

**A Community Health and Demographic Survey Near a Proposed Landfill Site in
Northwestern Duplin County, NC**

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Summary

The purpose of this report is to describe the current health and demographic characteristics of the population of residents living within two miles of the site of a proposed regional municipal solid waste landfill on Emmett Jackson Road in Faison, NC, and to assess the potential health risks that the landfill could pose for residents in the area. The health and demographic information was gathered using a survey, administered by Emily Wurth, a graduate student working under the supervision of Dr. David Savitz, Professor of Epidemiology at the University of North Carolina School of Public Health. The survey collected demographic information, information about the household's interaction with the environment, and health information for each household member. The study was approved by the Public Health Institutional Review Board at the University of North Carolina School of Public Health.

Methods

The study population included all households located within two miles of the center of the property at Emmett Jackson Rd, the site of the proposed regional solid waste landfill. The data collector went from door-to-door throughout the community to recruit residents to respond to the survey. Of the 230 inhabited households in the defined area, 212 households completed the survey, 10 households refused to respond, and 7 households could not be contacted, for a response rate of 92.2%. The survey responses were entered into an Excel database and analyzed using the quantitative analysis software, SAS 8.2, and qualitative analysis software, Atlas.ti 5.0.

Demographic Findings

A total of 212 households responded to the survey, reporting for 498 residents. The mean age of the survey respondents was 40.5 years. Approximately 101 residents (20.0%) were under age 18, and 79 residents (15.9%) were over age 65. When asked to self-identify their race or ethnicity, a majority (87.6%) of the respondents identified as Caucasian. Only 6.8 % identified as African American and 4.8 % as Latino.

On average, residents in this community reported spending 3.5 hours outdoor each day. The majority of residents (82.5%) did not report eating fish from nearby creeks, streams, rivers or ponds.

Although 38.0% of residents had lived in their homes for less than 10 years, over 17.0% of residents had lived in their homes for more than 40 years. An informal account indicated that 48.1% of the households included in the survey have at least one household member who had lived in the community for his/her entire life.

The proportion of home ownership among households in the survey is 84.0%. Forty-one households (19.3 %) own land that is used for farming within two miles of the site of the proposed landfill. Approximately 3, 300 acres of the land within this defined study area is used for farming. Sixteen households (7.6%) own livestock that is located within this area. Residents own cows, horses, chickens, turkeys, goats, and quail that are kept in this area. Sixty-three households (29.7%) reported having vegetable and fruit gardens at their household.

The majority of the households (67.9%) in this study area reported having a municipal water supply. However, 56 households (26.4%) reported having only well water and 12 households (5.7%) reported having both well water and municipal water supply. A total of 126 individuals reported drinking the well water, accounting for 25.4% of the residents who responded to the survey in this area. In addition, 33 of the 40 residents (82.5%) who lived within one mile of the site of the proposed landfill reported drinking well water.

Health Findings

The asthma prevalence was 15.8% for youth and 10.4% for adults. Allergies were reported to be present in 50.5% of all youth, and 47.2% of adults. Chronic sinusitis was not a condition included in the survey instrument; however, 4.3% of adults mentioned this as an “other” condition that affects their health. Rashes were reported to be present among 17.8% of youth and 9.3% of adults. Eczema was by far the most common rash accounting for 94.4% of all rashes among youth, and 40.5% of rashes among adults.

The following chronic health conditions were present among the *adult* residents in this community. Hypertension was reported for 31.3% of residents, and heart disease for 13.6%. Diabetes was found in 9.8% of adults, and arthritis in 31.5% of residents. Cancer was reported in 8.3% of the adult population. Gastrointestinal problems were reported for 18.7% of adults, with acid reflux accounting for 45.9% of all gastrointestinal problems.

Community Health and Environmental Concerns

An open ended question asked residents to express any health or environmental concerns they had about living in Duplin County. A total of 52 households (26.0%) reported no concerns. However, 115 households (57.5%) expressed concerns about the proposed landfill being developed in their community, with the most common reasons for the concern consisting of ground and surface water pollution, air pollution, health concerns, traffic problems, pests, odor, and the appearance of the landfill. The most common existing health or environmental concerns for residents were the intensive livestock operations, the fertilizers and pesticides used for agriculture, and the current well water quality.

Discussion

Based on the findings of the survey and a review of public health literature, the following potential health concerns exist for the community, if the landfill were to be developed:

- The increased exposure to diesel emissions from the estimated 250 tractor trailers hauling waste to the landfill could exacerbate the existing respiratory conditions, including asthma and allergies, among residents in this community.
- If landfill leachate were to escape into the groundwater, the residents living closest to the landfill would be at the greatest risk of their groundwater being contaminated, and 87.5% of residents living within one mile of the landfill drink their well water.
- There is the potential for increased exposure to the hazardous agents from the landfill through crop contamination of either commercial crops or local produce grown by residents.
- The landfill would be an additional potential source of exposure to air and water contamination for an area with existing air and groundwater contamination from the industrial livestock operations.

- A regional, solid waste landfill in this community may affect the built environment by discouraging the development of parks or greenspaces that promote physical activity as well as other health promoting facilities. Given the prevalence of chronic health conditions affecting residents in Eastern North Carolina, the community should want to promote healthy behaviors.
- The psychosocial stress for residents who perceive that the landfill would change the nature of this rural, farming community.

Introduction

The purpose of this report is to describe the current health and demographic characteristics of the population of residents living within two miles of the site of a proposed regional municipal solid waste landfill on Emmett Jackson Road in Faison, NC. The information gathered will be analyzed in this report to help assess the potential health risks that the regional, municipal solid waste landfill could pose for residents in the area. The health and demographic information was gathered using a survey, administered by Emily Wurth, a graduate student at the University of North Carolina at Chapel Hill (UNC-CH), working under the supervision of Dr. David Savitz, Professor of Epidemiology at the UNC-CH School of Public Health. The survey collected demographic information, information about the household member's interaction with the environment, and health information for each household member.

Section 1 of this report presents the *Background Information* on the potential routes of exposure to hazardous agents for residents living in close proximity to a regional municipal solid waste landfill. This section also presents a brief review of the literature on the health effects of living in close proximity to a municipal solid waste landfill. Section 2 describes the *Methods* used to collect the information from the residents in the community, and then to analyze the data. Section 3 details the *Findings* of the study. The Quantitative Findings section presents the analysis of the demographic and health information collected from the survey respondents. The Qualitative Findings section describes the health and environmental concerns of the residents in the community. Section 4, the *Discussion* section, considers the potential health risks that the landfill could pose for residents in the community based on the findings from the survey and a review of public health literature.

Section 1: Background Information

Regional municipal solid waste landfills contain residential, commercial and institutional waste. They can also accept non-hazardous sludge (from municipal sewage treatment facilities), construction and demolition debris and some industrial solid waste [1]. Although municipal solid waste landfills do not accept hazardous waste, household waste can contain chemical substances that are classified as hazardous, such as those found in pesticides, household cleaners, batteries, and paint[2]. These substances can enter the environment through the water and the air. Each of the routes of entry presents a potential source of exposure for humans.

Water Exposure

Groundwater and surface water can be contaminated by leachate, the substance that results from the interaction of water with waste from municipal solid waste landfills [3]. Many characteristics of the location sited for a landfill and the waste in the landfill determine leachate composition and how it enters and potentially affects the groundwater. These factors include: the toxicity and concentration of the contaminants, the permeability and type of the geologic strata, the direction of the groundwater flow and the depth of the water table. This report does not discuss these factors as related to the site of the proposed landfill in Duplin County; however, it should be noted that the high water table (closer to the ground surface) in Eastern North Carolina would allow contaminants to enter the groundwater more easily than in an area with a lower water table.

In response to the environmental contamination and subsequent human health risk associated with landfills that were frequently not well sited, not properly designed or not operated according to the minimum requirements, the United States Environmental Protection Agency issued Subtitle D regulations under the Resource Recovery and Conservation Act [3]. In order to “promote the use of safer waste units for solid waste disposal,” federal criteria were developed requiring that all municipal solid waste landfills have liners and leachate collection systems to monitor the groundwater quality [4]. These regulations are in place to minimize contamination of ground and surface water; however, in other documents, the Environmental Protection Agency itself has acknowledged that “even the best liner and leachate collection system will ultimately fail due to natural deterioration, and recent improvements in municipal solid waste landfill containment technologies suggest that releases may be delayed by many decades at some landfills” [5]. For this reason, communities with lined landfills developed since Subtitle D regulations were issued should be concerned with the long term health and environmental effects in their communities.

Humans can be exposed to contaminated ground or surface water by: drinking contaminated ground or surface water, consuming fish from contaminated water, bathing or swimming in contaminated water or inhaling volatilized (a liquid or solid that changed into a gas) compounds through bathing in contaminated water[6].

Air Exposure

The airborne emissions from municipal solid waste landfills originate from landfill gases, dust emitted from the operations of the landfill, diesel emissions from trucks hauling waste, and emissions from the equipment used to move waste at the landfill [7]. Landfill gases are released at waste disposal facilities due to the three processes: anaerobic decomposition of organic matter, volatilization and chemical reactions occurring in the waste. Due to their large amounts of organic matter, municipal solid waste landfills produce the largest amount of landfill gases. The amount and type of gases emitted are affected by the characteristics of the landfill such as the composition and moisture content of the waste, and the, oxygen level and temperature in the landfill [7].

The most commonly emitted gasses from landfills are methane (40-60%) and carbon dioxide. Smaller concentrations of nitrogen, oxygen, hydrogen sulfide, water vapor, ammonia, and a variety of non-methane organic compounds (benzene, vinyl chloride, and trichloroethylene) are also found in landfill gases. The gases of vinyl chloride, ethyl benzene, toluene, benzene and ammonia produce odors [7]. Landfill gases may migrate from the landfill both above and below the ground. In the air, the wind affects the exposure level of residents. Underground, gases can migrate through the soil and rock and enter homes, or be released upwards into the air. The Subtitle D regulations issued by the Environmental Protection Agency require that landfills have gas collection and control systems [3]. Although these measures greatly reduce the amount of landfill gases released into the air, they do not prevent the underground migration of gases, which can subsequently be released into the air [7].

The airborne emissions coming from landfills may affect human health through physiological responses to chemical and physical agents, such as irritation, inflammation, or mutation. Psycho-physiologic responses to the odor from the landfill can also affect health [6]. In addition

to the nuisance of odor, the mental and physical health effects of odor have been examined by public health researchers [7]. For example, Shusterman reports that odors may also trigger health symptoms through the exacerbation of underlying medical conditions, innate odor aversions, and stress-induced illness [8].

Literature on Health Effects of Landfills

Public health researchers have studied the health effects of living in close proximity to municipal solid waste landfills. Studies examined the health effects of living close to a single municipal solid waste landfill [9-14]. The primary route of exposure for the studies was through landfill gas emissions. The proximity to the site of the landfill was the indicator of exposure, determined either by measuring the distance from the households to the landfill or by using postal codes from the area surrounding the landfill. A number of different research designs were used by researchers; however, a common feature of the studies was the inclusion of a comparison group. Studies identified reference communities with similar characteristics to the exposed communities to serve as comparison groups [9-15]. Some studies also established zones of exposure based on the proximity to the landfill, classifying low, medium and high exposure [10, 11].

The studies examined various health outcomes and found the following. Residents living closer to landfills had increased risk of respiratory conditions, skin conditions, mood conditions [13] and nose, throat and eye irritation [16] compared to those living further from the landfill. Cancer was another health outcome of interest to researchers. One study found that the rate of stomach cancer, liver cancer, lung cancer, and cervical cancer was higher among people living in proximity to a municipal solid waste landfill [10]. Reproductive health effects were also measured in the studies. One study found that the odds of having a low birth weight baby were higher in exposed areas than in non-exposed areas [11]. Another study found that the rate of congenital malformation was higher in exposed areas [14].

There are limitations to the applicability of the findings of the studies to the landfill that has been proposed in the northwestern part of Duplin County. The studies were conducted in communities near landfills that were constructed in the 1940's through the 1980's, prior to the establishment of the Subtitle D regulations that mandated the use of landfill gas collection systems; therefore, they do not provide an accurate exposure comparison to the air emissions from landfills that would be developed in 2006.

The methodological limitations of these studies present additional concerns for the applicability of the findings. For example, most studies did not use environmental sampling to determine the exposure; rather, they used the distance to the landfill as the indicator. It is uncertain if the distance from the landfill accurately reflects the residents' exposure to landfill gases. And none of the studies examined the potential health effects of exposure through contact with contaminated water. Furthermore, some of the studies failed to address the lifetime residential history of participants, which could result in misclassification of exposure. The public health literature on the health effects of living near landfills is somewhat limited and demonstrates the need for additional studies that measure the health effects of regional, solid waste landfills developed since the issuance of Subtitle D regulations.

Section 2: Methods

This section describes the methods used to collect and analyze the health and demographic information from the residents in the area surrounding the proposed landfill in northwestern Duplin County.

Sampling and Recruitment

The study sample was drawn from the households located within two miles of the center of the property at Emmett Jackson Rd, the site of the proposed regional solid waste landfill. The Duplin County Tax Office developed the maps used to determine which households were located within two miles of the center of the property. The study was approved by the Public Health Institutional Review Board at the School of Public Health at UNC-CH. The board reviewed the study purpose and design, as well as all written materials pertaining to the study. The data collector went from door-to-door throughout the community to recruit residents to respond to the survey. A recruitment script was used to explain the purpose of the study to the residents (See Appendix A for Recruitment Script). In addition to the door-to-door recruitment, community members set up appointments at households within the defined study area to improve the efficiency of the data collection process.

Approximately 230 inhabited households are located within the defined study area. Of those, 212 households completed the survey, 10 households refused to respond to the survey, and 7 households were unable to be contacted because no one was home at the time of contact to respond to the survey. The data collector attempted to contact each household a minimum of 4 times on at least 3 different dates. The response rate for the survey was 92.2%. The high response rate can be explained by the cooperative relationship between community members and the data collector, as well as the high community visibility of the proposed landfill.

Survey Protocol

The demographic and health survey was administered in-person by a graduate student from the School of Public Health at UNC-CH. All residents over 18 years were eligible to respond to the survey for the household. A bilingual translator, trained in human subject research ethics by the Institutional Review Board, allowed for Spanish speaking residents to respond to the survey. All study participants signed an Informed Consent Form approved by the Institutional Review Board. The consent form was translated into Spanish for the Spanish-speaking respondents. (See Appendix B for Consent Forms). The survey was pilot tested with the first 10 households contacted in the community. Minor changes were made to the survey instrument following the pilot testing period. The survey took each respondent between 10 and 20 minutes to complete. The survey asked specific questions about the household's demographic information, the household's interaction with the physical environment, and the health status of each household member. The survey included one open-ended question that allowed the respondents to express any health or environmental concerns they have about living in Duplin County. (See Appendix C for Survey).

Data Analysis

The interviewer recorded each response using a paper survey. The written responses were entered into an Excel database and analyzed using the quantitative analysis software, SAS 8.2. This software was used to calculate the frequencies and proportions of the data presented in the Findings section of this report. The survey included the following open-ended question: “Is there anything else that you would like to tell me about any environmental concerns or health concerns you have about living here in Duplin County?” The responses to this question were written down by the data collector as systematically as possible. The written responses were entered into an electronic file, and coded and analyzed qualitatively using Atlas.ti 5.0. This qualitative analysis software was used to identify common themes in the responses from community members to this question as well as frequencies of how often the themes or issues were mentioned by respondents.

Section 3: Findings

Quantitative Findings

The quantitative findings present the demographic and health characteristics of the survey respondents at both the individual and household level.

Demographic Information

A total of 212 households responded to the survey. All of the households are located within two miles of the site of the proposed landfill on Emmett Jackson Road. Of the 212 households, 18 households are within one mile of the site of the proposed landfill with the remaining households 1-2 miles from the site. Health and demographic information was collected on each individual within the households that responded to the survey. A total of 498 residents are included in the analysis. The demographic characteristics of the residents are presented in Table 1.

Table 1. Demographic Information			
Category	Variable	N (498)	Percent of total sample
Age	Under 18 years	101	20.3
	18-65 years	317	63.8
	Over 65 years	79	15.9
Gender	Male	234	47
	Female	264	53
Self-Identified Race/ Ethnicity	White	436	87.6
	African American	34	6.8
	Latino	23	4.8
	American Indian	3	0.6
	Asian	1	0.2
	Latino/Caucasian	1	0.2

The mean age of the survey respondents was 40.5 years. Approximately 101 residents (20.0%) were under age 18, and 79 residents (15.9%) were over age 65. Based on these rates, 36% of residents in this community could be classified as dependents. Approximately 53.0% of the residents included in the survey were female, and 47.0% were male. Table 2 shows that as age increased, the proportion of females in the population increased. Among those under 18 years, females made up 51.5% of the population, but among residents over 65 years, 58.2% of the population was female. The greater life expectancy of women in the United States would explain this trend. According to the National Center for Health Statistics, in the U.S. in 2002, the life expectancy for men was 74.5 years and for women it was 79.9 years, a difference of 5.4 years [17].

Table 2. Gender by Age Group		
Variable	N (498)	Percent of age group
Male	234	47.0
Under 18 years	49	48.5
18-65 years	151	47.6
Over 65 years	33	41.8
Female	264	53.0
Under 18 years	52	51.5
18-65 years	166	52.4
Over 65 years	46	58.2

When asked to self-identify their race or ethnicity, a majority (87.6%) of the respondents identified as Caucasian. Only 6.8 % identified as African American and 4.8 % as Latino. Table 3 presents the demographic information for residents living within one mile of the site of the proposed landfill.

Table 3. Demographic Information for Residents within 1 Mile of Proposed Landfill			
Category	Variable	N (40)	Percent of total sample
Age	Under 18 years	9	22.5
	18-65 years	24	60.0
	Over 65 years	7	17.5
Gender	Male	17	42.5
	Female	23	57.5
Race/ Ethnicity	White	38	95.0
	African American	2	5.0

On average, residents in this community reported spending 3.5 hours outdoor each day. Many residents indicated that they spend much more time outdoors in the summer than in the winter; however, this number represents an average over the seasons and the days of the week. The majority of residents (82.5%) did not report eating fish from nearby creeks, streams, rivers or ponds. The residents who did report eating fish vary in the frequency in which they consume local fish. Some residents reported eating local fish once a week (2.4% of respondents), some eat fish once a month (4.2% of respondents), and the greatest percentage of residents only eat local fish a few times a year (7.0% of respondents).

Household Information

Table 4 depicts how long residents have lived in their current homes. Although 38.0% of residents had lived in their homes for less than 10 years, over 17.0% of residents had lived in their homes for more than 40 years. This survey data reporting how long residents had lived in their homes underestimates the connection residents have to the area, as some residents may have moved between homes within this community.

Table 4. How Long Residents Have Lived in Current Home		
Range of Years	n Households (212)	Percent of Households
Less than 10 years	81	38.1
10-19 years	45	21.3
20-39 years	35	16.5
30-39 years	14	6.6
40-49 years	17	8.0
50 or more years	20	9.4

Many residents reported that they have lived in the Calypso-Faison area their entire lives, even if they have not lived in the same house during that time. While the survey did not have a question that asked how long residents had lived in this community, a community member who has lived in the community for her entire life made this observation for each household included in survey. She indicated if at least one adult in the household had lived within two miles of the site of the proposed landfill for his/her entire life. According to this account, 48.1% of the households surveyed had at least one household member who lived in the community for his/her entire life.

Table 5 presents the distribution of household annual income among residents who responded to the survey. Approximately 30.0% of the households in the survey have an annual income of less than \$25,000, with 15.0% reporting an income less than \$15,000. However, 37.3% of residents have a household income greater than \$50,000, and 16.5% of residents have an income greater than \$75,000. The remaining 21.7% reported an income between \$25,000 and \$50,000.

Table 5. Household Annual Income Level		
Income Level	n (212)	Percent of households
<\$15,000	32	15.1
\$15,000-<\$20,000	21	9.9
\$20,000-<\$25,000	17	8.0
\$25,000-<\$30,000	12	5.7
\$30,000-<\$40,000	13	6.1
\$40,000-<\$50,000	21	9.9
\$50,000-<\$75,000	44	20.8
\$75,000-<\$100,000	24	11.3
>\$100,000	11	5.2
Missing	17	8.0

Table 6 presents the household level information for the households included in this survey. The proportion of home ownership among households in the survey was 84.0%. Among the residents living within one mile of the site of the proposed landfill, the proportion of home ownership was 88.9%.

Agricultural Involvement

As presented in Table 6, forty-one households (19.3 %) reported owning land that is used for farming within two miles of the site of the proposed landfill, accounting for approximately 3,300 acres of the land within this defined study area. The crops grown on this farmland are primarily corn, cotton, tobacco, soybeans, wheat, as well as some produce. Sixteen households (7.6%) own livestock that is located within this defined area. Residents own cows, horses, chickens, turkeys, goats, and quail. The rates of land and livestock ownership within this study area do not represent the overall rates of agricultural involvement in this part of the county. Many residents reported owning farmland and livestock that is located in other parts of Duplin County. The intention of the report is to characterize the area within two miles of the site of the proposed landfill; therefore, information on land ownership and use outside the study area was not collected for this survey.

Sixty-three households (29.7%) reported having vegetable and fruit gardens at their household. Of those residents with gardens, 77.0% reported giving away their produce to neighbors, friends and family members. Only 1.9% of residents reported selling the produce from their gardens.

Table 6. Household Information			
Category	Variable	n (212)	Percent of Households
Home Ownership	Own home	178	84.0
	Rent home	32	15.1
	Other	1	0.5
Farmland Ownership (within study area)	Do not own farmland	171	80.7
	Own farmland	41	19.3
Livestock Ownership (animals within study area)	Do not own livestock	196	92.5
	Own livestock	16	7.6
Garden Use	Do not have garden	149	70.3
	Have Garden	63	29.7
	Do not give away garden produce	8	3.8
	Give away garden produce	49	23.1
Water Supply	Municipal Water	144	67.9
	Well water	56	26.4
	Both municipal and well water	12	5.7
Well Water Drinking	Drink well water	49	23.1
	Do not drink well water	19	9.0
	NA (Municipal Supply)	144	67.9
Well Water Other Uses	All household uses (bathing, cooking, washing etc.)	57	26.9
	Outdoor watering	8	3.8
	Washing cars	2	0.9
	Outdoor watering and washing cars	1	0.5
	NA (Municipal Supply)	144	67.9
Home Business	No business in home	193	91.0
	Business in home	19	9.0

Water Supply

Table 7 presents information on water supply and water use patterns on both the household and individual levels. The majority of the households (67.9%) in this study area reported having municipal water supply. However, 56 households (26.4%) reported having only well water and 12 households (5.7%) reported having both well water and municipal water supply. Of the 56 households with only well water, 48 households (77.7%) reported drinking the well water. Of the 12 households with both well and municipal water supply, only 1 household reported drinking the well water.

A total of 126 individuals reported drinking the well water, accounting for 25.4% of the residents who responded to the survey in this area. Some residents with access to only well water reported that they do not drink the well water, indicating that they buy bottled water to drink. All of the 56 households with only well water and one household with both well water and municipal water reported using the well water for all other household activities including: bathing, cooking, cleaning dishes, washing clothes, feeding animals, watering gardens, and washing cars. The 11 remaining households with both well water and municipal water reported that they used the well water for watering their gardens, washing their cars, or both watering gardens and washing cars.

Table 7. Well Water Drinking Patterns within 2 miles of Site of Proposed Landfill			
Category	n (212 households 498 residents)	Number Drink Well Water	Percent in group who drink well water
Have Only Municipal Water			
Households	144	0	0
Residents	332	0	0
Have Only Well Water			
Households	56	49	87.5
Residents	144	125	87.5
Have Well and Municipal			
Households	12	1	8.3
Residents	22	1	4.8

Eighteen households that responded to the survey are located within one mile of the site of the proposed landfill. As presented in Table 8, 16 of the 18 households reported having only well water (88.9%), and the other 2 reported having both well water and municipal water supply (11.1%). Of those 16 households with well water, 14 indicated that they drink the well water (87.5%). The 2 households with both water types reported drinking the municipal water. A total of 40 residents live within one mile of the site of the proposed landfill. Thirty-seven of those residents reported having only well water and 33 residents reported drinking the well water.

Table 8. Well Water Drinking Patterns within 1 mile of Site of Proposed Landfill			
Category	n (18 households 40 residents)	Number Drink Well Water	Percent in group who drink well water
Have Only Municipal Water			
Households	0	0	0
Residents	0	0	0
Have Only Well Water			
Households	16	14	87.5
Residents	37	33	89.2
Have Well and Municipal			
Households	2	0	0
Residents	3	0	0

Table 9. Age-Adjusted Prevalence of Health Conditions

Category	Health Condition	Age group (Adult=18 and over Youth=under 18)	n Youth (101) Adult (396)	Percent of Age Group with Condition
Respiratory Conditions	Asthma	Youth	16	15.8
		Adult	41	10.4
	Bronchitis	Adult	28	7.1
	Allergies	Youth	51	50.5
		Adult	187	47.2
Chronic sinusitis	Adult	17	4.3	
Skin Conditions	Rashes (all types)	Youth	18	17.8
		Adult	37	9.3
	<i>Eczema</i>	Youth	17	16.8
		Adult	15	6.8
	<i>Psoriasis</i>	Adult	6	1.5
<i>Hives</i>	Adult	4	1.0	
Heart Related Conditions	Hypertension	Adult	124	31.3
	Heart Disease	Adult	54	13.6
Cancer	Cancer (all types)	Adult	33	8.3
	<i>Skin</i>	Adult	7	1.8
	<i>Melanoma</i>	Adult	5	1.3
	<i>Colon</i>	Adult	4	1.0
	<i>Breast</i>	Adult	4	1.0
Gastrointestinal Conditions	Gastrointestinal Conditions (all types)	Adult	74	18.7
	<i>Acid Reflux</i>	Adult	34	8.6
	<i>Ulcers</i>	Adult	5	1.3
	<i>Hernia</i>	Adult	5	1.3
Immune Conditions	Immune Conditions (all types)	Adult	25	6.3
	<i>Thyroid</i>	Adult	22	5.6
Neurological Conditions	Neurological Conditions (all types)	Youth	3	3.0
		Adult	30	7.6
	<i>Stroke</i>	Adult	7	1.8
	<i>Cognitive Disability</i>	Adult	5	1.3
Other Conditions	Kidney Disease	Adult	25	6.3
	Arthritis	Adult	124	31.5
	Diabetes	Adult	39	9.9

*Conditions affecting less than 2% of the age-group were not included in the table.

*Conditions in italics are subtypes of conditions listed above. Only subtypes of conditions present in more than 1% of the age-specific population were included in the table.

Health Status of Residents

Table 9 presents the age-adjusted prevalence of the health conditions included in the survey. The table categorizes the health conditions, and presents the prevalence of health conditions specific to youth (defined as residents less than 18 years), and adults (defined as residents who are 18 years or older) in the community. As highlighted in the footnote of the table, the major health conditions are only listed if they affect as least 2.0% of the age group. For the subtypes of the health conditions, statistics were presented if at least 1.0% of the group was affected by the condition. This explains why the prevalence rates of many of the chronic conditions are not presented for youth.

Respiratory conditions were common among both the youth and adults members of the community. The asthma rate was 15.8% for youth and 10.4% for adults. Allergies were very prevalent in this community, as 50.5% of all youth and 47.2% of adults in the community reported having allergies. Chronic sinusitis was not a condition included in the survey instrument; however, 4.3% of adults mentioned this as an “other” health condition.

Rashes were present among 17.8% of youth and 9.3% of adults. Eczema was by far the most common rash accounting for 94.4% of all rashes among youth. Adults were affected by a greater number of rashes as only 40.5% of adults with rashes reported having eczema. Psoriasis and hives were the other rashes reported by adults.

The following chronic health conditions were present among the *adult* residents in this community. Hypertension was reported for 31.3% of residents, and heart disease for 13.6%. Diabetes was reported in 9.8% of adults, and arthritis in 31.5% of residents. Cancer was reported in 8.3% of the adult population. Skin cancer accounted for 7 of the 33 cases, or 21.2% of all cancer cases in the community. Melanoma accounted for 15.2% of cases, and breast cancer and colon cancer each accounted for 12.1% of the total cases of cancer in the community. Among adults, 18.7% reported gastrointestinal problems. The most common type of gastrointestinal problem was acid reflux, accounting for 45.9% of all gastrointestinal problems. Ulcers and hernias were other types of gastrointestinal problems reported among residents.

Birth Information

The sample had 212 women, 165 of whom have ever been pregnant (77.8%). These women had a combined total of 472 pregnancies. Of the 472 pregnancies, 63 (13.4%) were miscarriages and 408 were live births (86.4%). Table 10 indicates that 5.9 % of all the live births were low birth weight (less than 5.5 pounds at birth), 7.1% were premature (born three or more weeks early), and 4.2% of the babies were born with a birth defect.

Table 10. Birth Conditions		
Condition	n (408 births)	Percent of births
Low birth weight (< 5.5 pounds)	24	5.9
Premature (3 or more weeks early)	29	7.1
Birth defects	17	4.2

Water Source and Health Status of Residents

Table 11 compares the prevalence of health conditions between the residents who drink well water and the residents who drink municipal water. The table presents the odds ratio as a measure of comparison between the two groups, providing the confidence intervals for the odds ratios. The health conditions with odds ratios greater than one were more prevalent among residents who drink well water, and those less than one were more prevalent among residents who drink municipal water. As demonstrated in the table, chronic sinusitis, neurological conditions and kidney disease were more prevalent among residents who drink well water. Gastrointestinal problems and cancer had a slightly higher prevalence among residents who drink the well water. Asthma and rashes were much more prevalent among residents who drink municipal water, and the chronic conditions of hypertension, heart disease, arthritis and diabetes were slightly more prevalent among those who drink the municipal water. The small sample size for this survey makes these odds ratios imprecise measures; therefore, it is difficult to draw significant conclusions from this data.

Table 11. Adult Age-Adjusted Prevalence Rates Comparing Residents who Drink Well Water to those who Drink Municipal Water							
Category	Health Condition	Well Water		Municipal Water		Odds Ratio	95% Confidence Intervals
		n (97)	Percent	n (298)	Percent		
Respiratory Conditions	Asthma	6	6.2	35	11.7	0.50	0.20, 1.22
	Allergies	43	44.3	143	48.0	0.86	0.55, 1.37
	Bronchitis	7	7.2	21	7.1	1.03	0.42, 2.49
	Chronic Sinusitis	7	7.2	10	3.4	2.24	0.83, 6.06
Skin Conditions	Rashes	6	6.2	30	10.1	0.59	0.24, 1.46
	<i>Eczema</i>	3	3.1	12	4.0	0.76	0.21, 2.75
Heart-Related Conditions	Heart Disease	11	11.3	43	14.4	0.76	0.38, 1.54
	Hypertension	26	26.8	98	32.9	0.75	0.45, 1.25
Cancer	Cancer	10	10.3	23	7.7	1.37	0.63, 3.00
Gastrointestinal Conditions	Gastrointestinal Conditions	21	21.7	52	17.5	1.31	0.74, 2.31
	<i>Acid reflux</i>	10	10.3	23	7.7	1.37	0.63, 3.00
Immune Conditions	Immune Conditions	6	6.2	19	6.4	0.97	0.38, 2.50
	<i>Thyroid</i>	5	5.2	17	5.7	0.90	0.32, 2.50
Neurological Conditions	Neurological Conditions	12	12.4	18	6.0	2.20	1.02, 4.74
Other Conditions	Kidney Disease	9	9.3	16	5.4	1.80	0.77, 4.22
	Arthritis	26	26.8	97	32.6	0.76	0.46, 1.26
	Diabetes	8	8.3	31	10.4	0.77	0.34, 1.75

Qualitative Findings

Qualitative research can be used to understand the interpretations and experiences of individuals within their social context. The final question on the survey gave residents the opportunity to express in a confidential manner, any environmental or health concerns they have about living in Duplin County. The open-ended question¹ asked, “Is there anything else that you would like to tell me about any environmental concerns or health concerns you have about living here in Duplin County?” The responses to this question reflect the beliefs and perceptions of the community members regarding their overall health and quality of life and the issue of the regional solid waste landfill in their community. The value of this information is to measure, record and understand the perceptions of the residents who would be most acutely affected by the landfill if it were developed in their community.

Many residents expressed concerns about the potential health and environmental effects that they believe the proposed landfill could have on their community in the future. Residents also mentioned existing environmental or health issues of concern to them. The two categories of responses, *potential concerns related to the landfill* and *existing health and environmental concerns* will be presented separately.

The survey instrument was pilot tested on the first 10 households surveyed in the community. The original survey did not include this open-ended question; therefore, these 10 households are not included in the qualitative analysis. Two other households were not able to respond to this question. Therefore, a total of 200 households responded to this question. When asked this question, 52 households (26.0%) reported no environmental or health concerns about living in this community.

Concerns Related to the Landfill

As illustrated in Table 12, 115 households (57.5%) expressed concerns about the proposed landfill being developed in their community. The most frequently mentioned concerns related to the landfill were: water pollution (26.5%), groundwater contamination (15.5%), an increase in traffic (12.5%), and an increase in the number of pests in the area (11.0%). These responses and other repeated concerns will be described in more detail, using illustrative quotes from community residents.

¹ The same wording was used to ask the question at each household; however, open-ended questions do not provide response options to respondents. The fact that predetermined responses are not provided decreases the comparability of the responses across residents; however, this format allows residents to freely express any issues of concern to them. It also reduces the bias of a survey instrument that provides predetermined responses to participants.

Table 12. Concerns Related to the Proposed Landfill

Category	Issue	n (200 households)	Percent of Households
Overall Concern	Concerned about Landfill	115	57.5
Health and Environmental Concerns	Water Pollution (all types)	53	26.5
	<i>Groundwater Contamination</i>	31	15.5
	<i>Goshen Swamp</i>	12	6.0
	Air Pollution	12	6.0
	Environmental Concerns	13	6.5
	Health Concerns	16	8.0
Accountability for Waste	Accountability for Waste	18	9.0
Quality of Life Concerns	Traffic	25	12.5
	Pests (birds, rodents, flies)	22	11.0
	Smell	19	9.5
	Appearance of landfill	12	6.0
	Diseases (communicable)	11	5.5
	Future Generations	11	5.5
	Change Nature of the Community	6	3.0
Economic Concerns	Property Value Decline	9	4.5
	Disincentive for Community Growth	6	3.0

This table includes all responses mentioned by six households or more. Many other issues were mentioned by fewer than six households, but are not included in this table. Examples of the other topics mentioned include: the contamination of produce, the drawn-out negotiation process for the landfill, the belief that somebody has to have a landfill, and the belief that the landfill should be located in a less populated area.

Health and Environmental Concerns

The potential impact on the environment and health from the landfill were the most commonly mentioned concerns for community residents. The potential for the landfill to contaminate the water in the area was a concern in many households. As described in the quantitative results, the residents who live in closest proximity to the landfill depend on well water, and they are concerned about how the landfill could affect their water supply. One resident said, “I really have a lot of concerns about the landfill, because I know it's gonna get in the water.” Another community member expressed, “I have concerns about our well water and not knowing what's going into the ground and what we drink.”

The concern that the landfill could pollute the surface water was another issue reported by residents. Residents are specifically concerned about contamination of the Goshen Swamp, which is located next to the site of the proposed landfill. As one resident stated, “I don't understand how they could put a landfill so close to a swamp. It's very close to it. There's no way that landfill's not gonna contaminate the water.” Residents also mentioned concern about the watershed, saying “I'd be concerned about polluting the Goshen swamp and Cape Fear River

Basin.” Another community member expressed, “I think it will be an environmental hazard for our area and the Goshen swamp which will lead to the Neuse River.”

Some residents believed that the landfill could pollute the air in their community. Community residents expressed “I do have concerns about the air quality if the landfill comes,” and “I don't like the idea of a landfill coming here because of the air you may breathe because of it.” In addition to these general concerns about the air, residents believed that the change in air quality could exacerbate their existing respiratory health conditions, or those of their family members. As one mother said, “with the allergies and asthma that we have, we're concerned about the air quality changing with the landfill.” Another resident stated, “when you have so many allergies, the air you breathe concerns you. I don't want that landfill here.”

Accountability of Waste

Residents expressed that Duplin County should be accountable for its own waste, but it should not be responsible for the waste of other states. The idea that the landfill would accept waste from many states concerned residents. A community member expressed, “I don't like the idea of everyone bringing their trash here and dumping it.” Another resident asked, “we are building a landfill for New Jersey and New York's garbage?” Finally a resident stated, “I don't think we need a multi-state dump. I think a few counties would be fine.”

Many residents shared this feeling that they would support a landfill for Duplin County. “My opinion is the landfill should be for Duplin County only, not for everybody in the country. It's our trash, nobody else wants ours.” Another community member stated, “if it was a county landfill for this county, I wouldn't say anything.” A community member agreed, saying “I think we need someplace to put our trash but let's have a county landfill.” Residents also mentioned that the county and the residents should be more accountable for their own waste reduction. “I think it's only appropriate to take care of our own trash. We do not actively and aggressively take care of our recycling.” Another resident expressed that “we as Americans create too much waste. We need to recycle and reduce waste.”

Quality of Life Concerns

Another theme that emerged from the responses of residents in the community is the concern that the landfill could affect the quality of life in this rural, farming community. The issues most commonly mentioned by residents were traffic, pests, diseases, odor and the appearance of the community. Residents also imagined the landfill changing the nature of their community and affecting the health and well-being of future generations.

Residents reported that they believe an increase in traffic due to tractor trailers hauling trash to the landfill would affect their quality of life. As one resident stated, “the increase in our traffic will cause more pollution and noise.” Another resident stated, “I do worry about the landfill coming here. I worry about the big trucks going by.” The safety issues related to the increased traffic were reported by residents. “There will be an increase in traffic and there are safety concerns with that.” Another resident agreed saying “the only other thing would be the traffic from the landfill. The connector has already had some accidents.”

Many residents believed the landfill would attract pests, specifically rodents, insects and birds. As one community member described “my concern with the landfill is the increase in rodents, because there are already a lot around the swamp. And the increase in birds and bird droppings and what may be associated with diseases.” The worry that the birds would bring disease to the area was a common perception among residents, particularly since the Avian Flu was a topic in the media during this time. As one resident stated, “I’m also concerned about the seagulls and bird flu.” The odor that the landfill would emit was another concern among residents. As one resident stated, “I’ve heard there could be foul odors from the landfill.”

Due to the high water table in Eastern North Carolina, the landfill would be built above the ground and could grow to be 275 feet high. For this reason, many residents mentioned their concern about the appearance of the landfill and its effect on their quality of life. A community member described this by saying, “I would hate to look out in the morning and see a mountain over there. I won’t be able to see the sun come up.” Another couple stated, “we don’t want to step out our backdoor and see that thing.” According to another community member, “having a big huge pile of trash and all of those trucks on the road will affect my mental health.” The “trash on the side of the road,” falling from the trucks was another way that residents perceived that the landfill would negatively affect the appearance of their community.

Due to the factors mentioned above, residents expressed concern that the landfill would change the nature of their rural community. Residents described their community as a quiet, rural, farming community comprised of families that have lived in the area for most of their lives. They are worried that the landfill would change their community as they perceive it. As one resident described, “It would change the quality of life in this nice quiet, rural area.” Another resident of Calypso stated, “Calypso is the best place to live. I’m afraid if they put that landfill there that it will change Calypso.” And another expressed “living in this area my whole life, I don’t see anything positive that could come from it. One of the best things about living here is the natural beauty and it could change that.”

Many residents believed the community is a good place to raise children. This resident expressed concern that the landfill would change that, saying, “we don’t need that here. A small quiet little town like this, and people spend so much time outside, and raise their kids.” Residents also believed that the future generations would bear the negative impacts of the landfill. One community member stated, “I might not see the effect, but I have grandchildren that could be harmed by the landfill.” Another resident expressed, “I’m more concerned about my offspring. I’ve only got a few more years left, but they’ve got a lifetime ahead of them and it won’t be a nice or a healthy place to live.” Finally residents identified with the farming tradition and the good farmland in this community. As one community member stated, “these are generational farms. People love the land. They don’t sell it....People pass down their farms in this community.” Another resident expressed that “it’s always been pristine farmland. It would be so sad to ruin that.”

Economic Concerns

The potential decrease in their property value if the landfill is built in their community was a perceived economic concern of residents. “We’re concerned the property value will go down if the landfill is in the area.” Another resident expressed, “I’m not moving, but if I lived on that

street, I think I'd move. What are they going to do about the property value of those residents? Would they have a class action suit?"

Other community members reported that they believe the development of the landfill would discourage growth in the area. "I don't know why our commissioners would even consider the dump. We need more industries but we don't need a dump. It won't help this area grow. People aren't going to want to move near a dump." Another resident shared this sentiment saying, "socio-economically this part of the county would suffer. No new businesses or residential areas would come. People would not want to bring their children to these schools."

Existing Environmental and Health Concerns

Table 13 presents the existing environmental and health concerns mentioned most frequently by survey respondents. The most repeated concerns mentioned were the intensive livestock operations in the county (14.4%), the fertilizers and pesticides used in farming (7.5%) and the current water supply (4.5%). Each of these issues will be discussed in more detail using illustrative quotes from the residents.

Table 13. Existing Health and Environmental Concerns		
Issue	N (202 households)	Percent of households
Intensive Livestock Operations (hogs, turkeys, chickens)	29	14.5
<i>Smell</i>	11	5.5
<i>Water Pollution</i>	7	3.5
<i>Lagoons and Spraying</i>	7	3.5
Farming Fertilizers and Pesticides	15	7.5
Current Water Supply	9	4.5
Septic Tanks	4	2.0
Cancer Rate	3	1.5
Plywood Plant	4	2.0
The items included in the table above list all the existing health and environmental concerns mentioned by 3 or more households. Many other responses were mentioned by fewer than 3 households, but they are not all included in the tables. Examples of the other concerns mentioned by only one household include: the smoke from Georgia Pacific in Dudley, the increase in traffic from the feed plant, the flooding of an individual's property from the road, and the high voltage power lines.		

Intensive Livestock Operations

The intensive livestock operations (hog, turkey and chicken houses) were the most frequently mentioned existing environmental issue by residents. Residents complained of the smell associated with living in close vicinity to these farms. As one resident described "I'm concerned about the hog operations. They smell awful. It'll knock you down." Other residents described how the odor infiltrates their property. "There's a turkey farm over there and it just stinks. I rarely open my window here." Another community member said "the hog houses smell like it's right at your back door."

The waste management system of collecting the hog waste in lagoons and then spraying it out on the fields was another concern of community members. One resident said “the livestock in the county-it’s infested with livestock. Where is the waste gonna go? It goes into the lagoons but they pump it out into the fields.” Another respondent expressed, “I wish they could come up with something other than the hog lagoons.” The most common concern with the waste was the contamination of the water supply and the creeks, streams and rivers in the area. As one resident explained, “we’re in the Cape Fear river basin and with the turkeys and hog farms we’re flooding the river with waste.” Another resident said, “we have concerns about water supply due to the hog lagoons. More and more of our water supply is being contaminated due to that.”

Other residents mentioned the effect of the hog waste on the local fish supply as a concern. As one resident stated, “we have hog operations all around. I don’t like eating the fish because, I don’t know about the run-off from the hog houses and stuff.” According to another community member, “the creek looks like a hog lagoon. Nobody’s gonna eat fish from the creeks around here.”

Farming Fertilizers and Pesticides

Residents expressed concerns about the chemicals sprayed on the crops in the area and their belief that they affect the water quality, health, and quality of life for residents. As one resident expressed, “I’m concerned about the fertilizers and chemicals sprayed on crops and how they affect the groundwater.” According to another resident, “the water is not the best. It’s heavily ironed from the fertilizers and pesticides.”

Residents perceived that more chemicals are being used by farmers in the community than were used in the past. As one resident explained, “the only concerns I have is about the farmers. When we have a big rain, all of the chemical fertilizers run down the hill to the ditch. The round-up that’s been sprayed on the crops kills the grass and weeds. There’s no till farming anymore---one hundred percent chemicals to control the grass, weeds, worms and bugs.”

A few residents mentioned the immediate health problems they experience when the chemicals are sprayed on the fields. As one resident explained, “the only concern I have is when they put down all those chemical on the fields. That’s why I think I have a touch of asthma. When they spray the chemicals on the cotton, I can’t go outside.” A mother stated, “we’re concerned about pesticides...when they spray around here we don’t go outside and I try to keep the kids away. We plan to move because of it.”

Current Water Supply

Approximately 26.0% of households in the survey get their drinking water from wells. Residents mentioned various concerns related to the well water supply in this community. According to one resident, “the water’s terrible up this way. About everybody has bad water.” Another community member expressed, “the concern I have is with the groundwater around here. It is unsafe. You couldn’t wash white clothes at the house.” Residents explained that they have to pay for expensive filtration systems for their well water. As one resident expressed, “the water is horrible. I pay over \$100 per month for filtration. Without the system I couldn’t wash my clothes.”

Environmental Burden in Community

The final theme that emerged from the concerns expressed by residents is that the landfill would place an additional environmental burden on a community with existing health and environmental concerns. Some residents mentioned the chemicals from the farming as an existing concern. As one resident stated, “we already live in a farming community and God knows what kind of chemicals have been floating around here. So we don't want to add to those problems. We're just a half-mile from the proposed site for the landfill through those trees.” Another resident expressed, “I have a lot of allergies to the chemicals they spray for farming, and the crops biodegrading... I couldn't even go in the yard. My eyes were swollen and itchy.”

A few other residents mentioned the hog farms, saying, “I think we already have a lot of hog farms around here and they don't have much benefit. I think that's all we need. I don't think this community needs more chemicals that pollute the water supply.” Another community member shared this concern saying, “I worry about the environment of Duplin County from the hog waste. Is this landfill just additive on top of a problem we already have? They're lined and they're well maintained, but you can't tell what's going on underground. From the point of adding to a problem we already have, I'm against it [the landfill].”

Section 4: Discussion

The World Health Organization defines health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” [18]. Assessing and protecting the health of a community and evaluating potential impacts to community health presented by a regional municipal solid waste landfill demands attention to all these aspects of well-being. The quantitative and qualitative findings from the survey along with the public health literature will be used to make this assessment.

A theoretical framework adopted from a report prepared by Steve Wing, an epidemiologist at the University of North Carolina School of Public Health, will be used as the foundation for this discussion. He describes categories of the causes of health problems that can result from a solid waste landfill. Two of these categories will be used in this report. The first category consists of *hazardous agents*, which include chemical toxicants, biological pathogens, odors, and noise. The other category consists of *ecological hazards*, such as a change in the natural environment or social resources of the community, the physical or social barriers to exercise and nutrition, and the stress created by the change in the nature of this community. These two categories of hazards can also interact to affect the health of a community [6].

Health Risks due to Hazardous Agents

Air Quality and Respiratory Health

As residents mentioned in the qualitative findings, the development of the landfill would significantly increase the volume of traffic of tractor trailers hauling waste to the landfill. Based on the Franchise Agreement and Data Sheet provided to Duplin County by Waste Industries, an average of 5,000 tons of waste will be hauled to the landfill each day. If one tractor trailer holds 20 tons of waste, it is estimated that up to 250 tractor trailers would drive through this community to the landfill every day [19]. Diesel emissions from trucks release large amounts of

nitrogen oxides and particulate matter into the air. Both of these agents have been shown to be linked to asthma and other respiratory problems [20]. Children, the elderly, people with respiratory problems, and people who smoke are at the greatest risk for the respiratory problems associated with diesel emissions [21]. As presented in the findings section, 20.0% of residents in this community are children and 15.9% of the population is elderly, making these populations more vulnerable to the respiratory conditions associated with diesel emission. The National Center for Health Statistics provides national statistics to offer a general point of comparison to the statistics found in this survey. A direct comparison is difficult to make, since the same questions were not asked of the two samples, so there is potential for overreporting relative to the national survey². Keeping this limitation in mind, these statistics show that the asthma rate of youth surveyed in Duplin County (15.8%) is higher than the national rate (12.0%); the adult rate in the community (10.4%) is also slightly higher than the national rate (9.7%). Markedly higher levels of allergies were reported for children in the survey (50.5%) compared to the national rates (12.0%) and for adults (47.2%) in this community as compared to the national rates (8.6%) [22]. The increased exposure to diesel emissions could exacerbate the existing respiratory conditions among residents in this community.

Well water

As mentioned in the quantitative findings section of this report, 87.5% of residents living within one mile of the site of the proposed landfill drink well water. The Environmental Protection Agency report stated that although landfill lining technology has improved, all liners have the potential to leak over time [5]. Landfill leachate escaping into groundwater would put the residents living closest to the landfill at the greatest risk of their drinking water supply being contaminated. According to the results of this survey, these residents are more likely to have well water and to drink their well water. Therefore, the residents at greatest risk do not have access to the public services that could protect them from the exposure. Residents expressed concerns about the quality of their existing water supply. The landfill could add an additional source of potential contamination to the drinking water of this community.

Produce Contamination

The agricultural nature of this community presents another potential route of exposure for residents. As presented in the findings section, 3,300 acres in this area is used for commercial agriculture, and 29.7% of residents have vegetable and/or fruit gardens in this area. There is the potential for increased exposure to the hazardous agents in the landfill through this pathway of crops grown locally whether through commercial farming or local produce from the gardens of residents.

Environmental Burden

In the qualitative findings, several residents expressed that the landfill would be an additive burden on a community with existing environmental concerns. The industrial livestock

² The community survey asked for residents to self-report if they have asthma or allergies. The National Center for Health Statistics reports the number of individuals who were ever diagnosed by a healthcare provider with the health condition. For example, it presents the number of individuals ever diagnosed with asthma, and the number of individuals ever diagnosed with hay fever.

operations were mentioned as an existing concern for residents in this community. Due to the high concentration of the hog and turkey farms in Duplin County, the environmental and health effects of the intensive livestock operations will be discussed in more detail. North Carolina is the second largest hog producing state in the country, and Duplin County produces more hogs than any other county in the nation. As of 2003, Duplin County had 2.17 million hogs [23]. This means that there are approximately 45 hogs for every resident of Duplin County [24]. Managing the waste generated from this number of animals in the environment is difficult. The current waste management system stores the hog waste in lagoons, and then sprays the waste onto fields as a fertilizer.

Reports have shown that the intensive livestock operations present a source of exposure through the water and air for residents living close to the hog farms [25]. A study conducted by the state of North Carolina in 1998 found that more than 10% of private wells tested near hog and chicken operations were contaminated with excessive levels of nitrates [26]. If the landfill were developed in this community and the lining of the landfill were to leak, it would present another potential source of groundwater or surface water contamination for a community already facing water contamination from the intensive livestock operations in the county.

A study conducted in Eastern North Carolina found elevated levels of headache, runny nose, sore throat, excessive coughing, diarrhea, and burning eyes were reported among residents living close to industrial hog operations[27]. As mentioned above, markedly higher levels of allergies were reported for children in the community (50.5%) compared to the national rates (12.0%) and for adults (47.2%) in the community as compared to the national rates (8.6%); however, again the potential exists for overreporting in the community relative to the national survey. A report produced by the North Carolina State Center for Health Statistics provides statistics for adults living in Eastern North Carolina³. According to this report, the adult asthma prevalence in Eastern North Carolina is 11.5%, the national prevalence of 9.7%, and the self-reported prevalence of asthma in the community was 10.35% among adults[28]. Although the asthma prevalence for children in Eastern North Carolina was not available, the community self reported a prevalence was 15.84% among youth, compared to the national prevalence of 12.0%[22]. Regardless, developing a landfill in this community would present an additional potential source of exposure for residents to the landfill gases and diesel emissions. This exposure could exacerbate the existing respiratory conditions for residents, some of whom already face exposure to the intensive livestock operations.

Finally, the offensive odor of the industrial hog operations has been examined by researchers [29]. A study conducted in North Carolina examined the psychological stress of living with hog odor. It found that residents living close to the hog farms for at least five years experienced more tension, depression, anger and fatigue than those not exposed to hog odor [30]. The qualitative findings section confirmed that the residents in this community experience odor from the intensive livestock operations in the county. The landfill would present an additional

³ The North Carolina State Center for Health Statistics used the BRFSS questionnaire to collect the data on residents in Eastern North Carolina. This questionnaire asks respondents if they have been diagnosed with the health condition by a healthcare provider.

exposure to odor in a community already burdened with odor, which could contribute to the mental health effects for the residents in this community.

Ecological Hazards

The ecological hazards for this community will be described in this section. According to the report, “like other locally unwanted land uses, regional solid waste landfills impact health through mechanisms related to psychosocial reactions, community resources and development” [6].

Built Environment and Health

The built environment’s effect on health has been the focus of much attention in public health. For example, the built environment affects access to opportunities for physical activity, which has been proven to have a positive effect on health [31]. A regional, solid waste landfill in this community may discourage the development of parks, schools, greenspaces or other recreational facilities that promote physical activity among residents. One resident expressed concern that the increased traffic on the roads may discourage her family from walking on the country roads for exercise. She described “we walk on this road for our health and we're concerned that with the traffic we won't be able to do that.” The built environment may also affect the diet of residents by determining the availability, type and distribution of restaurants and food stores [31].

The availability of health promoting facilities in the area surrounding the site of the proposed landfill is important given the current health status of residents in Eastern North Carolina. The eastern region of the state has been shown to have elevated rates of chronic health conditions. The adult prevalence of diabetes in Eastern North Carolina is 8.5%, higher than the national rate of 6.6%. The prevalence of cancer in the eastern part of the state is 11.6%, markedly higher than the national prevalence of 6.6%. Hypertension, a risk factor for cardiovascular disease, affects 30.1% of Eastern North Carolinians, which is the same as the national prevalence of 30.0 %; however, this condition affects almost one out of every three adults. The prevalence of cardiovascular disease in Eastern North Carolina is 9.9%, slightly lower than the national prevalence of 11.0% [22, 28]. For all of these chronic health conditions, diet and physical activity are the most highly recommended prevention and treatment measures. Therefore, it is in the interest of the community to attract facilities that would promote physical activity and access to healthy foods among residents.

As described in the qualitative findings, residents fear that the landfill would discourage other businesses and residents from locating in this area in the future, which would affect the economic status in the area. The connection between socio-economic status (SES) and health has been well established in public health literature. If the landfill were to have a negative effect on the local economy, it could also have a detrimental effect on the health of residents. However, it should be noted that the landfill could bring additional revenue to the county in the form of host fees, so some residents in the area could benefit economically depending on how the revenue was allocated by the county [19]

Psychosocial Stressor

The community that completed the health survey is comprised of many families who have lived in this area for most of their lives. The rural area consists of many generational farms that have been passed down through families. The quiet nature of this farming community has encouraged families to stay in the area, and it has attracted people who grew up in the area to return as adults. The rural nature of the community encourages residents to spend time outdoors, and the survey respondents reported spending an average of 3.5 hours outside each day. The qualitative findings section describes the fears that residents have about how the landfill could change the quality of life in the community including: the noise and safety concerns from the traffic, the increase in rodents, insects and seagulls, and the unsightly appearance of the landfill and trash in their community. (See Table 12 for the proportions of residents who voiced their concern about these issues.) Residents who have lived in this area for most of the lives have a sense of community identity with this area. This change, that they perceive to be negative, could be a psychosocial stressor for the residents in this area. The development of the landfill in their community could have a detrimental effect on their mental and social well-being of residents, dimensions of health according to the World Health Organization.

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Appendix A: Recruitment Script

Hi. My name is _____. I am conducting a community survey of people living in Duplin County as part of a research study. The purpose is to learn about the health and demographic characteristics of Duplin County residents living close to the site of the proposed landfill. This information is being collected to determine the potential health risks for residents living near the proposed landfill. The survey will be conducted with the two hundred households within 2 miles of the proposed landfill. You are being asked to be in the study because you live in a household that is located within this area. If you agree to participate in this study, you will be asked questions about your demographic information, your household's interaction with the environment, your health status, and the health status of the other members in your household. It should take about 15 minutes to complete. Are you interested in participating in this survey?

Appendix B: Consent Forms English Version

University of North Carolina-Chapel Hill Consent to Participate in a Research Study Adult Participants Social Behavioral Form

IRB Study #05-2721

Consent Form Version Date: 11/04/05

Title of Study: Survey of Duplin County Residents Living near Proposed Landfill

Principal Investigator: Emily Wurth

UNC-Chapel Hill Department: #7440

UNC-Chapel Hill Phone number: 919-966-3761

Email Address: ewurth@email.unc.edu

Faculty Advisor: Dr. David Savitz, Department of Epidemiology

Funding Source: Citizens for a Safe Environment

Study Contact telephone number: 919-923-4294

Study Contact email: ewurth@email.unc.edu

What are some general things you should know about research studies?

You are being asked to take part in a research study. To join the study is completely voluntary.

You may refuse to join, or you may withdraw your consent to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. You may not receive any direct benefit from being in the research study. There also may be risks to being in research studies.

Details about this study are discussed below. It is important that you understand this information so that you can make an informed choice about being in this research study.

You will be given a copy of this consent form. You should ask the researchers named above, or staff members who may assist them, any questions you have about this study at any time.

What is the purpose of this study?

The purpose of this research study is to learn about the demographic and health characteristics of Duplin County residents living within two miles of the site of the proposed landfill. The survey will be conducted with approximately two hundred households in this defined area. This information is being collected to assess the potential health risks for residents living in close vicinity to the proposed landfill.

You are being asked to be in the study because you live in a household that is located within two miles of the site of the proposed landfill.

Are there any reasons you should not be in this study?

You should not be in this study if you are less than 18 years of age.

How many people will take part in this study?

If you decide to be in this study, you will be one of approximately two hundred households taking part in this study.

How long will your part in this study last?

The only time you will be contacted as a part of this project is by the data collector to complete this survey. This survey will take about 15-30 minutes to complete.

What will happen if you take part in the study?

If you agree to participate in this study, you will be asked questions about your demographic information, your household's interaction with the environment, your health status, and the health status of the other members in your household. You will be asked to respond to each question. You may elect not to answer any questions on the survey and you may stop responding to the survey at any time. This information will be collected from approximately two hundred households in Duplin County. The principal investigator will analyze the data to assess the potential health risks for residents living in close vicinity to the proposed landfill.

What are the possible benefits from being in this study?

Research is designed to benefit society by gaining new knowledge. You may not benefit personally from being in this research study.

What are the possible risks or discomforts involved from being in this study?

The risks for participating in this study are minimal. You may feel uncomfortable disclosing your personal health information, so you may elect not to answer any questions on the survey. Your participation in this study is voluntary.

How will your privacy be protected?

Your address and identification number will be documented on a cover sheet of the survey that will be removed following the completion of the survey. This cover sheet will be stored separately from the completed surveys. Your identification number is the only identifying information that will remain on the completed surveys. All participant identification information will be stored in a locked file in the office of the principal investigator. The principal investigator, Emily Wurth, is the only researcher who will be analyzing the data. Preliminary data analysis will be shared with faculty mentor, Dr. David Savitz.

Participants will not be identified in any report or publication about this study. Although every effort will be made to keep research records private, there may be times when federal or state law requires the disclosure of such records, including personal information. This is very unlikely, but if disclosure is ever required, UNC-Chapel Hill will take steps allowable by law to protect the privacy of personal information. In some cases, your information in this research study could be reviewed by representatives of the University, research sponsors, or government agencies for purposes such as quality control or safety.

Will you receive anything for being in this study?

You will not receive anything for taking part in this study, but your information is very important.

Will it cost you anything to be in this study?

There will be no costs for being in the study other than your time.

What if you have questions about this study?

You have the right to ask, and have answered, any questions you may have about this research. If you have questions, or concerns, you should contact researcher, Emily Wurth, at 919-923-4294

What if you have questions about your rights as a research participant?

All research on human volunteers is reviewed by a committee that works to protect your rights and welfare. If you have questions or concerns about your rights as a research subject you may contact, anonymously if you wish, the Institutional Review Board at 919-966-3113 or by email to IRB_subjects@unc.edu.

Participant's Agreement:

I have read the information provided above. I have asked all the questions I have at this time. I voluntarily agree to participate in this research study.

Signature of Research Participant

Date

Printed Name of Research Participant

Signature of Person Obtaining Consent

Date

Printed Name of Person Obtaining Consent

Appendix B: Consent Form Spanish Version

University of North Carolina-Chapel Hill
Consentimiento para participar en un estudio de investigación
Sujetos adultos
Formulario Biomédico

Nº de estudio del IRB #05-2721

Fecha de la versión del formulario de consentimiento: 1/30/06

Título del estudio: Estudio de Duplin Condado residentes que viven cerca del basural propuesto

Investigador principal: Emily Wurth

Departamento de la UNC-Chapel Hill: Health Behavior Health Education

Número telefónico de la UNC-Chapel Hill: 919-923-4294

Dirección de correo electrónico: ewurth@email.unc.edu

Asesor facultativo: Dr. David Savitz

Origen del financiamiento: Citizens for a Safe Environment

Número telefónico del contacto del estudio: 919-923-4294

Correo electrónico del contacto del estudio: ewurth@email.unc.edu

¿Cuáles son algunas de las cuestiones generales que usted debe saber sobre los estudios de investigación?

Se le pide que participe en un estudio de investigación. La participación en este estudio es voluntaria. Puede negarse a participar, o puede retirar su consentimiento para participar en el estudio, por cualquier motivo.

Los estudios de investigación tienen como objetivo obtener nueva información que pueda ayudar a otras personas en el futuro. Es posible que no reciba ningún beneficio directo por participar en este estudio de investigación. También pueden existir riesgos asociados con la participación en estudios de investigación.

La decisión de no participar en el estudio o de abandonar el estudio antes de su finalización no afectará su relación con el investigador, con el prestador de atención médica o con la University of North Carolina-Chapel Hill. Si es un paciente enfermo, no tiene que participar en el estudio de investigación con el fin de recibir atención médica.

Los detalles sobre este estudio se analizan a continuación. Es importante que entienda esta información de modo que pueda decidir en forma fundamentada acerca de la participación en este estudio de investigación. Se le entregará una copia de este formulario de consentimiento. Debe preguntar a los investigadores mencionados anteriormente, o a los miembros del personal que los asisten, cualquier consulta que tenga acerca de este estudio en cualquier momento.

¿Cuál es el objetivo de este estudio?

El propósito de este estudio de la investigación es aprender sobre el demográfico y características de la salud de Duplin Condado residentes que viven dentro de dos millas del sitio del basural propuesto. El estudio se dirigirá con aproximadamente doscientas casas en esto definió el área. Están pidiéndole que esté en el estudio porque usted vive en una casa que se localiza dentro de dos millas del sitio del basural propuesto.

¿Existe algún motivo por el que usted no deba participar en este estudio?

Usted no debe participar en este estudio si usted está menos de 18 años de la edad.

¿Cuántas personas participarán en este estudio?

Si usted decide participar en este estudio, usted se avisará como una parte de este proyecto está por el coleccionista de los datos completar este estudio.

¿Cuánto tiempo participará en este estudio?

La única vez que le entrarán en contacto con como parte de este proyecto está al lado del colector de datos para terminar este estudio. Este estudio tomará cerca de 15-30 minutos para terminar.

¿Qué ocurrirá si participa en este estudio?

Si usted está de acuerdo en participar en este estudio, usted se preguntará las preguntas por su información demográfica, la interacción de su casa con el ambiente, su estado de salud, y el estado de salud de los otros miembros en su casa. Le pedirán responder a cada pregunta. Usted puede elegir para no contestar a ningunas preguntas sobre el examen y usted puede parar el responder al examen en cualquier momento. El investigador principal analizará los datos para determinar los riesgos de salud potenciales para los residentes que viven en vecindad cercana al basural propuesto.

¿Cuáles son los posibles beneficios por participar en este estudio?

La investigación se diseña para beneficiar la sociedad ganando el nuevo conocimiento. Usted no puede beneficiar personalmente de estar en este estudio de la investigación.

¿Cuáles son los posibles riesgos o molestias que implica la participación en este estudio?

Los riesgos por participar en este estudio son mínimos. Usted puede sentir los descubriendo incómodos su información de salud personal, para que usted puede elegir para no contestar ninguna pregunta en el estudio.

¿De qué manera se protegerá su privacidad?

Se documentarán su dirección y número de identificación en una hoja de la tapa del estudio que se quitará el partidario la realización del estudio. Esta hoja de la tapa se guardará separadamente de los estudios completados. Su número de identificación es la única información que identifica que permanecerá en los estudios completados. Toda la información de la identificación del participante será almacenada en un archivo bloqueado en la oficina del investigador principal. El investigador principal, Emily Wurth, es el único investigador que analizará los datos. El análisis de datos preliminar será compartido con el mentor de la facultad, el Dr. David Savitz.

No se identificará a ninguna persona en ningún informe o publicación relacionada con este estudio. Aunque se realizarán todos los esfuerzos por conservar los registros de investigación en forma privada, podrá ocurrir que la ley federal o estatal exija que tales registros, incluida la información personal, sean revelados. Esto es muy poco probable, pero si alguna vez se pide que sean revelados, UNC-Chapel Hill tomará las medidas permitidas por ley para proteger la privacidad de la información personal. En algunos casos, su información reunida en este estudio de investigación podría ser examinada por representantes de la Universidad, patrocinadores de la investigación u organismos gubernamentales con fines tales como el control de calidad o la seguridad.

Bobbie Buff traducirá el examen a español. Todo que usted dice será hoy confidencial.

¿Recibirá algo por participar en este estudio?

Usted no recibirá nada por tomar la parte en este estudio, pero su información es muy importante.

¿Le costará algo la participación en este estudio?

No le costará nada participar en este estudio aparte de su tiempo.

¿Quién patrocina este estudio?

Citizens for a Safe Environment financia esta investigación. Esto significa que el patrocinador le paga al equipo de investigación para realizar el estudio. Sin embargo, los investigadores no poseen un interés financiero directo con el patrocinador o en los resultados finales del estudio.

¿Qué sucede si desea formular preguntas sobre este estudio?

Usted tiene el derecho para preguntar, y ha contestado, cualquier pregunta que usted puede tener sobre esta investigación. Si usted tiene cualquier pregunta, siéntase libre para avisar Emily Wurth a (919) 923-4294.

¿Qué sucede si desea formular preguntas sobre sus derechos como sujeto de una investigación?

Toda investigación realizada con voluntarios humanos es examinada por un comité que trabaja para proteger sus derechos y su bienestar. Si tiene preguntas o inquietudes acerca de sus derechos como sujeto de una investigación, puede ponerse en contacto, de manera anónima si lo desea, con el Institutional Review Board (Comité de revisión institucional, IRB por sus siglas en inglés) al 919-966-3113 o por correo electrónico a IRB_subjects@unc.edu.

Acuerdo del sujeto:

He leído la información proporcionada más arriba. He realizado todas las preguntas que tengo en este momento. Acepto voluntariamente participar en este estudio de investigación.

Firma del sujeto de investigación

Fecha

Nombre del sujeto de investigación en imprenta

Firma de la persona que obtiene el consentimiento

Fecha

Nombre de la persona que obtiene el consentimiento en imprenta

ID # _____

Appendix C: Household Survey

1. Total Number of persons in household _____
2. Number of household members under 18 years of age _____
3. Number of household members over 65 years of age _____
4. Do you own or rent your property? _____
5. How long have you lived at this property? _____
6. Do you have a private well or a community water supply? _____
7. (If well water) Do you drink the well water? _____
8. (If well water) For what other purposes do you use the well water? _____

9. Is the land around your house used for farming? Yes No
10. (If yes) What types of crops are grown on the land? _____

11. (If yes) How many acres of crops are there? _____
12. Do you have a vegetable garden? Yes No

ID # _____

13. (If yes) Do you sell or give away food grown in your garden? Yes No

14. (If yes) What type of food from your garden do you sell? _____

15. Do you own livestock? Yes No

16. (If yes) What type of livestock? _____

17. (If yes) How many of each type of animal? _____

18. For what other business purpose(s) is your property use (e.g., church, rental property, store, etc.) _____

19. Household Income—(Use Income Card)

Please tell me which letter on this card corresponds to your annual household income. _____

A	<\$15,000
B	\$15,000 - <\$20,000
C	\$20,000 - <\$25,000
D	\$25,000 - <\$30,000
E	\$30,000 - <\$35,000
F	\$35,000 - <\$40,000
G	\$40,000 - <\$50,000
H	\$50,000 - <\$75,000
I	\$75,000- \$100,000
J	>\$100,000

ID # _____

	Household Member #1	Household Member #2	Household Member #3	Household Member #4
Age				
Gender				
Race (Caucasian, African American, Hispanic, Other)				
Time spent outside each day				
Times/week consumes fish from nearby creeks, streams or rivers				
Indicate if this person has had any of the following diseases:				
Asthma				
Emphysema				
Chronic Bronchitis				
COPD (Chronic Obstructive Pulmonary Disease)				
Cancer/Leukemia/Lymphoma				
Allergies				
Rashes (describe)				
Arthritis				
Gastrointestinal problems				
Liver disease or problems				
Diabetes				
Hypertension				
Heart Disease				
Kidney Disease				
Immune Problems				
Reproductive Problems				
Neurological Problems				
Other (please describe)				

ID # _____

	Household Member #5	Household Member #6	Household Member #7	Household Member #8
Age				
Gender				
Race (Caucasian, African American, Hispanic, Other)				
Time spent outside each day				
Times/week consumes fish from nearby creeks, streams or rivers				
Indicate if this person has had any of the following diseases:				
Asthma				
Emphysema				
Chronic Bronchitis				
COPD (Chronic Obstructive Pulmonary Disease)				
Cancer/Leukemia/Lymphoma				
Allergies				
Rashes (describe)				
Arthritis				
Gastrointestinal problems				
Liver disease or problems				
Diabetes				
Hypertension				
Heart Disease				
Kidney Disease				
Immune Problems				
Reproductive Problems				
Neurological Problems				
Other (please describe)				

For women who have had children:

ID # _____

Household Member # _____

How many times in total have you been pregnant? _____

For each pregnancy, please indicate if you have experienced the following:

	Pregnancy #1	Pregnancy #2	Pregnancy #3	Pregnancy #4
Year of Event				
Miscarriage				
Live Birth				
Gender of baby				
Low Birth Weight (< 5.5 pounds)				
3 or more weeks early				
Birth defect				
Other (describe)				
Other outcome				

	Pregnancy #5	Pregnancy #6	Pregnancy #7	Pregnancy #8
Year of Event				
Miscarriage				
Live Birth				
Gender of baby				
Low Birth Weight (<5.5 pounds)				
3 or more weeks early				
Birth defect				
Other (describe)				
Other outcome				

ID # _____

For women who have had children:

Household Member # _____

How many times in total have you been pregnant? _____

For each pregnancy, please indicate if you have experienced the following:

	Pregnancy #1	Pregnancy #2	Pregnancy #3	Pregnancy #4
Year of Event				
Miscarriage				
Live Birth				
Gender of baby				
Low Birth Weight (< 5.5 pounds)				
3 or more weeks early				
Birth defect				
Other (describe)				
Other Outcome				

	Pregnancy #5	Pregnancy #6	Pregnancy #7	Pregnancy #8
Year of Event				
Miscarriage				
Live Birth				
Gender of baby				
Low Birth Weight (<5.5 pounds)				
3 or more weeks early				
Birth defect				
Other (describe)				
Other Outcome				

ID # _____

20. Is there anything else that you would like to tell me about any environmental concerns or health concerns you have about living here in Duplin County?