Massachusetts
Department of
Public Health

Evaluation of the Incidence of Leukemia, Multiple Myeloma, and Non-Hodgkin Lymphoma in Fitchburg and Leominster, MA

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I. SUMMARY

In response to a request from a cancer epidemiologist at the University of Massachusetts (UMass) Medical Center, the Community Assessment Program (CAP) of the Massachusetts Department of Public Health/Bureau of Environmental Health (MDPH/BEH) evaluated the incidence of leukemia, multiple myeloma and non-Hodgkin lymphoma (NHL) in Fitchburg and Leominster for the years 2006 to 2010. Incidence rates of these three blood-related cancers were not statistically significantly elevated at the community level during this time period. At the census tract (CT) level, two CTs had statistically significant elevations of cancer:

- In Fitchburg, NHL was statistically significantly elevated among females in CT 7106.
- In Leominster, leukemia was statistically significantly elevated among females in CT 7095.

For each of these statistically significant elevations, trends in the ages at diagnosis and the subtypes followed what would be expected based on national trends. In addition, the geographic distribution of the addresses at the time of diagnosis followed the pattern of population density. Overall, there does not appear to be an unusual pattern of leukemia, multiple myeloma or NHL in the communities of Fitchburg and Leominster based on the information reviewed in this report.

With respect to the former Foster Grant/American Hoechst site, a review of the history of the site was conducted in response to concerns raised by the requestor. Due to difficulties in re-creating past site conditions, this report is limited in its evaluation of possible past exposures. Information on potential air emissions from the plant when it was in operation was not available. However, based on available historical environmental assessments, it appears unlikely that nearby residents

would have been exposed to contaminants on-site in soil, sediment, surface water, and/or groundwater.

II. INTRODUCTION

An evaluation of hematopoietic cancers in Fitchburg and Leominster, MA was conducted at the request of a cancer epidemiologist at the UMass Medical Center in Worcester, which is a regional referral center for these cancers. Hematopoietic cancers originate in blood and bone marrow. CAP analyzed data from the Massachusetts Cancer Registry (MCR) for diagnoses of leukemia, NHL and multiple myeloma from 2006 to 2010 for the communities of Fitchburg and Leominster and their census tracts. For those cancer types with an elevation of incidence, CAP conducted a review of available risk factor information and the distribution of diagnoses, both geographic and temporal. The area around the site of the former Foster Grant/American Hoechst plastics factory was of special concern to the requestor. This former factory was located at 289 North Main Street in CT 7096 in Leominster (Figures 1 and 2). CAP reviewed readily available documents from Massachusetts Department of Environmental Protection (MassDEP) describing site conditions to address these concerns.

III. METHODS FOR ANALYZING CANCER INCIDENCE

A. CASE IDENTIFICATION/DEFINITION

Cancer incidence data for leukemia, NHL and multiple myeloma from 2006 to 2010 were obtained for Fitchburg and Leominster from the MCR. At the time of the initiation of this evaluation, 2010 represented the most recent completed year of data available. The MCR is a

population-based surveillance system that has been monitoring cancer incidence in the Commonwealth since 1982. All new diagnoses of invasive cancer, as well as certain in situ (localized) cancers, are required by law to be reported to the MCR (M.G.L. c.111 s.111b). Diagnoses are reported based on residential address at the time of diagnosis. This information is kept in a confidential database and reviewed for accuracy and completeness.

It should be noted that duplicate records have been eliminated from the MCR data used in this report. Duplicate records are additional reports of the same primary site cancer diagnosed in an individual by another health-care provider. The decision that a record was a duplicate and should be excluded from the analyses was made by the MCR. However, reports of individuals with multiple primary site cancers are included as separate diagnoses in this report. In general, a diagnosis of a multiple primary cancer is defined by the MCR as a new cancer in a different location in the body or a new cancer of the same histology (cell type) as an earlier cancer, if diagnosed in the same primary site (original location in the body) more than a specified period of time after the original diagnosis depending upon the type of cancer (NCI 2012).

B. Calculation of a Standardized Incidence Ratio (SIR)

The standardized incidence ratio (SIR) is a comparison of the number of diagnoses in the specific area (i.e., community or census tract) to the number of expected diagnoses based on the statewide rate. An SIR is the ratio of the observed number of cancer diagnoses in an area to the expected number of diagnoses multiplied by 100. Age-specific statewide incidence rates are applied to the population distribution of a community or CT to calculate the number of expected cancer diagnoses. A CT is the smallest geographic area for which cancer incidence rates can be calculated by MDPH. Comparison of SIRs between communities or census tracts is not possible

because each area has different population characteristics. An SIR is not calculated when fewer than five diagnoses are observed.

C. Interpretation of a Standardized Incidence Ratio

An SIR is an estimate of the occurrence of cancer in a population relative to what might be expected if the population had the same cancer experience as a larger comparison population designated as "normal" or average. Usually, the state as a whole is selected to be the comparison population, which provides a stable population base for the calculation of incidence rates.

An SIR of 100 indicates that the number of cancer diagnoses observed in the population evaluated is equal to the number of cancer diagnoses expected in the comparison or "normal" population. An SIR greater than 100 indicates that more cancer diagnoses occurred than expected and an SIR less than 100 indicates that fewer cancer diagnoses occurred than expected. Accordingly, an SIR of 150 is interpreted as 50% more diagnoses than the expected number; an SIR of 90 indicates 10% fewer diagnoses than expected.

Caution should be exercised, however, when interpreting an SIR. The interpretation of an SIR depends on both the size and the stability of the SIR. Two SIRs can have the same size but not the same stability. For example, an SIR of 150 based on four expected diagnoses and six observed diagnoses indicates a 50% excess in cancer, but the excess is actually only two diagnoses. Conversely, an SIR of 150 based on 400 expected diagnoses and 600 observed diagnoses represents the same 50% excess in cancer, but because the SIR is based upon a greater number of diagnoses, the estimate is more stable. It is very unlikely that 200 excess diagnoses of

cancer would occur by chance alone. As a result of the instability of incidence rates based on small numbers of diagnoses, SIRs are not calculated when fewer than five diagnoses are observed for a particular cancer type.

D. Calculation of the 95% Confidence Interval

To help interpret or measure the stability of an SIR, the statistical significance of an SIR can be assessed by calculating a 95% confidence interval (CI) to determine if the observed number of diagnoses is "statistically significantly different" from the expected number or if the difference may be due solely to chance (Rothman and Boice 1982). Specifically, a 95% CI is the range of estimated SIR values that has a 95% probability of including the true SIR for the population. If the 95% CI range does not include the value 100, then the study population is significantly different from the comparison or "normal" population. "Statistically significantly different" means there is less than a 5% percent chance that the observed difference (either increase or decrease) in the rate is the result of random fluctuation in the number of observed cancer diagnoses.

For example, if a confidence interval does not include 100 and the interval is above 100 (e.g., 105-130), then there is a statistically significant excess in the number of cancer diagnoses. Similarly, if the confidence interval does not include 100 and the interval is below 100 (e.g., 45-96), then the number of cancer diagnoses is statistically significantly lower than expected. If the confidence interval range includes 100, then the true SIR may be 100. In this case, it cannot be determined with certainty whether the difference between the observed and expected number of diagnoses reflects a real cancer increase or decrease or is the result of chance. It is important to

note that statistical significance alone does not necessarily imply public health significance. Determination of statistical significance is just one tool used to interpret cancer patterns.

In addition to the range of the estimates contained in the confidence interval, the width of the confidence interval also reflects the stability of the SIR estimate. For example, a narrow confidence interval (e.g. 103-115), allows a fair level of certainty that the calculated SIR is close to the true SIR for the population. A wide interval (e.g. 85-450) leaves considerable doubt about the true SIR, which could be much lower than or much higher than the calculated SIR. This would indicate an unstable statistic. Due to the instability of incidence rates based on small numbers of diagnoses, statistical significance is not assessed when fewer than five diagnoses are observed.

E. Evaluation of Cancer Risk Factor Information

Cancer is not just one disease but rather a general term used to describe a variety of different diseases. Studies have generally shown that different cancer types have different risk factors. One or even several factors acting over time can be related to the development of cancer.

Available risk factor information was reviewed for residents of Fitchburg and Leominster who were diagnosed with a cancer type that was elevated at the community or census tract level during 2006 to 2010. This information is collected for each individual at the time of diagnosis and may include the individual's age at time of diagnosis, the stage of disease, and the individual's history of tobacco use and occupation.[1] The available risk factor information was

[1] Based on recent research by the MCR (MCR 2013), which included an evaluation of the reliability of the tobacco use history information reported to the MCR, it appears that the category of "never smoker" is less reliable than other reporting categories (such as current or former smoker). Many individuals are reported as never having smoked when, based on medical record reviews, they are individuals who are not current smokers but whose past tobacco use is unknown. These individuals should more accurately be reported as having an unknown tobacco use history

compared to known or established incidence patterns for the specific type of cancer. To protect the privacy of those residents diagnosed with cancer during this time period, the information is presented in this report as a summary without any specific identifying details. Unfortunately, information about personal risk factors such as family history, medical history, diet, and other factors that may also influence the development of cancer is not collected by the MCR. Therefore, it was not possible to consider their contributions to cancer development in this investigation.

F. Determination of Geographic Distribution of Cancer Diagnoses

Using a computerized geographic information system (GIS), address at the time of diagnosis was mapped for each individual diagnosed with leukemia, NHL or multiple myeloma in Fitchburg and Leominster during 2006 to 2010. This allowed for an evaluation of the spatial distribution of the individual diagnoses at a smaller geographic level within a community (i.e., neighborhoods). This evaluation of the point pattern of diagnoses included consideration of the variability in population density within the community.

The MDPH is bound by state and federal patient privacy and research laws not to make public the names or any other information (e.g., place of residence) that could personally identify individuals with cancer whose diagnoses have been reported to the MCR (M.G.L. c.111. s. 24A). Therefore, for confidentiality reasons, it is not possible to release maps showing the locations of individuals diagnosed with cancer in public reports. However, a summary of the evaluation of geographic distribution with any notable findings is presented in this report.

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rather than being categorized as never having used tobacco products. This misclassification is expected to result in an overestimate of those categorized as "never smokers" and an underestimate of those categorized as "former smokers".

IV. RESULTS

Tables 1 and 2 contain incidence data for three types of cancer (leukemia, multiple myeloma, and NHL) for the 5-year time period of 2006 to 2010 for the communities of Fitchburg and Leominster, respectively. No statistically significant elevations were observed in either community. In many instances, the number of observed diagnoses was less than or about as expected (within one or two diagnoses) based on the statewide experience. While not statistically significant, the following elevations were observed:

- Leukemia among males (22 observed compared to about 16 expected) in Leominster
- Multiple myeloma among males (12 observed compared to about 7 expected) in Fitchburg
- NHL among both males (28 observed compared to about 23 expected) and females (27 observed compared to about 21 expected) in Fitchburg and among females (25 observed compared to about 21 expected) in Leominster

Tables 3 through 8 contain incidence data for the three cancers of interest for each census tract in the two communities. Statistically significant elevations were observed for leukemia among females in Leominster CT 7095 with 7 observed diagnoses compared to about 3 expected (SIR = 270, 95% CI = 108 – 556); and NHL among females in Fitchburg CT 7106 with 9 observed diagnoses compared to about 3 expected (SIR = 280, 95% CI = 128 – 532). While not statistically significant, the following elevations were observed:

- Leukemia among males in Leominster CT 7095 (7 observed compared to about 3 expected) and males in Leominster CT 7092.02 (6 observed compared to about 3 expected)

- NHL among females in Fitchburg CT 7102 (7 observed compared to about 4 expected) and females in Leominster CT 7092.01 (6 observed compared to about 3 expected)

The incidence of those cancer types where elevations were observed is discussed further in the following sections.

A. FITCHBURG

a. Multiple Myeloma

In Fitchburg, the incidence of multiple myeloma was greater than expected among males (12 observed versus 7 expected) during 2006-2010. This elevation was not statistically significant. There were no unusual geographic concentrations of diagnoses and the distribution of diagnoses followed population density patterns. A review of the temporal distribution of diagnoses showed that the number of diagnoses varied from year to year, though it was observed that half of diagnoses among males occurred in 2009. Diagnoses were spread over several CTs with the number of observed diagnoses occurring within one or two of the expected number. In CT 7108, where a total of 6 diagnoses were reported for males and females combined, the spatial distribution of diagnoses followed population density patterns. Two diagnoses that occurred among individuals living in close proximity to each other were within a nursing home. According to the American Cancer Society (ACS), most people diagnosed with multiple myeloma are at least 65 years old (ACS 2016a). In Massachusetts, the median age at diagnosis for individuals diagnosed with multiple myeloma from 2009 to 2013 was 68 for males and 70 for females (MCR 2016). In Fitchburg, the median age at diagnosis was 70 for males and 72 for females.

Other risk factors for multiple myeloma include exposure to ionizing radiation, family history and certain preexisting medical conditions (ACS 2016a, ACS 2015). It is not possible to evaluate these factors since the MCR does not collect information related to these risk factors.

b. Non-Hodgkin Lymphoma

During 2006-2010, the incidence of NHL was greater than expected in Fitchburg for both males (28 observed versus 23 expected) and females (27 observed versus 21 expected). Neither elevation was statistically significant. The number of diagnoses of NHL in any given year in Fitchburg fluctuated over the 5-year time period, with a minimum of 2 for males and 3 for females, and a maximum of 10 for males and 9 for females. No unusual spatial patterns were observed. The incidence of NHL generally increases with age, with most diagnoses occurring in people in their 60s or older (ACS 2016b). The ages at diagnosis in Fitchburg followed expected national trends, with 63% of females and 50% of males diagnosed at age 60 and above. In Massachusetts, median age at diagnosis for NHL from 2009 to 2013 was 66 for males and 68 for females (MCR 2016). In Fitchburg, median age at diagnosis was 61 for males and 66 for females.

NHL is a classification of all lymphomas except Hodgkin lymphoma. B-cell lymphomas account for about 85% of all NHL diagnoses in the US and consist of many subtypes. T-cell lymphomas are less common but also consist of many subtypes (ACS 2016b). Among both males and females diagnosed with NHL in Fitchburg during 2006-2010, 93% were diagnosed with B-cell lymphomas and 7% were diagnosed with T-cell lymphomas.

At the census tract level, a statistically significant elevation of NHL occurred among females in CT 7106 with 9 observed diagnoses versus about 3 expected (SIR = 280, 95% CI = 128 – 532). No geographic concentrations were observed as most of those diagnosed lived in areas of high population density. The number of diagnoses fluctuated from year to year over the 5-year time period 2006-2010 with a minimum of 1 diagnosis and a maximum of 5. The ages of females in CT 7106 diagnosed with NHL during 2006-2010 generally followed national trends, with 67% diagnosed at age 60 or older (ACS 2016b). Nearly all of the diagnoses were B-cell lymphomas.

CT 7102 had an elevated number of diagnoses of NHL among females (7 observed versus 4 expected). The elevation was not statistically significant. Diagnoses in this tract were not concentrated geographically or temporally. The ages at diagnosis and subtypes of NHL followed expected national trends. The average age at diagnosis was 70 and all consisted of B-cell lymphomas.

Although NHL is associated with a number of risk factors, such as a weakened immune system and certain infections, most patients do not have any known risk factors and the causes are unknown (ACS 2016b). This is complicated by the fact that NHL is actually a diverse group of lymphomas. It is possible that each subtype of NHL may have different risk factors associated with its development.

B. LEOMINSTER

a. Leukemia

Leukemia is generally divided into four major subtypes: acute lymphocytic leukemia (ALL), acute myeloid leukemia (AML), chronic lymphocytic leukemia (CLL), and chronic myeloid leukemia (CML). Most diagnoses of ALL occur in children, but 4 out of 10 diagnoses occur in adults (ACS 2016c, ACS 2016d). Risk factors for ALL include ionizing radiation exposure, exposure to certain chemicals such as benzene, certain viral infections and some inherited genetic diseases (ACS 2016d, ACS 2015). Conversely, AML is more common among older adults and the average age at diagnosis nationally is 67. Risk factors for AML include smoking, ionizing radiation exposure, exposure to certain chemicals and certain chemotherapy drugs used in treatment for a previous cancer (ACS 2016e, ACS 2015). CLL is also more common among older adults, with an average age at diagnosis of 71, and comprises about 25% of new diagnoses of leukemia (ACS 2016f). Finally, the average age at diagnosis for CML nationally is 64. One of the few known risk factors for CML is ionizing radiation exposure (ACS 2016g, ACS 2015).

Among males in Leominster, leukemia occurred more than expected (22 observed versus 16 expected) during 2006-2010. This elevation was not statistically significant. A review of the geographic distribution of addresses at the time of diagnosis and the temporal distribution of diagnoses did not reveal any unusual patterns. Ages and subtypes at diagnosis generally followed national trends. All of those diagnosed with AML who had a known tobacco use history from the MCR were current or former users of tobacco.

Leominster CT 7095 had a statistically significant elevation of leukemia among females during 2006-2010 with 7 diagnoses observed versus 3 expected (SIR = 270, 95% CI = 108 – 556). The dates of diagnosis ranged across the time period and the addresses at the time of diagnosis

generally followed patterns of population density. Subtypes followed what would be expected and primarily included AML and CML. In addition, the ages at the time of diagnosis followed what would be expected for each particular subtype. Although smoking is one of several established risk factors for AML, none of those for whom tobacco use history was reported to the MCR were current or former smokers. To protect the privacy of the females diagnosed with leukemia in CT 7095, no other specific subtypes will be discussed here. Males in CT 7095 also experienced leukemia at greater numbers than expected (7 observed versus 3 expected). No unusual spatial concentrations were observed, and the number of diagnoses in any given year varied between zero and 4. The subtypes primarily consisted of CLL and CML. The ages at the time of diagnosis followed what would be expected for each particular subtype, with nearly all occurring among older adults. When the geographic distribution of both males and females was examined together, no unusual concentrations were seen. When the temporal distribution of both males and females was examined together, the number of diagnoses occurring in a given year ranged from a minimum of one to a maximum of 6.

The incidence of leukemia among males in CT 7092.02 was elevated during 2006-2010 (6 observed versus 3 expected). No unusual temporal or spatial patterns were observed. Several different subtypes were diagnosed, including CLL, AML and ALL. The ages at the time of diagnosis followed what would be expected for each particular subtype.

b. Non-Hodgkin Lymphoma

NHL among females occurred more than expected in Leominster (25 observed versus 21 expected) during 2006-2010. This elevation was not statistically significant. A review of the

dates of diagnosis and geographic distribution did not reveal any unusual spatial concentrations or temporal patterns. The ages at diagnosis and subtypes of NHL followed national trends, with 76% diagnosed at age 60 or above, and 80% diagnosed with B-cell lymphomas.

NHL was also elevated for females in CT 7092.01 (6 observed versus about 3 expected), but the elevation was not statistically significant. The distribution of addresses at the time of diagnosis followed patterns of population density in the tract, with no unusual spatial or temporal clustering. Trends in age at diagnosis and subtypes of NHL in this tract followed expected national trends; 83% of these diagnoses were in their 60s and older, and all of the diagnoses were B-cell lymphomas.

V. ENVIRONMENTAL CONCERNS

To address concerns about possible environmental exposures from historical releases at the former Foster Grant/American Hoechst (FG/AH) factory site, CAP staff reviewed the history of the site and considered potential ways that people could have come into contact with contaminants associated with this site.

A. BACKGROUND

The former FG/AH factory site is located on a 63 acre property at 289 North Main Street in Leominster. The site is bounded by North Main Street (Route 12) and a railroad right-of-way to the west, Hamilton Street to the north, and undeveloped wetlands to the east and southeast. The former site is situated on the northwest border of CT 7096 (Figure 1). The northern part of the

site is largely flat, but the southern part of the property slopes towards the east and southeast into the wetlands. Priest Brook flows through the southern part of the property, entering from a culvert under North Main Street in the southwestern corner of the site and runs east towards the wetlands.

B. Site History

In 1936, Foster Grant purchased the property from the Richardson Piano Case Company for plastics production and expanded the site facilities, adding additional buildings, storage tanks, and a detention pond adjacent to the brook and wetlands. In 1978, Foster Grant merged with American Hoechst Corporation.

Activities at the facility included polystyrene plastic manufacturing, plastics research and development, electroplating, and sunglasses production. Most manufacturing and chemical storage on the property occurred in and around buildings in the northern and western parts of the site. Additional site features were buildings for plastics research and development along North Main Street, a water tower behind the research and development buildings, a plastics production building towards the center of the site where polymer manufacturing took place, and a wastewater treatment plant to the south of the site adjacent to the detention pond (CHES 1993). Plastics manufacturing ended in the early 1980s and electroplating of sunglass frames continued until 1984 (MDPH 1991). From 1985 to 1996 the site was host to changes in site ownership, demolition of factory facilities, construction of a mall and several phases of environmental monitoring and remediation.

Currently, the northwestern part of the property is occupied by the parking lot and retail buildings of the Water Tower Plaza mall. Fosta-Tek Optics, an optical products manufacturing company, owns a former Foster Grant building to the east of the mall on Hamilton Street. The detention pond is still present and collects runoff from the mall parking lot (CHES 1993).

C. Site Contamination and Remediation

The Massachusetts Contingency Plan (MCP), the statewide hazardous waste site cleanup program, was established in 1983 under Chapter 21E of Massachusetts General Laws (M.G.L. c21E, 310 CRM 40.0000). It authorizes the Massachusetts Department of Environmental Protection (MassDEP) to enforce regulations governing the investigation and cleanup of oil and hazardous material release sites. Releases can vary widely with respect to the source, materials involved and the amount released, and the geographic extent of contamination.

In 1986, the MassDEP was notified of contaminants in soil, groundwater and surface water at concentrations reportable under the MCP, and the property was assigned Release Tracking Number (RTN) 2-0000078. Over the course of several site assessments, areas of suspected or known contamination were identified. To the north, underground storage tanks of fuel oil were buried adjacent to the water tower and leaking fuel oil was noticed when the tanks were removed in 1987. In 1991, 761 tons of petroleum-contaminated soils were removed, and an additional 4,578 tons of impacted soil were removed in 1995 after the demolition of the water tower (CHES 1993, 1996).

A fence erected in 1990 separated the northern part of the site from the detention pond, brook and wetlands to the south (CHES 1993). The southern portion of the site contained scattered areas of contamination. Two unlined disposal pits were located adjacent to the detention pond. These pits were used for the disposal of solid waste, including glass, polystyrene beads and metal hydroxide sludge, a byproduct of onsite manufacturing processes (GZA 1985). The pits were excavated in 1991 and 7,774 tons of non-hazardous pit sludge were removed (CHES 1993).

Petroleum contaminants were detected in the detention pond sediments, likely the remnants of a past spill of fuel oil into the pond, as well as volatile organic compounds (VOCs), and metals (CHES 1993). The detention pond discharged water into Priest Brook, but sampling indicated that contaminants from the pond sediments were not travelling into the brook (CHES 1993).

Priest Brook flows north of the detention pond and into nearby wetlands. Contaminants detected in surface water and sediment of the brook included metals, ethylbenzene, and styrene (GZA 1985, 1986, CHES 1993). Solidified plastic styrene was visible on the edges of Priest Brook in several locations. This plastic was inert, and was not found to be impacting the underlying surface soil in these areas (CHES 1996). In 1995, 5,228 tons of contaminated soils and solidified plastic were removed from the Priest Brook area. Two culvert pipes through which Priest Brook flowed were also removed during remediation (CHES 1996).

Although a new version of the MCP was released in 1993, the FG/AH site was issued a waiver in 1990 that allowed it to be regulated under the 1988 version of the MCP (Alceon Corporation

1996). In 1996, a completion statement was submitted to MassDEP stating that a permanent solution had been achieved under this earlier version of the MCP and the site was closed out.

D. Exposure Assessment

In general, five conditions must be present for exposure to occur. First, there must be a source of the chemical or contaminant. Second, an environmental medium must be contaminated by either the source or by chemicals transported away from the source. Third, there must be a location where a person can potentially contact the contaminated medium. Fourth, there must be a means by which the contaminated medium could enter a person's body, such as ingestion, inhalation, or dermal absorption. Finally, a population of individuals that could potentially be exposed must be present (ATSDR 2005). A completed exposure pathway exists when all five elements are present and indicates that exposure to humans occurred in the past, is occurring in the present, or will occur in the future. A potential exposure pathway exists when one or more of the five elements is uncertain and indicates that exposure to a contaminant could have occurred in the past, could be occurring in the present, or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will not likely be present in the future.

In 1990, there was concern in the surrounding community about the potential effects of the FG/AH factory on the health of nearby residents. The plant had ceased operations by this point. In 1991, MDPH/BEH released a report titled "Assessment of Current and Future Exposure Potential at the Foster Grant/American Hoechst 21-E Site, Leominster, MA". This report assessed the potential exposure of nearby residents to contaminants remaining on-site in soil, groundwater and surface water; it did not assess potential air emissions when the plant was in

operation. Since remaining contaminants were localized within site boundaries, it was determined that there was no opportunity for exposure to occur, and therefore that the public health of nearby residents was not impacted (MDPH 1991). Subsequent risk assessments in 1993 and 1996 concluded that the concentrations of chemicals remaining on-site did not pose a risk to public health (Alceon Corporation 1993, 1996).

Due to difficulties in re-creating past site conditions, this report is limited in its evaluation of possible past exposures. However, since the contamination reported in soil, sediment, and surface water did not extend past the site boundaries (based on historical environmental assessment documents), no historical exposure pathways were likely for nearby residents unless they trespassed on to the site. There was no evidence of trespassing observed during a 1990 site visit by MDPH staff, who noted at the time that the locked chain link fence made the wetlands inaccessible to the public (MDPH 1991). Also, nearby residents historically obtained their water from the municipal water supply (CHES 1993, MDPH 1991). As stated in the MDPH 1991 report, no opportunity for exposure seemed to exist at that time.

VI. DISCUSSION

According to the ACS, not only will one out of three women and one out of two men develop cancer in their lifetime, but cancer will affect three out of every four families. For this reason, cancers often appear to occur in "clusters," and it is understandable that someone may perceive an unusually high number of cancer cases in their neighborhood or community. Upon close examination, many of these "clusters" are not unusual increases, as first thought, but are related to such factors as local population density, variations in reporting, or chance fluctuations in occurrence. In other instances, the "cluster" in question includes a high concentration of

individuals who possess related behaviors or risk factors for cancer. Some, however, are unusual; that is, they represent a true excess of cancer in a workplace, a community, or among a subgroup of people. A suspected cluster is more likely to be a true cancer cluster if it involves a large number of diagnoses of one type of cancer diagnosed in a relatively short time period rather than several different types diagnosed over a long period of time (e.g., 20 years), a rare type of cancer rather than a common type, and/or a large number of diagnoses among individuals in age groups not usually affected by that cancer. These types of clusters may warrant further public health investigation.

Descriptive epidemiological analyses such as this report can be useful in evaluating the pattern of cancer in a geographic context, assessing the possibility of a common cause or etiology, and determining whether further public health investigations or actions may be warranted. A descriptive analysis of cancer incidence data alone cannot be used to establish a causal link between a particular risk factor (either environmental or non-environmental) and the development of cancer. Similarly, this type of analysis cannot determine the cause of cancer in any one particular individual. The purpose of this report was to evaluate the incidence of cancer in the communities of Fitchburg and Leominster to determine whether any unusual patterns were evident.

Since the time of the initiation of this report, two additional years of cancer incidence data were added to the MCR. Diagnoses of leukemia, multiple myeloma and NHL were qualitatively assessed for 2011 and 2012 for Fitchburg and Leominster using readily available data, especially with respect to elevations observed for 2006 to 2010. Due to the small number of diagnoses of

each of the three types of cancer and the need to protect patient confidentiality, no specific details about these diagnoses are provided. However, the additional diagnoses did not contribute to any unusual geographic or temporal patterns. Also, the ages and subtypes followed what would be expected for each cancer type based on state and national trends.

VII. CONCLUSIONS

Overall, there does not appear to be an unusual pattern of leukemia, multiple myeloma or NHL in the communities of Fitchburg and Leominster based on the information reviewed in this report. The incidence of these three cancer types were not statistically significantly elevated at the community level in either Fitchburg or Leominster during 2006-2010. However, two CTs had statistically significant elevations during this time period:

- In Leominster, leukemia was statistically significantly elevated among females in CT 7095.
- In Fitchburg, NHL was statistically significantly elevated among females in CT 7106.

For each of these statistically significant elevations, the distribution of ages at diagnosis and the subtypes followed what would be expected based on national trends. In addition, the geographic distribution of the addresses at the time of diagnosis generally followed the pattern of population density within each community.

With respect to the former FG/AH site, a review of the history of the site was conducted in response to concerns raised by the requestor. Due to difficulties in re-creating past site conditions, this report is limited in its evaluation of possible past exposures. Information on potential air emissions from the plant when it was in operation was not available. However, based on available historical environmental assessments, it appears unlikely that nearby residents

would have been exposed to contaminants on-site in soil, sediment, surface water, and groundwater.

VIII. RECOMMENDATIONS

In response to the findings of this evaluation, the MDPH does not recommend further analysis of the incidence of these three cancer types in Fitchburg and Leominster. The MCR will continue to issue its periodic city/town cancer incidence reports. In addition, cancer incidence rates by community and CT are available on the Massachusetts Environmental Public Health Tracking (EPHT) website at www.mass.gov/dph/matracking.

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Figure 1
Former Foster Grant/American Hoechst Factory Location
Leominster, MA

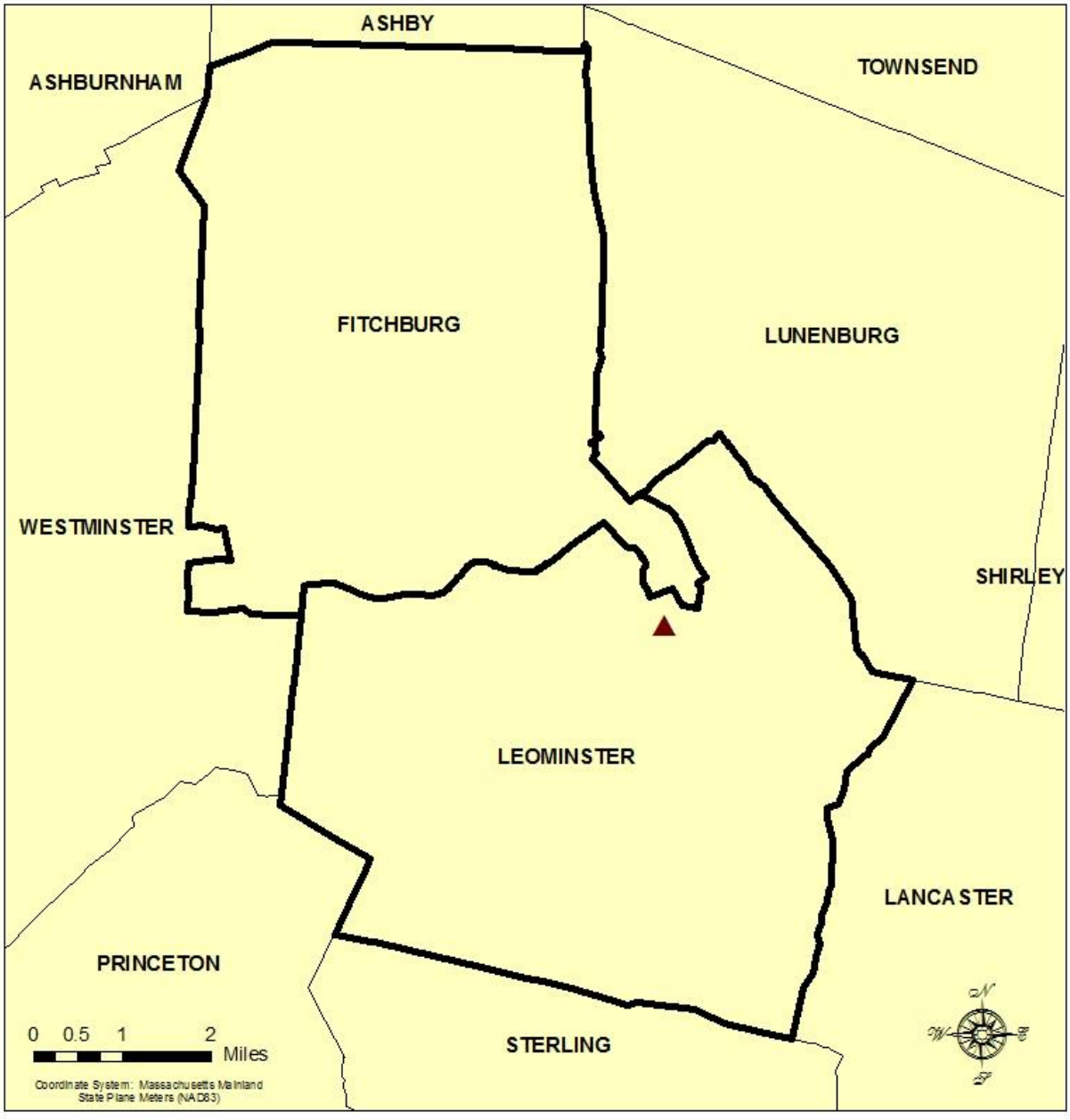
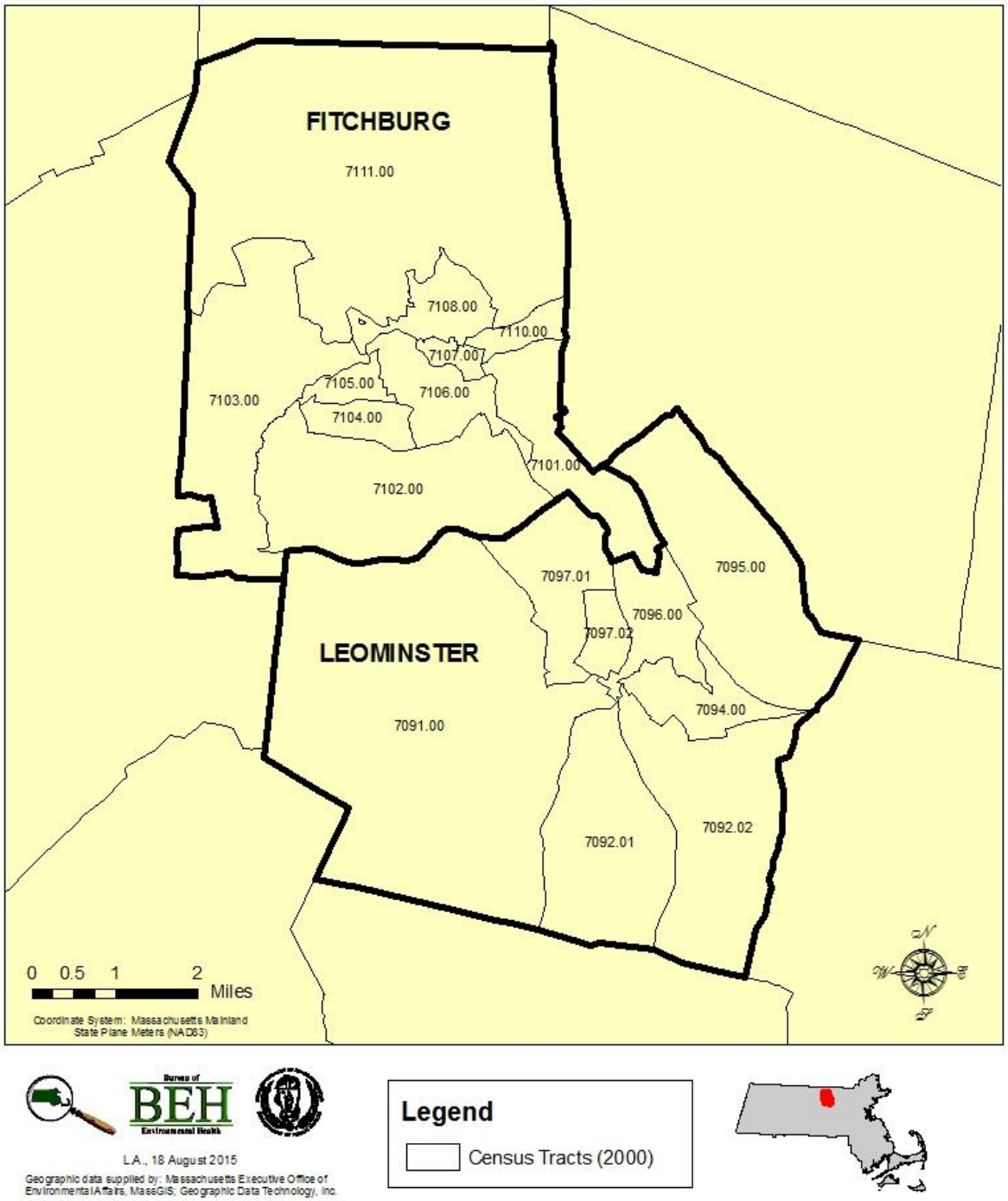


Figure 2
Census Tracts
Fitchburg and Leominster, MA



Bureau of
BEH
Environmental Health

L.A., 18 August 2015

Geographic data supplied by: Massachusetts Executive Office of Environmental Affairs, MassGIS; Geographic Data Technology, Inc.

Legend

Census Tracts (2000)

TABLE 1
Incidence of Leukemia, Multiple Myeloma and Non-Hodgkin Lymphoma
Fitchburg, Massachusetts
2006 - 2010

Cancer Type	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Leukemia	14	15.4	91	50 -- 153	9	12.6	71	33 -- 135
Multiple Myeloma	12	6.9	175	90 -- 305	8	6.0	134	58 -- 264
Non-Hodgkin Lymphoma	28	23.4	120	80 -- 173	27	20.6	131	86 -- 190

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 2
Incidence of Leukemia, Multiple Myeloma and Non-Hodgkin Lymphoma
Leominster, Massachusetts
2006 - 2010

Cancer Type	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
Leukemia	22	16.2	136	85 -- 206	14	12.8	109	60 -- 183
Multiple Myeloma	8	7.3	110	47 -- 216	3	6.1	NC	NC -- NC
Non-Hodgkin Lymphoma	26	24.9	104	68 -- 153	25	21.4	117	76 -- 173

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 3
Incidence of Leukemia
Fitchburg Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7101	0	1.4	NC	NC -- NC	1	1.1	NC	NC -- NC
CT 7102	4	2.9	NC	NC -- NC	1	2.2	NC	NC -- NC
CT 7103	1	1.1	NC	NC -- NC	1	0.8	NC	NC -- NC
CT 7104	0	1.0	NC	NC -- NC	2	0.8	NC	NC -- NC
CT 7105	1	1.1	NC	NC -- NC	1	1.0	NC	NC -- NC
CT 7106	4	2.4	NC	NC -- NC	0	2.0	NC	NC -- NC
CT 7107	0	0.6	NC	NC -- NC	0	0.6	NC	NC -- NC
CT 7108	3	1.7	NC	NC -- NC	1	1.6	NC	NC -- NC
CT 7110	0	0.9	NC	NC -- NC	1	0.8	NC	NC -- NC
CT 7111	1	2.2	NC	NC -- NC	1	1.7	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 4
Incidence of Multiple Myeloma
Fitchburg Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7101	1	0.6	NC	NC -- NC	1	0.5	NC	NC -- NC
CT 7102	2	1.4	NC	NC -- NC	0	1.1	NC	NC -- NC
CT 7103	1	0.5	NC	NC -- NC	0	0.4	NC	NC -- NC
CT 7104	0	0.5	NC	NC -- NC	1	0.4	NC	NC -- NC
CT 7105	0	0.5	NC	NC -- NC	1	0.5	NC	NC -- NC
CT 7106	0	1.0	NC	NC -- NC	0	0.9	NC	NC -- NC
CT 7107	1	0.3	NC	NC -- NC	1	0.3	NC	NC -- NC
CT 7108	3	0.7	NC	NC -- NC	3	0.7	NC	NC -- NC
CT 7110	2	0.4	NC	NC -- NC	0	0.3	NC	NC -- NC
CT 7111	2	1.0	NC	NC -- NC	1	0.8	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 5
Incidence of Non-Hodgkin Lymphoma
Fitchburg Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7101	3	2.1	NC	NC -- NC	3	1.8	NC	NC -- NC
CT 7102	4	4.4	NC	NC -- NC	7	3.8	186	75 -- 384
CT 7103	2	1.7	NC	NC -- NC	1	1.3	NC	NC -- NC
CT 7104	0	1.6	NC	NC -- NC	1	1.4	NC	NC -- NC
CT 7105	4	1.7	NC	NC -- NC	0	1.6	NC	NC -- NC
CT 7106	3	3.6	NC	NC -- NC	9	3.2	280 *	128 -- 532
CT 7107	2	1.0	NC	NC -- NC	0	1.0	NC	NC -- NC
CT 7108	5	2.6	195	63 -- 454	1	2.5	NC	NC -- NC
CT 7110	3	1.4	NC	NC -- NC	2	1.2	NC	NC -- NC
CT 7111	2	3.4	NC	NC -- NC	3	2.8	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 6
Incidence of Leukemia
Leominster Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7091	1	1.7	NC	NC -- NC	2	1.2	NC	NC -- NC
CT 7092.01	2	2.7	NC	NC -- NC	1	2.0	NC	NC -- NC
CT 7092.02	6	2.5	240	88 -- 522	0	1.8	NC	NC -- NC
CT 7094	2	1.8	NC	NC -- NC	0	1.4	NC	NC -- NC
CT 7095	7	3.3	214	86 -- 441	7	2.6	270 *	108 -- 556
CT 7096	0	0.9	NC	NC -- NC	1	0.7	NC	NC -- NC
CT 7097.01	2	2.4	NC	NC -- NC	1	2.1	NC	NC -- NC
CT 7097.02	2	1.0	NC	NC -- NC	2	1.0	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 7
Incidence of Multiple Myeloma
Leominster Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7091	2	0.8	NC	NC -- NC	1	0.6	NC	NC -- NC
CT 7092.01	2	1.2	NC	NC -- NC	1	1.0	NC	NC -- NC
CT 7092.02	1	1.1	NC	NC -- NC	0	0.9	NC	NC -- NC
CT 7094	0	0.8	NC	NC -- NC	1	0.6	NC	NC -- NC
CT 7095	0	1.5	NC	NC -- NC	0	1.2	NC	NC -- NC
CT 7096	1	0.4	NC	NC -- NC	0	0.3	NC	NC -- NC
CT 7097.01	1	1.1	NC	NC -- NC	0	1.1	NC	NC -- NC
CT 7097.02	1	0.5	NC	NC -- NC	0	0.5	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.

TABLE 8
Incidence of Non-Hodgkin Lymphoma
Leominster Census Tracts, Massachusetts
2006 - 2010

Census Tract	Males				Females			
	Obs	Exp	SIR	95% CI	Obs	Exp	SIR	95% CI
CT 7091	4	2.6	NC	NC -- NC	4	2.0	NC	NC -- NC
CT 7092.01	6	4.1	145	53 -- 315	6	3.4	178	65 -- 388
CT 7092.02	3	3.9	NC	NC -- NC	3	3.0	NC	NC -- NC
CT 7094	3	2.7	NC	NC -- NC	2	2.2	NC	NC -- NC
CT 7095	5	5.0	99	32 -- 232	5	4.3	116	37 -- 271
CT 7096	3	1.4	NC	NC -- NC	1	1.1	NC	NC -- NC
CT 7097.01	1	3.6	NC	NC -- NC	3	3.6	NC	NC -- NC
CT 7097.02	1	1.6	NC	NC -- NC	1	1.8	NC	NC -- NC

Note: SIRs are calculated based on the exact number of expected diagnoses.
Expected number of diagnoses presented are rounded to the nearest tenth.
SIRs and 95% CIs are not calculated when the observed number is < 5.

Obs = Observed number of diagnoses
Exp = Expected number of diagnoses
SIR = Standardized Incidence Ratio
95% CI = 95% Confidence Interval
NC = Not calculated
* = Statistical significance

Data Source: Massachusetts Cancer Registry, Office of Data Management and Outcomes Assessment, Massachusetts Department of Public Health.