumkin, H., Kantrowitz, W. (1987) Cancer Clusters in the Workplace: An Approach to Investigation. *Journal of Occupational Medicine*, Vol. 29 (No. 12):949-952.)

The confidence interval is used as a surrogate test of statistical significance (p-value). Both the p-value function and the spread of the function can be determined from the confidence interval. The difference between the observed versus the expected is considered significant if the confidence interval for the SIR does not include one (1.0) and if the SIR is greater than one (1.0).

(Rothman KJ. Greenland S, 1998. Modern Epidemiology. Lipincott-Raven Publishers. pp. 189-191)

APPENDIX C – CANCERS EVALUATED

Cancers

Gastrointestinal Tract
- Oral Cavity & Pharynx
- Esophagus
- Stomach
- Small Intestine
- Colon (Excluding Rectum)
- Rectum & Rectosigmoid Junction
- Anus, Anal Canal, and Anorectum
- Liver & Intrahepatic Bile Duct
- Gallbladder & Biliary Ducts
- Pancreas
- Other Digestive System

Urinary Tract
- Bladder
- Kidney & Renal Pelvis
- Other Urinary

Skin, Bone, Soft Tissue
- Bones & Joints
- Soft Tissues (including heart)
- Cutaneous Melanoma
- Other Melanoma

Respiratory Tract
- Larynx
- Lung & Bronchus
- Other Respiratory System

Blood and Lymph
- Hodgkin's Lymphoma
- Non-Hodgkin's Lymphoma
- Multiple Myeloma
- Lymphocytic Leukemia
- Myeloid Leukemia
- Monocytic Leukemia
- Other Leukemia

Head and Neck
- Eye & Orbit
- Brain
- Thyroid
- Other Endocrine

Female-specific cancers
- Breast
- Cervix
- Uterus
- Ovary
- Other Female Genital

Male-specific cancers
- Prostate
- Testis
- Other Male Genital

Other sites

APPENDIX D – CANCER TABLES

Table 1. Annual age-adjusted cancer incidence rates for cancer from all sites by by two five-year and one four-year periodscomparing Cottonwood Heights to Utah – 1988-2001.

Time Period	Cottonwood Heights Rate per 100,000	Utah Rate per 100,000	Cottonwood Heights Observed number cases	Cottonwood Heights Expected number cases	SIR[1]	95% CI[2]
1988-1992	284.77	403.0	62	89	0.70*	0.54, 0.90
1993-1997	373.08	400.7	107	119	0.90	0.74, 1.09
1998-2001	367.5	402.5	117	145	0.81*	0.67, 0.97
[1] Standardized Incidence Ratio						
[2] 95% Confidence interval						
* Statistically significantly decreased (p ≤0.05) from the expected number of cases.						
Data Source: Utah Cancer Registry, 2001.						

Table 2. Annual age-adjusted cancer incidence rates for cancer of the larynx by two five-year and one four-year periods comparing Cottonwood Heights to Utah – 1988-2001.

Time Period	Cottonwood Heights Rate per 100,000	Utah Rate per 100,000	Cottonwood Heights Observed number cases	Cottonwood Heights Expected number cases	SIR[1]	95% CI[2]
1988-1992	2.5	2.5	=<3	1.02	0.98	0.02, 9.27
1993-1997	2.1	2.2	=<3	1.05	0.95	0.02, 7.90
1998-2001	15.1	2.0	4	1.50	2.67*	1.44, 13.7
[1] Standardized Incidence Ratio						
[2] 95% Confidence interval						
* Statistically significantly increased (p ≤0.05) from the expected number of cases.						
Data Source: Utah Cancer Registry, 2001.						

TABLES CONTIINUED

Table 3. Annual age-adjusted cancer incidence rates for colon cancer by two five-year and one four-year periods comparing Cottonwood Heights to Utah – 1988-2001

Time Period	Cottonwood Heights Rate per 100,000	Utah Rate per 100,000	Cottonwood Heights Observed number cases	Cottonwood Heights Expected number cases	SIR[1]	95% CI[2]
1988-1992	32.5	32.47	=<3	6	0.52	0.10, 1.52
1993-1997	21.6	29.7	=<3	7	0.43	0.08, 1.19
1998-2001	8.8	29.6	=<3	9	0.22*	0.02, 0.81
[1] Standardized Incidence Ratio						
[2] 95% Confidence interval						
* Statistically significantly decreased (p ≤0.05) from the expected number of cases.						
Data Source: Utah Cancer Registry, 2001.						

Table 4. Annual age-adjusted cancer incidence rates for lung and bronchus cancer by two five-year and one four-year periods comparing Cottonwood Heights to Utah – 1988-2001

Time Period	Cottonwood Heights Rate per 100,000	Utah Rate per 100,000	Cottonwood Heights Observed number cases	Cottonwood Heights Expected number cases	SIR[1]	95% CI[2]
1988-1992	3.02	31.43	=<3	7	0.15*	0.00, 0.85
1993-1997	34.2	32.56	8	9	0.91	0.39, 1.79
1998-2001	22.05	30.83	5	10	0.50	0.16, 1.16
[1] Standardized Incidence Ratio						
[2] 95% Confidence interval						
* Statistically significantly decreased (p ≤0.05) from the expected number of cases.						
Data Source: Utah Cancer Registry, 2001.						

APPENDIX E - AIR SAMPLING TABLES

RESULTS

Table 5. Particulate Matter (PM_{10}) ambient air concentrations at Site #1 and Site #2, Cottonwood Heights area near gravel pit, 2002.

Run Number	**PM_{10} Sampling Date July 2002**	**Site #1 Intermountain Christian School Concentrations (ug/m^3)**	**Site #2 3474 East 6575 South Concentrations (ug/m^3)**
1	July 02	36	No Run
2	July 05	33	10
3	July 09	5	27
4	July 11	Void	10
5	July 15	17	8
6	July 17	Void	29
7	July 19	14	19
8	July 23	23	36
9	July 26	13	6
10	July 30	43	14
Minimum	**Site #1 July 09 Site #2 July 26**	**5**	**6**
Average		**23**	**18**
Maximum	**Site #1 July 30 Site #2 July 23**	**43**	**36**

Data Source: Utah Division of Air Quality, 2002

EPA Comparison Values:

PM10 -The 24-hour ambient air standard is 155 ug/m^3

TSP- The former 24-hour ambient air standard was 265 ug/m3

Table 6. Total Suspended Particulate (TSP) ambient air concentrations at Site #1 and #2, Cottonwood Heights area near gravel pit from August 3 to September 4, 2002.

Run Number	**PM_{10} Sampling Date July 2002**	**Site #1 Intermountain Christian School Concentrations (ug/m^3)**	**Site #2 3474 East 6575 South Concentrations (ug/m^3)**
1	August 03	29	128
2	August 06	36	62
3	August 08	32	97
4	August 12	83	39
5	August 14	28	29
6	August 16	57	Void
7	August 19	122	434
8	August 22	46	221
9	August 26	70	96
10	August 28	86	75
11	August 30	77	Void
12	September 04	60	Void
Minimum	**Site #1 & #2 August 14**	**28**	**29**
Average		**61**	**131**
Maximum	**Site #1 & #2 August 19**	**122**	**434**

Data Source: Utah Division of Air Quality, 2002

EPA Comparison Values:

PM10 -The 24-hour ambient air standard is 155 ug/m^3

TSP- The former 24-hour ambient air standard was 265 ug/m3

Table 7. Total Suspended Particulate (TSP) ambient air concentrations at Site #1 and Site #3, Cottonwood Heights area near gravel pit, 2004.

Run Number	**TSP Sampling Date April – June 2004**	**Site #1 Intermountain Christian School Concentrations (ug/m^3)**	**Site #3 3265 East 6985 South Concentrations (ug/m^3)**
1	April 13	35	No Run
2	April 15	29	21
3	April 23-24	16	2
4	April 26	49	28
5	April 29	26	Void-Flow Fault
6	May 4	41	15
7	May 6	44	29
8	May 18	67	Void–Battery Fault
9	May 20	47	35
10	May 26	26	15
11	June 2	40	28
12	June 4	22	58
13	June 8	76	118
14	June 15	Void–Battery Fault	25
Minimum	**April 23-24**	**16**	**2**
Average		**40**	**34**
Maximum	**June 8**	**76**	**118**

Data Source: Utah Division of Air Quality, 2004

EPA Comparison Values:

PM10 -The 24-hour ambient air standard is 155 ug/m^3

TSP- The former 24-hour ambient air standard was 265 ug/m3

Table 8: Semi-volatile compounds monitored in the Cottonwood Heights area in 2004 by the Utah Division of Air Quality. No detectable level found of any compound.

NUMBER	COMPOUND NAME	NUMBER	COMPOUND NAME
1	Acenaphthene	35	2,4-Dinitrophenol
2	Acenaphthylene	36	Dimethylphthalate
3	Anthracene	37	2,6-Dinitrotoluene
4	Aniline	38	2,4-Dinitrotoluene
5	Benzidine	39	Di-n-octylphthalate
6	Benz(a)anthracene	40	Fluoranthene
7	Benzo(a)pyrene	41	Fluorene
8	Benzo(k)fluoranthene	42	Hexachlorobenzene
9	Benzo(b)fluoranthene	43	Hexachlorobutadiene
10	Benzo(g,h,i)perylene	44	Hexachloroethane
11	Benzybutylphthlate	45	Hexachlorocyclopentadiene
12	Benzylalcohol	46	Indeno(1,2,3-c,d)pyrene
13	Benzoic acid	47	Isophorone
14	Bis(2-chloroethyl)ether	48	2-Methyl-4,6-dinitrophenol
15	Bis(2-chloroethoxy)methane	49	2-Methylnaphthalene
16	Bis(2-chloroisopropyl)ether	50	2-Methylphenol
17	Bis(2-ethylhexyl)phthalate	51	3-Methylphenol
18	4-Bromophenyl phenyl ether	52	4-Methylphenol
19	4-Chloroaniline	53	Naphthalene
20	2-Chloronaphthalene	54	2-Nitroaniline
21	4-Chloro-3-methyl phenol	55	3-Nitroaniline
22	2-Chlorophenol	56	4-Nitroaniline
23	4-Chlorophenyl phenyl ether	57	Nitrobenzene
24	Chrysene	58	2-Nitrophenol
25	Dibenzo(a,h) anthracene	59	4-Nitrophenol
26	Dibenzofuran	60	n-Nitrosodimethyamine
27	Di-n-butylphthalate	61	n-Nitrosodiphenylamine
28	1,4-Dichlorobenzene	62	n-Nitrosodi-n-propylamine
29	1,2-Dichlorobenzene	63	Pentachlorophenol
30	1,3-Dichlorobenzene	64	Phenanthrene
31	3,3-Dichlorobenzidine	65	Phenol
32	2,4-Dichlorophenol	66	Pyrene
33	2,4-Dimethylphenol	67	1,2,4-Trichlorobenzene
34	Diethylphthalate	68	2,4,6-Trichlorophenol