

# **Tazewell County Cancer Project**

## **SUMMARY REPORT**

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**Virginia Tech  
Center for Public Health  
Practice and Research**

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## **I. Executive Summary**

Tazewell County, Virginia is comprised of 518 square miles in the rural Appalachian Mountains in the far Southwest part of the state. With a population of just over 43,000, about 20% over the age of 65, and a median household income of around \$35,000 per year (18% below poverty level), the concern for health risks in this community is significant given that age and poverty are risk factors for cancer. In 2008, three county high school students were diagnosed with different types of sarcomas, which brought cancer to the forefront of community residents' concerns. Questions about water, air quality, the effects of underground and hilltop removal mining, as well as other environmental concerns were being discussed and questioned.

Though several previous but targeted studies were conducted to address this, none took into consideration both community engagement and environmental testing. The Tazewell County Cancer Project, funded by and in partnership with the Tazewell County Board of Supervisors, attempted to answer two primary questions: 1) Does Tazewell County have a higher instance of cancer when compared to the rest of Virginia, and 2) Are there known (behavioral/environmental) risk factors that could increase cancer risk in the county?

The project was divided into two parts: community engagement and environmental. The community engagement piece consisted of focus groups, key leader interviews, a school Photovoice project, two surveys (one with cancer patients and one randomized to be representative of the entire county), and open public meetings. On the environmental side, radon testing in the schools, public buildings and in homes, as well as water sampling were conducted.

We also reviewed the previous research and Virginia Cancer Registry (VCR) cancer statistics over a period of nine years.

Through community engagement projects, researchers learned that cancer is an emotional and sensitive topic for those who have been touched by it. We were unable to answer the question concerning Tazewell having a higher rate of cancer when compared to the state or other parts of Southwest Virginia because our cancer survey did not result in a number of responses directly comparable to that of the Virginia Cancer Registry (VCR). Therefore we were not able to substantiate claims of underreporting except through anecdotal information gleaned from town meetings and focus groups (“I know someone who had cancer but didn’t go to the doctor…”). The statistics from the VCR, when analyzed, did not show a higher instance of cancer in any area except for lung and uterus, and then only within a limited age group. Overall, Tazewell has a statistically lower instance of cancer when compared with the state.

Survey efforts reveal that the residents of Tazewell may lack proper nutrition (access and consumption of nutritious foods), have a higher tobacco use rate when compared to the state and lack in physical activity. Youth may be engaging in early sexual activity, alcohol consumption and tobacco use.

Throughout the community engagement piece, we found that lack of access to primary care was of great concern to residents when talking about cancer and other health risks. Many children are dependent upon the school nurses for treating illnesses because of a lack of primary care.

The primary concern related to the environmental testing performed surrounds high levels of radon in 30% of the 26 buildings tested. This is of concern because radon is a well-established carcinogen that contributes to risk of lung cancer. In addition, it is worth noting that some water fountains and sinks in the schools yielded samples with detectable lead concentrations. Although these samples did not exceed the current national guidelines for lead in school water (<20 ppb), they did exceed the lower lead limit that has been mandated in some schools throughout the country (<10 ppb). However, it is important to recognize that: 1) these samples were collected in a highly conservative manner, i.e. they were collected in a manner designed to be a “worst case scenario” when the water had been left stagnant in the pipes for some time; 2) all but one of the fountains exceeding 10 ppb dropped to lower levels when collected in a re-test during normal operating hours; and 3) while lead is of substantial concern as a childhood exposure, it has not been identified as a definitive carcinogen. Therefore, while we would recommend replacing the one water fountain that did not pass the re-test, simple flushing of the school pipes after long breaks in the school year should be sufficient to prevent exposure. No water concerns were observed in household testing, although the homes tested were all solely reliant on municipal water, and roughly a third of the county is likely dependent on private water supplies.

It is important to recognize that while, with the exception of radon, no obvious environmental contributors to cancer were identified by this study, we cannot say definitively that environmental factors do not contribute to observed cancer cases. It is very difficult to investigate cancer incidence in small communities, particularly when there are many different types of cancer to consider. Also, this study was relatively small in scope and examined only the most common contaminants. Examination of waters for organic chemicals is not practical



without a known target. No indoor or outdoor air testing was completed in this study (e.g. for PM10, PM2.5), and there is very little air monitoring in general in the Central Appalachian region.

Overall, these efforts suggest the following recommendations:

- Residents should test their individual homes for radon as it was found in testing and is a concern for lung cancer.
- Schools and public buildings should flush their water systems regularly to ensure no stagnation in the system, which can lead to metal leaching and biofilm buildup. We do recommend replacing one water fountain at the Tazewell Career and Technical Center, as water at this point intermittently exceeds the recommended lead action limit.
- Residents reliant on private water systems (wells, springs, and cisterns) should be encouraged to participate in home water testing programs.
- A concerted effort should be made to bring more primary care to the county. One way this affects cancer is the recommendations for appropriate screenings, and information about leading a healthy lifestyle.
- Access to nutritious food and areas for safe physical activity should be available throughout the county.
- Tobacco awareness and education programs should be continued in the schools at all levels, as well as information on the risks of early sexual activity and alcohol consumption.

## **II. Motivation: Review of VDH Cancer Cluster Study**

In 2009, a request was made by the District Director of the VDH in Tazewell County to the Virginia Cancer Registry to determine “whether a cancer cluster exists” in that county. The request arose from concern by a nurse in the Tazewell County School System as well as concerned citizens after three high school students attending the same school were diagnosed with pediatric cancers. Specifically, the questions asked during the research were to determine whether the Tazewell County case reports were:

- Unusually high in number
- Of a specific body site and cancer type
- Occurring close together with respect to space and time

The research looked at individuals with a sarcoma diagnosis (ie. cancer of concern) at less than 18 years of age occurring from 2005-2010. Eight children were identified with a cancer diagnosis and two met the criteria for this study. The other six were not sarcomas, and therefore, not included in the study.

Two pediatric cases of sarcoma were identified and both patients died from their disease. One was male, the other female. Both were diagnosed at a late stage in the disease. They both had attended the same schools from childhood and were otherwise in good health with no history of substance abuse issues. One was born in Tazewell County and the other moved to the area at age 4. One had well water; one public water. One had two grandparents with cancer, the other with no known cancer cases in the family. Though they were both diagnosed with sarcomas, these were different types of sarcomas. Neither was classified as associated with a known cause, although it is believed that one may be related to genetic influences.

The local VDH concluded: “Diagnoses were confirmed in the two case-patients meeting the case definition. Although both were rare forms of sarcoma, they were not the same type of cancer. Cancer rates for the county are not significantly higher than rates in the CPHD or the state. Considering the different types of cancers in this population and lack of data supporting a common cause exposure, it is unlikely that meets the definition of a cancer cluster.”

### III. Past Applicable Efforts in the Tazewell Area

#### *III.A: Carilion/TCH Health Improvement Strategy*

A seven-month Community Health Needs Assessment was conducted in 2013 by the Tazewell Community Hospital. This included a broad-based community health survey, focus groups, and stakeholder surveys. Additionally, a review was conducted to identify health needs and resources to address those needs. The issues of greatest concern to health providers and residents identified by this effort included:

- Substance abuse prevalence
- Obesity prevalence/lack of exercise
- Access to primary care
- Mental health disorders/access to psychiatric services
- High cost of services to the uninsured

#### *III.B: VCU Community Cancer Needs Assessment*

Starting in 2013 and continuing through September of 2014, researchers at the VCU Massey Cancer Center conducted a Comprehensive Cancer Needs Assessment in the Cumberland Plateau Health District (Buchanan, Dickenson, Russell, and Tazewell Counties). The project was funded by the Virginia Tobacco Indemnification and Community Revitalization Commission. Two data collectors from the Southwest region conducted surveys, key-stakeholder interviews, focus groups, and a review of cancer data. From that data, the following conclusions and recommendations were drawn:

- Compared to Virginia, age-adjusted incidence rates are **lower** for the majority of site-specific cancers. Incidence rates were significantly lower for female breast cancer, male genital cancers, and GI cancers. ***Only respiratory cancer incidence rates were significantly higher than rates for Virginia.***
- However, in contrast to cancer incidence, ***the district has a higher age-adjusted mortality (death) rate than Virginia when all cancers are grouped together.*** Notably, the mortality rate for respiratory cancers in the district is significantly higher when compared to that of Virginia. Respiratory and GI cancer deaths account for 53% of the cancer deaths in the district.

- Poor lifestyle behaviors (eating, exercise, tobacco use), lack of primary and oncology care, poor access to cancer screenings, and lack of support services and groups were identified as concerns in focus groups and surveys of both cancer patients and of the general population.
- Identified needs include community health education to promote risk reduction and prevention and improved access to care including primary, specialty services, and oncology.

### *III.C: Simmons Rand PHA Report*

In 2013-14, a Public Health Assessment study by the Virginia Department of Health (VDH) was conducted on the Simmons-Rand Property in Richlands to identify and prevent health hazards resulting from exposure to harmful contamination in the environment. Residents living on adjoining property expressed concern about the number of cancer cases diagnosed among them, with particular concern about the drainage system that runs adjacent to their backyards. Though not officially designated as a “brownfield”, the 3.26 acre site is slated for remediation under the Virginia Voluntary Remediation Program as of January 2016 (More here: <http://www.deq.virginia.gov/Portals/0/DEQ/Land/RemediationPrograms/VoluntaryRemediationProgram/psr.pdf>). This program encourages property owners to voluntarily remove hazardous materials under the guidance of the Department of Environmental Quality in order to facilitate future sale.

This study, completed by VDH and Arcadis, an environmental consulting company, concluded that the site posed minimal, if any, threats to the public health. Although the site is contaminated by a variety of heavy metals and chemicals, they concluded that minimal risk is presented because:

- Groundwater is not used for potable water in this area (i.e. local residents in Richlands are served by municipal water).
- Dermal contact (i.e. playing with, eating) of the soils from Tracts 3 and 4 of the site could pose a risk to children due to high levels of lead. As this exposure would have to be deliberate (i.e. chose to walk/play on this land), restriction of children’s access to this area should control exposure.

There are plans to set up groundwater monitoring wells near the site (particularly Tract 2) to determine whether hazardous chemicals are migrating into groundwater. While not an immediate concern to drinking water, over sufficient time, this could pose a threat to other water sources, and so will be targeted by the VDH. The study does emphasize that *“The additional cancer risks calculated from...exposure...are all very small when compared to the United States’ background cancer rate, which is one in three.”* It is worth noting, that the greatest health concern raised was for children’s exposure to lead in soil - while lead is a known neurotoxin, it is not a known carcinogen.

## IV. New Analyses of Available Data

### *IV.A: Updated Cancer Incidence Rates from the Virginia Cancer Registry*

#### IV.A.1 Purpose

The purpose of analyzing reported cancer statistics is to determine if there is a “statistical significance” between cancers reported from Tazewell County and those overall in Virginia, i.e. if there is no statistical significance, any differences in incidence cannot be assumed to be due to anything other than random chance.

#### IV.A.2 Methodology

The Virginia Cancer Registry provided a Microsoft Excel spreadsheet of the most common cancers for the years 2003-2012. Both the actual count of cancers was reported and the rate, which is per 100,000 population. In other words, information is aggregated for Tazewell as if there were at least 100,000 people in the county. This gives an accurate comparison with the state per 100,000 of the population. A statistician from Virginia Tech analyzed the data using a Chi-squared test, which provides a p-value for each statistical question (e.g. “Is there a significant difference in bladder cancer incidence between these two groups?”). If the p-value is below 0.05, that is an indication of “statistical significance.” So, if there is a statistical difference—either higher or lower—for Tazewell compared to Virginia, the p-value will be below 0.05.

#### IV.A.3 Findings

Of the specific cancers tested, there was ***NO*** statistical significance between the incidence of cancer in Tazewell to that of the entire state of Virginia for the following cancers:

**Brain, Cervix, Hodgkin’s Lymphoma, Kidney, Leukemia, Melanoma (skin), Myeloma, Non-Hodgkin’s Lymphoma, Oral, Ovary, Pancreas, Stomach, Liver and Uterus.**

There was a statistical significance in cancer incidence between Tazewell and Virginia for the following cancers within these *specific age groups only*:

**Bladder:** In the age group 70-79, bladder cancer was significantly **LOWER** in Tazewell than in the rest of the state. For bladder cancer overall, there is **NO** statistical difference.

**Breast (Women):** Breast cancer for Tazewell is significantly **LOWER** for all age groups, and overall when compared to Virginia.

**Colorectal:** In the age group 70-79, Colorectal cancer is significantly **LOWER** in Tazewell than Virginia. For colorectal cancer overall, there is **NO** statistical difference.

**Prostate:** Prostate cancer shows Tazewell at a statistically **LOWER** significance overall when compared to the state.

**Testis:** In the age group 40-49 years, Testicular cancer is showing statistically **LOWER** significance when compared to the state. For testicular cancer overall, there is **NO** statistical difference.

**Uterus:** This cancer shows a **HIGHER** significance when compared with Virginia in the 50-69 year age group, though overall there is no statistical significance.

**Lung:** Overall, there is no statistical significance between Tazewell and Virginia; however, lung cancer incidence is significantly **HIGHER** in Tazewell than Virginia for the 40-59 year age group.

**Other:** Cancers other than those mentioned specifically or that are unclassified show a **HIGHER** statistical significance for Tazewell in the 60-69 year age group and in the 80+ age group, though there is not an overall statistical significance. There were 239 “other” cancers reported over the time period 2003-2012. These cancers are any not listed on the cancer registry list.

**All Cancers Combined:** Overall, there is NO statistical significance in cancer rates for Tazewell compared with Virginia EXCEPT in the 60-79 year age group, which shows a **LOWER** significance for Tazewell when compared with the state.

When comparing reported cancers between Tazewell County and Virginia during the time period 2003-2012, the overall conclusion would be *“There is no statistical difference in overall cancer rates between Tazewell County and Virginia.”* Breast cancer and Prostate cancer show a statistically **LOWER** significance overall. In certain age groups, there was a statistically **LOWER** significance for Bladder, Colorectal, and testis. In some age groups, there is a statistically **HIGHER** significance for “other” cancers and for cancer of the Uterus and Lungs.

#### IV.A.4 Discussion

Overall, Tazewell’s reported cancer rate is not significantly different when compared with cancer in Virginia. It is worth noting that Breast Cancer and Prostate Cancer—the two most highly reported cancers for women and men respectively—are significantly LOWER for Tazewell as compared to the entire state of Virginia. However, it is also worth noting that information we received from anecdotal reports such as town meetings, verbal conversations, our Facebook focus group, and focus groups conducted by partner projects in Tazewell such as the VCU Cancer Needs Assessment (Section III.B), indicate that: 1) lack of primary care, for example, Svisits when patients would be educated about and/or screened for these (and other) cancers, is a concern; and that 2) in general, in keeping with reports by the American Heart Association (AHA, 2016) men tend to only go to the doctor when there is an acute problem and not for preventive care, which might result in under-diagnosis of prostate cancer.

A significantly higher rate of lung cancers in the 40-59 year age group may reflect early use of tobacco products by Tazewell residents. YRBSS statistics for Tazewell Middle School show that 24% of students had “ever tried cigarette smoking” and 9.1% of students “used chewing tobacco or snuff on 1 or more of the past 30 days.” The statistics are even higher for the older students at Tazewell High School, where 52% have tried cigarettes and 21.1% have used chewing tobacco or snuff (See Section IV.B). Additional workplace exposures can contribute to lung cancer, although no particular exposure appeared prevalent from the mailed survey (Section V.B). Exposure to environmental carcinogens such as radon may also contribute to lung cancer risk;



results from the mailed survey indicate very few homeowners have ever tested their home for radon, and our random field study did observe some results of concern (Section VII.B.1). It is worth noting that radon in the public schools does not appear to be of concern (Section VII.A.1).

#### *IV.B. Youth Risk Behavior Surveillance System (YRBSS) Information*

##### IV.B.1 Purpose

Many lifestyle factors and specific behavioral choices can affect cancer. Some, such as alcohol and tobacco use, may be “dose related” in that the longer someone is a user, the chances of negative health outcomes, including cancer, increase. Consequently, we reviewed results for Tazewell County for 2011 from the YRBSS, which is conducted by the State of Virginia, to determine whether underlying behavioral risk factors might be prevalent in this population.

##### IV.B.2 Findings

The statistics in Table 1 below represent results from both Tazewell Middle and Tazewell High School (the applicable YBRSS locations).

##### IV.B.3 Discussion

Tazewell students are reporting early sexual activity, which may relate to HPV, the precursor to the most common type of cervical cancer. Tobacco use is directly linked to lung and mouth cancers, as well as other types of cancer. Alcohol use can be tied to a number of cancers such as stomach and esophageal, and the combination of alcohol and tobacco increases cancer risk even more.

**TABLE 1. SUMMARY STATISTICS FROM THE VIRGINIA YBRSS IN TAZEWell (NR = “NOT REPORTED”)**

	Survey Prompt, e.g. "I have..."	Percent of students who responded "YES"	
		Tazewell Middle	Tazewell High
<b>ALCOHOL USE</b>	Had at least one drink of alcohol on one or more of the past 30 days	11.9	37
	Had five or more drinks of alcohol in a row on one or more of the past 30 days	NR	26.2
<b>SEXUAL BEHAVIOR</b>	had sexual intercourse	22.7	50.7
	had sexual intercourse for the first time before age 13	16.7	11.7
	had sexual intercourse with four or more people during their life	3.5	14.6
	had sexual intercourse during the past 3 months	NR	33.3
<b>SMOKING</b>	tried cigarette smoking	24.7	52
	smoked a whole cigarette for the first time before age 13	14.4	19.1
	smoked cigarettes on one or more of the past 30 days	8.4	25.5
	smoked two or more cigarettes per day on the days they smoked during the past 30 days	3.8	20.6
	who were current smokers and have tried to quit smoking during the past 12 months	NR	NR

## V. Survey Efforts

### V.A: Cancer Patient Survey

#### V.A.1 Purpose

The purpose of this survey was to piggy-back on previous surveys that have been collected to see if we could determine trends in under-reporting of tumors to the Virginia Cancer Registry (i.e. to determine whether more cancers were reported to us through the survey than were available in the VCR). Additionally, we wanted to determine if there were any trends in workplace, tobacco use, type of cancer, and treatment options.

### V.A.2 Methodology

The survey was designed to require only 5-10 minutes to complete, and is available in its entirety in Appendix A. The electronic survey links were placed on the Tazewell County Cancer Project Facebook page, as well as on the County Board of Supervisors homepage. Paper copies were placed in 13 facilities across the county including libraries, hospitals, Social Services, the Health Department, oncology offices, the YMCA, Senior Citizens offices and Community Services Board offices (see Appendix B for complete list). Surveys were filled out on-line or on paper by either the cancer survivor, or a family member of a deceased cancer patient. Paper surveys were mailed back to the Center in a self-addressed and stamped envelope, and entered into the SurveyMonkey database.

### V.A.3 Findings

A total of 299 surveys were returned, 80% of whom are currently living in Tazewell County (20% former Tazewell residents).

- 165 Females responded; 126 males responded
- The average age of the cancer patient = 57.7 years (Note: Those who already died from cancer were excluded from this average)
- Range of ages of cancer patients = 18 years to 86.5 years (not including those who already died)
- Places of employment were varied, with no concentration in any one industry
- Those using tobacco products before or at time of diagnosis were 55.67%, making 44.3% never tobacco users.
- Types of cancer ranged from breast, at 21.12% to Stomach and Sarcomas at 2.02%.
  - Lung 15.5%
  - Colon 9.3%
  - Prostate 6.73%
  - Skin 6.6%
  - Leukemia 5.72%
  - Pancreatic 5.5%
  - Other cancers not listed or unknown 17.85%
    - A full report of cancers can be found in Appendix C
- Cancer diagnosis was made by:

- Specialist 41.84%
- Family Doctor 30.95%
- Surgeon 27.21%
- 55.29% were diagnosed outside of Tazewell County while 44.71 were diagnosed in the County. Other diagnosis sites:
  - Virginia: Abingdon, Bristol, Charlottesville, Blacksburg, Roanoke, Radford, Lebanon
  - Tennessee: Kingsport, Johnson City, Bristol
  - North Carolina: Winston Salem, Raleigh (Duke Medical)
  - West Virginia: Bluefield, Princeton
  - Kentucky: Kelley County
  - Texas: Houston
  - Minnesota: Mayo Clinic
- 89% went to an Oncologist for treatment, 11% did not.
- 85.37% were treated for their cancer, 14.63% were not.
- 18.57% were treated in Tazewell County. 81.43% went outside the county for treatment. Treatment places were similar to place of diagnosis.
- 94.52% of respondents reported that they knew at least one other person in Tazewell with cancer.

#### V.A.4 Discussion

Based on this survey, breast, lung, colon and lymphoma cancer were the most reported, along with a notable percentage of unspecified cancers. These findings are in-line with the cancer statistics from the Virginia Cancer Registry, where all diagnosed tumors are reported. The respondent may not know the actual site of the cancer. Or, other cancers could include gallbladder, esophagus, anus, pleura, soft tissue including heart, as well as many others. The majority of respondents were treated by an oncologist outside of Tazewell County, but stayed within the greater tri-cities region including Bluefield/Princeton, WV, Abingdon, VA, Bristol, Kingsport & Johnson City. Some did travel longer distances such as North Carolina and Charlottesville, VA. Over 50% of those diagnosed with cancer were tobacco users prior to their diagnosis.

Many residents have asked whether or not there was under-reporting of cancer tumors to the Virginia Cancer Registry. Due to differences in reporting, as well as the relatively low number of surveys, we cannot tell from these statistics whether or not there is under-reporting of cancer to the state registry for Tazewell. According to the VCR statistics, Tazewell does have a lower cancer rate when compared to Virginia (Section IV.A).

### *V.B: Representative Mailed Survey*

#### V.B.1 Purpose

Cancer has been linked to both environmental exposures (e.g. air/water quality, occupational exposures) and behavior (e.g. smoking). Cancer mortality has also been linked to proximity/availability of health care. In order to explore the prevalence of these factors in Tazewell and better understand the population under study, a voluntary mailed survey was developed and randomly first issued to residents in 2014.

#### V.B.2 Methodology

A health behaviors and environmental exposures survey was developed that consisted of 24 selected questions adapted from Centers for Disease Control's Behavioral Risk Factor Surveillance System (complete survey available in Appendix D). The survey was to be completed by one adult living in the household.

Mailings were based on a database of names and addresses of Tazewell households from Tazewell County and appropriately randomized to ensure statistical representation of the county. Based on the adult population of Tazewell County, our statistician determined that a minimum of 150 completed surveys were needed to get a representative sampling of information. Addresses were categorized by zip code and a representative sample of each zip code in the community was generated. Five hundred households were randomly generated and surveys were mailed to all of them. Fifty-eight were initially returned. After two months, a second batch of surveys was sent to 500 new random Tazewell County households which resulted in an additional 72 surveys. Two-hundred fifty more random surveys were mailed.

Of the 1,200 surveys mailed, 60 were returned as “undeliverable” (wrong address) and 172 were returned by respondents (response rate = 14%). For the most part, these surveys were answered completely, though the response rates to particular questions are provided as appropriate in the “Findings” section. It is important to note that there might be a certain amount of respondent bias, as is typically seen in mail-in surveys and self-reported information (Brief et al. 1988).

### V.B.3 Findings

#### ***V.B.3.a Behavioral factors***

Eighty-four men and 85 women completed the survey, with the largest number being in the 60-70 age group (32%), followed by 19% from the 50-60 age group and 17% from the 70-80 age group. One survey was returned by a resident over 90 years of age, and 2% were returned from the 20-30 year age group. The average respondent age was 63. The Median age for Tazewell County is 43 (City Data, 2012).

The older age of the respondents may make a difference in some of the question outcomes. For example, smoking prevalence is highest in Virginia among those aged 18-24 (19.4%), while those aged 65 and older had the lowest smoking rates (9.3%) (CDC, 2010). In this mailed survey, 10% of respondents reported smoking at least weekly, while 90% reported not smoking at all. Of those who reported having quit smoking (117), 38.5% reported smoking in the past for more than 5 years. Thirteen respondents reported smoking every day, and 151 reported not smoking at all. However, 45 reported smoking in the past for more than 5 years (former smokers) and 72 did not smoke for 5 years. Fourteen report using smokeless tobacco every day, while 147 did not use smokeless tobacco. Twelve are former smokeless users and used them for more than 5 years. There may be some cross-over in this statistic in that some may be dual users, and some reporting was unclear. In comparison to Virginia in its entirety, the adult smoking rate for the state of Virginia was 16.4% (CDC, 2010).

While there is no serious alcohol use reported by respondents (82% reported no drinking at all), the amount of fruits and vegetables consumed on a daily basis is far lower than the state average. Seventy-one percent of respondents reported eating 0-1 servings of fruit per day and 60% reported eating 0-1 servings of vegetables per day. The average in Virginia is 1.7 servings per

day (CDC, 2013). Those reporting no exercise outside the “regular job” is 34.9%, which is significantly higher than the state level of 22.5%.

Most respondents (97%) reported having some type of health insurance. Fifty-nine percent of respondents saw a healthcare provider 0-5 times in the past 12 months, and 24% saw one 5-10 times in the past 12 months. Apart from cost, medical treatment was most frequently delayed because appointments were hard to obtain and the wait time in doctors’ offices was too long. Twenty percent of respondents have received a cancer diagnosis from a doctor or other health professional.

***V.B.3.b Air Quality***

Of the 171 respondents, 144 (84%) reported that they were nonsmokers, though 42 of these respondents indicated that they had smoked in the past for more than five years (29%).

Respondents were not asked if there was a smoker in their home, so there is no measure of secondary exposure.

The presence/absence of twelve different household utilities/appliances is provided below (Table 2). The majority of homes had air-conditioning, electric heat, and an electric stove.

**TABLE 2. PRESENCE OF HOUSEHOLD UTILITIES**

<b>Household utility</b>	<b>n</b>	<b>%</b>
Air conditioner	116	67
Fireplace	75	44
Gas	42	24
Oil	19	11
Electric	110	64
Wood Stove	32	19
Kerosene heat	6	3
Electric Stove	112	65
Gas stove	20	12
Air purifier	17	10
Humidifier	45	26
De-humidifier	50	29

The majority of respondents (n=161) indicated the age of their home. The average respondent home was built in 1962 (median = 1971), with the oldest home built in 1800 and the newest built in 2012. Only 20 homeowners (12% of respondents) indicated that they had ever tested their home for radon (Note: 168/172 responded). None of the homeowners who tested their homes for radon reported that the observed level of radon was high or of concern.

***V.B.3.c Water quality***

All participants answered the question: “Does your water come from...(selections)”. A summary is provided in Table 3. Twenty-five homeowners indicated more than one drinking water source: in 24 of these cases, one of the sources was bottled water, and the remaining homeowner indicated their water was from both a “community system” and a “town/city system”. Sixteen homeowners selected “other” for their water source, and in ten cases they further specified this source as a “spring”. The other six homeowners who indicated an “other” listed “county” (2); “creek” (1); “Buchanan County” (1); “have well but seldom drink water” (1); and “don’t drink water” (1).

**TABLE 3. SOURCES OF HOUSEHOLD DRINKING WATER**

<b>Source</b>	<b>n</b>
Private well	48
Community water system	19
Town or city water system	78
Grocery store (bottled water)	34
other	16

One homeowner who selected “bottled water” used the “other” space to write “I don’t have water in my home”. Two homeowners who indicated they had access to town or city water left negative comments regarding their perception of the Tazewell Public Service Authority: “Unhealthy H2O – John Flanigan (sic) Dam through Buchanan County PSA sold to Tazewell County PSA, no filtration except chloride” and “I don’t drink the water from Taz Co PSA”.

***V.B.3.d Potential workplace exposures***

Workplace exposures are summarized in Table 4; the most common current and past exposure was to “dust or fibers” (26% current; 53% past). It is important to note that we did not ask for specifics regarding appropriate use (or availability) of personal protective equipment at their place of employment during these exposures (i.e. an x-ray technician might be chronically



exposed to radiation but wears a lead vest to prevent exposure at levels that pose human health risk). We also did not ask for specific types of exposure (i.e. which chemical) or duration of exposure (i.e. every day vs. every year).

**TABLE 4. SELF-REPORTED OCCUPATIONAL EXPOSURES**

Exposure	Current		Past	
	# yes	%	# yes	%
Metals	13	8	31	18
Dust or fibers	45	26	91	53
Chemicals	28	16	58	34
Fumes	21	12	52	30
Radiation	7	4	20	12
Biological agents	23	13	49	28

***V.B.3.e Other potential environmental exposures***

Approximately 65% (n=111) respondents stated that pesticides or herbicides were used in their home/garden/on pets, though the dose or type of chemical used was not specified. Twenty-seven respondents (16%) stated that they lived “next to or near an industrial plant, commercial business, dump site or non-residential property”, though the exact site is not specified.

**V.B.4 Discussion**

***V.B.4.b Behavioral Factors***

In general, those responding to the survey have poor eating habits, incorporating few nutrient-rich fruits and vegetables into their diet on a daily basis. Current tobacco use rates in Tazewell, according to this survey, are slightly higher than the state average, and there are also many reported former smokers. Most have health insurance, but access to care is hampered by the inability to get an appointment and long waiting times in offices. Most respondents are employed or retired but report exposure to potentially harmful substances on the job. When combining all of these aspects, poorer health outcomes are to be expected and among this responding population, 20% have been diagnosed with cancer.

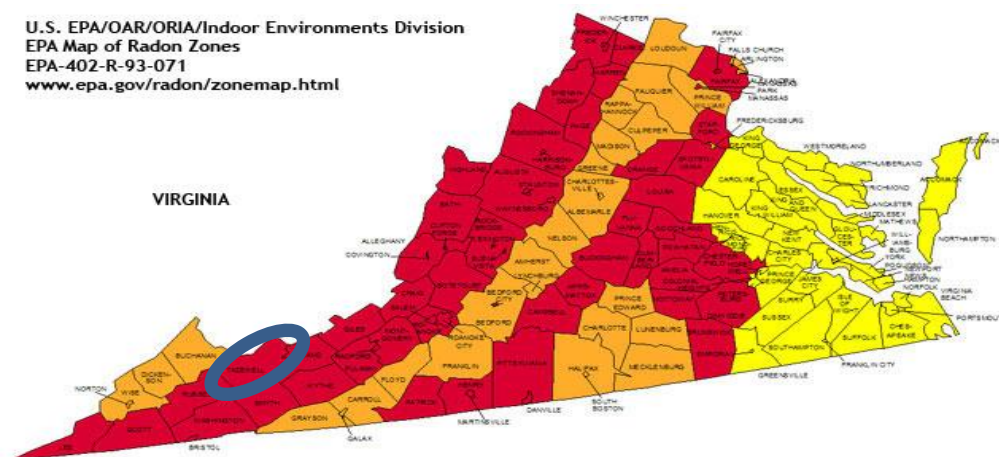
A diet rich in fruits and vegetables, daily exercise, not using tobacco products and having access to healthcare, greatly reduce the risk of many types of cancer. When residents don’t have ready-access to healthcare or a regular provider, especially in an aging population when the risk of

cancer is increased, they may not be getting recommended cancer screenings or coached on prevention. This might include information on diet and exercise and monitoring tobacco use.

Based on this self-reported survey, concentrating efforts to bring more primary care providers to the area would benefit the overall health of Tazewell County residents. Encouraging residents to grow gardens and shop at farmers' markets may increase fruit and vegetable consumption. Making access to playgrounds, hiking and biking trails and recreational programs may increase physical activity among residents.

#### ***V.B.4.b Environmental Factors***

The lack of radon testing in the county (<15% of respondents), while not perhaps surprising, is of concern given that the county of Tazewell is located on a well-known “radon” belt (e.g. it is underlain by soils and geology that are likely to release radon) as reflected by the figure below, where the county is circled in blue. This is of *serious potential concern*, given the well-established link between radon and lung cancer. Although radon testing cannot be required of private homeowners, programs that provide education and encourage testing, perhaps through access to remediation grants, should be encouraged if possible.



**FIGURE 1. EPA MAP OF RADON ZONES; TAZEWELL CIRCLED IN BLUE**

The responses to the water access questions were typical for a rural county in the southeastern United States, with roughly two-thirds of the county dependent on municipal/public drinking water and the remainder dependent on private wells and springs. While none of this can be

directly connected to cancer, it is worth noting that it can be very difficult to monitor water quality in homes dependent on private wells and springs, as these are private property and not subject to the United States Safe Drinking Water Act (SDWA) monitoring and reporting requirements.

It is also interesting that multiple residents indicated distrust of the water system, though none of the residents provided details explaining this distrust. Again, while this does not connect directly to cancer exposure, it may be connected to cancer concerns. Recent research at Virginia Tech indicates that homeowners dependent on municipal waters may be confused by federally mandated Consumer Confidence Reports, and that this may reduce confidence in local water supplies and infrastructure (Phetxumphou et al. 2015; Roy et al. 2015). Efforts to engage and educate the public may improve confidence.

### *V.C: Tazewell County Environmental Inventory and Mapping*

#### V.C.1 Purpose

Concerns were voiced by members of the community that all cases of cancer had not been acknowledged; to address this concern we developed and solicited participation in a cancer survey. In order to determine whether spatial patterns in cancer incidence were readily apparent, the team mapped these reported cases of cancer as well as known potential environmental contamination concerns.

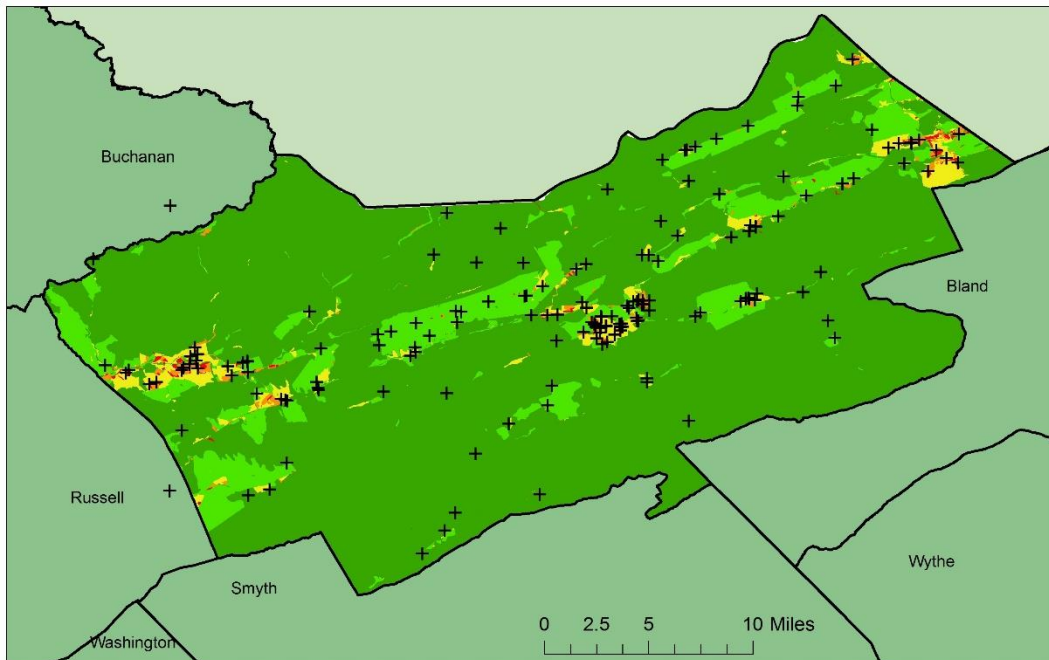
#### V.C.2 Methodology

The brief, two page cancer incidence survey developed by the team is provided in Appendix A. Surveys were handed out at all town hall meetings, and were available with stamped return envelopes at the Municipal Office and county libraries. Surveys were also available online through the Tazewell County webpage ([www.tazewellcounty.org](http://www.tazewellcounty.org)) and the project facebook page (<https://www.facebook.com/TazewellVACancerProject/>). Addresses indicated by survey respondents were mapped in the GIS software ArcMAP 10.1 ([www.esri.com](http://www.esri.com)).

In conjunction with mapping self-reported cancer prevalence, the team also inventoried known environmental concerns (e.g. water impairments, coal production, etc) and mapped these to Tazewell to determine whether cancer incidence appeared greater near these potential risks.

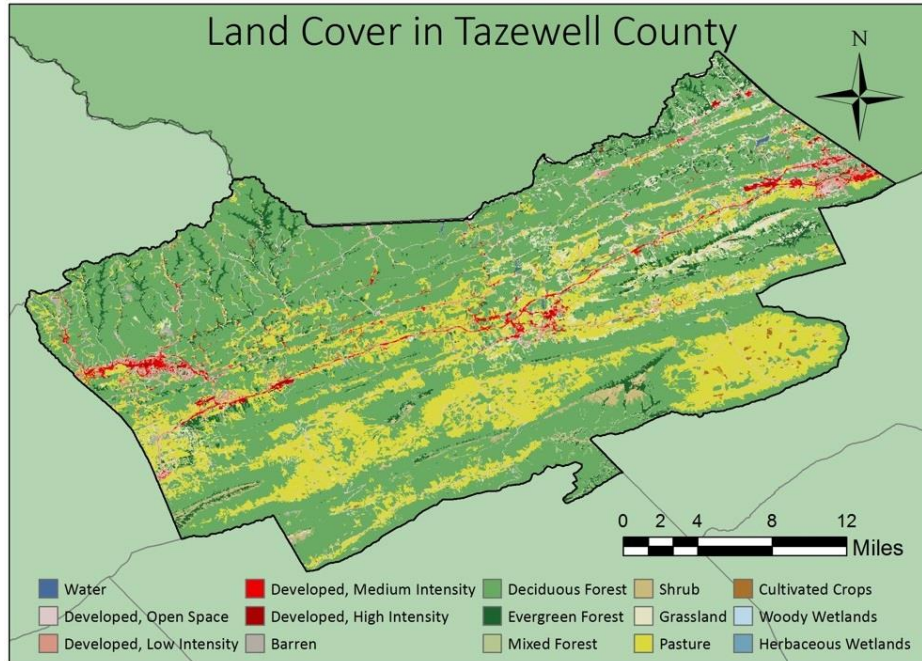
### V.C.3 Findings

As reported in section V.A, 299 surveys were returned to the project team. These self-reported cases were mapped using ArcMAP GIS to the address provided (Figure 2). For the sake of perspective, the map also includes population density information from the 2010 US Census, i.e. dark red areas indicate areas of higher population (major towns like Bluefield, Tazewell, and Richlands) and green areas indicate less populated areas. No immediate “clusters” were apparent from this data; the cases appear uniformly distributed across the higher population areas of the county.



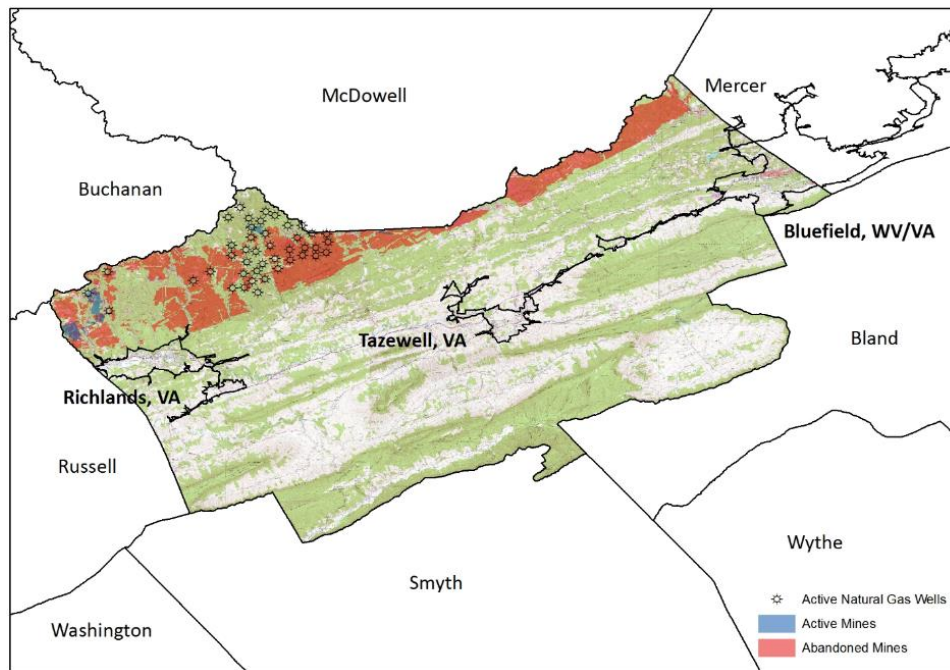
**FIGURE 2. SELF-REPORTED CANCER CASE LOCATIONS**

General landuse designations were obtained from the NLCD (National Land Cover Database) for Tazewell County (Figure 3). The majority of the county is deciduous forest (green) or pasture (yellow). Very little of the land is under row crop production, which would have raised concerns related to pesticide/nutrient contamination of groundwater.



**FIGURE 3. MAJOR LANDUSE IN TAZEWEEL COUNTY**

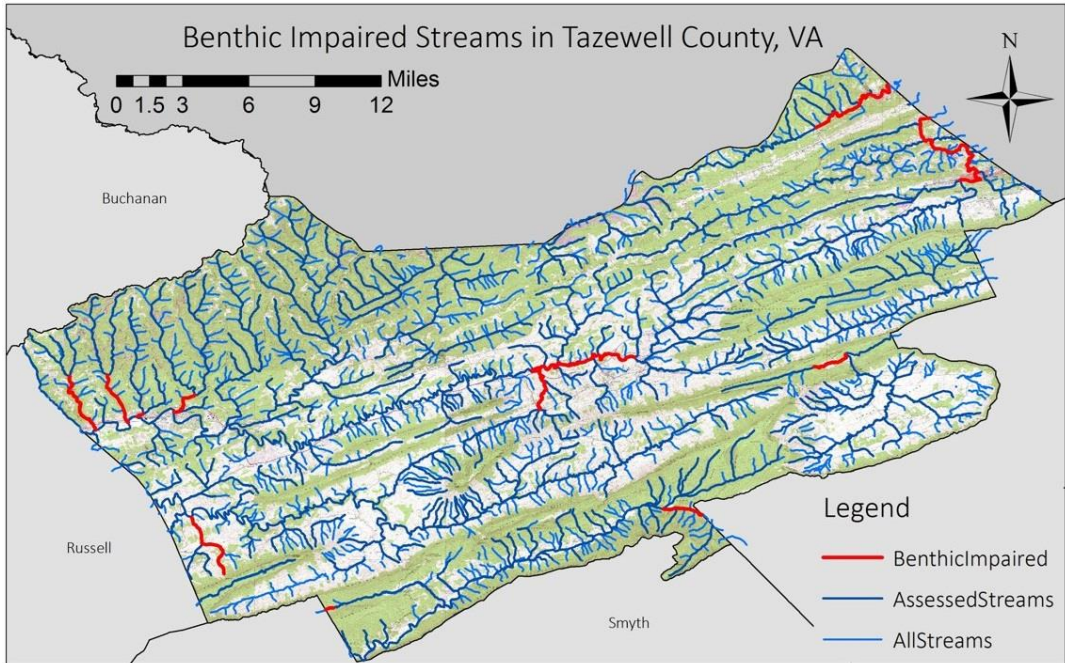
The latest mining history and permit data was obtained from Virginia DMME (department of Mines, Minerals, and Energy) and is provided in Figure 4. Accordingly to this data, Tazewell comprises 141.31 km<sup>2</sup> of abandoned or closed minelands, and 5 km<sup>2</sup> of active mines. As can be observed by comparing the mining map with the landuse map, much of the abandoned minelands have been reclaimed and are now forested. All current mining activity occurs along the Buchanan/West Virginia borders in the north. The town of Tazewell also has permits for 43 production wells (36 gas wells and 7 gas/pipeline) along the border of Buchanan and West Virginia as well.



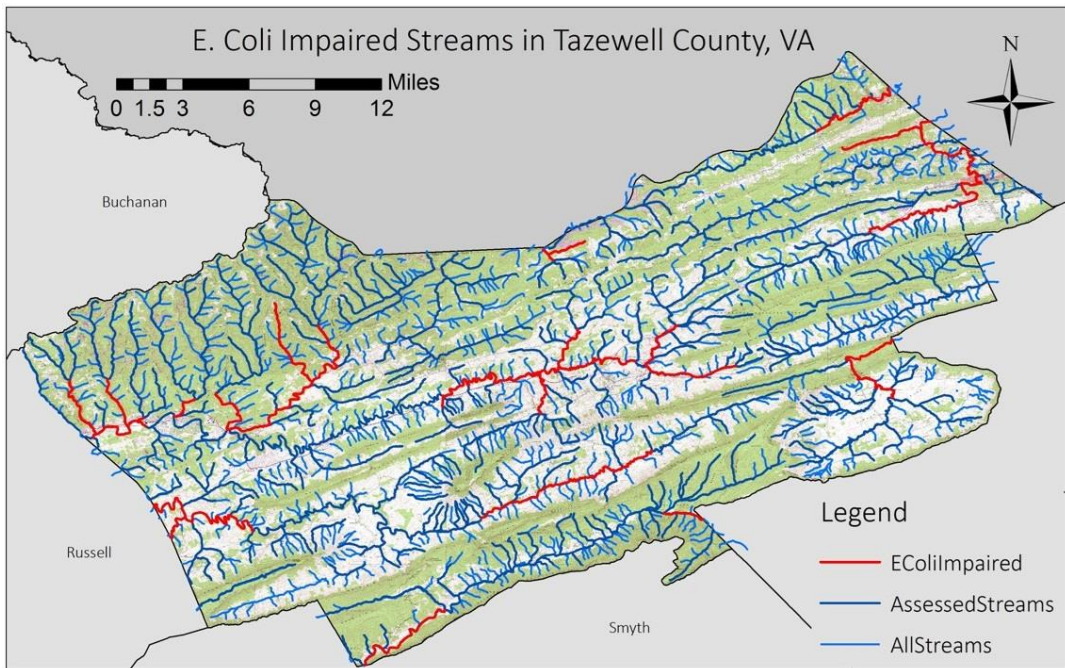
**FIGURE 4. MINING AND OIL WELL LOCATIONS IN TAZEWELL COUNTY**

Water quality impairments are provided in Figures 5-7. These are streams that have been designated as “impaired”, i.e. not suitable, for the stream’s designated use (swimming and fishing) by the state of Virginia under the US Clean Water Act. The most common surface water impairment in Tazewell County is for elevated concentrations of *E. coli*, a fecal indicator bacteria associated with risks of gastrointestinal illness. This is also the most common contaminant in the state of Virginia, and the nation as a whole. The other two most prominent surface water quality impairments are benthic impairments (damaged aquatic ecology), and a PCB impairment of the Bluestone River.

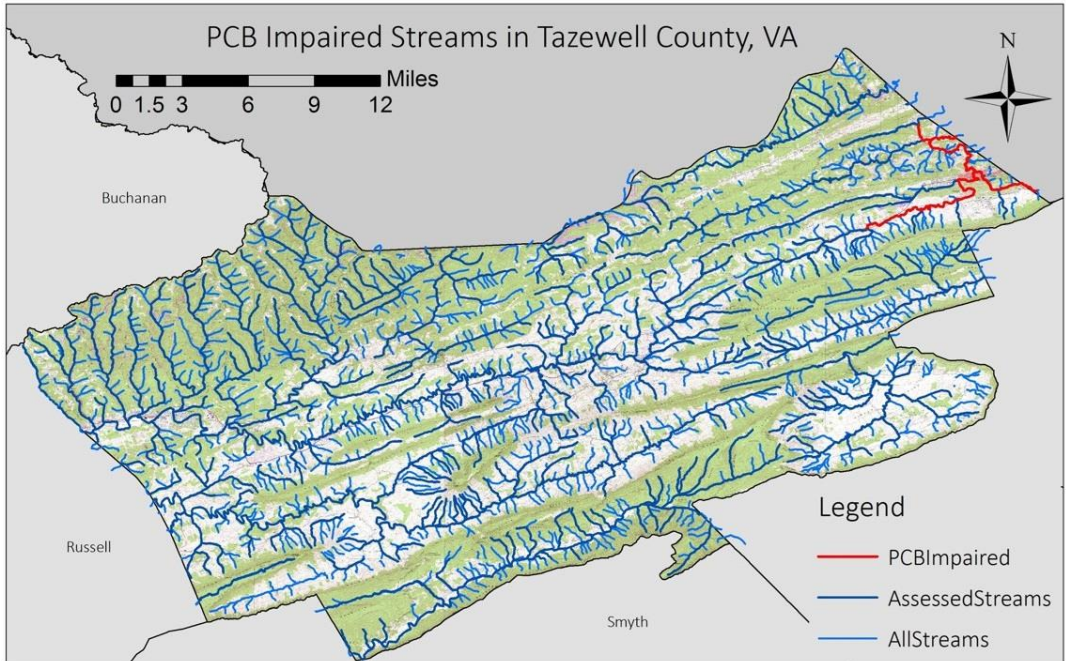




**FIGURE 5. BENTHIC IMPAIRMENTS IN TAZEWell COUNTY**

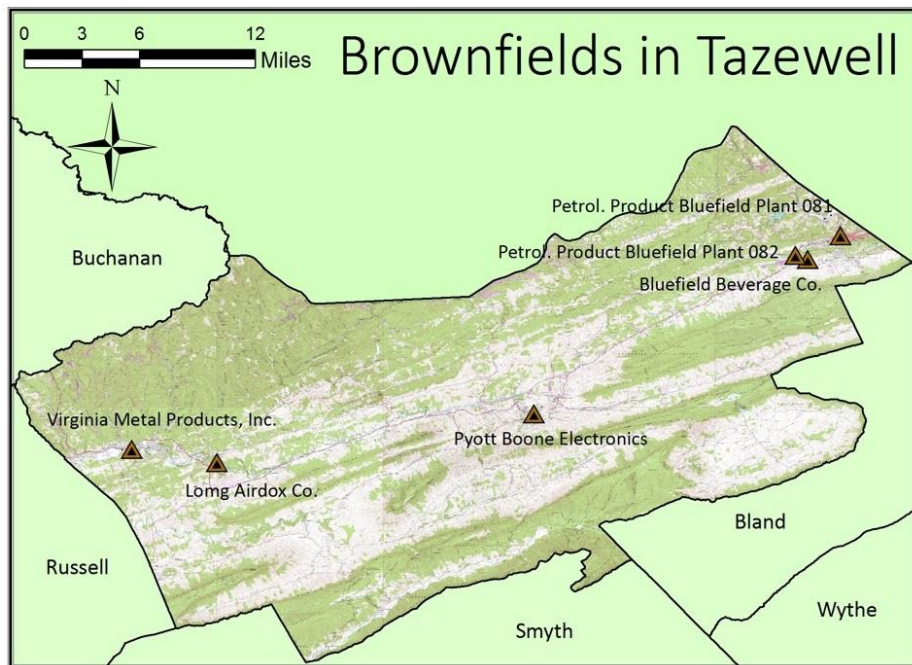


**FIGURE 6. *E. COLI* IMPAIRMENTS IN TAZEWell COUNTY**



**FIGURE 7. PCB IMPAIRMENTS IN TAZEWELL COUNTY**

The locations of six brownfields were obtained from the Town of Tazewell (Figure 8). A “brownfield” is an abandoned commercial or industrial site that may require cleanup or investigation of some environmental contaminants prior to re-development. Brownfields are not “Superfund” sites (sites of known serious environmental contamination).



**FIGURE 8. LOCATIONS OF BROWNFIELDS IN TAZEWELL COUNTY**



#### V.C.4 Discussion

Because the self-reported cancer cases appeared largely randomly distributed throughout the county, with a slightly higher incidence in higher population areas, there is no obvious environmental link between these cases and a specific contaminant. However, it is important to recognize the following:

- Cancer is a chronic illness that develops over many years. Those with cancer may have suffered the exposure that induced their cancer when living in a different location than when they were diagnosed. Similarly, mapping home addresses does not take into account exposures that may have occurred at the workplace.
- Proximity to a potential sources of environmental contamination may not mean there is a pathway to exposure, e.g. exposure to contaminated surface water would require direct contact to that untreated water.
- This effort only examined self-reported cases of cancer, which, due to personal privacy concerns, could not be validated. The actual cancer incidence in the county could be higher or lower.

## **VI. Outreach and Engagement Efforts**

### *VI.A: Town Meetings*

#### VI.A.1 Purpose

The addition of two town meetings was decided upon after making the original proposal to the Board of Supervisors in an effort to:

- a. Give residents an open forum to help direct the project's efforts;
- b. Gain insight and direction as to particular areas of concern where investigation and/or engagement is needed; and
- c. Give residents an opportunity to tell their cancer stories so that the researchers would gain knowledge and insight into their culture and the concerns regarding cancer.

#### VI.A.2 Methodology

Two town meetings were scheduled: one in Richlands and one in Tazewell. Recruitment information played on radio stations, appeared in newspapers, and was spread by several email list-serves and by personal email, as well as word of mouth. The exact same specific questions were asked at both meetings:

- What are your thoughts about this project?
- What do you think should be covered in this project?
- Do you have any suggestions about how we might gain information about cancer in your community?
- What are the best ways to reach people in your community and neighborhood to get surveys filled out and to get focus group participants? (probe: churches, schools, etc.)
- Are there areas of your county you are particularly concerned about in relation to cancer? (probe: Are there things that should be "investigated"?)
- What factors in Tazewell County do you feel contribute to cancer?
- What else would you like us to know about your community that may affect this study?

Twelve women and one man were in attendance at the Tazewell meeting and two women and one man at the meeting in Richlands. All who spoke were cancer survivors or had a close relationship with someone who had/has cancer. Each participant signed a consent form that was approved by the Virginia Tech Institutional Review Board ("IRB", <http://www.irb.vt.edu/>).

### VI.A.3 Findings

Many common themes appeared at both meetings. Residents feel that there is “something” in Tazewell that causes cancer. The most frequently mentioned concerns were: public buildings including (especially) the schools; the water—both public and well; power lines; pesticides; soil and air contamination; and possible toxins in specific communities. The coal industry—dust and old mine sites—was frequently mentioned. The concern for three high school students who presented with sarcomas in 2008 led many to conclude that the schools are a possible site of contamination. Additionally, teachers report a high instance of cancer, breast in particular, and illness among their peers. Lack of primary and oncology care is a great concern, and there is little to no confidence in the hospital and oncology center at Richlands. Most who are diagnosed with cancer go out of the area for oncology care, specifically Wake Forest, Duke and UVA. Some went to a doctor in Bluefield, WV. Several people spent time on the web looking for cancer information, and one participant started a log of known cancer patients in Tazewell County. In relation to underreporting of cancer, many felt that even for those with cancer, this was not the primary diagnosis on the death certificate and therefore, not being counted as such in cancer statistics. Cancer is often undiagnosed and patients choose not to have treatments, and may ask their physicians not report a diagnosis to the cancer registry.

Participants emphasized that the best way to reach people in Tazewell is by word-of-mouth and personal contact, through the school system, via the internet including Facebook, and the Free Press.

### VI.A.4 Discussion

Cancer is an extremely emotional and personal topic, especially for those who have lost a close family member to the disease, and people want to share their stories and experiences. There are many families with multiple cancers, as well as neighborhoods reported to have multiple households with cancers and that, along with the three former high school students with cancer, contribute to the feeling that there is more or “so much” cancer in Tazewell County. Residents feel strongly that there is an environmental contributor –or multiple environmental contributors-- to cancer, primarily the water, “sick” buildings, and factors related to mining. There is concern that the schools are particularly toxic. There is concern that the lack of primary care is

contributing to the poor health of Tazewell residents, including cancer, and contributing to a higher risk of cancer death.

Because of the town meetings, we changed the cancer survey to include all cancers and not just cancers diagnosed over the past 10 years, and we scheduled meetings with the county engineer (water and infrastructure) and school officials. We also decided to start a Facebook page so that cancer patients could share their stories and have a voice in the project.

## *VI.B: Facebook Page*

### VI.B.1 Purpose

The goal with the Facebook page was to give citizens a forum to tell and share their cancer stories. These stories provided invaluable information about the plight of cancer patients in Tazewell County. Additionally, the page was used to announce where and when project events would be taking place, and eventually, to host the focus group. Survey links were also posted to this page. The page went live in May of 2014, and remains active today. It will be deactivated in June 2016, unless the town requests that it remains live.

This Facebook Page is public and may be viewed at

<https://www.facebook.com/TazewellVACancerProject>.

### VI.B.2 Methodology

The Facebook page was created and administered by a member of our research team, with guidance from the whole team. Post on the page were made to advertise project activities such as surveys, town meetings, Focus Groups and environmental testing. Posts of encouragement were also made periodically in an effort to keep people engaged.

### VI.B.3 Findings

The first “Like” and post came on the page one day after the page was launched. As of this writing, the page has 1271 “Likes”, which equates to that many followers. A total of 44 posts were made by our research team and 17 private messages were answered. Individual posts reached as many as 3772 people through comments and “shares.” Posts from followers on the page include:

- Stories about individual cancer experiences: *“I am a 15 month survivor of Triple Negative Breast Cancer. This disease has become all too common in this area. On my street alone, four out of six homes have had a resident diagnosed with some form of cancer.” And “I lost my sister at the young age of 55 to cancer i wonder if it came from the land field may be getting in the wells”*
- Questions about former Tazewell residents who have been diagnosed other places and people diagnosed recently moved to the area: *“We moved to Tazewell after living in Florida for 30 years and when we got there, my husband was diagnosed with cancer.”*
- Expressions of concern about cancer in general: *“...check this out. I fully support this study. Far too many cases. We wear orange for Riley who is battling ALL.”*
- Sharing the page with others who had cancer: *“If you guys in Tazewell County know anyone who is suffering, in remission or died from cancer and aren't apart of the [Tazewell County Cancer Project](#) then do it damn it! They have a survey that you should check it out.”*
- Questions about the project and individual projects such as surveys, focus groups and environmental testing: *“First I have heard about this. Do we have an abnormal amount of cancer in Tazewell Co?”*
- General thoughts about cancer: *“Cancer ~ a most insidious and dreaded disease with known catalysts it is often studied to death without any negligible, positive actions due to costs, politics and community relations. When developing a community, keep the water supply free of toxins, insure air and water carry no carcinogens. Allowing PCBs, pesticides, herbicides into a water source will give cancer clusters.”*
- And expressions of gratitude for the project: *“I am so glad to see research on this Cancer Project! We have lost too many family and friends. Thank you”*

#### VI.B.4 Discussion

Residents and former residents of Tazewell County seem genuinely interested in the project and are glad to have a place to share their stories and thoughts about cancer. Additionally, more awareness and information about cancer in Tazewell was shared with those not affected directly

by the disease or unaware of the project. Residents see the project as a positive step toward investigating cancer in the county.

## *VI.C: Facebook Focus Group*

### VI.C.1 Purpose

The focus group is a widely used and accepted method of qualitative data collection in public health practice and research. Traditionally the focus group method has taken the form of an in-person small group discussion facilitated by a trained moderator. However, barriers to community participation in traditional focus groups include lack of time, transportation, and resources. These concerns are especially true for Tazewell County, which is large geographically, but has a relatively low population density with many small communities and neighborhoods. To address these barriers, a new focus group method using an existing social media presence was developed as part of the yearlong cancer project.

### VI.C.2 Methodology

Initially, we scheduled focus groups in Tazewell, Claypool Hill, Pocahontas, and Bluefield. Advertising was posted in the local newspapers, radio station, through our Facebook page and through large list-serves and private emails. The County posted the information on their website. Our goal was to have six to eight participants in each group. However, we were not able to reach this goal and in some cases, recruited only one or two potential participants, which would be too small for a valid study. After rethinking ways to reach a viable number, we decided to pioneer the Facebook Focus Group. Although not everyone in Tazewell has a readily available computer, many use the internet through their phones, and we believed this approach would still improve overall access and participation in comparison to an in-person focus group.

Participants were recruited for the Facebook-based focus group using the existing public Tazewell County Cancer Project Facebook page. The page was created at the beginning of the project in response to community input that Facebook would be the most effective way to reach a large number of residents in Tazewell County. The focus group recruitment statement (Appendix E) was communicated as a “post” to the page. Interested individuals were instructed to privately email the focus group moderator for information about participation. Eleven individuals

completed the necessary procedure for participation. All (100%) of participants were female and white, non-Hispanic. Age breakdown is shown in Table 5.

**TABLE 5. FACEBOOK FOCUS GROUP AGE PROFILE**

<i>Age Range</i>	<i>Count</i>	<i>Percentage</i>
18-40	4	36%
41-64	5	46%
65-80	2	18%
<b>Total</b>	<b>11</b>	<b>100%</b>

Individuals who emailed the focus group moderator with their interest received preliminary information about the focus group and a copy of the consent form. They were asked to review the consent form on their own and contact the moderator with any questions they might have. Individuals who were willing to participate indicated consent by returning the form via email with their name, address and email information. Once the proper consent was received, participants were able to be added to the Facebook-based focus group for participation.

Participants participated within a “secret” Facebook group created with the specific purpose of being the focus group platform. Facebook has three privacy options for groups: Public, Closed and Secret. The “secret” option was chosen for this group because it provided the most security. Only individuals added by the moderator could access the group, only group members were able to view and search for the group name and group description. Only current group members were able to view posts in the group and on their Facebook News Feed.

Once proper consent was obtained and the participants were added to the Facebook-based focus group, the moderator began posting questions. The focus group consisted of a series of eight questions which were posted over a two-week period:

- What does a healthy community look and feel like?  
Probe: What makes the people healthy and what makes a community healthy? What kind of habits does a healthy person adopt?
- What makes a person or a community unhealthy?  
Probe: What kind of lifestyle does an unhealthy person
- What are your experiences with cancer, either your own, or someone you cared for, or someone you had direct contact with while they were sick?

- What do you think causes cancer?
- What factors are present in Tazewell County that you think contribute to cancer?
- What do you feel needs to be done in Tazewell County to reduce the cancer rate?
- Are there any incidences, places, hazards or anything else you can think of that you feel, as researchers, we should be taking a close look at in Tazewell County in relation to cancer?
- What do you hope to see or learn from this study?

The research team determined that the time frame (posting one question every few days) was necessary to give participants adequate time to read and respond to both the question posed and each other's responses. The moderator was notified through Facebook each time a new post, comment or "like" was made, which allowed for appropriate facilitation of the questions. The moderator was able to see when most participants had had a chance to respond and when discussion was coming to an end, allowing them to post a new question and generate new discussion. The recruitment statement, informed consent document, and focus group questions were approved by the Institutional Review Board of Virginia Tech (IRB 14-408).

### IV.C.3 Findings

Four main topics were discussed during the Facebook-based focus group: (1) community health, (2) cancer experience, (3) risk factors, and (4) prevention. Each is summarized below with descriptive quotes from participants.

#### ***Community Health***

When discussing what makes a community healthy, participants identified several key concepts they felt were essential to overall community health such as exercise, eating well, having access to health care, spirituality, social support, and environment.

Most of the participants pointed out the importance of engaging in some type of regular physical activity. The community can encourage and support this by providing safe ways to exercise such as hiking trails and sidewalks to make the community easily walkable: "...*Even in a small town like Tazewell, I also think sidewalks in the residential areas are basic, because then people can just walk. Where we live, my sons walked to school, to church, and to my office downtown. I see [my neighbor] jogging every day it makes a difference.*"



Participants found eating well to be equally as important as exercising. For individuals to have a healthy diet, they need both access to healthy foods and to make an effort to incorporate those into their diet. Participants' ideas of healthy eating included: "...opportunities to grow gardens and raise livestock, options for obtaining healthy foods," "Healthy eating with as much organic food as possible. Limited consumption of sugar, caffeine and alcohol." "I think healthy people cook most of their meals from scratch using real food." Individuals' diets can contribute to unhealthy communities when they are instead eating unhealthy meals. One participant stated, "I think children who drink soda instead of water and snack on chips, etc. instead of fruits or veggies become unhealthy adults."

Participants discussed the importance of having access to quality medical care in a community in order to keep its residents healthy. This helps to ensure that individuals are receiving regular check-ups and preventative health services. One participant stated that healthy individuals must, "...listen to your body and get regular checkups with your doctor to treat health conditions before they become major problems."

Mental and emotional health were addressed through discussion of the importance of social support and spirituality in a healthy community. Participants felt that a strong community support system- "*caring neighbors and strong social ties within the town*" – helped improve overall community health. Also important were good spiritual habits such as: "*pray,*" "*implement a spiritual, positive attitude in response to life's ups and downs,*" "*being close to God in prayer.*" Some participants felt that "*poor social and spiritual habits*" and "*lacking spiritual stability and faith*" could contribute to an overall unhealthy community.

Environment was identified a factor that could either make a community healthy or unhealthy depending on the circumstances. Healthy communities should have, "*more recycling, less waste discarded in landfills, and better water and air quality.*" Communities are unhealthy when there are toxins and pollutants present in the environment, food and/or water sources.

### ***Cancer Experience***

Focus group participants had been affected by cancer in various ways. For most, the experience was very personal – some had battled or were currently battling cancer, others had lost close

family members to the disease. While each story was unique, there were several themes that emerged throughout the different experiences.

It is evident that any type of cancer causes a significant physical burden on the individuals who are battling the disease. It disrupts the life of the person fighting it and all those that are close to them, *“For that entire year, I had to have an extra person to drive with me, because sleep apnea caused me to be unable to stay awake during the day. It was very scary, to me and to my staff. They said I would fall asleep while talking!”* Several participants discussed the toll that battling cancer had on their bodies: *“...the fatigue, the bone pain, the weight gain (I also put on 20 pounds in 6 weeks) and the side effects of the steroids, while invisible, still have a negative effect.”* *“I went through six months of chemo, losing all of my hair and gaining (yes, gaining) 20 pounds. I handled the hair loss better than the weight gain – go figure.”* Other participants had watched a love one battle with cancer and reflected on that experience: *“By the end [my mother] didn’t hardly weigh 70 pounds. She couldn’t eat anything.”*; *“My experience with my sick daughter was rough. People here in Tazewell looked at her like she was a mutant. Parents let their children point and stare at [her]... A year and a half into her treatment she developed what is known as drop foot. The chemo had killed her nerves and she needed leg braces to help her walk.”*

Most of the focus group participants expressed some type of negative emotions toward cancer and the effect it had on their lives. Many were angry and felt it was unjust the way that cancer had affected their family: *“Cancer took my beautiful, smart, athletic, sweet baby and took his hopes, dreams and bright future. It is a terrible beast that affects the whole family.”*; *“I’m angry! I feel the ball was dropped and now I’ve lost my mom and my best friend. She was 61 – too young to be gone! I’ve never seen someone suffer so much.”* There were also feelings of hopelessness – for some of the cancers there were not many options. One woman – who was fighting cancer at the time – stated, *“Emotionally, I have had to live in a state of controlled fear. I just always felt like I was standing on the edge of a cliff, waiting for someone to push me off. There is no cure for [my cancer] and eventually it just crashes your immune system.”*

Access to quality health care was an issue that many participants faced in their experiences with cancer. Some had difficulty receiving the care they needed – one woman said, *“I had to have my tonsils removed because they were so large they compromised my airway. It took a year to find a surgeon who would agree to perform the surgery, and even then I had to be scheduled twice because I couldn’t meet the baseline lab requirements.”* Paying for the care can be a major concern, as one woman describes, *“Beginning in 2010, my insurance company began doing everything they possibly could to cancel me and they finally did manage to cancel me in 2012...For the first time in my life I felt impoverished. Until you go through it, you have no idea how being uninsured strips you of your dignity – and magnifies the fear.”*

Quality of health care was also a concern, as some participants felt a higher standard of care could have made a difference in overall outcomes. One woman discusses her mother’s battle with cancer, *“In 2008, my mom had an aorta abdominal blockage, when this was found they also found a lesion on the pancreas. It was referred to as an IPMN. The hospital that did her surgery for the blockage seemed to make no big deal of this lesion. From what I’ve read IPMN can lead to cancer of the pancreas. Surgery could have probably been done and maybe prevented the cancer from happening. At the time of my mom’s death in September 2013, it had been 5 years since the lesion was noted in October 2008. 5 years is the survival rate when caught early.”* Most of the participants focused on cancer treatment, but this provides an example where preventative care may not have received the concern that it entailed.

While there was plenty of discussion about the negative impacts of cancer, focus group participants did show hope and positivity toward their situations. Faith played an important role in providing comfort and giving hope. Despite continuing to battle cancer one participant stated, *“As my oncologist says, ‘we just keep fighting it until they find a cure!’ I have been blessed with being able to continue working my job through all of this and now I am blessed to have my first grandchild born this year in June. God is good!”* Another participant described how the social support from her community has helped her through her experience, *“The support I received from my family, my friends, and my community was amazing and truly humbling. People I didn’t even know prayed for me and are still praying for me. God is good, and He is the reason I’ve come this far.”* While social support can contribute to easing the experience, lack of support can

make battling cancer much more difficult. One woman shares feelings of isolation as “*children would stare at [my daughter] and point... We didn't have support then.*”

### ***Risk Factors***

Participants expressed some uncertainty about what causes cancers, but most could agree that it is the result of a combination of multiple factors. Many believed that environmental factors such as exposure to toxins could be a cause. One woman says, “*I think a lot of it is caused by a lifetime of exposure to the chemicals in and on our food and water.*” Other participants also believed that genetics play an important role. Sometimes cancer is just the result of “*genetic bad luck.*”

Participants were asked to think more specifically about what could be present in Tazewell County that might contribute to cancer. Most people again focused on the environmental component and the possibility of the presence of harmful chemicals. Specific possibilities suggested include: “*asbestos lining of the town water pipes,*” “*possible run off into ground water,*” and “*radon.*” The participants also identified several specific places they felt should be further investigated in Tazewell County. There were two main concerns of many of the participants: Tazewell High School and the town of Tazewell. One participant says, “*I think the number of teachers and students at Tazewell High School with cancer is a real concern.*” The town of Tazewell overall was a concern, but there is a specific neighborhood that is also brought up. One woman says, “*Three homes on the corner of Fincastle Turnpike and Jefferson Avenue have four people with five cancer diagnoses: (3) leukemia, (1) lymphoma and (1) non-leukemia. Sounds like a high incidence to me.*”

### ***Prevention***

Concerning how to address the issue of cancer in Tazewell County, the majority of participants felt that better education is essential. Education should be focused on early detection, but also on better overall health. One woman says, “*Health and nutrition information available to our young people is sorely lacking... Education on general health and wellness needs to become a priority in both schools and in communities with easy access to information.*” Many felt efforts should be focused on children to help them maintain good habits throughout their lives and grow into healthier adults.

A number of the participants felt that more programs and services relating specifically to cancer would be useful. Several people specifically suggested the desire to make the Livestrong program available for cancer survivors at the local YMCA. Another suggestion was for expanding support groups, *“I feel more cancer support groups could be helpful to help educate and encourage survivors.”* In addition to these types of programs, participants also believed there needs to be improved access to medical care especially regarding preventative care and early screening.

#### VI.C.4 Discussion

This new Facebook focus group methodology proved useful in meeting data collection needs as part of the Tazewell County Cancer Project.

When discussing what makes a community healthy, participants identified several key concepts they felt were essential to overall community health such as exercise, eating well, having access to health care, spirituality, social support, and environment.

Focus group participants had been affected by cancer in various ways. For most, the experience was very personal – some had battled or were currently battling cancer, others had lost close family members to the disease. While each story was unique, there were several themes that emerged throughout the different experiences.

Participants expressed some uncertainty about what causes cancers, but most could agree that it is the result of a combination of multiple factors. Many believed that environmental factors such as exposure to toxins could be a cause. Other participants also believed that genetics play an important role. Other possible carcinogens mentioned include asbestos, radon, and harmful chemicals.

Participants believed Prevention Education should be focused on early detection, but also on better overall health. More programs and services relating specifically to cancer would be useful, e.g. the Livestrong program should be available for cancer survivors at the local YMCA.

## *VI.D: Key Stakeholder Interviews*

### VI.D.1 Purpose

In an effort to gain knowledge of and professional opinions about health and cancer in Tazewell County, we conducted two key stakeholder interviews. These interviews provided a more intimate and personal opportunity to gain information that may not be said in other, more public settings.

### VI.D.2 Methodology

A member of our research team attempted to contact a number of health professionals in Tazewell County. Suggestions were taken from participants at the Town meetings and by asking individuals via email. After many attempts, two professionals, a nurse and a hospital administrator, were willing to take the time for this discussion. Permission was granted to participate and tape the phone call interviews, by signing a written statement approved by the Virginia Tech Institutional Review Board. A total of eight questions were asked of each interviewee.

### VI.D.3 Findings

When asked about Tazewell's cancer rates compared to surrounding counties and the rest of Virginia, one respondent didn't feel rates were higher or much different. The other thought the rates might be high and thought they *"come in pods."* *"I don't have anything to prove that."* Both brought up the high school students with cancer and thought this had raised concerns, but also thought it was coincidental. But they acknowledged the alarm that this caused in the community.

Cancers diagnosed at the hospital are reported to a Cancer Registry by someone in Medical Records. However, the hospital in Tazewell doesn't *"diagnose a lot."*

Cancers are diagnosed all over the county and no one school has a monopoly on cancer. However, in terms of the community, *"it just seems like if you hear one neighbor or one close neighbor, another neighbor down the road..."; "And then it settles down and then from work I hear that somebody in another (community)...It just seems to be in all different communities."* When addressing the three students diagnosed around the same time, *"Two of the students lived*

*in Tazewell County their whole lives but in totally different sections of the county. And one was a transfer student; had not lived here her whole life.”*

In regards to possible environmental issues related to cancer in Tazewell, asbestos, power lines and old buildings were mentioned. *“I wish I knew what caused cancer and I wish we had a cure for it. But the only thing I can say that has, you know...it’s not just cancer in itself. But our buildings are very old.”*; *“We’re out of school in the summer, everybody’s doing great. As soon as we come back into the school, you know, everybody gets sick. They get colds and sinus infections and, you know, they cough all year. Now they’re not necessarily talking about cancer, but they’re saying that they get sick. I’m sitting there thinking well, you know, you’re in a building. It is fall and you’re with children.”* Most of the children in the schools drink from water bottles and don’t drink the water in the schools. *“I guess I don’t really have an opinion about environmental factors. I just wonder, I mean...I wonder sometimes if it’s something we eat or what we’re exposed to.”*; *“I think a lot of people are related and I think there is some genetic component there because we’re a close-knit community. I would say just lifestyle factors; like obesity, smoke exposure, tobacco use, you know, in general, whether it be dipping or smoking or second-hand, you know, they’re getting the second-hand smoke.”*

Breast, prostate, leukemia, pancreatic, colon, lung and skin cancer are mentioned as the most prevalent in Tazewell County.

Barriers for diagnosis and treatment of cancer in Tazewell include finances, lack of screenings, transportation and the difficulty in getting and in keeping doctors, both primary care and oncologists: *“Sometimes I think people put off either exploring or seeking or whatever because that’s (Pikeville) a long drive. So they will just delay it. You know, they might have a suspicious something or something might be happening, and they just think, you know, that’s a long way to go. So they might not be on top of it.”*; *“But if we had better primary care access, if we had more screenings...we used to, as a hospital, we used to have a community checkup day is what we called it. And we did lots of different screenings. But we don’t do that anymore.”*

Most people leave Tazewell County for their oncology and primary care. In regards to whether most cancers are found at an early or a late stage, it is dependent upon whether or not the individual has a primary care provider. *“If they don’t have a primary care or access to a primary care, they keep putting it off and putting it off until they are in severe pain, and then they come to our E.R. And then by that time, you know, they’ve lost a lot of ground.”*

#### VI.D.4 Discussion

Cancer is found in all communities throughout Tazewell County. Asbestos, power lines and “sick buildings” are of concern, as well as lifestyle factors, especially smoking, and genetics with respect to potential causes. Breast, prostate, leukemia, pancreatic, colon, lung and skin cancer seem to be most prevalent. The most dominant barrier to diagnosis and treatment is the lack of primary and oncology care. Transportation and finances drive both diagnosis and treatment choices. More cancers would be found earlier if primary care were readily available.

#### *VI.E: PhotoVoice School Project*

##### VI.E.1 Purpose

Photovoice is a community engagement strategy which uses photography to help people identify community assets and challenges; it gives people a voice to act as potential catalysts for change in their community. Photovoice has been widely used as a community engagement strategy with different populations to engage disenfranchised communities who otherwise are seldom heard.

As part of the Tazewell County Cancer Project, the researchers engaged youth from the Tazewell County Career and Technical Center (TCCTC) to gain a deeper understanding of youth perspectives on cancer in the county. It also allowed the research team to engage youth meaningfully and share the voices of students who are seldom heard. Adding a qualitative, visual component to the project enhances the quality of the Tazewell County Cancer Project.

##### VI.E.2 Methodology

Seven youth ages 16-18 from TCCTC were recruited through an English class. Two students were female and five were male. Students were from several different parts of Tazewell County (Bluefield, Tazewell, Richlands, Abb’s Valley). Researchers met with the students twice over the course of one month in April 2015.



During the first hour-long session, students were introduced to the photovoice methodology and discussed the benefits of participating in a photovoice project. Researcher followed an informed consent process, including ensuring all students signed a photo release form. All students under the age of 18 assented and obtained parental consent to participate.

Students also received information on the ethics of taking pictures, such as not taking photos of illegal activities, asking people before taking the picture (and getting signed consent) and always keeping safe while out taking pictures. They also were given a short introduction to photography methods, and tips on taking good pictures. Students participated in a discussion on cancer and possible causes.

At the end of the session, each student was loaned a point and shoot digital camera and was asked to go out and take pictures of their community, focusing on topics that reminded them of cancer (in a positive or negative sense), to explore what they liked, and what they didn't like in Tazewell County. Students were given clear expectations about project outcomes.

During the second session, each student met individually with researchers to analyze their pictures through reflection. Researchers pulled up students' pictures on a laptop computer and students selected one to three of their favorite pictures. Students were then asked to answer questions about these pictures. Questions included:

- Why did you pick this picture?
- What is really happening here?
- How does this relate to cancer?
- Why does the situation, concern or strength exist?
- What can we do about it?

All cameras were returned to the researchers. Each student who participated in the project received a \$25 Walmart gift card for their time. Chosen pictures, along with selected quotes describing the pictures will be displayed at key locations in town as determined by students.

### VI.E.3 Findings

Students and researchers picked 14 pictures to further explore and eventually exhibit (see Appendix F). Pictures included nature scenes such as animals and mountains, people receiving cancer care, people who had either succumbed to or overcome cancer, cancer risk factors such as tobacco and more. Emerging themes included: Nature and peacefulness, Family, Access to healthcare, Environmental hazards, Tobacco and Cancer.

#### ***Nature and peacefulness***

A strong sense of belonging, love of place, mountains and nature emerged from the discussions with the youth. Many of the youth took pictures of or from the mountains in their community, of a river, or of animals. Nature was often related to a sense of peacefulness or tranquility, which is especially needed in trying times, such as when a loved one has cancer. Nature also reminded some of the youth of people in their lives who had succumbed to cancer. Nature was associated with a sense of being home, of where they were from. One of the students, Tyler, took a picture of the view of a mountain from his recently deceased grandfather's house - the picture he took was from a porch swing where his papaw would sit. Ryver stated that participating in this project was really fun, because it gave him a chance to: *“go and actually look at the beauty of Bluefield.”*

#### ***Family***

Many of the youth who participated in the project felt a strong connection to family. Several of the youth participated in the project as a way to commemorate a loved one who had recently died of cancer, and one participated to honor a sibling currently undergoing cancer treatment. Through their comments, youth discussed the importance of family ties and the devastation that cancer has played in their lives, they also discussed the joys of spending time with family and loved ones. Ryver said: *“the project in general, I mainly did it for my uncle Will and my grandma who died recently, but my uncle, he died a day after Christmas and I did it mainly for him because he would have wanted me to do something like this.”*

#### ***Access to healthcare***

Youth expressed a sense of frustration at dealing with medical professionals both in Tazewell and in the region. Cody's family is directly affected by cancer: his 7 year old brother Riley is undergoing treatment for Acute Lymphocytic Leukemia which he was diagnosed with at age four.

They have seen many doctors in the past three years. His girlfriend, “J” recalls several occasions when they had to drive to and from Roanoke, only to be treated poorly by providers: *“they were rude, they didn’t know how to handle pediatrics at the ER.”*

Breanna recalls driving to Bristol with her sick grandmother: *“to someone with cancer, a drive of like an hour is actually, it literally drains you. It is not a fun trip when you go down there and back.”* Breanna also complained about the inadequacy of local providers: *“our doctors, they are not the brightest out of some of the ones I have went to, and there are just a lot of things that could be fixed, like having nice facilities, instead of having to drive to Bristol or somewhere else to get treatment.”*

### ***Environmental Hazards***

Youth talked about the beauty and nature abundant in Tazewell County, but also contrasted this with environmental issues such as pollution, trash, ruins and waste found in their communities. Jeremiah focused on abandoned buildings, and what could be done with them: *“...the danger of it, if a kid were to get in or something, it’s got black mold and different things falling. I mean a kid could get hurt.”* Ryver stated that with more time, he would have loved to take more pictures of Pocahontas, where he is from: *“it used to be an old coal town and then it started falling apart and they just left it. It is just falling into the road.”* Their love of nature and community made the youth sad to see communities and buildings in ruins and polluted.

### ***Tobacco***

The youth were well aware of the ill effects of tobacco, and the direct link to cancer. Tyler was the most vocal about this, as one of his pictures was a can of snuff. Researchers engaged him in a long discussion about tobacco. Tyler has been dipping for eight years, and it was passed down to him through generations: *“people do it every single day, and I am one of those people - I ain’t gonna lie to you. But I grew up doing it...Papaw always told me it was in my veins.”* Tyler’s dad also dips: *“my dad he used to smoke, and where he worked in the coal mines, you couldn’t smoke, so he dipped.”*

There were also some misconceptions about harmfulness of snuff versus cigarettes. Tyler admitted: *“the way I see it, I would rather lose my jaw than lose my lungs, that’s the reason I dip*

*and not smoke.” and “[my dad] stopped smoking all together, his respiratory system got 20 times better...and then he went to dipping and he’s just as calm as collected as he can be. Doesn’t have any health problems anymore.”*

### ***Cancer***

All but one of the youth reported a direct connection to cancer with at least one person from their family. Most of them participated in the project to commemorate a loved one, to share their story. Some youth reported concerns about how commonplace cancer had become. Ryver stated: *“anything we eat or drink anymore is cancer related. I mean the air even - we could be breathing something right now that we don’t even know about.”*

### **VI.E.4 Discussion**

Tyler summarizes the contrast found in Tazewell County: *“you gotta get the beauty and the beast of it. Because, I mean, the beast of it is that there’s a lot of tobacco around here and people dip and all that, but then again, you gotta look at the scenery and all that - it brings peace during troubling times.”* Youth described a calm, serene, peaceful county which is also rife with pollution, crumbling towns, high tobacco use and plagued with cancer.

The perspective that youth bring to this project is invaluable and must be considered in any cancer prevention project in Tazewell County. Strong ties to family and love of place and nature must be considered while working in Tazewell County. In addition, the perceived mistrust and limitations of local medical professionals should be taken into account.

## **VII. Environmental Field Testing**

### *VII.A: Environmental Sampling in the Schools*

#### VII.A.1 Radon

##### ***VII.A.1.a Purpose:***

Since Tazewell County is in the high radon belt (see Figure 1), radon is an important contaminant of concern when addressing cancer in the Tazewell community. Radon is an invisible, radioactive gas that occurs naturally in nature. Radon travels through rocks and soil into the air where it is able to spread out. In buildings, where there is nowhere else for radon to go, it builds up inside. Breathing in radon is the second greatest cause of lung cancer (behind smoking) and causes tens of thousands of deaths every year. Smokers also have a greater risk of getting lung cancer if their homes have high radon levels.

##### ***VII.A.1.b Methodology***

Short term (3-7 day) radon tests provided by the Virginia Department of Health (VDH) were deployed and collected in five Tazewell County schools (Career and Technical Center, Tazewell High School, Tazewell Elementary School, Tazewell Middle School and North Tazewell Elementary School) in July 2015. This served as an initial school pilot to compare with results collected by VDH in the 1990s.

##### ***VII.A.2.c Findings and Discussion***

Results show no elevated levels above 4 pCi/L, the level of concern to public health (Appendix F). This is in keeping with more extensive radon testing during the 1990s throughout Tazewell. Upon discussion of the results and testing procedures with Ryan Paris from VDH in Richmond, we were advised that we do not need to do more radon testing in schools, since levels are not expected to change significantly over time (as was confirmed by our results).

#### VII.A.2 Water Sampling

##### ***VII.A.2.a Purpose:***

Participants in the town meetings frequently mentioned concerns regarding drinking water quality. Concerns related to school drinking water quality were particularly common, given the perception of a high incidence of cancer amongst students and teachers. To explore the quality of water in the schools, two field sampling trips were conducted in Summer 2015 and December 2015 to record levels of the most commonly tested water quality contaminants.

### VII.A.2.b Methodology

Water samples were collected from three to four points (e.g. kitchen tap, water fountains) at all seventeen Tazewell public schools over the summer of 2015 and tested for the water quality parameters listed in the table below. A subset of ten sampling points that yielded water samples with high lead values (>10 ppb) during this initial testing were re-tested on Dec 5, 2015.

TABLE 6. WATER QUALITY TARGETS FOR SCHOOL STUDY

Water Quality Parameter	Regulatory Limit	Potential Risks
Arsenic	<10 ppb	General carcinogen
Copper	<1.3 ppm	Liver and kidney damage
Cadmium	<5 ppb	Kidney damage
Lead	<10 ppb	Neurological defects; learning disabilities in children; probable human carcinogen
Selenium	<50 ppb	Circulatory issues; current high profile conflicting reports as to whether it is protective/risk-inducing for cancer
Nitrate	<10 mg/L	Methemoglobinemia, gastric cancers
Total coliforms	Absent	Indicator of potential contamination pathway, particularly for pathogens
<i>E. coli</i>	Absent	Gastrointestinal distress; potential exposure to fecal pathogens, including <i>Helicobacter pylori</i> (associated with ulcers and stomach cancer)

#### Initial Testing (Summer 2015)

Sampling times were coordinated, with the assistance of public school staff, to be “maximally conservative”, e.g. to collect under “worst case” scenarios in order to ensure the most strict protection of public health. For example, all samples were collected in the morning or during a time when the taps had not been used for eight hours or more. This “stagnation time” (the time the water is sitting in the pipes) maximizes any potential for corrosion, e.g. the sloughing off of pipe metals into the water. To determine whether “flushing” (running the taps for a prolonged period) reduced any potential metals concentrations by moving the stagnant water out of the

system, we collected three samples in a row and analyzed each separately for metals concentrations:



**FIGURE 9. WATER SAMPLING PROCEDURE FOR METALS**

A single additional sample was collected and tested for nitrate, total coliform, and *E. coli* levels (these are not generally affected by stagnation). All sampling materials were processed and sample analyses were conducted in accordance with the American Public Health Association’s Standard Methods for the Examination of Water and Wastewater (Available: <https://www.standardmethods.org/>).

#### *Follow-up Testing (December 2015)*

The ten water sampling locations that yielded water samples that contained lead levels >10 ppb were re-sampled in December 2015. This sampling trip was designed to better mimic likely use by students: all taps were sampled during school hours and following a week of normal classes. Only a first draw and one minute flush sample were collected to minimize collection time and disturbance of the normal school day. Collected samples were only re-tested for metals, coliform, and *E. coli* bacteria as all nitrate samples had been far below the regulatory limits.

#### **VII.A.2.c Findings**

##### *Initial Field Study (Summer 2015)*

The entire suite of results, including all metal draws and sampling locations, is appended to this report (Appendix H). There were *no* violations of the maximum contaminant levels (“MCLs”) outlined in the USEPA’s National Primary Drinking Water Standards (Available: <http://water.epa.gov/drink/contaminants/>) for arsenic, cadmium, *E. coli*, nitrate, or selenium.

Two samples were positive for total coliform bacteria (one at Tazewell High School, and one at Tazewell Career and Technical Center), which does violate the EPA’s primary maximum

contaminant level. This is of *minimal concern*, as total coliform bacteria are non-pathogenic and do not necessarily indicate the presence of fecal bacteria (as in the case of an *E. coli* positive sample; note: all samples collected were *E. coli* negative). However, they may suggest a pathway for environmental contamination. The schools are encouraged as a best practice, to clean and flush all water taps regularly.

One sample at the Tazewell Career and Technical Center (Water fountain by stairs from A to B wing, nursing room, second draw) exceeded the EPA MCL for copper (1.44 ppb). This is of *minimal concern* as the exceedance is relatively small and no associated health problems have been reported. However, we would suggest re-testing, and it is worth noting that this tap was also above the recommended lead level.

Samples collected from ten water sources in eight schools exceeded 10 ppb lead, which is of *moderate concern*, as exposure to elevated levels of waterborne lead by children has been recognized as a serious health issue. However, it is important to recognize that these samples were collected in a “worst case scenario” manner: the water had been left stagnant for a protracted time, water was collected at full flow, and water was collected in a smaller volume (125 mL) considered more typical of a child’s consumption. Also, note that while the official regulatory level for lead in school water is 20 ppb, we compared the samples taken at Tazewell to the more conservative 10 ppb level adopted recently by the Seattle public school system following a “lead in schools” scare (Lambrinidou et al. 2010). It is likely the official national regulatory benchmark will decrease to this value in the next few years. No samples collected during the initial testing were above 20 ppb (maximum level observed = 18.4 ppb). The water sources above 10 ppb lead were:

- Cedar Bluff Elementary: Cafeteria Sink for Produce (13.9 ppb, first draw)
- Raven Elementary: Water fountain in gym (13.1 ppb, second draw)
- Richlands Elementary: Water fountain near gym (10.2 ppb, second draw); Water fountain near Room 32 (10.1 ppb, second draw)
- Richlands High School: Water fountain by Library (10.6 ppb, first draw)
- Richlands Middle School: Water fountain near cafeteria (13.1 ppb, second draw)
- Springville Elementary: Water fountain near room 9 (15.5 ppb, first draw)



- Tazewell Career and Technical Center: Water fountain in hallway by cosmetology room (17.3 ppb, second draw); Water fountain by stairs from A to B wing, nursing room (13.5 ppb, first draw; 17.2 ppb, second draw)
- Tazewell Middle School: Cafeteria Sink for Produce (18.4 ppb, first draw)

Follow-up Testing (December 2015)

Out of an abundance of caution, we re-tested the taps at the schools that yielded samples that exceeded 10 ppb lead. The entire suite of results for these ten re-test locations is appended to this report (Appendix I). There were *no* violations of the MCLs outlined in the USEPA's National Primary Drinking Water Standards for arsenic, cadmium, total coliform, *E. coli*, or selenium.

During the re-testing effort on Friday, December 4, 2015 samples collected from all ten locations were below 10 ppb lead except the water fountain in the hallway by the cosmetology room in the *Tazewell Career and Technical Center*. The first draw for this sample was 31.5 ppb, and after one minute of flushing the level dropped to 12.5 ppb. While the both the first draw and one minute flush samples collected from the water fountain by stairs from A to B wing, nursing room at the Tazewell Career and Technical Center were below 10 ppb lead, both of these samples still exceeded the 1.3 ppm MCL for copper. As stated before, copper exceedances are of *minimal concern*.

**VII.A.2.d Discussion**

Only a small number of water fountains or kitchen prep areas yielded water samples with concentrations that exceeded recommended drinking water contaminants, and most of these exceedances were quite small (e.g. coliform but not *E. coli* positive). Water quality was improved when re-testing the schools under normal operating conditions, as opposed to when they were closed during the summer. This is to be expected, as high levels of metals and biofilms are expected when water is stagnant for long periods. As a regular best practice at all schools in the future, we suggest flushing each tap at every school for five minutes following any three day or more break in the school year. This should not only reduce the risk for the presence of lead, but also any other metals related to corrosion or bacteria associated with biofilm buildup.

The continued lead concentrations above recommended levels at the cosmetology water fountain at the Tazewell Career and Technical Center are of *moderate concern*, especially as the levels only appeared to increase following regular use. As stated previously, the relationship between lead and cancer is not well defined, but there are substantial concerns related to childhood development and lead exposure, and this issue has recently been in the news (e.g. Flint, Michigan). We do suggest that the school consider either shutting down or replacing this water fountain, as old pipes or connections may be releasing lead, and public concern is likely to surround any data suggesting unacceptable lead concentrations. It may also be prudent to plan regular monitoring of random taps at this school in future years.

## *VII.B: Environmental Sampling in Private Homes and Public Buildings*

### VII.B.1 Radon

#### ***VII.B.1.a Purpose***

As discussed in Section VII.A.1 on schools, because Tazewell County is situated on a “radon belt” of underlying soils, and as radon is a known carcinogen, it is of serious potential environmental health concern.

#### ***VII.B.1.b Methodology***

Virginia Department of Health provided the radon kits to use in Tazewell County. Members of the Tazewell County Board of Supervisors accompanied students from the Virginia Tech team as they set radon kits in homes and then returned within the week to collect the kits and send to the testing lab. The team explained the nature of the testing, obtained signed consent, and then issued homeowners a very short survey (Appendix J) regarding water supply, past radon testing, and general demographics. All home owners received a letter with the results of the test. Virginia Department of Health reported all results directly to the Virginia Tech team. The team tested 26 homes and public buildings in Tazewell County in the locations of Tazewell, North Tazewell, Jewell Ridge, Richlands, Bluefield and Pocahontas.

#### ***VII.B.1.c Findings***

None of the buildings tested in this effort had ever been tested for radon (according to the homeowner/building manager’s knowledge). This is in keeping with the mailed behavioral/environmental health survey discussed in Section V.B, where 88% of respondents stated they had never had their homes tested for radon.

The guide in table 7 provides an interpretation of radon results. Of the 26 home radon tests deployed, six were in the high range and two were in the medium range (30% of homes). Of the 6 in the high range, they are well above the level that necessitates mitigation (e.g. max value of 10, which is 2.5 times the recommended upper limit). This is a significant finding.

**TABLE 7. A GUIDE FOR RADON TEST INTERPRETATION**

<b>Above 4.0 pCi/L</b>	<b>Your radon levels are a risk to your health. You should look into mitigation to lower the levels in your home.</b>
<b>Between 2.0 and 4.0 pCi/L</b>	<b>Your radon levels are higher than they should be. You should look into mitigation, but it is not required.</b>
<b>Between 0.4 and 2.0 pCi/L</b>	<b>Your radon levels are a little high, but you do not need to do anything.</b>
<b>Below 0.4 pCi/L</b>	<b>Your radon levels are the same as they would be in outside air. You do not need to take any action.</b>

***VII.B.1.d Discussion and Recommendations***

Given that the county is located in a high radon belt, these findings are not surprising. While the sample size is small, the findings indicate the need for more widespread testing across the county. Education of county residents will be crucial given that the survey findings indicate that residents are currently not testing their homes. Thankfully, radon can easily be tested for and if high levels are found, the home can be fixed (this is called mitigation) so that radon is no longer a problem.

The Virginia Tech team recommends that the county consider mitigation strategies. Home radon levels can be lowered by mitigation. Choices for mitigating the home depend on the home’s unique needs. The most common type is soil suction, where the radon is vacuumed out below the ground and released outside where it will disperse to a level that is no longer dangerous. Most of the time, a contractor is hired so they can inspect the home and make a plan that is best for the homeowner. Both Environmental Protection Agency (EPA) and Virginia Department of Health (VDH) recommend that homeowners hire a certified contractor who has experience with radon

mitigation. The contact information for three local, nationally certified radon mitigation providers are provided in Appendix K. For more options, see the National Radon Proficiency Program ([www.nrpp.info](http://www.nrpp.info)) or the National Radon Safety Board ([www.nrsb.com](http://www.nrsb.com)).

## VII.B.2 Water Sampling

### ***VII.B.2.a Purpose***

Participants in the town meetings frequently mentioned concerns regarding drinking water quality. These concerns were echoed by several comments submitted in the mailed environmental health survey, which suggested distrust in the public water supply.

To explore these concerns, project students accompanied Board of Supervisors to homes in their district and offered free water quality testing to screen for common contaminants. This effort was completed in conjunction with radon testing. In addition to collecting field data, this effort provided residents an additional opportunity to voice concerns and interact with the team.

### ***VII.B.2.b Methodology***

Targeted homes/buildings were selected by the Board members and/or randomly approached during four trips in June, August, and September of 2015. The team explained the nature of the testing, obtained signed consent, and then issued homeowners a very short survey (Appendix J) regarding water supply, past radon testing, and general demographics. Project students set the radon test and arranged for a follow-up visit within seven days to pick up the radon tests and collect water samples. Homeowners were instructed not to use their water for 6-8 hours prior to water samples collection to ensure an accurate “first draw” sample for metals, i.e. allowing the water to sit stagnant in the pipes overnight would provide the most conservative measure of potential metals exposure.

On the day of sample collection, water samples were collected at the point of use (e.g. kitchen tap) as instructed by homeowners. A single sample was collected immediately as a first draw, pipes were flushed for one minute, and then three additional samples were collected for additional bacteria, nitrate, and flushed metals analyses. Following transport to the Virginia Tech Blacksburg campus on ice, all samples were tested for the water quality parameters listed in the table below. All sampling materials were processed and sample analyses were conducted in accordance with the American Public Health Association’s Standard Methods for the

Examination of Water and Wastewater (Available: <https://www.standardmethods.org/>).

Homeowners were mailed confidential reports of their water quality within one month.

**TABLE 8. WATER QUALITY TARGETS FOR HOUSEHOLD STUDY**

<b>Water Quality Parameter</b>	<b>Regulatory Limit</b>	<b>Potential Risks</b>
Arsenic	<10 ppb	General carcinogen
Copper	<1.3 ppm	Liver and kidney damage
Lead	<10 ppb	Neurological defects; learning disabilities in children; probable human carcinogen
Selenium	<50 ppb	Circulatory issues; current high profile conflicting reports as to whether it is protective/risk-inducing for cancer
Nitrate	<10 mg/L	Methemoglobinemia, gastric cancers
Total coliforms	Absent	Indicator of potential contamination pathway, particularly for pathogens
<i>E. coli</i>	Absent	Gastrointestinal distress; potential exposure to fecal pathogens, including <i>Helicobacter pylori</i> (associated with ulcers and stomach cancer)

**VII.B.2.c Findings**

Samples were collected from twenty-six private homes and five public buildings (Tazewell Municipal Office, Tazewell County Administration/Eric Young Building, Amish Furniture, Main Street United Methodist Church, Pocahontas Baptist Church). The average building was built in 1941, and all buildings were reliant on municipal (public) water. Residents/employees indicated that sixteen of these taps were frequently used for drinking water. The entire dataset collected is available in Appendix L.

Water quality in these buildings was uniformly within applicable Safe Drinking Water Act levels, with the exception of one private residence that tested positive for total coliform at a low level (but no *E. coli*). Although these particular homeowners were alerted to this issue, coliform contamination is not necessarily related to poor source water quality, but may be the result of

contamination by hands. No significant metals concentrations were observed, which was not surprising given that pH was slightly above neutral (average = 7.65), rendering the water non-corrosive. Nitrate levels were very low (average = 0.41 mg/L).

#### ***VII.B.2.d Discussion***

While all water samples observed were of high quality, an important limitation of this study is that only homes reliant on municipal water were tested. This does support the operations of the five major municipal water authorities, which have experienced no significant Safe Drinking Water Act violations in recent years.

However, it is worth noting that, from the mailed environmental survey and town engineers' estimates, roughly one-third of the county is reliant on private water supplies (wells, spring, cisterns). Private supplies can provide excellent water of high quality if appropriately managed, but past research does indicate that water quality in these systems is more likely to be contaminated, perhaps due to a lack of awareness or resources. Although no samples from wells or springs were collected in this effort, a past extension-based effort led by one of the project team members (Dr. Krometis) did collect 23 samples at the point-of-use from homes reliant on private supplies in Tazewell County in 2011-2012 (Smith et al. 2014). Nitrate and metals levels were below maximum contaminant levels in all of these studies, but bacterial contamination was very high (87% positive for coliform, 52% positive for *E. coli*). It is important to recognize that neither of these bacteria types are carcinogens themselves, and are most often associated with risk of gastrointestinal illnesses; however, the high prevalence of contamination does suggest that many private systems are likely compromised, and so susceptible to any groundwater contamination in the area. Outreach and education of these homeowners is recommended.

## **VIII. Ongoing Efforts and Next Steps**

Given the high rates of radon observed in some homes, our team has also secured an additional grant from the Virginia Department of Health and the US Environmental Protection Agency to conduct additional testing in a random sampling of homes in 2016. We look forward to coordinating with the Board of Supervisors of this educational and testing effort.

We have also secured funds from the Virginia Tech Center for Global Change and Institute for Society, Culture, and the Environment to collect oral histories in Tazewell and to link residents' stories with current and historical satellite imagery and state vital records to begin to investigate how changes in development in the county have affected public health. Opportunities to participate in this study may be advertised on the project Facebook page in the future.

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# APPENDIX A: Self-Reported Cancer Survey

**Disclaimer:**

This survey is to be taken by those who were diagnosed with cancer while living in Tazewell County. A family member may fill this out for a cancer patient who is not able to do it or because the patient is no longer here. By taking this survey, you are agreeing to allow us to use the information in our study. **We will never use your name** or identify you in any way if we use this information in public, either talking about it or writing it, unless we contact you and you say it is OK. We will put a dot on a map where your address is and may include the type of cancer you have, but will never put a name with that information. It is possible that someone might guess it is you if they seek that information. We may compare your information with state information. You do not have to take this survey, but it will help us learn important things about cancer in Tazewell County. Only take this survey if you were living in Tazewell County at the time of you were diagnosed with cancer.

Please check here if you are filling this out for a family member who died of cancer in Tazewell County in the past 10 years \_\_\_\_\_. Please use the cancer patients name and information.

**Name** \_\_\_\_\_

**Phone** \_\_\_\_\_

**House Address:** \_\_\_\_\_ **Town:**

\_\_\_\_\_

**Zip Code** \_\_\_\_\_

**email address**

\_\_\_\_\_

**I am a:** Man \_\_\_\_\_ Woman \_\_\_\_\_ **Month & Year of Birth:** \_\_\_\_\_

**Where do you work?** \_\_\_\_\_ **What is your job?**

\_\_\_\_\_

**Did you (or the patient) use tobacco products of any kind (smoke, chew, etc.) before or at the time you were diagnosed with cancer?**

Yes \_\_\_\_\_

No \_\_\_\_\_

**What year did the doctor tell you that you had cancer?** \_\_\_\_\_

**What kind of cancer did you (do you) have?**

Breast \_\_\_\_\_

Uterus \_\_\_\_\_

Ovaries \_\_\_\_\_

Prostate \_\_\_\_\_

Lung or bronchial \_\_\_\_\_

Leukemia (blood) \_\_\_\_\_

Lymphoma \_\_\_\_\_  
Stomach \_\_\_\_\_  
Bladder \_\_\_\_\_  
Brain \_\_\_\_\_  
Some other type \_\_\_\_\_

**Who told you that you had cancer?**

Regular Doctor \_\_\_\_\_  
Surgeon \_\_\_\_\_  
Other Specialist \_\_\_\_\_

**Where was this doctor or nurse located?**

In Tazewell County \_\_\_\_\_  
Not in Tazewell \_\_\_\_\_ Where? City \_\_\_\_\_ State \_\_\_\_\_

**Did you go to a Cancer Specialist (Oncologist)?**

Yes \_\_\_\_\_  
No \_\_\_\_\_

**Did you have treatments for your cancer?**

Yes \_\_\_\_\_  
No \_\_\_\_\_

**If yes, where did you have treatments?**

Tazewell County \_\_\_\_\_ Name of hospital or office  
\_\_\_\_\_

Someplace Else \_\_\_\_\_ Where? City \_\_\_\_\_ State \_\_\_\_\_

Do you know of other people living in Tazewell who have cancer?

Yes \_\_\_\_\_  
No \_\_\_\_\_

**If you said yes, would you contact them and ask them to take this survey?**

Yes \_\_\_\_\_  
No \_\_\_\_\_

**You can find this survey on the Tazewell County website at [www.tazewellcounty.org](http://www.tazewellcounty.org).**

**The Tazewell Cancer Project is being conducted through the Center for Public Health Practice and research at Virginia Tech, and is funded by the Tazewell County Board of Supervisors.**

## **APPENDIX B: Cancer Survey Locations**

Cancer Center of Southwest Virginia  
6719 Governor Gc Peery Hwy  
Richlands, VA 24641

Clinch Valley Medical Center  
6801 Gov. G. C. Peery Highway  
Richlands, VA 24641

Virginia Oncology Care  
2951 Front Street #1200  
Richlands VA 24641

Tazewell County Public Library  
102 Suffolk Ave  
Richlands VA

Appalachain Agency for Senior Citizens  
216 College Ridge Rd  
Cedar Bluff, VA

Cumberland Mountain Community Services Board  
196 Cumberland Rd  
Cedar Bluff VA 24609

Carilion Tazewell Community Hospital  
141 Ben Bolt Ave  
Tazewell VA 24651

YMCA  
106 Gratton Rd  
Tazewell VA 24651

Tazewell Public Library  
310 E Main St  
Tazewll VA

Tazewell County Health Department  
235 Chamber Dr  
Tazewll VA 24651

Tazewell County Social Services  
253 Chamber Dr.  
Tazewell, VA

Bluefield Branch Library  
108 Huffard Dr  
Bluefield VA

Bluefield Hematology-Oncology  
1027 Frederick St  
Bluefield, WV 2470

## APPENDIX C: Full list of Reported Cancers from Survey

Answer Choices	Responses
– Bladder	5.39% 16
– Brain	4.38% 13
– Breast	21.21% 63
– Colon	9.43% 28
– Kidney	5.05% 15
– Leukemia (blood)	5.72% 17
– Liver	6.06% 18
– Lung or bronchial	15.15% 45
– Lymphoma	9.43% 28
– Ovaries	3.37% 10
– Pancreas	5.05% 15
– Prostate	6.73% 20
– Sarcoma	2.02% 6
– Skin	6.06% 18
– Stomach	2.02% 6
– Thyroid	3.03% 9
– Uterus	3.37% 10
– <a href="#">Responses</a> Some other type	17.85% 53
Total Respondents: 297	

## APPENDIX D: Representative Mailed Survey

The Purpose of this survey is to learn about typical lifestyle choices of adult residents of Tazewell County. The head of the household—man or woman—should complete this survey and mail it back in the enclosed envelope (postage is provided). There are no risks to taking this survey and your participation will guide researchers in the study of health and cancer in Tazewell County. You don't have to include your name or address on this survey, unless you are willing to answer follow-up questions. Your consent to participate includes permission to use your responses in reporting the results of the study, however, at no time will we identify participants by name without written consent. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research. There is no compensation for completing this survey, and participation is voluntary. If you have any questions at this time about the project, please call or email Amy Smith at 276-492-6207, [asmith@vt.edu](mailto:asmith@vt.edu), or questions about rights as human subjects contact IRB Chair, Dr. David M. Moore, (540) 231-4991, [moored@vt.edu](mailto:moored@vt.edu). If you have additional questions later, give us a call and we will be happy to discuss any concerns you may have.

**Permission:** By completing this survey and sending it back to Virginia Tech, you have willingly agreed to participate.

Male \_\_\_\_\_ Female \_\_\_\_\_ Age \_\_\_\_\_

1. Do you smoke cigarettes?
  - a. Every day
  - b. Some days
  - c. Less than once a week
  - d. Not at all
  
2. If you quit smoking, did you smoke in the past for more than 5 years?
  - a. Yes
  - b. No
  
3. Do you use smokeless tobacco such as chewing tobacco, Snuff, Snus?
  - a. Every day
  - b. Some days
  - c. Less than once a week
  - d. Not at all
  
4. If you quit using smokeless products, did you use them in the past for more than 5 years?
  - a. Yes
  - b. No
  
5. During the past 30 days, how many days per week or per month did you have at least one drink of any alcoholic beverage such as beer, wine or liquor?
  - a. \_\_\_\_\_ days per week
  - b. No drinks in the past 30 days

6. During the past month, not counting juice, how many times per day, week, or month did you eat fruit? Count fresh, frozen or canned fruit?
  - a. \_\_\_\_\_times per day
  - b. \_\_\_\_\_days per week
  - c. \_\_\_\_\_days per month
  - d. Never
  
7. During the past month, how many times per day, week or month did you eat vegetables?
  - a. \_\_\_\_\_times per day
  - b. \_\_\_\_\_days per week
  - c. \_\_\_\_\_days per month
  - d. Never
  
8. During the past month, other than your regular job, did you participate in any physical activities or exercises such as running, golf, gardening, or walking for exercise?
  - a. Yes
  - b. No
  
9. Do you currently have health insurance, either provided by the government, by your employer or that you purchase on your own?
  - a. Yes
  - b. No
  
10. Other than cost, there are many other reasons people delay getting needed medical care. Have you delayed getting needed medical care for any of the following reasons in the past 12 months? Select the most important reason.
  - a. You couldn't get through on the phone
  - b. You couldn't get an appointment soon enough
  - c. Once you got there, you had to wait too long to see the doctor
  - d. The clinic or doctor's office wasn't open when you got there
  - e. You didn't have a ride to the office
  
11. How many times have you been to a doctor, nurse or other health professional in the past 12 months?
  - a. \_\_\_\_\_times
  - b. Not at all
  
12. Has a doctor or other health professional ever told you that you have cancer?
  - a. Yes
  - b. No
  
13. Which of the following do you have in your home? (select all that apply)
  - a. \_\_\_ Air conditioner
  - b. \_\_\_ Fireplace
  - c. \_\_\_ Central heating ( \_\_\_ Gas \_\_\_ Oil \_\_\_ Electric)
  - d. \_\_\_ Wood stove

- e.  Kerosene heat
  - f.  Electric stove
  - g.  Gas stove
  - h.  Air purifier
  - i.  Humidifier
  - j.  De-humidifier
14. Are pesticides or herbicides used in your home or garden or on pets? For Example: bug or weed killers, flea and tick sprays, collars, powders or shampoos
- a.  Yes
  - b.  No
15. Does your drinking water come from
- a.  a private well
  - b.  community water system
  - c.  town or city water system
  - d.  grocery store (namely bottled water)
  - e.  other, please specify:
16. Do you live next to or near an industrial plant, commercial business, dump site or non-residential property?
- a.  Yes
  - b.  No
17. About what year was your home built? \_\_\_\_\_
18. Has your home been tested for radon?
- a.  Yes
  - b.  No
19. If yes, did the radon test result in a level of concern?
20. Are you employed?
- a.  Yes
  - b.  No
21. If yes, complete the Job Profile:
- a. Job Title:
  - b. Type of Industry:
  - c. Date (month/year) job began



22. If you are retired or not working, complete the job profile for the job you held the longest

- a. Job Title:
- b. Type of Industry:
- c. Year job began: \_\_\_\_\_ Year you retired: \_\_\_\_\_

23. In your workplace are you currently exposed to any of the following? (select all that apply)

- a. \_\_\_\_\_ metals (such as arsenic, cadmium, lead)
- b. \_\_\_\_\_ dust or fibers (such as coal dust, silica, asbestos, other fibers)
- c. \_\_\_\_\_ chemicals (such as benzene, pesticides, solvents such as vinyl chloride, TCE)
- d. \_\_\_\_\_ fumes
- e. \_\_\_\_\_ radiation
- f. \_\_\_\_\_ biological agents such as mold, cockroaches, dust mites

24. 4. Have you been exposed to any in the past? (select all that apply)

- a. \_\_\_\_\_ metals (such as arsenic, cadmium, lead)
- b. \_\_\_\_\_ dust or fibers (such as coal dust, silica, asbestos, other fibers)
- c. \_\_\_\_\_ chemicals (such as benzene, pesticides, solvents such as vinyl chloride, TCE)
- d. \_\_\_\_\_ fumes
- e. \_\_\_\_\_ radiation
- f. \_\_\_\_\_ biological agents such as mold, cockroaches, dust mites

You do not have to give us your name and contact information. However, if you are willing to answer follow-up questions about this survey, please include your

Name: \_\_\_\_\_ Phone Number: \_\_\_\_\_

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

## **APPENDIX D: Facebook recruitment**

### **Virginia Polytechnic Institute and State University--IRB**

#### **Consent for Participants in Research Project Involving Human Subjects**

**Purpose of this Research Project:** The purpose of this focus group is to gain an understanding of what residents of Tazewell County know and how they feel about healthy (and unhealthy) communities. This is a type of qualitative research that allows researchers to better know the community they are studying. About 36 participants will be chosen among adults over 18 years of age who use Facebook and Web-based programs such as email. All responses will be made in writing and posted on a private Facebook page. This research is being conducted by the Tazewell County Cancer Project and the Center for Public Health Practice and Research at Virginia Tech.

**Procedures:** Study participants will email their interest and questions to Shelly Rasnick [rasnicks@vt.edu](mailto:rasnicks@vt.edu). If qualified by age (over 18 years), participants will be emailed a consent form. They must read the form and return it in a return email stating that “I have read the consent form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent by returning this email and including the following information.” Returning the above statement serves as the participants written consent to participate. A series of 8 questions will be posted to the site over a two-week period. Participants will write their responses and post them to the site. Others in this private group will see all of the responses and may react in writing to them. Participants will have about 2 days to respond before the next question is posted. Participants will be identified on the site with the name they use on Facebook.

**Risks:** There are minimal risks to this type of research. Facebook, by virtue of their ownership statement, will have access to and ownership of the information. However, they are not likely to use this information in any way. We will never identify information posted to a specific individual in any presentation or publication without written consent. However, others in the group may know who you are.

**Benefits:** The benefit to participants is helping researchers learn more about the feelings of residents in Tazewell County and to help guide future research as it relates to health and cancer

in Tazewell County. No promise or guarantee of benefits have been made to encourage you to participate.

**Extent of Anonymity and Confidentiality:** Participants will be identified by the name they use on Facebook. Others in the group will know who you are. Only those admitted to this private group and the research team will have access to the information. Your consent to participate includes permission to use your responses in reporting the results of the study, however, at no time will we identify participants by name without written consent. It is possible that the Institutional Review Board (IRB) may view this study's collected data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

**Compensation:** There is no compensation for this project.

**Freedom to Withdraw:** You may withdraw from this study at any time, simply by not answering questions and by notifying Shelly Rasnick [rasnicks@vt.edu](mailto:rasnicks@vt.edu) by email. If at any time the researchers deem posts to be offensive, inappropriate or off subject, participants will be notified by email and these posts or individuals may be removed from the study forum.

**Subject's Responsibilities:** I voluntarily agree to participate in this study. I have the following Responsibilities:

- To honestly and sincerely give my opinion when answering each question.
- To not use vulgar, offensive or inappropriate language when answering.
- To respect other's responses as their true and honest opinion.

**Questions:** If you have any questions at this time about the project, please call or email Amy Smith at 276-492-6207, [asmith@vt.edu](mailto:asmith@vt.edu), or questions about rights as human subjects contact IRB Chair, Dr. David M. Moore, (540) 231-4991, [moored@vt.edu](mailto:moored@vt.edu). If you have additional questions later, give us a call and we will be happy to discuss any concerns you may have.

**Subjects Permission:** "I have read the consent form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent by returning this email and including the following information:"

NAME \_\_\_\_\_

ADDRESS \_\_\_\_\_

EMAIL \_\_\_\_\_

RETURN TO Shelly Rasnick [rasnicks@vt.edu](mailto:rasnicks@vt.edu)

## APPENDIX E: Photovoice Pictures

### Nature and Peacefulness



*Mountains have their own look and appeal – it is just calm, serenity and peace. It’s what you need most in the time of cancer* Tyler, 18.



*I like the peacefulness of it– it is really clean, and there is a lot of places, especially where I live that people just throw their trash and things there. It needs to be cleaned up* Jeremiah, 18.



*This is over East River...there is just a calm and serene view that you can unwind from having all the stress of life. You can practically detox in one area in Bluefield* Hunter, 17



*[These sheep] are basically just healthy and doing their thing- what animals are supposed to do...none of our grass has chemicals on it...I wonder if it would be better if we go back to walking and planting our own foods and having our own animals and getting everything natural* Breanna, 17



Family



*This was one of her favorite things, even when she was sickest, she would ask to hold the baby, Breanna, 17*

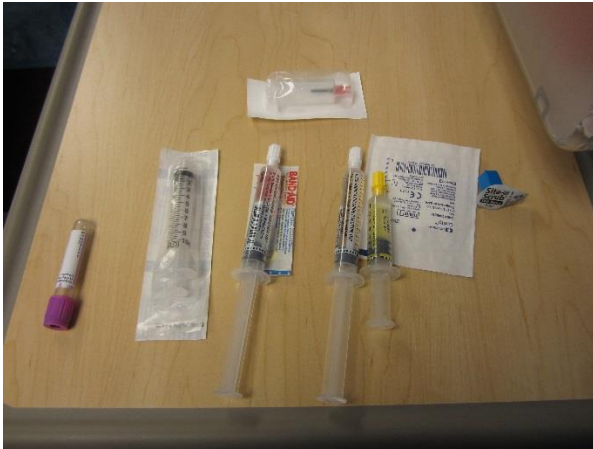


*My mamaw and I would sit in the yard and watch the clouds. I am doing this project based on things we liked doing...she was a really big inspiration, for someone that had cancer... til the day she died, she didn't let it get to her Breanna, 17*



*This brings all of my friends and family together...at my sister's wedding. This little woman here actually survived lung cancer...and now she is trying to teach her family and everyone else around her that you don't have to turn to smoking. And you don't ever need to give up- she is 73 years old and fought through it. Hunter, 17*

Access to healthcare



*Mom took him to the doctor and they kept trying to tell her it was arthritis. So she was like, no, I want more tests done...they did blood work. Our regular doctor called and said go to Roanoke, now. They went and did more tests- he was there for two weeks – I didn't think he was ever going to come home. Cody and "J", age 17*



*He has definitely come a long way. You can tell when he is sick and when he is not... He can run literally all day, if you don't tell him to sit he will go and go. But you can tell when he is starting to feel bad because he won't get up and go outside...He won't ride his skateboard when he is sick- you can always tell. Cody and "J", age 17*

Environmental hazards



*There is almost half an acre where that company building sits – if they could tear it down and maybe do something different with it. Just something- rec center, whatever they can do with it to make something with more potential out of it, something rather than just that. Jeremiah, 18*



*Our environment around there is pretty dirty, but it seems to me like the deer are pretty healthy...we have a little pond near there that is filled with barrels and everything, I choose not to go near it or step in in because I don't know what is in there. Ryver, 17*

Tobacco

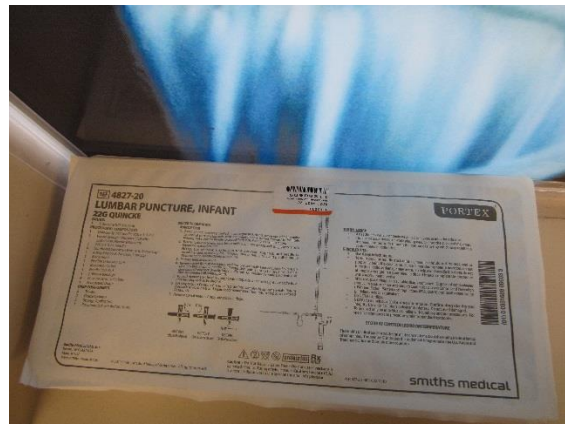


*Most people say that snuff is better for you than cigarettes...I just think they are both bad for you, but it's one of those habits I haven't kicked yet. Tyler, 18*

Cancer



*His cancer is a childhood cancer and it is not likely that adults get it – it is something you are born with...you can't get it from like smoking a cigarette like you can lung cancer and it is not genetic. It is just how your body grows. Cody and "J", 17*



*This is the kit for the spinal...they said the needle could never be too long, but it could be too short. Cody and "J", 17*



## APPENDIX F: School Radon Results

School Location -- August 4, 2015 results		
Career -- Nursing Room	8037343	Test error
Career -- Cosmetology	8037347	3.4
Career -- Drafting Room	8037344	1.3
Career -- Room 2	8037354	2.2
N Tazewell Elem -- Office behind cafeteria	8037366	1.6
N Tazewell Elem -- Room 2	8037350	< 0.3
N Tazewell Elem -- Room 6	8037368	1.6
N Tazewell Elem -- Room 9	8037365	1.4
Tazewell Elem -- Fieldhouse	8037361	1.3
Tazewell Elem -- Room 13	8037356	< 0.3
Tazewell Elem -- Room 24	8037357	1.3
Tazewell Elem -- Room 4	8037362	< 0.3
Tazewell High -- Basement Room 1	8037353	0.6
Tazewell High -- Library	8037345	1.1
Tazewell High -- Room 108	8037349	< 0.3
Tazewell High -- Room 111	8037348	< 0.3
Tazewell Middle -- Band Room	8037352	< 0.3
Tazewell Middle -- Cafeteria Storage	8037355	0.7
Tazewell Middle -- Room 20	8037367	0.9
Tazewell Middle -- Room 35	8037351	< 0.3

## APPENDIX G: School Water Quality Data (Initial Testing)

### Abbs Valley Elementary

#### Sample Description:

- Point 1: Water fountain by gym
- Point 2: Cafeteria Sink for Produce
- Point 3: Water fountain by entryway
- Point 4: Water fountain by Cafeteria

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.2423 Point 2: 0.1301 Point 3: 0.1429 Point 4: 0.3236 Average: 0.2097	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: 1.7 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.5 Point 2: 2.3 Point 3: 0.8 Point 4: 6.7 Average: 2.8	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.1 Point 2: 1.0 Point 3: 0.9 Point 4: 1.0 Average: 1.0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Copper (ppm <sup>2</sup> )	Point 1: 0.1158 Point 2: 0.072 Point 3: 0.139 Point 4: 0.2603 Average: 0.1468	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 5.8 Point 2: 3.2 Point 3: 1.5 Point 4: 6.1 Average: 4.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.1 Point 2: 1.2 Point 3: 0.9 Point 4: 0.8 Average: 1.0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals: Taken after 5 minute flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1046 Point 2: 0.0472 Point 3: 0.0912 Point 4: 0.0826 Average: 0.0814	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.7 Point 2: 1.1 Point 3: 1.7 Point 4: 3.4 Average: 2.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.7 Point 2: 0.8 Point 3: 0.8 Point 4: 0.9 Average: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.33 Point 2: 0.30 Point 3: 0.31 Point 4: 0.30 Average: 0.31	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Cedar Bluff Elementary

Sample Description:

- Point 1: Water fountain near Rooms 114, 116
- Point 2: Cafeteria Sink for Produce
- Point 3: Water fountain near library, Room 211
- Point 4: Water fountain by Room 204

<b>Contaminant</b>	<b>Results</b>	<b>MCL</b>	<b>Within Regulations?</b>
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0 Point 3: 0 Point 4: 0.1 Average: 0.2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0252 Point 2: 0.1096 Point 3: 0.0841 Point 4: 0.1388 Average: 0.0894	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Lead (ppb <sup>1</sup> )	Point 1: 0.5 Point 2: 13.9 Point 3: 1.2 Point 4: 1.2 Average: 4.2	10	Point 1: Yes Point 2: No Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.9 Point 3: 0.9 Point 4: 1.0 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Second Draw Metals: Taken after 60 second flush**

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0.1 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0944 Point 2: 0.0336 Point 3: 0.0601 Point 4: 0.0867 Average: 0.0904	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.6 Point 2: 5.4 Point 3: 0.5 Point 4: 3.5 Average: 2.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.7 Point 2: 0.7 Point 3: 0.7 Point 4: 1.0 Average: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals: Taken after 5 minute flush**

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0465 Point 2: 0.0146 Point 3: 0.0328 Point 4: 0.0261	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes

	Average: 0.03		Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.5 Point 2: 2.0 Point 3: 0.5 Point 4: 0.6 Average: 0.9	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.7 Point 2: 0.4 Point 3: 0.8 Point 4: 0.7 Average: 0.7	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.69 Point 2: 0.63 Point 3: 0.69 Point 4: 0.59 Average: 0.65	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Dudley Primary

Sample Description:

Point 1: Water fountain by cafeteria on 2nd floor

Point 2: Cafeteria Sink for Produce

Point 3: Water fountain by old entryway

Point 4: Water fountain by new entryway

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1684 Point 2: 0.0256 Point 3: 0.0787 Point 4: 0.548 Average: 0.2052	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.3 Point 2: 0.9 Point 3: 1.3 Point 4: 3.8 Average: 2.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.0 Point 2: 0.8 Point 3: 0.9 Point 4: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.053 Point 2: 0.0031 Point 3: 0.0455 Point 4: 0.996 Average: 0.2743	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Lead (ppb <sup>1</sup> )	Point 1: 1.9 Point 2: 0.4 Point 3: 3.8 Point 4: 6.5 Average: 3.2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.0 Point 2: 1.4 Point 3: 1.0 Point 4: 1.1 Average: 1.1	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals: Taken after 5 minute flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1673 Point 2: 0.004 Point 3: 0.0112 Point 4: 0.0793 Average: 0.0655	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.4 Point 2: 0.3 Point 3: 1.3 Point 4: 2.2 Average: 1.6	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 1.1 Point 3: 0.9 Point 4: 0.8 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.87 Point 2: 0.90 Point 3: 0.88 Point 4: 0.91 Average: 0.89	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes



	Average: 0		Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Graham High School

Sample Description:

- Point 1: Water fountain by entryway
- Point 2: Water fountain down hall from entryway
- Point 3: Cafeteria Sink for Produce
- Point 4: Water fountain by cafeteria

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0979 Point 2: 0.2475 Point 3: 0.0164 Point 4: 0.1749 Average: 0.1342	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3 Point 2: 0.7 Point 3: 0.8 Point 4: 0.8 Average: 0.7	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 1.0 Point 3: 1.3 Point 4: 0.7	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes

	Average: 1.0		Average: Yes
<b>Second Draw Metals: Taken after 60 second flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0556 Point 2: 0.1203 Point 3: 0.0039 Point 4: 0.178 Average: 0.0894	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3 Point 2: 1.0 Point 3: 0.2 Point 4: 2.4 Average: 1.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 0.9 Point 3: 0.8 Point 4: 1.0 Average: 1.0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals: Taken after 5 minute flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0222 Point 2: 0.018 Point 3: 0.0026 Point 4: 0.1777 Average: 0.0551	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Lead (ppb <sup>1</sup> )	Point 1: 0.2 Point 2: 0.4 Point 3: 0.6 Point 4: 6.9 Average: 2.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.8 Point 3: 1.0 Point 4: 1.1 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.89 Point 2: 0.90 Point 3: 0.88 Point 4: 0.88 Average: 0.89	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Graham Intermediate

Sample Description:

Point 1: Water fountain by cafeteria and bathroom, High

Point 2: Water fountain by entryway

Point 3: Cafeteria Sink for Produce

Point 4: Water fountain by cafeteria and bathroom, Low

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Copper (ppm <sup>2</sup> )	Point 1: 0.5566 Point 2: 0.2577 Point 3: 0.8481 Point 4: 0.1772 Average: 0.4599	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 6.1 Point 3: 1.1 Point 4: 4.1 Average: 2.8	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.0 Point 2: 1.0 Point 3: 1.1 Point 4: 1.2 Average: 1.1	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.3024 Point 2: 0.0265 Point 3: 0.0899 Point 4: 0.2865 Average: 0.1763	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.1 Point 2: 0.7 Point 3: 0.8 Point 4: 6.3 Average: 2.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 1.2 Point 3: 1.0 Point 4: 1.0 Average: 1.0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals:</b> Taken after 5 minute flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.069 Point 2: 0.0153 Point 3: 0.4145 Point 4: 0.0655 Average: 0.1411	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.7 Point 3: 0.8 Point 4: 1.7 Average: 1.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.8 Point 3: 1.1 Point 4: 1.0 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.90 Point 2: 0.90 Point 3: 0.90 Point 4: 0.86 Average: 0.89	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes

	Average: 0		Average: Yes
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- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Graham Middle School

Sample Description:

Point 1: Water fountain near basketball/football area

Point 2: Water fountain by entryway on right

Point 3: Cafeteria Sink for Produce

Point 4: Water fountain by entryway on left

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0218 Point 2: 0.3798 Point 3: 0.2486 Point 4: 0.2344 Average: 0.2805	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3 Point 2: 0.3 Point 3: 8.1 Point 4: 1.3 Average: 2.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.1 Point 2: 1.0 Point 3: 1.0 Point 4: 1.1 Average: 1.1	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0182 Point 2: 0.2392 Point 3: 0.0281 Point 4: 0.0858 Average: 0.0928	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.2 Point 2: 0.4 Point 3: 0.8 Point 4: 0.6 Average: 0.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 0.9 Point 3: 0.8 Point 4: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals:** Taken after 5 minute flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.097 Point 2: 0.2281 Point 3: 0.247 Point 4: 0.3782 Average: 0.2376	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3 Point 2: 1.9 Point 3: 8.1 Point 4: 0.3 Average: 2.7	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 0.7 Point 3: 1.0 Point 4: 1.2 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 1.02 Point 2: 0.92 Point 3: 0.92 Point 4: 0.92 Average: 0.95	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

North Tazewell Elementary

Sample Description:

- Point 1: Room 5 Sink
- Point 2: Water fountain in cafeteria
- Point 3: Cafeteria Sink for Produce
- Point 4: Drinking fountain near Room 7

Contaminant	Results	MCL	Within Regulations
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.1 Point 3: 0.9 Point 4: 0 Average: 0.25	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0842 Point 2: 0.0639 Point 3: 0.1165 Point 4: 0.0734 Average: 0.0845	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes



Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3 Point 2: 0.7 Point 3: 5.4 Point 4: 2.6 Average: 2.3	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0.025	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0566 Point 2: 0.0553 Point 3: 0.0294 Point 4: 0.0477 Average: 0.0473	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.4 Point 2: 0.7 Point 3: 0.2 Point 4: 0.4 Average: 0.4	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

<b>Flushed Draw Metals: Taken after 5 minute flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0509 Point 2: 0.031 Point 3: 0.0262 Point 4: 0.0457 Average: 0.0499	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.3 Point 2: 2.7 Point 3: 0.1 Point 4: 0.2 Average: 1.3	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.34 Point 2: 0.33 Point 3: 0.39 Point 4: 0.39 Average: 0.36	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Raven Elementary

Sample Description:

Point 1: Water fountain near front entrance

Point 2: Water fountain in gym

Point 3: Water fountain near Nurse's room

Point 4: Cafeteria Sink

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.1 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.2321 Point 2: 0.3328 Point 3: 0.2006 Point 4: 0.0589 Average: 0.0206	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 2.2 Point 3: 6.7 Point 4: 2.3 Average: 3.2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 1.2 Point 3: 1.1 Point 4: 1.0 Average: 1.1	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Copper (ppm <sup>2</sup> )	Point 1: 0.1393 Point 2: 0.4553 Point 3: 0.1116 Point 4: 0.0034 Average: 0.1774	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 13.1 Point 3: 6.8 Point 4: 1.0 Average: 5.6	10	Point 1: Yes Point 2: <b>Yes</b> Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 0.8 Point 3: 1.0 Point 4: 1.0 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals:** Taken after 5 minute flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0434 Point 2: 0.0859 Point 3: 0.027 Point 4: 0.0029 Average: 0.0398	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 1.5 Point 3: 0.8 Point 4: 0.6 Average: 1.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.6 Point 2: 0.7 Point 3: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes

	Point 4: 0.9 Average: 0.8		Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.65 Point 2: 0.66 Point 3: 0.27 Point 4: 0.68 Average: 0.57	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands Elementary

Sample Description:

- Point 1: Water fountain near Room 10
- Point 2: Water fountain near gym
- Point 3: Water fountain near Room 32
- Point 4: Water fountain near Rooms 21, 22

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1458 Point 2: 0.0469 Point 3: 0.4254 Point 4: 0.1461 Average: 0.191	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 8.3 Point 2: 6.1 Point 3: 7.5 Point 4: 2.0 Average: 6.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.7 Point 2: 0.8 Point 3: 0.9 Point 4: 0.9 Average: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0463 Point 2: 0.0425 Point 3: 0.1336 Point 4: 0.0229 Average: 0.0613	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 6.4 Point 2: 10.2 Point 3: 10.1 Point 4: 0.6 Average: 6.8	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 1.0 Point 3: 0.9 Point 4: 1.0 Average: 1.0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals:** Taken after 5 minute flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes
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	Point 4: 0 Average: 0		Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0177 Point 2: 0.0198 Point 3: 0.0281 Point 4: 0.0266 Average: 0.0231	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 6.0 Point 3: 0.9 Point 4: 0.8 Average: 2.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.8 Point 3: 0.7 Point 4: 0.5 Average: 0.7	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.61 Point 2: 0.60 Point 3: 0.61 Point 4: 0.61 Average: 0.61	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands High School

Sample Description:

Point 1: Water fountain by Library

Point 2: Water fountain by Rooms 219, 218  
 Point 3: Water fountain near Room 224  
 Point 4: Cafeteria Sink

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.384 Point 2: 0.3031 Point 3: 0.4947 Point 4: 0.1624 Average: 0.3361	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 10.6 Point 2: 5.6 Point 3: 1.1 Point 4: 3.9 Average: 5.3	10	Point 1: <b>Yes</b> Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.0 Point 2: 0.8 Point 3: 1.0 Point 4: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1657 Point 2: 0.1307 Point 3: 0.3461 Point 4: 0.2652 Average: 0.227	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes



	Average: <1.0		Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 6.3 Point 2: 4.7 Point 3: 6.8 Point 4: 2.0 Average: 5.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 0.7 Point 3: 1.0 Point 4: 0.8 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals: Taken after 5 minute flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1334 Point 2: 0.131 Point 3: 0.2458 Point 4: 0.1984 Average: 0.1772	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.5 Point 2: 3.6 Point 3: 0.8 Point 4: 0.7 Average: 1.9	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.8 Point 3: 0.5 Point 4: 0.9 Average: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.56 Point 2: 0.69 Point 3: 0.63 Point 4: 0.64 Average: 0.63	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands Middle School

Sample Description:

Point 1: Water fountain on 3rd floor by elevator

Point 2: Water fountain on 2nd near elevator

Point 3: Water fountain near gym

Point 4: Water fountain near cafeteria

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1588 Point 2: 1.558 Point 3: 0.3748 Point 4: 0.5494 Average: 0.66	1.3	Point 1: Yes Point 2: No Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 3.7 Point 2: 4.4 Point 3: 1.3 Point 4: 3.6 Average: 3.3	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.9 Point 3: 1.1 Point 4: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1185 Point 2: 0.0877 Point 3: 0.0595 Point 4: 0.2323 Average: 0.125	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 4.9 Point 2: 4.0 Point 3: 1.3 Point 4: 13.1 Average: 5.8	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.9 Point 2: 0.8 Point 3: 0.8 Point 4: 0.7 Average: 0.8	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals:</b> Taken after 5 minute flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0783 Point 2: 0.0581 Point 3: 0.0321 Point 4: 0.0735 Average: 0.0605	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes

	Average: <1.0		Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 3.5 Point 2: 2.4 Point 3: 0.8 Point 4: 2.4 Average: 2.3	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.5 Point 2: 0.6 Point 3: 0.7 Point 4: 0.6 Average: 0.6	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.58 Point 2: 0.61 Point 3: 0.62 Point 4: 0.62 Average: 0.61	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Springville Elementary

Sample Description:

- Point 1: Water fountain near room 9
- Point 2: Water fountain near Room 14
- Point 3: Cafeteria Sink for Produce

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.2385 Point 2: 0.5246 Point 3: 0.2882 Average: 0.3504	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 15.5 Point 2: 4.6 Point 3: 4.4 Average: 8.2	10	Point 1: No Point 2: Yes Point 3: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 1.1 Point 2: 0.8 Point 3: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0943 Point 2: 0.212 Point 3: 0.0255 Average: 0.1106	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 6.8 Point 2: 7.5 Point 3: 1.8 Average: 5.4	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.7 Point 2: 1.0 Point 3: 0.9 Average: 0.9	50	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes

**Flushed Draw Metals:** Taken after 5 minute flush

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Average: 0	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0371 Point 2: 0.0606 Point 3: 0.0137 Average: 0.0248	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.0 Point 2: 3.0 Point 3: 0.9 Average: 2.0	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.5 Point 2: 0.7 Point 3: 0.6 Average: 0.6	50	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.28 Point 2: 0.30 Point 3: 0.30 Average: 0.29	10	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell Career & Technical Center

Sample Description:

- Point 1: Water fountain in hallway by cosmetology room
- Point 2: Office Sink
- Point 3: Water fountain by stairs from A to B wing, nursing room
- Point 4: Water fountain in Building Trades room

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.075	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.4444 Point 2: 0.1438 Point 3: 0.9545 Point 4: 0.6166 Average: 0.541	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 3.4 Point 2: 8.2 Point 3: 13.5 Point 4: 0.3 Average: 6.4	10	Point 1: Yes Point 2: Yes <b>Point 3: No</b> Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.209 Point 2: 0.0581 Point 3: 1.449 Point 4: 0.2728 Average: 0.4972	1.3	Point 1: Yes Point 2: Yes <b>Point 3: No</b> Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Lead (ppb <sup>1</sup> )	Point 1: 17.3 Point 2: 3.5 Point 3: 17.2 Point 4: 0.3 Average: 9.6	10	Point 1: No Point 2: Yes Point 3: No Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0.1 Average: 0.05	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals: Taken after 5 minute flush**

Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0298 Point 2: 0.021 Point 3: 0.0693 Point 4: 0.1251 Average: 0.0613	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 1 Point 3: 5.5 Point 4: 0 Average: 2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.22 Point 2: 0.22 Point 3: 0.17 Point 4: 0.39 Average: 0.25	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 2.0 Point 2: 0 Point 3: 1.0 Point 4: 0	0	Point 1: No Point 2: Yes Point 3: No Point 4: Yes



	Average: 0.75		Average: No
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell Elementary

Sample Description:

- Point 1: Cafeteria Kitchen Sink
- Point 2: Water fountain by front entrance
- Point 3: Water fountain by kindergarten & restrooms
- Point 4: Water fountain by gym

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0.1 Average: 0.05	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1706 Point 2: 0.5692 Point 3: 0.0958 Point 4: 0.2494 Average: 0.2713	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 9.6 Point 2: 0.4 Point 3: 0.1 Point 4: 0.1 Average: 2.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.009 Point 2: 0.0337 Point 3: 0.0863 Point 4: 0.116 Average: 0.0613	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.2 Point 2: 0.2 Point 3: 0.9 Point 4: 0.7 Average: 0.5	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0.025	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals:</b> Taken after 5 minute flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0039 Point 2: 0.0157 Point 3: 0.0282 Point 4: 0.0375 Average: 0.0213	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes

	Point 4: <1.0 Average: <1.0		Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.1 Point 3: 0 Point 4: 0.1 Average: 0.05	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Remaining Items:**

Nitrate (ppm <sup>2</sup> )	Point 1: 0.45 Point 2: 0.37 Point 3: 0.42 Point 4: 0.40 Average: 0.41	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell High School

Sample Description:

Point 1: Water fountain by Room 110, Guidance

Point 2: Water fountain in middle of cafeteria

Point 3: Sink in Kitchen Cafeteria

Point 4: Water fountain on 2nd floor hallway near rooms 215, 214, and stairwell

Contaminant	Results	MCL	Within Regulations
<b>First Draw Metals:</b> Taken from stagnated pipes			

Arsenic (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.6 Point 3: 0.1 Point 4: 0.1 Average: 0.2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.3674 Point 2: 0.1464 Point 3: 0.4049 Point 4: 0.0646 Average: 0.2458	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2 Point 2: 2.5 Point 3: 3.9 Point 4: 1.3 Average: 2.4	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.3 Point 3: 0 Point 4: 0.1 Average: 0.125	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0719 Point 2: 0.2286 Point 3: 0.0215 Point 4: 0.0603 Average: 0.0956	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.1 Point 2: 7.4 Point 3: 1.4 Point 4: 1.4 Average: 3.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0.1 Point 3: 0.1 Point 4: 0 Average: 0.05	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Flushed Draw Metals:</b> Taken after 5 minute flush			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0382 Point 2: 0.0647 Point 3: 0.0088 Point 4: 0.0495 Average: 0.04	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.3 Point 2: 2.8 Point 3: 0.5 Point 4: 3.4 Average: 2	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0.1 Point 4: 0 Average: 0.025	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.33 Point 2: 0.36 Point 3: 0.30 Point 4: 0.34 Average: 0.3325	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 10.9 Average: 2.725	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: No Average: No
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes

	Average: 0		Average: Yes
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1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell Middle School

Sample Description:

- Point 1: Water fountain near Room 18
- Point 2: Water fountain near Room 39
- Point 3: Cafeteria Sink for Produce
- Point 4: Office Sink

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.1 Average: 0.1	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0957 Point 2: 0.3481 Point 3: 0.2658 Point 4: 0.0397 Average: 0.1873	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 3.2 Point 2: 0.2 Point 3: 18.4 Point 4: 0.2 Average: 5.5	10	Point 1: Yes Point 2: Yes <b>Point 3: No</b> Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0.025	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			

Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1 Point 3: 0.1 Point 4: 0.2 Average: 0.125	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0153 Point 2: 0.0237 Point 3: 0.0136 Point 4: 0.0353 Average: 0.022	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.4 Point 2: 0.1 Point 3: 0.8 Point 4: 0.4 Average: 0.9	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

**Flushed Draw Metals: Taken after 5 minute flush**

Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0 Point 3: 0 Point 4: 0.1 Average: 0.05	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0166 Point 2: 0.1851 Point 3: 0.0048 Point 4: 0.0268 Average: 0.0583	1.3	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <1.0 Point 2: <1.0 Point 3: <1.0 Point 4: <1.0 Average: <1.0	5	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.4 Point 2: 0.3 Point 3: 0.3 Point 4: 1.1 Average: 0.8	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

Selenium (ppb <sup>1</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	50	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<b>Remaining Items:</b>			
Nitrate (ppm <sup>2</sup> )	Point 1: 0.27 Point 2: 0.35 Point 3: 0.35 Point 4: 0.25 Average: 0.31	10	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0 Point 3: 0 Point 4: 0 Average: 0	0	Point 1: Yes Point 2: Yes Point 3: Yes Point 4: Yes Average: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.



## APPENDIX H: School Water Quality Data (Follow-up Testing)

### Cedar Bluff Elementary

Point 1: Cafeteria sink for produce

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0065	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.5	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1	50	Point 1: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.194	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: 0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.3	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes
<b>Remaining Items:</b>			
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

### Raven Elementary

Point 1: Water fountain in gym

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0615	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.4	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes

**Second Draw Metals: Taken after 60 second flush**

Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.100	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.6	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes

**Remaining Items:**

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands Elementary School

Point 1: Water fountain near gym

Point 2: Water fountain near Room 32

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals: Taken from stagnated pipes</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1 Point 2: <0.1	10	Point 1: Yes Point 2: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0465 Point 2: 0.0106	1.3	Point 1: Yes Point 2: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: <0.1	5	Point 1: Yes Point 2: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.6 Point 2: 0.8	10	Point 1: Yes Point 2: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.7	50	Point 1: Yes Point 2: Yes
<b>Second Draw Metals: Taken after 60 second flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1 Point 2: <0.1	10	Point 1: Yes Point 2: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0708 Point 2: 0.0427	1.3	Point 1: Yes Point 2: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: 0.2 Point 2: <0.1	5	Point 1: Yes Point 2: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.3 Point 2: 0.8	10	Point 1: Yes Point 2: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes

	Point 2: 0.2		Point 2: Yes
<b>Remaining Items:</b>			
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0	0	Point 1: Yes Point 2: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0	0	Point 1: Yes Point 2: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands High School

Point 1: Water fountain by library

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1372	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.2	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.4	50	Point 1: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.2586	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 2.4	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes

**Remaining Items:**

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Richlands Middle School

Point 1: Water fountain near cafeteria

Contaminant	Results	MCL	Within Regulations?
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**First Draw Metals: Taken from stagnated pipes**

Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0592	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 1.5	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.5	50	Point 1: Yes

**Second Draw Metals: Taken after 60 second flush**

Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1038	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 3.4	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes

**Remaining Items:**

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.

2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Springville Elementary

Point 1: Water fountain near Room 9

<b>Contaminant</b>	<b>Results</b>	<b>MCL</b>	<b>Within Regulations?</b>
<b>First Draw Metals: Taken from stagnated pipes</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0259	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.3	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.2	50	Point 1: Yes
<b>Second Draw Metals: Taken after 60 second flush</b>			
Arsenic (ppb <sup>1</sup> )	Point 1: 0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.038	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.5	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.3	50	Point 1: Yes

**Remaining Items:**

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.  
 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell Career and Technical Center

Point 1: Water fountain in hallway by cosmetology room

Point 2: Water fountain by stairs from A to B wing, nursing room

Contaminant	Results	MCL	Within Regulations?
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**First Draw Metals:** Taken from stagnated pipes

Arsenic (ppb <sup>1</sup> )	Point 1: 0.1 Point 2: 0.1	10	Point 1: Yes Point 2: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.3104 Point 2: 1.358	1.3	Point 1: Yes Point 2: No
Cadmium (ppb <sup>1</sup> )	Point 1: 0.8 Point 2: 0.3	5	Point 1: Yes Point 2: Yes
Lead (ppb <sup>1</sup> )	Point 1: 31.5 Point 2: 5.7	10	Point 1: No Point 2: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.2 Point 2: 0.4	50	Point 1: Yes Point 2: Yes

**Second Draw Metals:** Taken after 60 second flush

Arsenic (ppb <sup>1</sup> )	Point 1: <0.1 Point 2: <0.1	10	Point 1: Yes Point 2: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.5576 Point 2: 1.7445	1.3	Point 1: Yes Point 2: No
Cadmium (ppb <sup>1</sup> )	Point 1: 1.3 Point 2: 0.5	5	Point 1: Yes Point 2: Yes
Lead (ppb <sup>1</sup> )	Point 1: 12.5 Point 2: 2.2	10	Point 1: No Point 2: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.4 Point 2: 0.3	50	Point 1: Yes Point 2: Yes

**Remaining Items:**

Total Coliforms (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0	0	Point 1: Yes Point 2: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0 Point 2: 0	0	Point 1: Yes Point 2: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.  
 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.

3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

Tazewell Middle School

Point 1: Cafeteria sink for produce

Contaminant	Results	MCL	Within Regulations?
<b>First Draw Metals:</b> Taken from stagnated pipes			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.0152	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 0.1	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: <0.1	50	Point 1: Yes
<b>Second Draw Metals:</b> Taken after 60 second flush			
Arsenic (ppb <sup>1</sup> )	Point 1: <0.1	10	Point 1: Yes
Copper (ppm <sup>2</sup> )	Point 1: 0.1703	1.3	Point 1: Yes
Cadmium (ppb <sup>1</sup> )	Point 1: <0.1	5	Point 1: Yes
Lead (ppb <sup>1</sup> )	Point 1: 4.1	10	Point 1: Yes
Selenium (ppb <sup>1</sup> )	Point 1: 0.1	50	Point 1: Yes
<b>Remaining Items:</b>			
Total Coliforms (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes
<i>E. Coli</i> (MPN <sup>3</sup> )	Point 1: 0	0	Point 1: Yes

- 1: ppb=parts per billion (1,000,000,000), it is the number of items in one billion pieces of water.
- 2: ppm=parts per million (1,000,000), it is the number of items in one million pieces of water.
- 3: MPN=the most likely number of bacteria cells (bodies) per 100 milliliters (about one big sip) of water.

# APPENDIX I: Household Questionnaire

## SAMPLE IDENTIFICATION

Date Collected: \_\_\_\_/\_\_\_\_/\_\_\_\_

Sample Number:

Name: \_\_\_\_\_ Telephone: (\_\_\_\_) \_\_\_\_\_ - \_\_\_\_\_

Mailing Address:

\_\_\_\_\_  
Street address City Zip

Sample GPS Location: \_\_\_\_\_

INTERVIEW WITH HOMEOWNER: (Interviewer(s): \_\_\_\_\_)

1. What year was your home built (if known)? \_\_\_\_\_
2. Has your home ever been tested for radon?  yes  no  
if "YES": a) When did this testing occur?
  - Within the last year
  - Within the last 1-5 years
  - Within the last 5-10 years
  - More than 10 years agob) Were you told your radon levels were high?  yes  no  
if "YES": Do you have a radon mitigation system?  yes  no
3. Do you have air-conditioning?  yes  no
4. What type of foundation is your home built on?
  - basement  slab  crawlspace  mixed
5. Where does your water come from?  municipal/county
  - well
  - spring
  - cistern
  - other: \_\_\_\_\_
6. Do you drink the water from the tap?  yes  no
7. How many smokers live at home?  0  1  2  3 or more
8. What is the range of your annual household income?
  - Prefer not to answer  \$35,000 - \$49,999
  - Under \$15,000  \$50,000 - \$74,999
  - \$15,000 - \$24,999  \$80,000 - \$99,999
  - \$25,000 - \$34,999  \$100,000 and above
9. How many people live in this house on a regular basis? \_\_\_\_\_
10. Is anyone pregnant?  yes  no
11. How many children (<18 years old) live with you?  1  2  3  4  5 or more
12. Is there anything else you would like to share with us?

## APPENDIX J: Household Radon Results

<b>Date Collected</b>	<b>General Location</b>	<b>Home Built</b>	<b>Radon Test</b>	<b>Radon Level</b>
6/23/2015	Tazewell, VA	1910	0.6	low
6/23/2015	Tazewell, VA	1930	6.2	high
6/23/2015	Tazewell, VA	1935	5.4	high
6/23/2015	Tazewell, VA	1996	6.6	high
6/23/2015	Tazewell, VA	1937	5	high
6/23/2015	Tazewell, VA	1905	1.8	low
6/23/2015	Tazewell, VA	1940	2.9	medium
6/23/2015	Tazewell, VA	1997	1.7	low
6/23/2015	Tazewell, VA	1985	0.3	low
6/23/2015	Tazewell, VA	1963	0.8	low
6/23/2015	North Tazewell, VA	n/a	0.8	low
6/23/2015	North Tazewell, VA	1950	0.6	low
6/23/2015	North Tazewell, VA	1950	10	high
6/30/2015	Richlands, VA,	1930	1.9	low
6/30/2015	Richlands, VA	1934	0.7	low
6/30/2015	Richlands, VA	1930	0.3	low
6/30/2015	Raven, VA	1980	0.3	low
8/4/2015	Richlands, VA	1912	1.3	low
8/4/2015	Richlands, VA	1950	0.9	low
8/4/2015	Jewell Ridge, VA	1929	2.7	medium
8/4/2015	Jewell Ridge, VA	1923	0.6	low
8/4/2015	Jewell Ridge, VA	1930	0.3	low
9/22/2015	Boissevain, VA	1981	0.7	low
9/22/2015	Pocahontas, VA	n/a	0.3	low
9/22/2015	Bluefield, VA	n/a	5.5	high
9/22/2015	Pocahontas, VA	n/a	0.3	low



## **APPENDIX K: Contact information for local radon mitigation**

1. Charles Barbre

Radon Or Us

Jumping Branch, WV

(304) 466-4287

[chuck@radonorus.com](mailto:chuck@radonorus.com)

2. Heather Lyall

Albright Recovery and Construction

Haysi, VA

(276) 865-0187

[albrightarc@gmail.com](mailto:albrightarc@gmail.com)

3. Brian Scott Turner

Radford Radon Abatement

Radford, VA

(540) 577-2782

[scott@radford-radon.com](mailto:scott@radford-radon.com)

## APPENDIX L: Household Water Quality Results

ID	Date Collected	pH	Metals (First Draw, ppb*)				Metals (Flushed, ppb*)				Nitrate, mg/L	Coliform, MPN/100 mL	<i>E. coli</i> , MPN/100 mL
			Arsenic	Copper	Lead	Selenium	Arsenic	Copper	Lead	Selenium			
T001	6/23/2015	7.58	0.03	188.80	1.89	-0.24	0.10	162.20	1.77	-0.19	0.28	0	0
T002	6/23/2015	7.65	0.05	22.25	4.04	-0.25	0.03	0.82	0.01	-0.23	0.27	0	0
T003	6/23/2015	7.64	0.06	1.21	-0.11	-0.03	0.02	0.16	-0.14	-0.26	0.27	0	0
T004	6/23/2015	7.52	0.03	8.80	1.52	-0.40	0.04	1.17	-0.01	-0.21	0.27	0	0
T006	6/23/2015	7.55	0.02	98.41	2.22	-0.30	0.04	6.83	0.15	-0.27	0.26	0	0
T007	6/23/2015	7.51	0.04	8.66	0.37	-0.20	0.06	0.52	0.18	-0.30	0.27	0	0
T008	6/23/2015	7.77	0.03	2.92	-0.03	-0.39	0.05	2.29	-0.08	-0.18	0.28	0	0
T009	6/23/2015	7.70	0.05	0.73	0.00	-0.27	0.04	0.32	0.04	-0.19	0.25	0	0
T010	6/23/2015	7.61	0.05	6.51	0.24	-0.26	0.08	0.77	-0.10	0.04	0.32	0	0
T011	6/23/2015	7.68	0.06	39.72	3.63	-0.24	0.09	9.69	1.33	-0.22	0.21	0	0
T012	6/23/2015	7.67	0.04	19.73	0.14	-0.33	0.03	1.32	-0.06	-0.30	0.16	0	0
T013	6/23/2015	7.70	0.04	50.44	1.79	-0.07	0.07	2.98	0.21	-0.13	0.27	0	0
T014	6/30/2015	7.60	0.07	7.63	0.41	0.10	0.09	2.18	0.12	-0.17	0.62	3	0
T015	6/30/2015	7.40	0.09	3.95	0.01	-0.02	0.08	0.76	-0.03	-0.02	0.58	0	0
T016	6/30/2015	7.55	0.11	16.42	0.21	0.23	0.10	23.54	0.31	-0.13	0.62	0	0
T018	8/4/2015	7.62	-0.35	0.71	0.27	-0.51	-0.39	1.32	0.19	-0.51	n/a	0	0
T019	8/4/2015	7.57	-0.36	6.31	0.12	-0.37	-0.33	1.39	0.09	-0.11	n/a	0	0
T020	8/4/2015	7.50	-0.36	9.74	0.04	0.44	-0.35	15.61	0.53	0.38	n/a	0	0
T021	8/4/2015	7.73	-0.34	4.93	0.16	0.13	-0.33	3.93	0.00	0.12	n/a	0	0
T023	8/4/2015	7.75	-0.34	12.05	0.98	0.62	-0.35	3.98	-0.08	-0.12	n/a	0	0
T024	9/18/2015	7.69	0.10	15.60	0.29	0.00	0.10	3.90	0.25	0.00	0.27	0	0
T025	9/18/2015	7.70	0.10	9.80	0.82	0.00	0.10	2.50	0.14	0.00	0.26	0	0
T026	9/18/2015	7.52	0.20	124.60	0.54	0.00	0.10	21.50	0.83	0.00	0.32	0	0
T027	9/18/2015	8.87	0.00	1,053.00	63.04	0.00	0.00	4.40	0.74	0.00	0.06	0	0
T028	9/18/2015	7.73	0.00	44.80	1.39	0.00	0.10	5.60	0.15	0.00	0.24	0	0
T029	9/18/2015	7.40	0.00	19.60	0.18	0.00	0.10	15.20	0.31	0.00	1.50	0	0
T030	9/18/2015	7.27	0.00	196.90	3.94	0.00	0.00	22.40	1.58	0.00	1.52	0	0
T032	9/18/2015	7.53	0.10	50.50	0.90	0.00	0.00	25.70	0.69	0.00	1.49	0	0

Note: Copper levels are listed in ppb while the copper standard is in ppm

