Summary of Cancer Incidence Studies Performed Near the White Street Landfill in Greensboro, NC

N.C. Division of Public Health
June 17, 2011

Purpose of the this Report

In 2009 the Guilford County Health Department requested the North Carolina Division of Public Health (DPH) to determine if cancer rates were higher than would be expected in the area near the White Street Landfill (the "landfill"). Community members living near the landfill were concerned they were suffering negative health effects because of their proximity to the landfill. This report documents the process DPH staff used to determine the area to be included in the cancer rate analysis completed in 2009 ("the cancer study") and explains the findings of that study. This report also discusses results of a second pancreatic cancer rate evaluation that matched the racial make-up of the reference population to that of the study population, the community living near the White Street Landfill.

Information Sources Used in the Cancer Investigation

In June 2009 the City of Greensboro requested DPH investigate cancer rates in the community living near the White Street Landfill ("the landfill"). The County also identified that a former unregulated dumpsite, the E.H. Glass dump (the "dumpsite"), was in the same general area. Over the next few months DPH staff collected information for the study from the City of Greensboro, Guilford County and the North Carolina Department of Environment and Natural Resources (DENR).

To complete the cancer rate investigation DPH gathered the following:

1. Information on the regulations required by DENR for monitoring the operations at the White Street landfill.
2. Chemical analyses of groundwater, surface water and air samples collected at the White Street landfill.
3. Information on the history of the White street landfill and the E.H. Glass dumpsite, including the types of materials disposed of there.
4. Information about environmental studies underway or planned for the former E.H. Glass dumpsite.
5. The history of the types of chemicals that may have been disposed at the land fill and dumpsite.
6. The time period when people may have been exposed to chemicals from the landfill or dumpsite.
7. Environmental information to determine who may have been exposed to chemicals released from either facility. This included the direction of groundwater and surface water flow, and the predominant wind direction in the area.

8. Current and past information on private drinking water wells in the area.
9. The types of cancers that may be associated with landfills or chemical exposures common around landfills.

History of the White Street Landfill and E.H. Glass Dumpsite

The ***White Street Landfill*** is located in northeastern Greensboro, at the north end of White Street. The City owns and operates the landfill. The landfill is required to operate under operational and environmental monitoring requirements established by DENR and the U.S. Environmental Protection Agency (EPA). These regulations require a set schedule of groundwater and air testing at the landfill to determine if chemicals are being released from the landfill into the groundwater or the air.

The initial waste-handling activity at the landfill began in 1943 and consisted primarily of incineration. The incineration ash was buried on-site. Refuse ("trash") was buried in 3 distinct areas on the property beginning in 1965. The landfill has accepted municipal solid waste ("MSW"), land clearing and inert debris ("LCID"), and construction and demolition ("C&D") waste during its operation. Currently, the White Street Landfill accepts only construction and demolition waste.

The initial series of groundwater monitoring wells ("MWs") were installed on the perimeter of the landfill property in 1993 and the first samples collected in 1994. The landfill is required to collect groundwater samples twice per year. Monitoring wells are used to collect samples of groundwater moving under and away from the landfill. The groundwater samples are analyzed at a laboratory to determine if chemicals are escaping from the landfill into the groundwater. DENR and EPA establish what types of chemicals are to be tested in the groundwater and the acceptable levels allowed. The analyses and quality control measures that must be used by the laboratory are also specified in the regulations.

In 1997 several chemicals were detected at elevated levels in the groundwater. Additional monitoring wells were installed to determine how far the chemicals had moved away from the landfill. The groundwater under the landfill moves from the south/southwest to the north/northeast toward Buffalo Creek. Additional monitoring wells were installed between the northeast boundary of the landfill and Buffalo Creek. Chemical testing of groundwater collected in the new wells and tests run on the surface water flowing in Buffalo Creek downstream of the landfill indicated that the contaminated groundwater was not affecting the creek. Later investigations indicated that some of the elevated concentrations of metals detected in the groundwater were not the result of contamination from the landfill, but were due to high levels of these metals occurring naturally in the area soils. It was also determined at that time that there were no private wells in the area that could be affected by the contaminated groundwater.

Table 1 at the end of this report lists substances found at elevated concentrations in the landfill groundwater monitoring samples since 1994.

The 65-acre property that includes the former ***E.H. Glass dumpsite*** is located at 1103 Nealtown Road in Greensboro. It consists of 2 separate unlined disposal areas (7.5 acres at the southeast end of the property and 16 acres covering the northwest and central portions of the property). The property is privately owned. There are 2 small ponds in the southern portion of the property. An unnamed stream flows along the western side of the property. The remainder of the property is covered by trees and dense vegetation. Disposed material is exposed on the property and in the stream (55-gallon drums and metal, plastic, and glass debris). There is evidence of illegal dumping, hunting and fishing on the property by trespassers. Little is known about what was buried at the site, other than reports of Vicks™ cold products buried in the southeast disposal area.

There is no required regulatory monitoring of the former dumpsite. A DENR-monitored environmental investigation is under way on the property to determine it's suitability for development. The investigation includes defining and mapping the waste disposal areas, searching for private wells in the area, testing the shallow groundwater on the site for chemicals, testing the pond water for chemicals, and monitoring for gases or vapors that may be released to the surface through the soil on top of the buried wastes. DPH has requested copies of the results of these investigations and will evaluate the data for potential exposures and health implications as the data becomes available.

Selection of the Cancer Study Area

To be harmed by an environmental contaminant a person must come into contact with that chemical, such as by:

- ingestion (eating the chemical),
- inhalation (breathing the chemical), or
- dermal contact (skin contact)

Having contact with a chemical does not necessarily result in harmful health effects. A chemical's ability to result in harmful effects is influenced by a number of factors, including:

- how much of the chemical a person is exposed to
- how long a time period a person is exposed to the chemical
- how often the person is exposed
- the amount and type of damage the chemical can cause to the body

To result in harmful health effects, the chemical must be present at concentrations high enough and for long enough to cause harm. Exposures at concentrations or time periods less than these levels do not cause harmful effects.

The evaluation process used by DPH to define communities near the landfill and dumpsite where people would most likely be harmed by chemicals potentially leaving the landfill included:

1. Determining how persons in the local community may come into contact with environmental contaminants moving off the landfill and dumpsite properties (drinking, breathing, skin).
2. Defining what areas of the local community would be most likely to come into contact with these chemicals.
3. What types of chemicals from the landfill and dumpsite people may have been in contact with.
4. Which of these chemicals have been identified as potentially causing cancer and what type of cancers they may cause.

Definition of the cancer study area - DPH defined the cancer study area as encompassing areas included in:

- the primary wind direction across and away from the landfill and dumpsite, and
- the direction of groundwater and surface water flow away from the landfill and dumpsite

The direction of wind, groundwater and surface water flow was determined from DENR environmental studies. The dominant direction of wind flow throughout most of the year is from the southwest to the northeast. To accommodate seasonal shifts in the direction of wind flow areas within 1/2 mile to the south/southwest were also included in the study area. Shallow groundwater in the area of the landfill and dumpsite flows north/northeast toward Buffalo Creek. Buffalo Creek flows from the southwest to the northeast, running along the northern border of the landfill property.

Using the above information, DPH defined the area of greatest potential contact with chemicals moving away from the landfill and dumpsite as the area to the northeast. A 1-mile area beyond the northeast boundary of the landfill was selected for determination of cancer occurrences. This distance was chosen to represent a distance identified as the likely maximum distance that airborne contaminants would travel away from the landfill area and be expected to be at potentially harmful levels. All census blocks with any portion of their area within 1-mile to the northeast or 1/2-mile distance to the southwest were included in the study area. This resulted in inclusion of census blocks to the northeast that covered an area up to 2-miles beyond the border of the landfill, and census blocks as far as 1 mile to the south/southeast. Figure 1 illustrates the cancer study area.

Source of cancer rate data – All health care providers in North Carolina who detect, diagnose, and treat cancer are required to report cancer cases to DPH's State Center for Health Statistics (SCHS) Central Cancer registry (CCR). Since

1990 more than 90% (and more than 98% in recent years) of cancer cases have been reported to CCR. The information provided includes the type of cancer and the patient's gender, age and address when the cancer was discovered. When DPH does a cancer study for a community, it uses the data gathered by the CCR.

Selection of the types of cancers to be included in the study - Not all chemicals cause cancer. "Cancer" is not one disease, but actually a group of individual diseases defined by the location in the body where the cancer initially develops. Cancers that develop initially in one part of the body may spread to other areas. It is the location in the body where the cancer first develops that is important for a cancer study.

Most cancers (likely 90-98%) are caused by factors other than exposure to environmental chemicals. Factors important in whether a person will develop cancer in their life-time include: whether or not they smoke, the quality of their diet, maintenance of a healthy weight, their overall health, and genetic factors they inherit from their parents.

We know that exposure to some chemicals can cause cancer under certain circumstances as discussed above. We determine what chemicals cause cancer by using laboratory tests exposing animals and studying accidental and work-related human exposures. We know that chemicals that can cause cancer each cause one or several specific types of cancer (such as lung, skin or brain cancer).

DPH physicians, epidemiologists and toxicologists reviewed the types of chemicals known or suspected to be in the landfill and dumpsite, determined which are known or expected of causing cancer and identified the types of cancer they may cause. There is little information about the types of wastes disposed in the E.H. Glass dumpsite. To be health protective, the types of cancers included in the study included those that have been reported as possibly associated with exposure to chemicals disposed of in older landfills and dumpsites. These cancers included:

- Liver cancer
- Pancreatic cancer
- Multiple myeloma[1]
- Leukemia[2]
- Brain and central nervous system cancers
- Hodgkin disease[3]

[1] Multiple myeloma is a rare form of cancer characterized by excessive production and improper function of white blood cells produced in the bone marrow. The white blood cells mass together to form a tumor somewhere in the body. Source: *Web*MD

[2] Leukemia is cancer of the blood cells. It starts in the bone marrow and is characterized by production of abnormal white blood cells (called leukemia cells). Source: *Web*MD

- Non-Hodgkins lymphoma[4]

Results of the N.C. DPH cancer study – The N.C. Central Cancer Registry (CCR) determined the number of the types of specified cancers in the selected study area. For the period from 1990 through 2006, a total of 114 cancer cases for the 7 types selected were identified to an address in the study area.

Next, the CCR determined the number of these types of cancers that would be expected in the area without any influence of the landfill/dumpsite ("the reference area"). This data is determined by looking at the rates of these cancers throughout North Carolina during the same time period (1990 – 2006).

A person's chance of developing cancer is strongly influenced by age. As we get older the chance of developing cancer increases. Developing some cancers is also influenced by gender. Because these factors may influence identification of elevated cancer rates they must be considered in a cancer rate study. CCR determined age and gender-specific cancer rates for the study area and for the state-wide reference data. Well-established statistical calculation methods are used for the age and gender adjustments and development of expected ranges of individual cancers in the study (the area of concern) and reference areas. The final determination of an elevated cancer rate for a specific type of cancer is based on comparison of the number of cases of individual cancers found in the study area to the number that would be expected based on the reference area data. The state-wide reference area averages were adjusted to match the age and gender characteristics of the study area to provide a suitable comparison. The number of cancers found in the White Street landfill study area, and the number that would be expected based on the state-wide reference data, are listed in Table 2.

Cancer rates in the study area greater than expected are identified by a 2-step criterion. The first indication of an elevated cancer rate is a number greater than 1.0 for the ratio of reported cases to expected cases. The second indicator is a value greater than 1.0 for the lower-end of the confidence interval ("range", Tables 2 and 3) that includes the study area cancer rate ("ratio", Tables 2 and 3). Both conditions must exist to indicate an elevated numbers of a cancer in the study area.

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[3] Hodgkin disease is a rare type of lymphoma that starts in cells called lymphocytes. A lymphoma is a cancer of the tissue found in the lymph nodes, spleen, liver and bone marrow. Source: American Cancer Society

[4] Non-Hodgkin's Lymphoma (NHL) is cancer in the lymphatic system of the immune system. There are many types of NHLs. It is characterized by uncontrolled growth of the cells of the lymphatic system. Source: *Web*MD

Criteria to identify an elevated cancer rate in the study area:

$\frac{\text{observed number of a cancer}}{\text{expected number of a cancer}}$	*greater than 1.0*
	AND
lower range of expected numbers of a cancer	*greater than 1.0*

The expected numbers of a cancer is adjusted to match the age and gender make-up of the study area to insure a statistical suitable comparison

The observed multiple myeloma, leukemia, brain and central nervous system and Non-Hodgkin's lymphoma cancer rates for the study community near the White Street landfill and the E.H. Glass dumpsite are greater than expected based on comparisons to the state-wide rates for these cancers. However, the second step of the analysis identified the calculated interval range for these cancers is less than one (1.0), identifying that the second criteria of the statistical comparisons for these cancers was not met, indicating that the rate of these cancers are not statistically significantly elevated in the study community.

The number of liver cancer and Hodgkin disease cases identified and expected were both less than 5, also indicating that rates for these cancers are not elevated in the study area.

The number of pancreatic cancer cases observed in the study area was 1.8 times the number expected based on the state-wide rates. The age and gender adjusted low-end confidence interval of expected number of pancreatic cancer cases is greater than 1.0. This combination of factors indicates that there appears to be an elevated rate of pancreatic cancers in the study area relative to typical rates observed state-wide in North Carolina.

Reference Populations Used for Comparison of Cancer Statistics - The above evaluation of higher than expected cancer rates was compared to age and gender adjusted rates for all of North Carolina. After identification of the potentially elevated rates of pancreatic cancer in the study area DPH repeated the statistical evaluation of pancreatic cancer rates using a reference population more closely matching that of the study area.

The study area around the landfills has a 55.540% African-American population. This percentage is higher than the state-wide average percentage of African-Americans. Since the African-American population is known to have a higher rate of pancreatic cancer and the African-American population in the study area is higher than the state average, a second comparison was made to provide an improved match of the reference population to the study area community.

CCR selected a reference population that is 55.596% African-American from Edgecombe, Northampton, Halifax and Warren counties. According to the 2000 U.S. Census the total population of the second reference area is 155,034. There were 307 pancreatic cancer cases identified in the reference area between 1990

and 2006. The total population of the study area is 12,078. The much larger population of the multi-county race matched reference area provides a more suitable statistical comparison point for the study area. Age and gender-specific pancreatic cancer rates for the reference and study areas were compared as described above.

Using the racially matched reference population, the ratio of observed to expected pancreatic cancer cases is 1.73 and the lower-end of the selected confidence interval is greater than 1.0 (ratio = 1.08). These values indicate that the observed number of cases of pancreatic cancer in the study community remains statistically significantly greater than the number expected. Based on this analysis, using a matched percentage of African-Americans in the reference population, DPH is 95% confident the pancreatic cancer rate in the study area is greater than what would be expected if the study area had the same distribution of pancreatic cancer that was observed in the reference population. The statistics for the pancreatic cancer re-analysis are summarized in Table 3.

The increased number of pancreatic cancers in the study community can not be attributed to differences in age, gender and race since the control population was selected for its demographic similarities to the reference population.

Identification of the elevated pancreatic cancer rates has not been linked to environmental exposures associated with the White Street landfill. There are no detections of substances moving beyond the boundaries of the landfill where people may come into contact with them, or that have been associated with an increased risk of pancreatic cancer.

The most likely exposure routes to which persons would be exposed to contaminants moving away from the landfill includes ingestion of contaminants in well waters or inhalation of gases or particles in the air. The available analytical data does not indicate that either of these routes presents an identified exposure route for the White Street landfill. A clean soil “cap” (layer of soil) is placed on the landfill at the end of each day and landfill gases are captured through an engineered system to prevent release to the air. Both of these activities reduce the potential for persons to be exposed to chemicals in the air. As discussed above, no chemicals released into the groundwater from the landfill have reached areas where there are private wells.

In addition, the mechanism of chemicals causing cancer involves typically long-term exposures or short-term exposures at a very high concentration. Generally, a period of many years and possibly decades occurs between exposure and a cancer developing to a size or effect that can be detected.

What is known about the history of the White Street landfill does not indicate the landfill is a likely source for environmental contaminants that have resulted in the elevated pancreatic cancer rate in the study area community. This does not

mean that other unidentified environmental contaminant sources that the community has been exposed to, including but not limited to the E.H. Glass dumpsite, may be contributing to the elevated pancreatic cancer rates. Environmental investigations of the unregulated dumpsite, E.H. Glass, are underway and DPH will evaluate that data as it becomes available.

It is possible there is no environmental contaminant related to the increased rate of pancreatic cancers in the community and they are the result of other risk factors, such as genetic and life-style factors.

Regardless of the cause or causes of the pancreatic cancers in the community near the White Street landfill DPH wishes to assist the community by providing information about the risk factors associated with pancreatic cancer to assist the community in taking steps to reduce their risks for developing this disease.

Limitations of the Study

- Cancer cases are recorded as the patient's residence at the time of diagnosis and do not consider latency of cancer development, genetic factors, lifestyle influences or occupational exposures.
- Other potential sources of historical environmental exposures in the community have not been investigated.
- There are limited disposal records for the E.H. Glass dumpsite and no historical analyses of air or groundwater.

Conclusions

NC DPH identified communities around the White Street landfill and former E.H. Glass dumpsite that had the greatest potential to be exposed to environmental contaminants leaving the landfill or dump site in the air or groundwater. Cancers believed associated with exposures to substances commonly disposed of in landfills were selected for evaluation in the potentially exposed community. The pancreatic cancer rates were identified as elevated relative to rates that would be expected in North Carolina populations matched by race, gender and age. No known release from the White Street landfill has been indentified that explains the elevated rate of pancreatic cancers in the community. Investigations at the E.H. Glass former unregulated dumpsite are on-going and chemicals found in the soil, groundwater and air from this location will be evaluated for their potential for adverse health effects, including pancreatic cancer.

Pancreatic cancer rates are often elevated in African-American populations. Regardless of future environmental investigations relevant to this community, DPH would like to assist the community and county with responding to the identification of elevated pancreatic cancer rates in this community. Information follows at the end of this document to begin these efforts.

Table 1. Substances detected in White Street landfill groundwater monitoring samples collected since 1994.

Volatile Organic Compounds (VOCs)	Inorganic Substances
methylene chloride	cadmium [1]
cis-1,2-dichloroethene	chromium [1]
2-butanone	nickel
benzene	thallium
1,2-dichloroethane	vanadium [1]
trichloroethene	zinc [1]
1,2-dichloropropane	
vinyl chloride	

[1] The high levels of these metals in groundwater were determined to be related to naturally–occurring high concentrations of these metals in local soils

Table 2. Number and types of cancers found and the number expected in the study area around the White Street Landfill and E.H. Glass dumpsite. Data compiled by N.C. Central Cancer Registry (CCR). Time period includes 1990 through 2006.

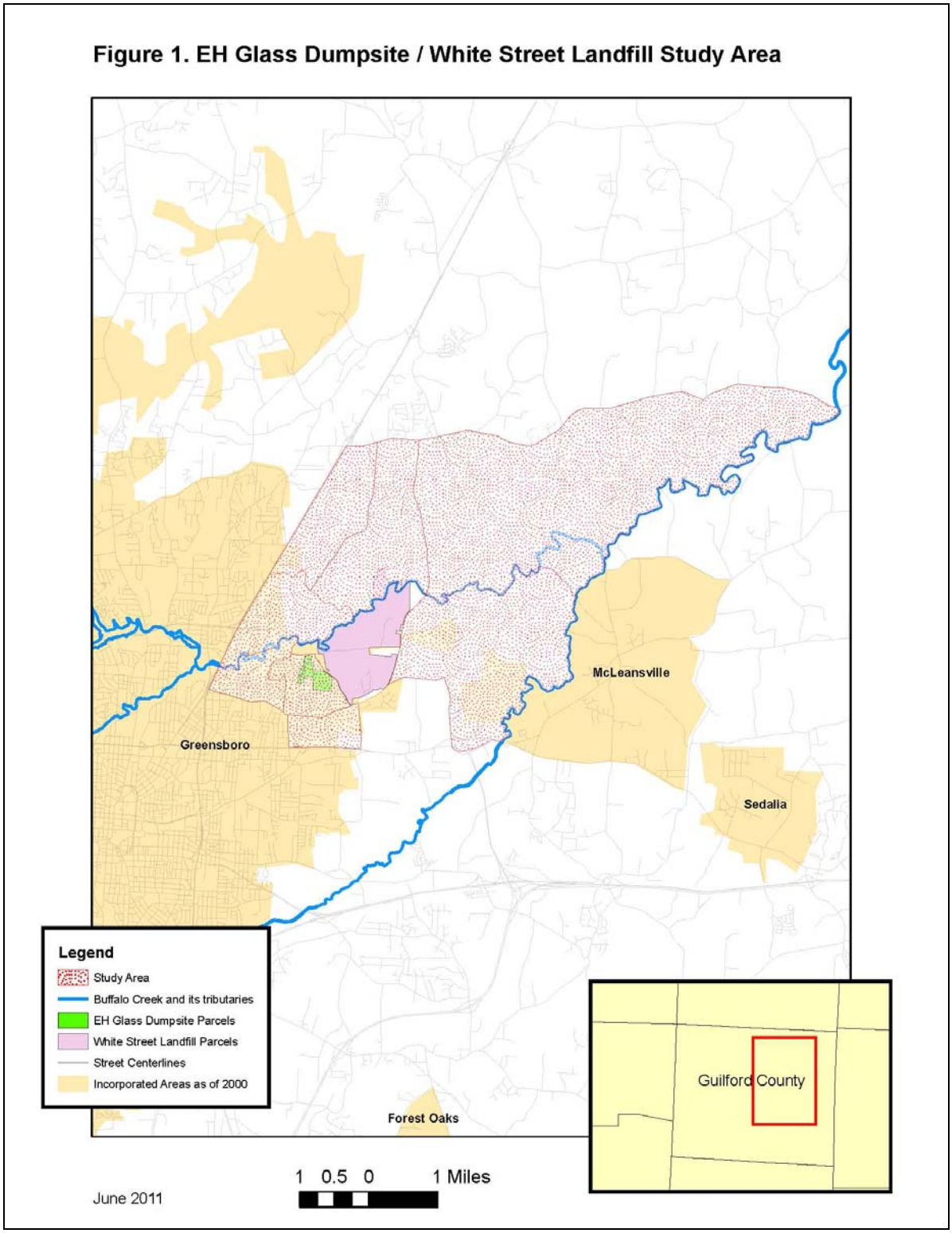
Type of cancer [1]	Number of cancer cases reported in study area	Number of cancer cases that would be expected in study area	Ratio of number of cancers reported to number found	Range determined to identify elevated number of cancers [2]	Cancer rate is elevated in study area [3]
Liver	Less than 5 [4]	Less than 5 [4]	Not applicable	Not applicable	Not applicable
Pancreatic	27	15	1.8	1.1 – 2.5	YES
Multiple myeloma	13	6	2.0	0.9 – 3.1	NO
Leukemia	17	14	1.2	0.6 – 1.8	NO
Brain/CNS [5]	22	16	1.4	0.8 – 1.9	NO
Hodgkin Disease	Less than 5 [3]	Less than 5 [3]	Not applicable	Not applicable	Not applicable
Non-Hodgkin's Lymphoma	27	26	1.0	0.6 – 1.4	NO

[1] Types of cancers determined to likely be associated with chemical exposures associated with landfills and dump sites
[2] Statistical analyses of the data are used by CCR to identify a range of ratios of reported cases to expected cases. Ratios not within this range may indicate unexpected numbers of cancers. Range represents a 95% confidence interval.
[3] Elevated rates of cancer in the study area are identified by statistical calculation comparisons to expected state-wide ranges of these cancers
[4] Cancer cases less than 5 are not specified in CCR reports to protect the identity of the patient
[5] CNS = central nervous system

Table 3. Re-analysis of pancreatic cancer data using a racially matched reference population. Data compiled by N.C. Central Cancer Registry (CCR). Time period includes 1990 through 2006.

Type of cancer	Number of cancer cases reported in study area	Number of cancer cases that would be expected in study area	Ratio of number of cancers reported to number found	Range determined to identify elevated number of cancers	Cancer rate is elevated in study area
Pancreatic	27	16	1.73	1.1 – 2.4	YES

Figure 1. Cancer rate study area selected for communities potentially impacted by White Street landfill or E.H. Glass dumpsite.



WHAT WE KNOW ABOUT PANCREATIC CANCER

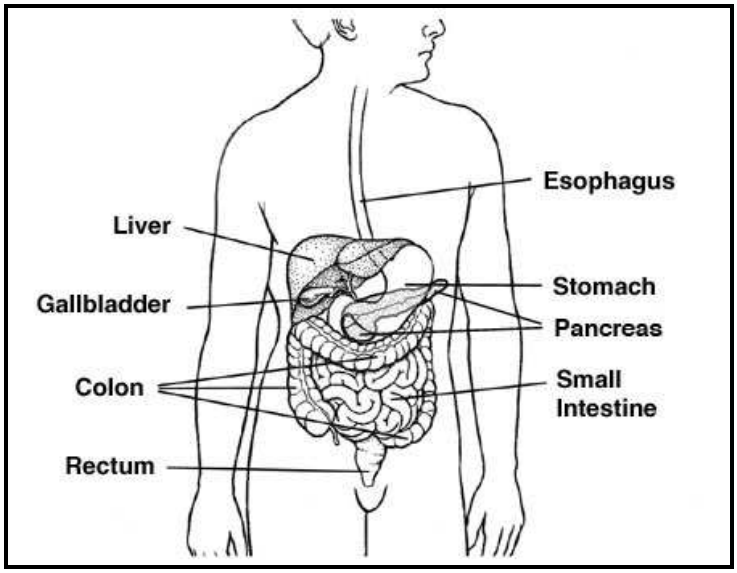
The following is excerpts taken from the American Cancer Society's **Pancreatic Cancer Overview**, 2010. The full document is available at: www.cancer.org

What is cancer?

Cancer begins when cells in a part of the body start to grow out of control. There are many kinds of cancer, but they all start because of this out-of-control growth of abnormal cells. In most cases the cancer cells form a tumor. Not all tumors are cancer. When cancer cells get into the bloodstream or lymph vessels, they can travel to other parts of the body. There they begin to grow and form new tumors that replace normal tissue. Different types of cancer can behave very differently.

What is pancreatic cancer?

The pancreas is an organ found deep in the body, behind the stomach. It is shaped a little bit like a fish. It is about 6 inches long and less than 2 inches wide. It goes across the belly (abdomen). The pancreas aids in the break down of fats and proteins in the foods we eat and in balancing the amount of sugar in the blood.



There were about 43,100 new cases of pancreatic cancer and about 36,800 deaths in the United States in 2010. Your chance of developing pancreatic cancer in your lifetime is about 1 in 71. The risk is about the same for men and women. A person's risk may be changed by certain risk factors listed below.

What causes pancreatic cancer?

We still do not know exactly what causes most cases of pancreatic cancer. But some risk factors have been linked to the disease. A risk factor is something that affects a person's chance of getting a disease such as cancer. Some risk factors, like smoking, can be controlled. Others, like a person's age or race, can't be changed. Having a risk factor, or even several risk factors, does not mean that you will get the disease. And some people who get the disease do not have any known risk factors.

Risk factors for pancreatic cancer

***Age** – As we get older our chance of developing any cancer generally increases, including pancreatic cancer. 90 out of 100 persons that get pancreatic cancer are older than 55. The average age is 72.*

***Gender** – Men are slightly more likely than women to get pancreatic cancer.*

***Race** – African-Americans are more likely to get pancreatic cancer than whites.*

***Smoking** – Smoking increases tour risk of pancreatic cancer 2-3 times. Smokeless tobacco use also increases your risk.*

***Obesity and lack of exercise** – People that are very overweight or don't get much exercise are more likely to develop pancreatic cancer.*

***Diabetes** - Pancreatic cancer is more common in people that have diabetes, especially type 2 diabetes. We don't know why.*

***Chronic Pancreatitis** - Persons with this ailment have a slightly increased risk, but most people with chronic pancreatitis do not get pancreatic cancer.*

***Cirrhosis of the Liver** – Cirrhosis is the scarring of the liver and may result from liver damage associated with hepatitis or alcohol use. People with cirrhosis of the liver may have an increased risk of pancreatic cancer.*

***Work exposure** – Persons with heavy exposure to dyes, pesticides, and chemicals may have an increased risk of pancreatic cancer.*

***Family history** - Cancer of the pancreas seems to run in some families. In some cases this may be related to inherited genetic characteristics. In other families we don't know why there is an increased risk.*

***Stomach problems** - Having too much stomach acid or having bacteria called H. pylori in the stomach may increase the risk of pancreatic cancer.*

How can I reduce my chance of getting pancreatic cancer?

There is no sure way to prevent pancreatic cancer. The best advice is to adopt lifestyle choices that reduce the risk factors listed above and to get frequent physical exams. Your physician may use tests such as CT scans, MRIs or PET scan, ultrasound or biopsies to look for pancreatic cancer.

Signs and symptoms of pancreatic cancer include:

***Jaundice** – A yellow color of the eyes and skin.*

***Pain in the abdomen or middle of the back** may be caused by pancreatic cancer.*

***Weight loss** – Also, feeling tired and loss of appetite*

***Digestive problems, especially with fatty foods**. Stools may be pale, bulky, greasy and float in the toilet. Also, nausea, vomiting, and pain that increases after eating.*

Swollen gallbladder

***Blood clots and fatty tissue changes** – May be associated with pancreatic cancer. Uneven texture of the fatty tissue under the skin.*

***Diabetes** – Pancreatic cancer can cause problems with blood sugar and occasionally can cause diabetes.*