Surveillance2013

Vermont Yankee Nuclear Power Station

Report on Public Health Monitoring

VERMONT
DEPARTMENT OF HEALTH
Agency of Human Services

108 Cherry Street, PO Box 70
Burlington, VT 05402

healthvermont.gov

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Executive Summary

The Vermont Department of Health has been monitoring and reporting on radiation emissions and radiological effluents (discharges) from the Vermont Yankee Nuclear Power Station since 1971. The purpose of this environmental surveillance is to protect the public's health from excess amounts of radiation.

This *2013 Surveillance Report* details more than 2,400 separate measurements of more than 1,000 samples of air, water, milk, soil, vegetation, sediment and fish taken during the year at the Vermont Yankee site boundary (property line), on site at Vermont Yankee, from the Connecticut River, and from the towns surrounding the station.

The Health Department enforces the state's Radiological Health Rule, which limits the amount of ionizing radiation that any member of the public could be exposed to if standing at the site boundary of the station. The Rule also limits the amount of gaseous, liquid, radioiodine and radioactive particulate effluents that any member of the public could possibly be exposed to as a result of operations at Vermont Yankee.

The Rule specifically limits the annual direct gamma radiation from Vermont Yankee to a measured exposure value of 20 milliroentgen above background radiation at the site boundary on land. The Rule also limits specific emissions or discharges from Vermont Yankee to an effective dose of no more than 5 millirem from each pathway to any member of the general public.

The Connecticut River site boundary around Vermont Yankee is regulated by the U.S. Nuclear Regulatory Commission, which limits the annual direct gamma radiation to any member of the general public at this boundary to 100 millirem.

2013 Surveillance Results:

- Measurements in this report confirm no dose in excess of any limit established by the Vermont Department of Health's Radiological Health Rule.
- The numerous samples and measurements of the environment on site and around Vermont Yankee in 2013 show no instances of non-compliance with the Radiological Health Rule, from either operations at Vermont Yankee or the tritium-contaminated plume of groundwater first detected in January 2010.
- The Health Department's continuing analysis of cancer statistics for people who live in the communities surrounding Vermont Yankee shows that cancer incidence and mortality do not differ significantly from people in the rest of Windham County, elsewhere in Vermont, or in the U.S. as a whole.

For questions or more information – The information presented in this report is sometimes complex. We invite interested readers to contact the Health Department's Radiological and Toxicological Sciences program at 802-865-7730 with any questions.

Introduction

This *2013 Surveillance Report* describes the amount and types of radiation found on and near the Vermont Yankee Nuclear Power Station located in Vernon, Vermont. As an operating nuclear power station, Vermont Yankee generates and emits ionizing radiation in the form of direct gamma radiation, and discharges radioactive materials that emit alpha-, beta- and gamma-radiations. A person could be exposed to radiation released from Vermont Yankee in air or liquid discharges from the station, or from unmonitored releases or leaks.

The Vermont Department of Health enforces the state's Radiological Health Rule, which limits the amount of ionizing radiation that a member of the public could be exposed to if standing at the site boundary (property line) of the station. The Rule also limits the amount of gaseous, liquid, radioiodine and radioactive particulate effluents that a member of the public could possibly be exposed to as a result of operations at Vermont Yankee.

The Rule specifically limits the annual direct gamma radiation from Vermont Yankee to a measured exposure value of 20 milliroentgen above background radiation at the site boundary on land. The Rule also limits specific emissions or discharges from Vermont Yankee to an effective dose of no more than 5 millirem from each pathway to any member of the general public.

The Health Department monitors radiation levels on and near Vermont Yankee. Because both naturally occurring and human-made radiation is all around us in the environment, the Health Department also tests other areas of the state to provide background data on types and amounts of environmental radiation. Background measurements are compared to the types and amounts of radiation found on site and in areas near Vermont Yankee. The two sets of values are compared to determine if Vermont Yankee's operations are resulting in an increased radiation risk to the public.

This report presents more than 2,400 measurements taken from over 1,000 samples that were obtained at Vermont Yankee and from background locations during 2013. Air, water, milk, soil, vegetation, fish and sediment samples were collected and tested. Maps of locations where many samples or measurements were taken, as well as the testing procedures, are provided.

Most samples are tested by the Health Department Laboratory located in Burlington, Vermont. Measurements of direct gamma radiation exposures using thermoluminescent dosimeters (TLDs) are tested by a National Voluntary Laboratory Accreditation Program vendor of dosimetry. Analyses for the hard-to-detect radioactive metals strontium-89, strontium-90, iron-55 and nickel-63 are performed by only a small number of laboratories in the U.S. The Health Department contracted with a certified laboratory to perform these tests on our environmental samples.

The primary human health concern with chronic low-level exposure to ionizing radiation is the potential to develop cancer. For this reason, the Health Department also presents cancer incidence and cancer mortality data for the area near Vermont Yankee, compared to the same type of data for Vermont as a whole, and for the U.S. population.

Tritium Contamination

Testing and evaluation of the tritium contamination described in the 2010 Surveillance report continued in 2013. Thirty-eight wells on site were tested routinely throughout the year. The concentration of tritium in the contaminated wells generally continued to decline over the year and decreased from 2012. No tritium was found in any river water downstream from the station.

Results Presented in this Report:

- Direct gamma radiation measured continuously from more than 70 sites
- Air samples tested for radioactive particulates, gases, vapors and radioactive iodine collected by continuous air samplers
- Groundwater, drinking water wells and Connecticut River water near Vermont Yankee tested for tritium, gamma-emitting materials, total alpha radioactivity, total beta radioactivity, and hard-to-detect radioactive metals (iron-55, nickel-63, strontium-89 and strontium-90)
- Milk, vegetation, river sediments, fish and off-site soil tested for natural and human-made radioactive materials

These data show no radiation dose in excess of the Health Department's limits as a result of Vermont Yankee operations in 2013.

The full *Surveillance 2013* report is published at the Vermont Department of Health web site: www.healthvermont.gov. For questions about the content, call the Health Department's Radiological and Toxicological Sciences program at 802-865-7730.

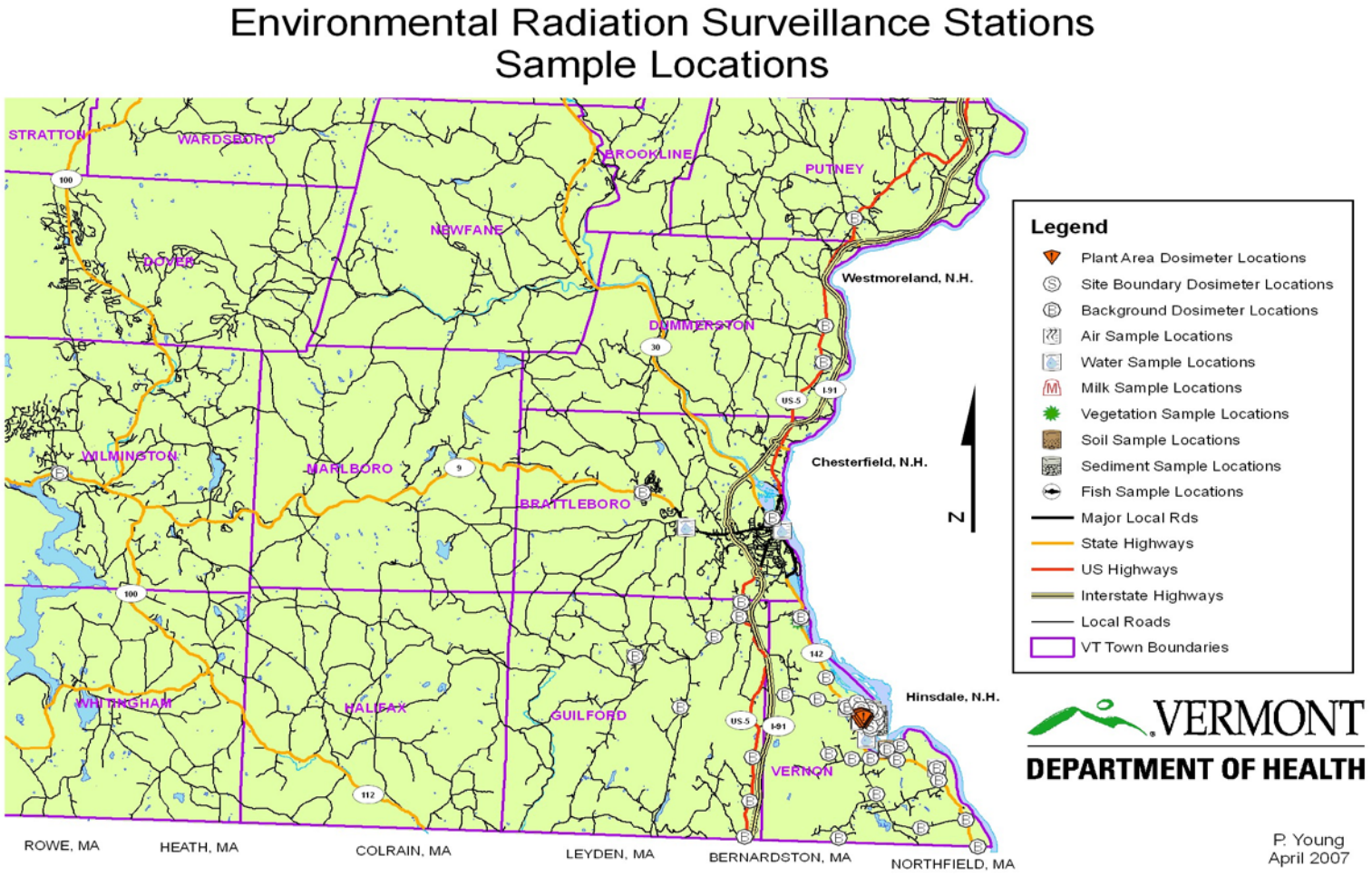
Program Results Summary

An overview of the 2013 sample data is presented in this summary. Detailed descriptions of sample measurement techniques and analyses are presented in further sections of this report. The total number, type of sample collected, type of analysis performed and summary results are reported in Table 1. Routine environmental sampling sites are shown in Maps 1 and 2. Map 1 shows all of the locations where routine samples were taken. Map 2 shows the sample locations in Vernon.

Table 1. 2013 Summary of Samples, Tests and Results

Sample Type	Sites	Number of Tests	Test Type	Results
Direct Gamma Radiation	72	287	Thermoluminescent dosimeters	Less than 20 milliroentgen per year at the land site boundary; no single quarter exceeded 10 milliroentgen.
Air: Particulates, Gases and Vapors	10	120	Total Alpha Radioactivity	Alpha radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		120	Total Beta Radioactivity	Beta radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		120	Iodine-131	No iodine-131 was detected in air samples.
		120	Gamma (gas/vapors) Radioactivity	Gamma radioactivity detected was of natural origin.
		4 (*quarterly composites)*	Gamma (particulates) Radioactivity	Gamma radioactivity detected was of natural origin.
Water	10	117	Total Alpha Radioactivity	Alpha radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
		117	Total Beta Radioactivity	Beta radioactivity within the historical range. No increase observed as a result of operations at Vermont Yankee.
	51	603	Tritium	All off-site, on-site active drinking water locations less than the lower limit of detection. Fourteen (14) on-site groundwater monitoring wells test positive for tritium. All positive wells were less than 25,000 pCi/L by December of 2013.
		603	Gamma Radioactivity	All detected gamma radioactivity of natural origin.
	51	189	Iron-55, Nickel-63, Strontium-89, Strontium-90	All samples less than the lower limit of detection.
Milk	2	18	Iodine-131	All samples less than the lower limit of detection.
		18	Gamma Radioactivity	Gamma radioactivity detected was of natural origin.
Vegetation	3	3	Gamma Radioactivity	No human-made radioactivity was detected.
Soil	4	5	Gamma Radioactivity	Gamma radioactivity detected was of natural origin.
Sediments	18	36	Gamma Radioactivity	Detected gamma radioactivity attributable to natural, Chernobyl or above-ground nuclear weapons testing origin.
Fish	2	8	Gamma Radioactivity	All detected gamma radioactivity attributable to natural, Chernobyl or above-ground nuclear weapons testing origin.
		8	Iron-55, Nickel-63, Strontium-89, Strontium-90	All detected radioactivity attributable to natural, Chernobyl or above-ground nuclear weapons testing origin.
Total number of tests		**2496**	*Representing 162 sample sites*	

Map 1


Environmental Radiation Surveillance Stations
Sample Locations
STRATTON
WARDSBORO
BROOKLINE
PUTNEY
NEWFANE
DOVER
Westmoreland, N.H.
DUMMERSTON
WILMINGTON
MARLBORO
Chesterfield, N.H.
BRATTLEBORO
N
WHITINGHAM
HALIFAX
GUILFORD
Hinsdale, N.H.
VERNON
ROWE, MA
HEATH, MA
COLRAIN, MA
LEYDEN, MA
BERNARDSTON, MA
NORTHFIELD, MA
Legend
Plant Area Dosimeter Locations
Site Boundary Dosimeter Locations
Background Dosimeter Locations
Air Sample Locations
Water Sample Locations
Milk Sample Locations
Vegetation Sample Locations
Soil Sample Locations
Sediment Sample Locations
Fish Sample Locations
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
VERMONT
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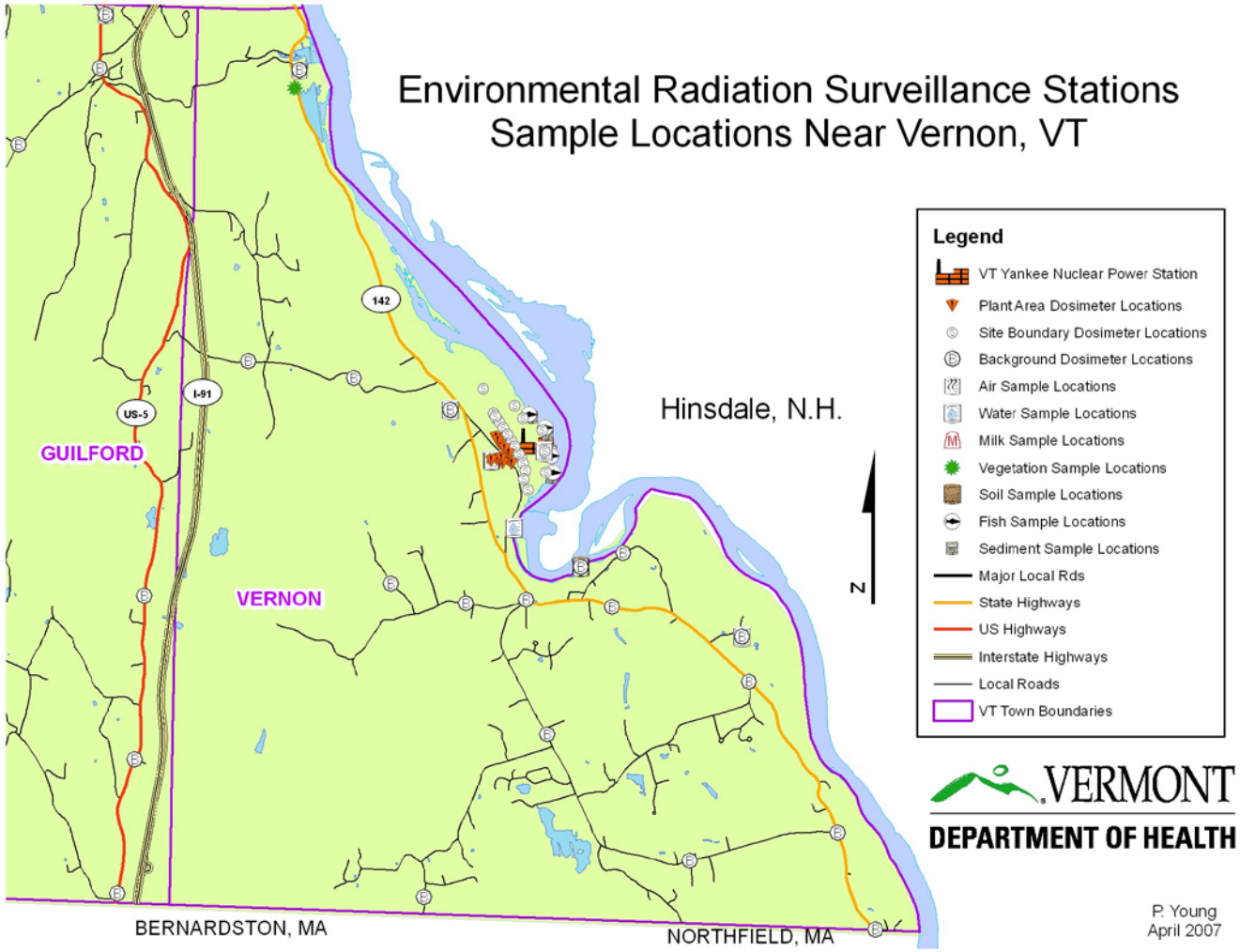
April 2007

Map 2


Environmental Radiation Surveillance Stations
Sample Locations Near Vernon, VT
Legend
VT Yankee Nuclear Power Station
Plant Area Dosimeter Locations
Site Boundary Dosimeter Locations
Background Dosimeter Locations
Air Sample Locations
Water Sample Locations
Milk Sample Locations
Vegetation Sample Locations
Soil Sample Locations
Fish Sample Locations
Sediment Sample Locations
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
VT Town Boundaries
Hinsdale, N.H.
GUILFORD
VERNON
BERNARDSTON, MA
NORTHFIELD, MA
142
I-91
US-5
N
VERMONT
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Types of Ionizing Radiation

There are three main types of ionizing radiation that could be released from Vermont Yankee: alpha particles, beta particles and gamma rays. The risk of adverse health effects from ionizing radiation is linked to the type and energy of radiation, and the length and method of exposure to the radiation. The Health Department tests for these forms of radiation in many sample types.

Alpha and Beta (particle) Radiation

Alpha and beta radiation are particle forms of radiation energy. Alpha- and beta-charged particles can only travel a short distance and are completely blocked by simple materials.

Alpha radiation is the most biologically hazardous form of ionizing radiation. For the same amount of alpha, beta and gamma radiation energy, the alpha radiation causes about 20 times more tissue damage. It is also the type of radiation that people can most easily shield against. A sheet of paper can stop an alpha particle, and so can the dead layer of skin that covers the outer surface of our bodies. Alpha particles can only cause harm if alpha-emitting materials are inhaled, ingested or otherwise taken into the body. The most common alpha radiation exposure for people is from naturally-occurring radon gas in their homes.

Table 2. Examples of Radioactive Elements that Produce Alpha-Radiations

Naturally-occurring alpha emitters	
Uranium-238	Radon-222
Thorium-232	Polonium-210
Radium-226	Bismuth-212
Human-made alpha emitters	
Americium-241	Plutonium-239

Beta radiation is also easily stopped by simple materials like plastics, aluminum and wood. Beta radiations may be able to go through the first few millimeters of human skin. Beta radiation can cause damage to internal tissues and organs if a beta-emitting material is inhaled, ingested or otherwise taken into the body.

Alpha and beta-emitting materials are released from the station's air stack at Vermont Yankee. They may also be emitted in liquid discharges from contaminated reactor systems.

Figure 1. Relative Ability of Ionizing Radiations to go through Materials

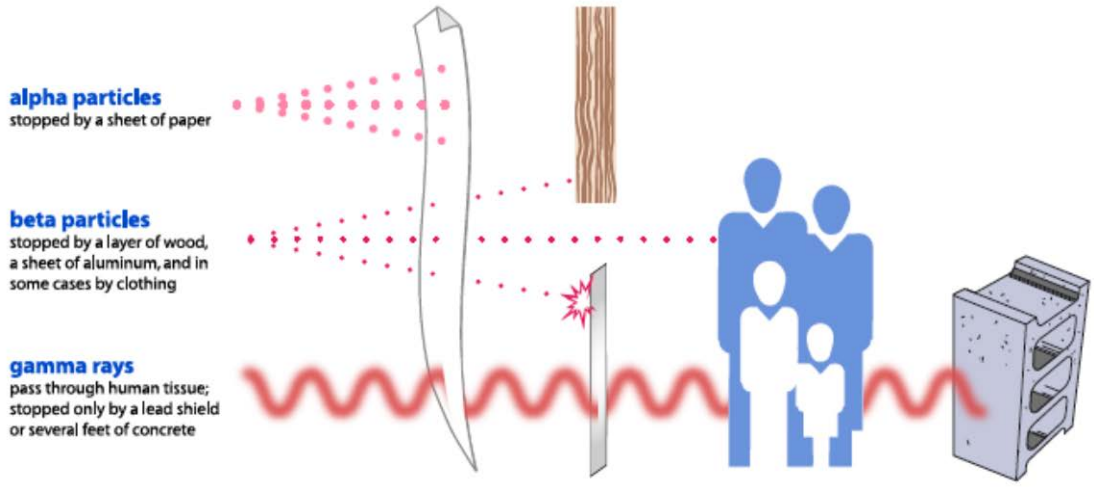


Table 3. Examples of Radioactive Elements that Produce Beta-Radiations

Naturally-occurring beta emitters	
Carbon-14	Potassium-40
Radium-228	Hydrogen-3, "tritium" (also human-made)
Human-made beta emitters	
Iodine-131	Technetium-99
Strontium-90	Hydrogen-3, "tritium" (also naturally-occurring)
Nickel-63	Iron-59

Gamma Radiation

Direct gamma radiation is an electromagnetic wave of energy similar to light, except that it passes through most materials in the form of an energy wave. Gamma radiation can also scatter off materials. Direct gamma radiation loses strength as it travels away from the source. It is also reduced after large numbers of collisions with electrons in the atom.

Gamma radiation passes through the skin and may pass through the whole body. If gamma radiation passes through the body, it may damage tissues. People can be affected by gamma radiation if they are located in an area where direct gamma radiation exists, or if they ingest a gamma-emitting material.

Direct gamma radiation is emitted from reactor and turbine systems such as those at Vermont Yankee. Gamma-emitting materials may also be released as gases or particles from the station's air stack.

Table 4. Examples of Radioactive Elements that Produce Gamma-Radiations

Naturally-occurring gamma emitters		
Beryllium-7	Potassium-40	Thallium-208
Bismuth-212	Bismuth-214	Lead-210
Lead-212	Lead-214	Polonium-210
Actinium-228	Radium-224	Radium-226
Radium-228	Thorium-228	Thorium-229
Thorium-230	Thorium-231	Thorium-232
Thorium-234	Uranium-233	Uranium-234
Uranium-235	Uranium-238	
Human-made gamma emitters		
Antimony-124	Antimony-126	Barium-140/ Lanthanum-140
Cerium-144/ Promethium-144	Cesium-134	Cesium-136
Chromium-51	Cobalt-56	Cobalt-58
Cobalt-60	Iodine-131	Iodine-132
Iodine-133	Iodine-135	Krypton-85
Krypton-88	Manganese-54	Neptunium-239
Plutonium-239	Plutonium-240	Ruthenium-103
Tellurium-132	Strontium-85	Strontium-89
Zinc-65	Xenon-133	Xenon-133m
Xenon-135	Zirconium-95/Niobium-95	

Ionizing Radiation Risks

The radiations to which people may be exposed as a result of Vermont Yankee operations are ionizing radiations. According to the International Agency for Research on Cancer (IARC), ionizing radiation can cause cancer in humans. The energy released by ionizing radiation may directly or indirectly damage the DNA of human cells and over time cause cancer. It has been shown that people who are exposed to high doses of ionizing radiation, in excess of 10,000 millirem, have a statistically higher risk of cancer. As with other cancer-causing agents, it is not possible to prove that low doses of ionizing radiation are without risk. The risk of developing cancer from chronic exposure to very low doses of radiation, such as the doses detailed in this report, is considered very low.

The risk management approach used for public health protection with ionizing radiation is called the ALARA Principle. The ALARA Principle states that every reasonable effort must be made to maintain radiation exposures ***A**s **L**ow **A**s **R**easonably **A**chievable*. The Health Department's Radiological Health Rule not only requires that exposures to ionizing radiation be less than specific limits, but also that Vermont Yankee and all other radiation users in industry, medicine and education use the ALARA Principle.

For more information about ionizing radiation risk:

- The National Academies of Science

  National Research Council. *Health Risks from Exposure to Low Levels of Ionizing Radiation: BEIR VII Phase 2*. Washington, DC: The National Academies Press, 2006.

- The Health Physics Society

  Health Physics Society, *Radiation Risk in Perspective*: *Position Statement of the Health Physics Society*. McLean, VA: The Health Physics Society, 2010

- The International Agency for Research on Cancer

  The International Agency for Research on Cancer, *Radiation, Volume 100D*. France: The World Health Organization, 2012

Cancer Prevalence, Incidence & Mortality

The primary health concern with chronic low-level exposure to ionizing radiation is the potential to develop cancer. Starting in 2007, the Health Department began presenting cancer-related health outcome data for the population in the area of Vermont Yankee. The Health Department tabulates, analyzes and provides data for cancer incidence (new cancer cases diagnosed) and cancer mortality (people dying from cancer) for Windham County and for the six towns nearest Vermont Yankee that make up the Emergency Planning Zone. The Health Department evaluates trends in all cancer types (all ages, all sites) and evaluates thyroid cancers, leukemia and pediatric (childhood) cancers separately because these types of cancers can be associated with excess radiation exposure or radiation exposure during fetal development.

Cancer Prevalence

Cancer is not one disease, but a group of more than 100 different diseases. Cancer is very common. Roughly one out of every two men and one out of every three women will develop some type of cancer in their lifetime. A cancer usually develops gradually as a result of a complex mix of factors related to personal behaviors, environment and genetics. Each type of cancer is caused by a different set of factors, some well-established, some uncertain, and some unknown.

Cancer *prevalence* means the number of people alive today who have ever been diagnosed with cancer. According to 2013 Behavioral Risk Factor Surveillance System (BRFSS) data, approximately 38,000 or seven percent of Vermonters age 18 and older have ever been told by a doctor they had cancer. This includes people who are newly diagnosed, in active treatment, or have completed active treatment, and people living with progressive symptoms of their disease.

With nine percent of people age 50 and older living with cancer in the U.S., it is not unusual to know several people who have cancer. As a population ages, the occurrence of new cancer cases can be expected to increase. With treatment advances, people are living

longer with a cancer diagnosis. The number of cancer survivors has doubled in the past 20 years.

Cancer Incidence

Cancer *incidence* means the number of newly diagnosed cases during a specific time period. Incidence data in Table 5 were compiled from Vermont Cancer Registry data. Incidence rates are shown for all cancers, thyroid cancers, leukemia, and childhood (pediatric) cancers for the 10 year period 2002 to 2011.

The data in Table 5 indicate that:

- Incidence rates for thyroid cancer, pediatric cancer, and leukemia in the Emergency Planning Zone are not different from Windham County, Vermont as a whole, or the U.S. population.
- The incidence of thyroid cancer in Windham County is significantly lower than Vermont and the U.S. rate.
- For all cancer types combined, the rate of cancer incidence in the six towns near Vermont Yankee (Brattleboro, Dummerston, Guilford, Halifax, Marlboro and Vernon) is lower than the Vermont rate but is not different from Windham County or the U.S. population.

The U.S. incidence rates and mortality rates are all races population rates. Analysis prior to the 2011 report compared only U.S. white population incidence and mortality rates to Vermont rates. This change is consistent with current Health Department publications that compare Vermont (all races) to U.S. (all races) rates.

Table 5. Cancer Incidence Rates Near Vermont Yankee, in Vermont & U.S.

Age Adjusted Vermont and U.S. Cancer Incidence, All Sites, Males and Females per 100,000 population, 2002-2011.

	Rate	Lower CL	Upper CL	Avg. cases per year
U.S.	473.5	473.3	473.8	1,445,556
Vermont	492.2	487.0	497.5	3,508
Windham County	475.6	457.1	494.6	262
Emergency Planning Zone	451.5	424.9	479.4	113

Age Adjusted Vermont and U.S. Cancer Incidence, Thyroid, Males and Females per 100,000 population, 2002-2011.

	Rate	Lower CL	Upper CL	Avg. cases per year
U.S.	11.4	11.4	11.4	33,931
Vermont	11.9	11.1	12.8	78
Windham County	7.8	5.5	10.8	4
Emergency Planning Zone	8.3	4.8	13.3	2

Age Adjusted Vermont and U.S. Cancer Incidence, Leukemia, Males and Females per 100,000 population, 2002-2011.

	Rate	Lower CL	Upper CL	Avg. cases per year
U.S.	13.1	13.1	13.1	39,352
Vermont	13.6	12.8	14.6	93
Windham County	16.1	12.8	20.0	9
Emergency Planning Zone	11.7	7.7	17.1	3

Age Adjusted Vermont and U.S. Cancer Incidence, Pediatric Cancers (Ages 0-19), Males and Females per 100,000 population, 2002-2011.

	Rate	Lower CL	Upper CL	Avg. cases per year
U.S.	17.4	17.4	17.5	14,063
Vermont	17.7	15.7	19.9	28
Windham County	15.6	9.0	25.2	2
Emergency Planning Zone	11.6	4.2	26.0	<1

-- Rates are only presented when the total number of cases is greater than 5.
Emergency Zone towns include: Brattleboro, Dummerston, Guilford, Halifax, Marlboro, and Vernon.
All rates are age adjusted to the 2000 U.S. standard population and rates are per 100,000 population.
Incidence rates are for invasive cancers and in situ urinary bladder cancers. Cancer diagnoses exclude basal cell and squamous cell skin cancers. A reporting delay by Department of Veterans Affairs (VA) has resulted in incomplete reporting of VA hospital cases in 2011.

Cancer Mortality

In Table 6, mortality rates from the U.S., Vermont, Windham County, and the Emergency Planning Zone towns are presented for the 10 years 2002 to 2011. The Vermont data are from the Vermont Department of Health's Vital Statistics System. Data for U.S. cancer mortality rates are from the Vital Statistics System of the United States. Cancer mortality data are presented for all cancers, thyroid cancers, leukemia and pediatric cancers.

The data in Table 6 indicate:

- For the years 2002 to 2011, cancer mortality rates for all cancers combined and the leukemia mortality rates in the six towns of the Emergency Planning Zone around Vermont Yankee do not differ from those for Windham County, Vermont or the U.S.
- Similar results were seen in mortality rates in the prior report.
- Mortality rates for thyroid and pediatric cancers in Windham County and the six towns could not be calculated as there were too few deaths (fewer than six) over the time period studied (10 years).

Table 6. Cancer Mortality Rates Near Vermont Yankee, in Vermont & U.S.

**Age Adjusted Vermont and U.S. Cancer Mortality, All Sites,
Males and Females per 100,000 population, 2002-2011.**

	Rate	Lower CL	Upper CL	Avg. deaths per year
U.S.	180.4	180.3	180.6	563,458
Vermont	178.8	175.7	182.0	1,266
Windham County	178.4	167.3	190.2	98
Emergency Zone	178.8	162.5	196.8	46

**Age Adjusted Vermont and U.S. Cancer Mortality, Thyroid,
Males and Females per 100,000 population, 2002-2011.**

	Rate	Lower CL	Upper CL	Avg. deaths per year
U.S.	0.5	0.5	0.5	1,542
Vermont	0.5	0.3	0.7	3
Windham County	--	--	--	<1
Emergency Zone	--	--	--	0

**Age Adjusted Vermont and U.S. Cancer Mortality, Leukemia,
Males and Females per 100,000 population, 2002-2011.**

	Rate	Lower CL	Upper CL	Avg. deaths per year
U.S.	7.2	7.1	7.2	22,131
Vermont	7.2	6.6	7.9	49
Windham County	8.1	5.9	11.0	4
Emergency Zone	7.6	4.5	12.5	2

**Age Adjusted Vermont and U.S. Cancer Mortality, Pediatric Cancers (Ages 0-19),
Males and Females per 100,000 population, 2002-2011.**

	Rate	Lower CL	Upper CL	Avg. deaths per year
U.S.	2.5	2.5	2.6	2,086
Vermont	2.2	1.5	3.0	4
Windham County	--	--	--	<1
Emergency Zone	--	--	--	<1

-- Rates are only presented when the total number of deaths is greater than 5.
Emergency Zone towns include: Brattleboro, Dummerston, Guilford, Halifax, Marlboro, and Vernon.
All rates are age adjusted to the 2000 U.S. standard population and rates are per 100,000 population.

Cancer Surveillance Methodology

The rates in this report are calculated at a 95 percent confidence level. This means, for example, given a reported incidence rate of 492.2 per 100,000 for Vermont in 2002-2011, that we are 95 percent confident (not due to chance alone) that the true 2002 to 2011 Vermont rate is in the range of 487.0 to 497.5 per 100,000. In the six towns near Vermont Yankee, the cancer incidence rate for all types of cancer combined is 451.5 cases per 100,000 people. Statistically speaking, this means we are 95 percent confident that the actual rate is between 424.9 cases and 479.4 cases per 100,000 people. Because the *ranges* for these populations do not overlap, we conclude that there is a meaningful statistical difference between the two rates.

In Table 6, it may appear that the cancer mortality rates are different in the Emergency Planning Zone around Vermont Yankee compared to Windham County, Vermont, or the U.S. However, the confidence intervals (ranges) for these rates overlap, and the cancer mortality rates are *not* statistically different. In Windham County, the death rate from cancer, all sites, males and females, was 178.4 deaths per 100,000 people, while the death rate in the six towns near Vermont Yankee was 178.8 deaths per 100,000 people. The same conclusion is drawn for Vermont and the U.S. as a whole. All sites, all ages cancer mortality rates are not significantly different.

Data Limitations

One limitation of these data is that the numbers of cancer cases and the number of cancer deaths in the six towns near Vermont Yankee are small. There are challenges associated with computing rates for small geographical areas, such as the Vermont Yankee Emergency Planning Zone, with an estimated population of 20,000 people in 2011. When the rates are based on a small number of cases, it is almost impossible to distinguish random fluctuation from true changes in the underlying risk of disease. This is an issue in a state like Vermont, which has many communities with small populations. To improve rate stability, the cases have been combined for the 10 year period from 2002 through 2011. For more information about cancer and for resources to assist those living with cancer in Vermont: http://healthvermont.gov/cancer.

Environmental Surveillance Methods

The types of surveys and analyses performed by the Vermont Department of Health are described here in relationship to their role in protecting the public from ionizing radiation resulting from operations at Vermont Yankee.

Direct Gamma Radiation Monitoring

Direct gamma radiation in air is measured by the Health Department by using thermoluminescent dosimeters (TLDs). Gamma radiation energy interacts with and changes the materials inside the TLDs. The more gamma energy, the more change occurs in the materials. The TLDs are then tested in a laboratory, by reversing the physical changes. When this occurs, light is emitted, and the amount of light measured in the process is directly related to the amount of gamma radiation energy the TLD received in the environment. These instruments are calibrated to provide a measure of radiation *exposure,* reported in milliroentgen.

TLDs are placed in the environment to measure how much direct gamma radiation is being given off from Vermont Yankee and how much exists from natural or other human-made sources in background areas of Vermont. The Health Department's dosimeters are located on the site boundary (property line), in the area of the station and at background locations in Windham County. A total of 72 locations are monitored. Samples are tested quarterly.

Vermont Yankee emits direct gamma radiation from components and nuclear reactor systems. Direct gamma radiation may also result when gases and particulates are released from the station's air stack. Measuring the amount emitted ensures that no member of the public is exposed to increased levels of gamma radiation as a result of operations at Vermont Yankee.

Continuous Flow Air Sampling

Continuous air samplers are located in Vernon, Guilford, Dummerston, Wilmington and Brattleboro. In 2011, an additional air sampler was added in Burlington. These air samplers have a mechanical pump that pulls air through two types of sample media. The samplers have an in-line flow meter that tracks the volume of air pulled through the sample. The air samplers run continuously.

The samplers collect alpha-, beta- and gamma-emitting materials in air. Each sampler has two collection media to capture these radioactive materials. The first medium is a glass fiber filter. As outdoor air is pulled through the sampler, particulates are collected on the glass fiber filter. Particulates that contain alpha-, beta- and gamma-emitting materials are collected on the glass fiber filter.

Located behind the glass fiber filter is the second medium, a charcoal cartridge. The cartridge is treated with triethylenediamine (TEDA), a compound that attracts radioactive iodine vapors. As air passes through, radioactive iodine as well as other gamma-emitting gases and vapors are collected.

The filter is sent to the Health Department Laboratory where the alpha- and beta-emitting materials are counted on a gas flow proportional counter. The charcoal cartridge is tested by the Health Department Laboratory on a gamma spectrometer. Samples are collected and tested monthly. In addition, every three months the filters are grouped together and tested by gamma spectroscopy. These grouped samples are called quarterly composites.

Measurements of total alpha and beta radiation, gamma radiation and specifically iodine-131 ensure that operations at—and discharges from—Vermont Yankee are within limits and do not result in an increased radiation exposure to the public.

Water Monitoring

Water samples are collected both on site at Vermont Yankee and off site at nearby locations. Off-site water samples include drinking water wells, a municipal water supply, and samples from the Connecticut River. These locations allow the Health Department to determine if radioactive materials have left the Vermont Yankee site and entered these waters. On-site groundwater monitoring wells are sampled and tested to determine if any radioactive materials are leaking from systems at Vermont Yankee. Several on-site wells are located side-by-side. These are coupled wells. They are in the same location, with one well set slightly deeper than the other. The shallower well is designated with an "S" after the well number, the deeper well has a "D" designation. On-site drinking water wells are also sampled and tested to ensure that the drinking water supplies are not contaminated.

Water samples can be tested for total alpha and beta radioactivity, and gamma-emitting materials. Alpha and beta radioactivity are tested with a gas proportional counter. Gamma-emitting materials are measured with a gamma spectrometer.

Water samples are also tested for tritium. Tritium is a radioactive form of hydrogen, and is a weak beta-emitter. Tritium is created when water passes through the reactor core and the hydrogen atoms in the water molecules and other trace elements like boron absorb neutrons from the fission of the reactor fuel. Tritiated water can leave the power station in the same ways that non-radioactive water leaves the station: in the air, in groundwater, and through discharges into surface water. Tritium is also created by cosmic radiation in the atmosphere. Tritium is tested with a liquid scintillation counter.

Since 2010, water samples have also been tested for four hard-to-detect radioactive metals: strontium-89, strontium-90, iron-55, and nickel-63. The Health Department contracts with a certified laboratory to perform these analyses. Strontium-90 is associated with nuclear reactor fission, but was also released in significant quantities in the 1940s, 50s and 60s during above-ground nuclear weapons testing, and as a result of global nuclear events like Chernobyl. Nickel-63 and iron-55 are associated with nuclear facility

operations. These radioactive metals can be released from leaking reactor systems or through permitted discharges. They are not identifiable by routine laboratory test methods.

Monitoring Food Chain Inputs

The Health Department also routinely tests milk, sediment, soil, vegetation and fish in the Vernon and Brattleboro area.

Milk Sampling

Milk samples are collected from two farms located in the vicinity of Vermont Yankee. Raw cows' milk samples are taken monthly and tested for gamma-emitting materials and specifically for iodine-131 (I-131).

Sediment Sampling

Sediments from the bottom of the Connecticut River are collected twice a year. They are tested for gamma-emitting materials.

Soil and Vegetation Sampling

Soil and vegetation are collected in areas near Vermont Yankee and tested for gamma-emitting materials. A variety of natural and cultivated plants are sampled to determine if radioactive materials are accumulating in the food chain. Vegetation samples are taken both in the immediate vicinity of Vermont Yankee and in the surrounding community. Soil samples are collected in areas near Vermont Yankee.

Fish Sampling

Fish are collected at two sites in the Connecticut River by an environmental contractor. One site is outside the Vermont Yankee discharge and the other site is about nine miles upstream from Vermont Yankee, where the Route 9 bridge crosses the Connecticut River. Fish are caught by a method known as electro-fishing. This involves putting a weak electric current in the water. Fish exposed to the current are temporarily stunned and float

to the surface where they are collected. Sport and pan fish species are caught and tested: large and small mouth bass, yellow perch and pumpkinseed.

Before testing, fish are divided into edible and inedible portions. The extent of the testing that can be done depends on the mass of fish collected. Fish are tested for gamma-emitting materials and strontium-90 and other hard-to-detect radioactive metals strontium-89, nickel-63, iron-55.

Laboratory Testing and Measurements

Laboratory instruments at the Health Department that are used to test samples are able to measure very small amounts of radioactivity. Each instrument has a limit as to how low it can measure or identify radioactivity. This limit is determined by the Health Department radiochemists and reported as the *Lower Limit of Detection* (LLD). Lower Limits of Detection are calculated for each sample, taking into account the specific instrument and sample characteristics such as type (*e.g.* water, soil, milk, air), length of time the sample is tested, and the amount of the sample tested. The Health Department's Lower Limits of Detection for routine gamma spectroscopy tests are presented in Table 8.

All of the Health Department's instruments meet strict quality control checks. Data reported by the Health Department is thoroughly reviewed by both the radiochemists and data review personnel.

Units of Measurement

For most results in this report, radioactivity is reported in units of *picocuries per mass or volume* of sample. One picocurie is one trillionth of a curie or 0.000000000001 curie. Curies and picocuries are units that measure the amount of radiation "activity" in the sample.

Direct gamma exposure is measured and reported in milliroentgen. Milliroentgen is a unit of exposure to ionizing radiation. One milliroentgen is equal to one thousandth of a roentgen or 0.001 roentgens.

Table 7. Units of Measurement

Type	Unit	Abbreviation	Measures (amount of)	Equivalent to
Radiation units	curie	Ci	activity of a radioactive material	1,000,000,000,000 picocuries (pCi)
	picocurie	pCi	activity of a radioactive material	0.000000000001 curie (Ci)
	roentgen	R	*exposure* to ionizing radiation	1000 milliroentgens (mR)
	milliroentgen	mR	*exposure* to ionizing radiation	0.001 roentgen (R)
	roentgen **e**quivalent **m**an	rem	*dose* equivalent of ionizing radiation	1000 millirem (mrem)
	milli**rem**	mrem	*dose* equivalent of ionizing radiation	0.001 roentgen equivalent man (rem)
Mass & Volume units	gram	g	mass	0.001 kilogram (kg)
	kilogram	kg	mass	1000 grams (g)
	liter	L	volume of liquid	1000 milliliters (mL)
	milliliter	mL	volume of liquid	0.001 liter (L)
	cubic meter	m^3	volume of air	1,000,000 centimeters^3 (cm^3)

Roentgens are units of radiation exposure in air. To determine the effect that the exposure would have on a person, roentgens are converted to **rem** ("**r**oentgen **e**quivalent **m**an"). A rem accounts for both the amount of radiation energy absorbed by a person and the potential biological effects of that energy in the human body. The Health Department's Radiological Health Rule provides limits for gamma radiation emitted from Vermont Yankee in units of measured exposure and relates it to a *biological dose*. As the Vermont Yankee site boundary TLDs measure exposure in milliroentgen, the corresponding limit in milliroentgen applies. Personal TLDs, like those worn by workers in nuclear power, medical or research facilities, are calibrated to provide a measure of *biological dose* for the wearer and are reported in millirem.

Uncertainty of Radiation Measurements

Measurements reported by a laboratory have an amount of *uncertainty* associated with them. Uncertainty is sometimes called error. Uncertainty results from variability in sampling and testing. The smaller the uncertainty associated with a measurement, the more accurate the number reported is likely to be. The uncertainty associated with a measurement is calculated by radiochemists and reported as a plus/minus (+/-) value. All of the measurements in this report are presented at the 95 percent confidence level. This means it is 95 percent certain (not due to chance alone) that the results are within the value and error range reported. Uncertainty can be minimized by increasing instrument efficiency, sample size and counting time.

Uncertainty of Thermoluminescent Dosimeter (TLD) Measurements

Dosimeter measurements over time are estimates and are also subject to uncertainty. The error for the sum of the quarterly results is the total propagated error at the 95 percent confidence level. The formula for the propagation of error is a root-mean-square formula:

$$[(\sigma_1^2) + (\sigma_2^2) + (\sigma_3^2) + (\sigma_4^2)]^{1/2}$$

Where (σ_1^2) is the uncertainty for quarter 1, (σ_2^2) is the uncertainty for quarter 2, (σ_3^2) is the uncertainty for quarter 3 and (σ_4^2) is the uncertainty for quarter 4. The Health Department regulates the direct gamma radiation exposure on the reported measurement.

Table 8. Health Department Gamma Spectroscopy Calculated Lower Limit of Detections

Radioactive element	Calculated Lower Limit of Detection: fish, water, vegetation & milk (pCi/L or pCi/kg)	Calculated Lower Limit of Detection: soil, sediment (pCi/kg)
Antimony-124	3	24
Antimony-126	3	23
Barium-133	4	30
Beryllium-7	24	183
Cadmium-109	48	349
Cerium-139	3	18
Cerium-141	4	29
Cerium-144	16	115
Cesium-134	4	25
Cesium-136	3	23
Cesium-137	4	24
Chromium-51	24	182
Cobalt-57	2	14
Cobalt-58	3	23
Cobalt-60	3	23
Iodine-131	3	23
Manganese-54	4	24
Mercury-203	3	22
Potassium-40	48	367
Ruthenium-103	3	22
Ruthenium-106	29	220
Silver-110m	3	23
Strontium-85	4	26
Tin-113	4	31
Yttrium-88	4	26
Zinc-65	6	46

Direct Gamma Radiation Results

Thermoluminescent dosimeters (TLDs) are located along the Vermont Yankee site boundary (property line) and in public areas in Vernon and in other Windham County towns. Thirteen TLDs placed at the Vermont Yankee site boundary are evaluated for compliance with the regulations detailed in the Health Department's Radiological Health Rule. The Health Department limits the measured exposure at the site boundary to no more than 20 milliroentgen per year above background radiation, and no more than 10 milliroentgen per calendar quarter above background radiation.

Site boundary TLDs:

- VY North Fence
- VY North Fence #2
- VY SW Fence
- VY SW Fence #2
- VY Parking Lot A
- VDH T07A
- Governor Hunt Road # 39
- VDH T07B
- VDH DR42
- VDH DR48
- VDH DR51A
- VDH DR52A
- VDH DR53A

Five additional TLDs—VDH DR43, DR44, DR45, DR46 and DR47—are located on the Connecticut River site boundary and are subject to the U.S. Nuclear Regulatory Commission limit of 100 millirem per year.

Additional Health Department TLDs are located in other areas of Vernon, and in Guilford, Brattleboro, Dummerston, Putney and Wilmington. These provide the background measurements of direct gamma radiation from both natural and human-made sources unrelated to the operation of Vermont Yankee. All TLDs are collected and tested every three months (quarterly).

Comparison to Background Levels

To determine the amount of direct gamma radiation exposure attributed to emissions from Vermont Yankee, the background gamma radiation is subtracted from the site boundary (property line) measurements. Background gamma radiation unrelated to Vermont Yankee may be from naturally-occurring sources, other industrial applications, and global contaminants remaining from above-ground weapons testing during the 1940s, 50s and 60s and global nuclear incidents like Chernobyl.

To measure the background of direct gamma radiation the additional 34 TLDs are placed in locations beyond the immediate area of Vermont Yankee's operations. These locations are as far west as Wilmington, as far north as Putney, and as far south as the Massachusetts state line in Guilford and Vernon. Each quarter's average exposure to these 34 TLDs is calculated and used to estimate environmental background radiation. Background gamma radiation levels for the four quarters of 2013 are presented in Table 9.

The exposures reported in Tables 10 and 11 show the total (gross) dosimeter measurement and the net value. The net value is calculated by subtracting the background radiation measurement from the total radiation measurement. For regulatory purposes, the net values are compared to the quarterly and annual limits.

Table 9. 2013 Average Direct Gamma Background Radiation Results

Calendar **Quarter**	Average Background Exposure Measurements (milliroentgen)
January 1 to March 31	14.1 ± 2.0
April 1 to June 30	14.4 ± 2.1
July 1 to September 30	13.5 ± 2.3
October 1 to December 31	14.8 ± 2.5
Total for Calendar **Year 2013**	56.8 ± 4.5
Calendar Year 2012	57.0 ± 4.4
Calendar Year 2011	56.1 ± 7.3
Calendar Year 2010	59.2 ± 7.1
Calendar Year 2009	57.9 ± 4.8
Calendar Year 2008	56.4 ± 4.6
Calendar Year 2007	56.2 ± 5.2

2013 Direct Gamma Radiation Exposure Results

The following tables are the results of the Health Department's TLD measurements of direct gamma radiation. Table 10 contains the results for the Vermont Yankee site boundary, and the dosimeters in the immediate area around the power station. Table 11 contains the results for the 34 dosimeters placed in locations beyond the immediate area of Vermont Yankee.

In 2013:

- 287 TLDs were tested for direct gamma radiation.
    - 135 of those provided background exposure measurements
    - 152 of those provided exposure measurements at the site boundary and in the immediate area of Vermont Yankee

Dosimeter locations on the site boundary bordered by land and used for direct gamma radiation compliance measurements reflect Vermont Yankee property purchases on or before August 1, 2008. The site boundary dosimeter location data are bolded in Table 10.

For 2013, the net site boundary results used for verifying compliance ranged from 0 to 11.7 milliroentgen.

Map 3 shows the locations of the site boundary and station area dosimeters. Maps 4 and 5 show the locations of the background dosimeters. The ID numbers on the maps can be matched to the locations in Tables 10 and 11.

For 2013, the quarterly limit of 10 milliroentgen and the annual limit of 20 milliroentgen were not exceeded.

Map 3

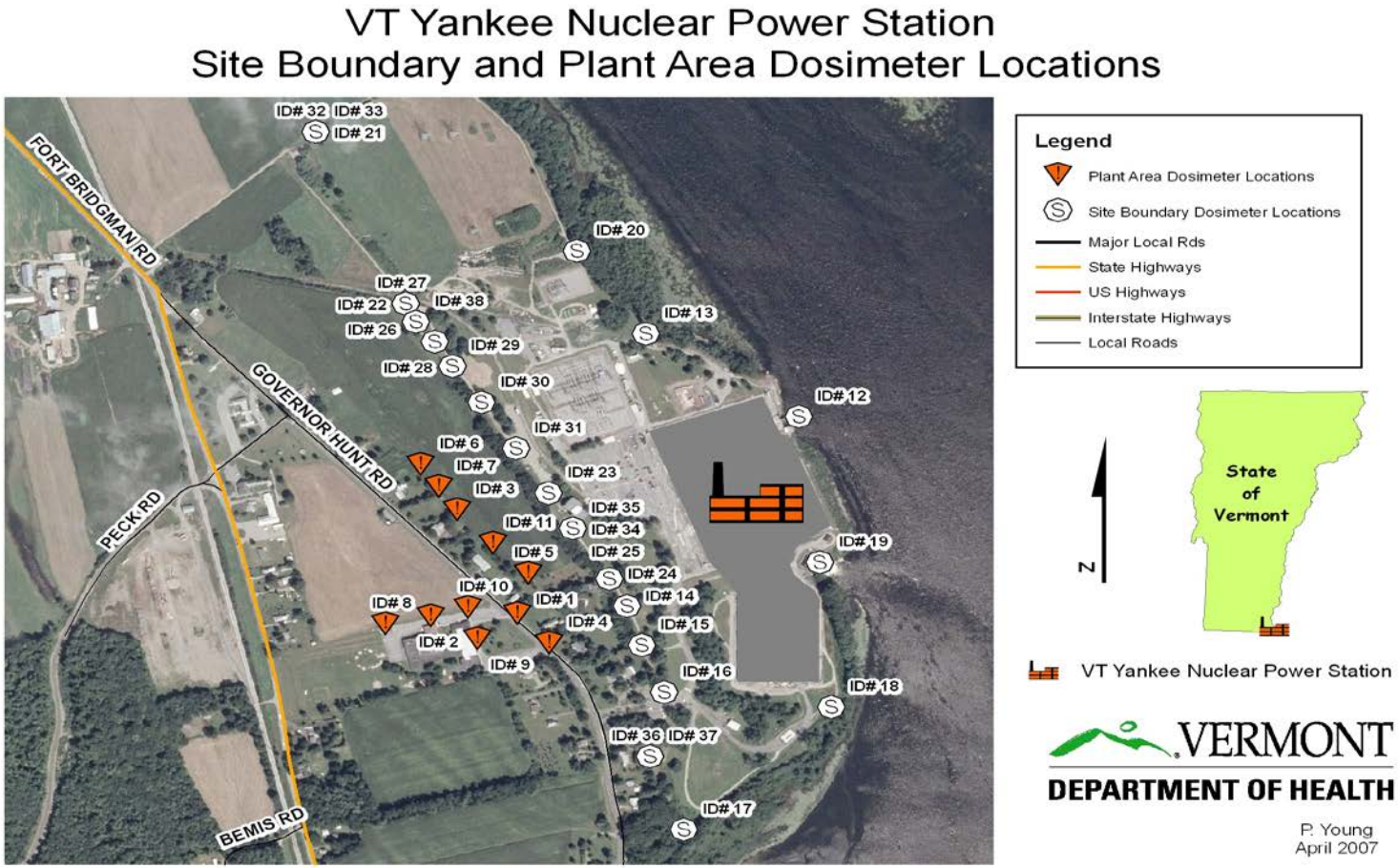

VT Yankee Nuclear Power Station
Site Boundary and Plant Area Dosimeter Locations
FORT BRIDGMAN RD
GOVERNOR HUNT RD
PECK RD
BEMIS RD
ID# 32
ID# 33
ID# 21
ID# 20
ID# 27
ID# 22
ID# 38
ID# 26
ID# 29
ID# 28
ID# 30
ID# 31
ID# 13
ID# 12
ID# 6
ID# 7
ID# 23
ID# 3
ID# 35
ID# 11
ID# 34
ID# 5
ID# 25
ID# 24
ID# 19
ID# 10
ID# 1
ID# 14
ID# 8
ID# 4
ID# 15
ID# 2
ID# 9
ID# 16
ID# 18
ID# 36
ID# 37
ID# 17
Legend
Plant Area Dosimeter Locations
Site Boundary Dosimeter Locations
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
N
State of Vermont
VT Yankee Nuclear Power Station
VERMONT
DEPARTMENT OF HEALTH
P. Young
April 2007

Table 10. 2013 Thermoluminescent Dosimeter Exposure Measurements and Net Gamma Radiation: Station Area & Site Boundary Locations

2013 **Site Boundary and Station Area** Dosimeter Exposure (milliroentgen)																											
Location	Map ID #	Qtr1 Gross	1SD Error	Avg Bkgrd	Qtr1 Net	Net Q1 >=0	2SD Error	Qrtr2 Gross	1SD Error	Avg Bkgrd	Qtr2 Net	Net Q2 >=0	2SD Error	Qrtr3 Gross	1SD Error	Avg Bkgrd	Qtr3 Net	Net Q3 >=0	2SD Error	Qrtr4 Gross	1SD Error	Avg Bkgrd	Qtr4 Net	Net Q4 >=0	2SD Error	Annual Net	2SD Error
Gov Hunt Road #39	**1**	15.87	1.04	**14.1**	**1.7**	**1.7**	**2.0**	16.28	0.56	**14.4**	**1.9**	**1.9**	**1.1**	15.26	0.85	**13.5**	**1.8**	**1.8**	**1.7**	16.65	0.83	**14.8**	**1.9**	**1.9**	**1.6**	**7.3**	**3.3**
VDH DR06	2	15.24	1.31	**14.1**	1.1	1.1	2.6	14.77	0.72	**14.4**	0.4	0.4	1.4	13.51	0.64	**13.5**	0.0	0.0	1.3	14.81	0.74	**14.8**	0.0	0.0	1.4	1.6	3.5
VDH DR51A	**3**	14.44	0.86	**14.1**	**0.3**	**0.3**	**1.7**	16.07	0.64	**14.4**	**1.7**	**1.7**	**1.3**	14.49	0.64	**13.5**	**1.0**	**1.0**	**1.3**	16.22	0.60	**14.8**	**1.4**	**1.4**	**1.2**	**4.5**	**2.7**
VDH DR52A	**4**	15.92	1.22	**14.1**	**1.8**	**1.8**	**2.4**	16.60	1.13	**14.4**	**2.2**	**2.2**	**2.2**	15.10	0.56	**13.5**	**1.6**	**1.6**	**1.1**	17.64	1.02	**14.8**	**2.9**	**2.9**	**2.0**	**8.5**	**4.0**
VDH DR53A	**5**	16.27	1.09	**14.1**	**2.1**	**2.1**	**2.1**	17.21	0.67	**14.4**	**2.8**	**2.8**	**1.3**	16.54	0.74	**13.5**	**3.1**	**3.1**	**1.4**	18.42	0.80	**14.8**	**3.6**	**3.6**	**1.6**	**11.7**	**3.3**
VDH T07A	**6**	14.71	0.92	**14.1**	**0.6**	**0.6**	**1.8**	14.68	0.66	**14.4**	**0.3**	**0.3**	**1.3**	14.27	0.60	**13.5**	**0.8**	**0.8**	**1.2**	15.46	0.59	**14.8**	**0.7**	**0.7**	**1.2**	**2.4**	**2.8**
VDH T07B	**7**	14.48	1.14	**14.1**	**0.3**	**0.3**	**2.2**	15.08	0.95	**14.4**	**0.7**	**0.7**	**1.9**	14.89	0.73	**13.5**	**1.4**	**1.4**	**1.4**	16.69	0.72	**14.8**	**1.9**	**1.9**	**1.4**	**4.4**	**3.5**
Vernon School (air sampler)	8	14.81	0.70	**14.1**	0.7	0.7	1.4	15.19	0.56	**14.4**	0.8	0.8	1.1	14.71	0.74	**13.5**	1.2	1.2	1.4	15.66	0.63	**14.8**	0.9	0.9	1.2	3.6	2.6
Vernon School Nurse	9	16.84	1.09	**14.1**	2.7	2.7	2.1	16.32	0.86	**14.4**	1.9	1.9	1.7	15.16	0.52	**13.5**	1.7	1.7	1.0	17.58	0.80	**14.8**	2.8	2.8	1.6	9.1	3.3
Vernon School Pole	10	13.84	0.68	**14.1**	-0.3	0.0	1.3	14.65	0.86	**14.4**	0.3	0.3	1.7	14.37	0.78	**13.5**	0.9	0.9	1.5	15.26	0.65	**14.8**	0.5	0.5	1.3	1.6	2.9
VY Parking Lot A	**11**	15.96	0.82	**14.1**	**1.8**	**1.8**	**1.6**	16.18	1.05	**14.4**	**1.8**	**1.8**	**2.1**	16.44	0.95	**13.5**	**3.0**	**3.0**	**1.9**	17.19	0.94	**14.8**	**2.4**	**2.4**	**1.8**	**9.0**	**3.7**
VDH DR45	12	29.32	1.60	**14.1**	15.2	15.2	3.1	31.49	2.81	**14.4**	17.1	17.1	5.5	27.77	1.92	**13.5**	14.3	14.3	3.8	29.87	2.07	**14.8**	15.1	15.1	4.1	61.7	8.4
VDH DR46	13	18.78	1.24	**14.1**	4.6	4.6	2.4	18.26	0.91	**14.4**	3.9	3.9	1.8	18.34	0.69	**13.5**	4.9	4.9	1.3	19.29	0.87	**14.8**	4.5	4.5	1.7	17.9	3.7
VDH DR08	15	17.91	1.24	**14.1**	3.8	3.8	2.4	18.13	1.26	**14.4**	3.8	3.8	2.5	18.23	0.90	**13.5**	4.8	4.8	1.8	19.90	0.86	**14.8**	5.1	5.1	1.7	17.4	4.2
VDH DR41	16	15.48	0.80	**14.1**	1.3	1.3	1.6	14.69	0.78	**14.4**	0.3	0.3	1.5	14.54	0.82	**13.5**	1.1	1.1	1.6	16.12	0.60	**14.8**	1.3	1.3	1.2	4.1	3.0
VDH DR42	**17**	13.81	0.68	**14.1**	**-0.3**	**0.0**	**1.3**	14.97	0.72	**14.4**	**0.6**	**0.6**	**1.4**	14.26	0.83	**13.5**	**0.8**	**0.8**	**1.6**	15.65	0.81	**14.8**	**0.9**	**0.9**	**1.6**	**2.3**	**3.0**
VDH DR43	18	15.35	1.05	**14.1**	1.2	1.2	2.1	15.97	1.15	**14.4**	1.6	1.6	2.2	16.14	0.81	**13.5**	2.7	2.7	1.6	17.84	0.83	**14.8**	3.0	3.0	1.6	8.5	3.8
VDH DR44	19	19.66	1.48	**14.1**	5.5	5.5	2.9	19.69	1.01	**14.4**	5.3	5.3	2.0	18.04	0.67	**13.5**	4.6	4.6	1.3	20.23	1.01	**14.8**	5.4	5.4	2.0	20.9	4.2
VDH DR47	20	16.36	1.23	**14.1**	2.2	2.2	2.4	16.59	1.44	**14.4**	2.2	2.2	2.8	16.35	0.53	**13.5**	2.9	2.9	1.0	18.20	0.99	**14.8**	3.4	3.4	1.9	10.7	4.3
VDH DR48	**21**	12.08	0.85	**14.1**	**-2.1**	**0.0**	**1.7**	12.65	0.83	**14.4**	**-1.7**	**0.0**	**1.6**	12.38	1.01	**13.5**	**-1.1**	**0.0**	**2.0**	14.38	0.88	**14.8**	**-0.4**	**0.0**	**1.7**	**0.0**	**3.5**
VDH T01	22	14.04	0.72	**14.1**	-0.1	0.0	1.4	14.64	0.70	**14.4**	0.3	0.3	1.4	13.48	0.69	**13.5**	0.0	0.0	1.3	14.96	0.60	**14.8**	0.2	0.2	1.2	0.4	2.7
VDH DR49	22	13.28	0.68	**14.1**	-0.9	0.0	1.3	14.16	0.71	**14.4**	-0.2	0.0	1.4	13.20	0.96	**13.5**	-0.3	0.0	1.9	13.41	0.67	**14.8**	-1.4	0.0	1.3	0.0	3.0
VDH DR51	23	16.56	1.10	**14.1**	2.4	2.4	2.1	18.60	1.33	**14.4**	4.2	4.2	2.6	18.07	0.58	**13.5**	4.6	4.6	1.1	18.85	0.82	**14.8**	4.1	4.1	1.6	15.3	3.9
VDH DR52	24	18.56	1.32	**14.1**	4.4	4.4	2.6	19.10	1.17	**14.4**	4.7	4.7	2.3	18.97	0.73	**13.5**	5.5	5.5	1.4	20.90	0.75	**14.8**	6.1	6.1	1.5	20.8	4.0
VDH DR53	25	20.04	1.06	**14.1**	5.9	5.9	2.1	20.36	1.33	**14.4**	6.0	6.0	2.6	19.36	0.71	**13.5**	5.9	5.9	1.4	22.01	0.71	**14.8**	7.2	7.2	1.4	25.0	3.9
VDH T03	26	14.71	0.96	**14.1**	0.6	0.6	1.9	14.71	0.60	**14.4**	0.3	0.3	1.2	13.38	0.65	**13.5**	-0.1	0.0	1.3	15.12	0.81	**14.8**	0.3	0.3	1.6	1.2	3.0

Site boundary dosimeter measurements are bolded.

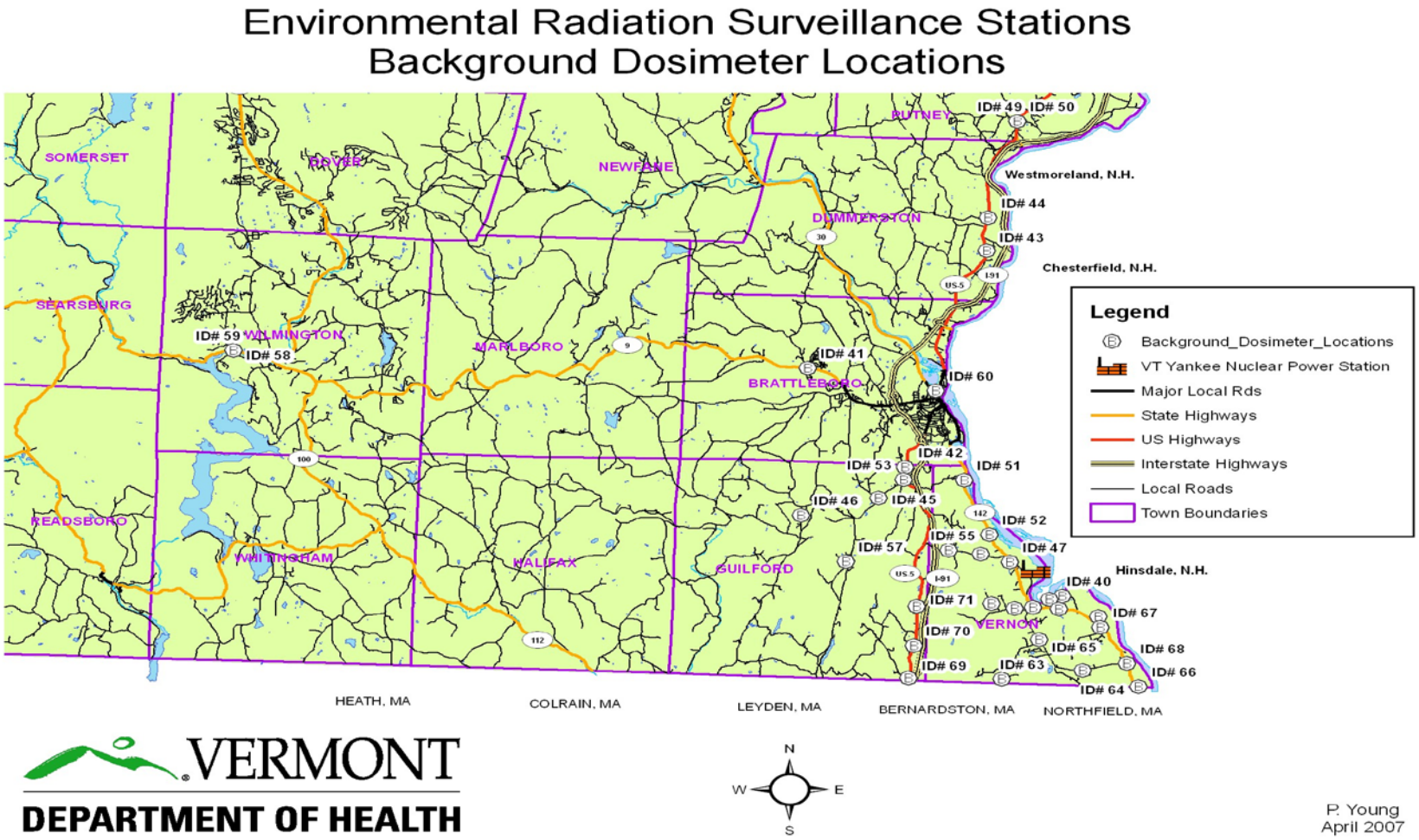
Table 10 (continued). 2013 Thermoluminescent Dosimeter Exposure Measurements and Net Gamma Radiation: Station Area & Site Boundary Locations

2013 **Site Boundary and Station Area** Dosimeter Exposure (milliroentgen)

Location	Map ID #	Qtr1 Gross	1SD Error	Avg Bkgrd	Qtr1 Net	Net Q1 >=0	2SD Error	Qrtr2 Gross	1SD Error	Avg Bkgrd	Qtr2 Net	Net Q2 >=0	2SD Error	Qrtr3 Gross	1SD Error	Avg Bkgrd	Qtr3 Net	Net Q3 >=0	2SD Error	Qrtr4 Gross	1SD Error	Avg Bkgrd	Qtr4 Net	Net Q4 >=0	2SD Error	Annual Net	2SD Error
VDH T05	28	16.40	1.26	**14.1**	2.3	2.3	2.5	15.68	0.69	**14.4**	1.3	1.3	1.3	14.78	0.81	**13.5**	1.3	1.3	1.6	16.13	0.88	**14.8**	1.3	1.3	1.7	6.2	3.7
VDH T04	29	14.88	0.90	**14.1**	0.7	0.7	1.8	14.96	0.67	**14.4**	0.6	0.6	1.3	14.39	0.90	**13.5**	0.9	0.9	1.8	15.57	0.60	**14.8**	0.8	0.8	1.2	3.0	3.1
VDH T06	30	15.68	0.75	**14.1**	1.5	1.5	1.5	16.19	0.62	**14.4**	1.8	1.8	1.2	14.76	0.66	**13.5**	1.3	1.3	1.3	16.89	0.82	**14.8**	2.1	2.1	1.6	6.7	2.8
VDH DR07	31	16.67	0.93	**14.1**	2.5	2.5	1.8	17.33	1.08	**14.4**	3.0	3.0	2.1	16.30	0.61	**13.5**	2.8	2.8	1.2	18.48	0.92	**14.8**	3.7	3.7	1.8	12.0	3.5
VY North Fence	**32**	13.46	0.74	**14.1**	**-0.7**	**0.0**	**1.5**	13.50	0.87	**14.4**	**-0.9**	**0.0**	**1.7**	13.35	0.64	**13.5**	**-0.1**	**0.0**	**1.3**	13.09	0.58	**14.8**	**-1.7**	**0.0**	**1.1**	**0.0**	**2.8**
VY North Fence #2	**33**	13.99	1.02	**14.1**	**-0.1**	**0.0**	**2.0**	13.59	0.68	**14.4**	**-0.8**	**0.0**	**1.3**	14.10	0.47	**13.5**	**0.6**	**0.6**	**0.9**	14.94	0.69	**14.8**	**0.2**	**0.2**	**1.4**	**0.8**	**2.9**
VY Parking Lot #2	34	18.88	1.12	**14.1**	4.7	4.7	2.2	20.51	0.71	**14.4**	6.1	6.1	1.4	19.80	0.85	**13.5**	6.3	6.3	1.7	21.42	0.87	**14.8**	6.6	6.6	1.7	23.8	3.5
VY Parking Lot, ID	35	19.49	1.35	**14.1**	5.4	5.4	2.6	20.78	0.71	**14.4**	6.4	6.4	1.4	20.17	0.82	**13.5**	6.7	6.7	1.6	20.90	1.01	**14.8**	6.1	6.1	2.0	24.6	3.9
VY SW Fence	**36**	13.13	0.80	**14.1**	**-1.0**	**0.0**	**1.6**	14.31	0.86	**14.4**	**-0.1**	**0.0**	**1.7**	12.88	0.49	**13.5**	**-0.6**	**0.0**	**1.0**	14.05	0.55	**14.8**	**-0.7**	**0.0**	**1.1**	**0.0**	**2.7**
VY SW Fence #2	**37**	13.05	0.79	**14.1**	**-1.1**	**0.0**	**1.6**	14.55	0.62	**14.4**	**0.2**	**0.2**	**1.2**	13.63	0.59	**13.5**	**0.2**	**0.2**	**1.2**	14.02	0.57	**14.8**	**-0.8**	**0.0**	**1.1**	**0.3**	**2.5**
VDH T02	38	14.31	1.15	**14.1**	0.2	0.2	2.3	14.48	0.83	**14.4**	0.1	0.1	1.6	13.26	0.72	**13.5**	-0.2	0.0	1.4	14.57	0.64	**14.8**	-0.2	0.0	1.3	0.3	3.4
Meteorology Tower	n/a	13.61	0.74	**14.1**	-0.5	0.0	1.5	14.10	0.86	**14.4**	-0.3	0.0	1.7	14.55	0.70	**13.5**	1.1	1.1	1.4	15.31	0.62	**14.8**	0.5	0.5	1.2	1.6	2.9

Site boundary dosimeter measurements are bolded.

Map 4


Environmental Radiation Surveillance Stations
Background Dosimeter Locations
SOMERSET
NEWFANE
PUTNEY
Westmoreland, N.H.
DUMMERSTON
Chesterfield, N.H.
SEARSBURG
WILMINGTON
MARLBORO
BRATTLEBORO
READSBORO
WHITINGHAM
HALIFAX
GUILFORD
VERNON
Hinsdale, N.H.
ID# 49
ID# 50
ID# 44
ID# 43
ID# 59
ID# 58
ID# 41
ID# 60
ID# 53
ID# 42
ID# 51
ID# 46
ID# 45
ID# 52
ID# 55
ID# 57
ID# 47
ID# 40
ID# 71
ID# 67
ID# 70
ID# 65
ID# 68
ID# 69
ID# 63
ID# 66
ID# 64
Legend
Background_Dosimeter_Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
Town Boundaries
HEATH, MA
COLRAIN, MA
LEYDEN, MA
BERNARDSTON, MA
NORTHFIELD, MA
VERMONT
DEPARTMENT OF HEALTH
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April 2007

Map 5

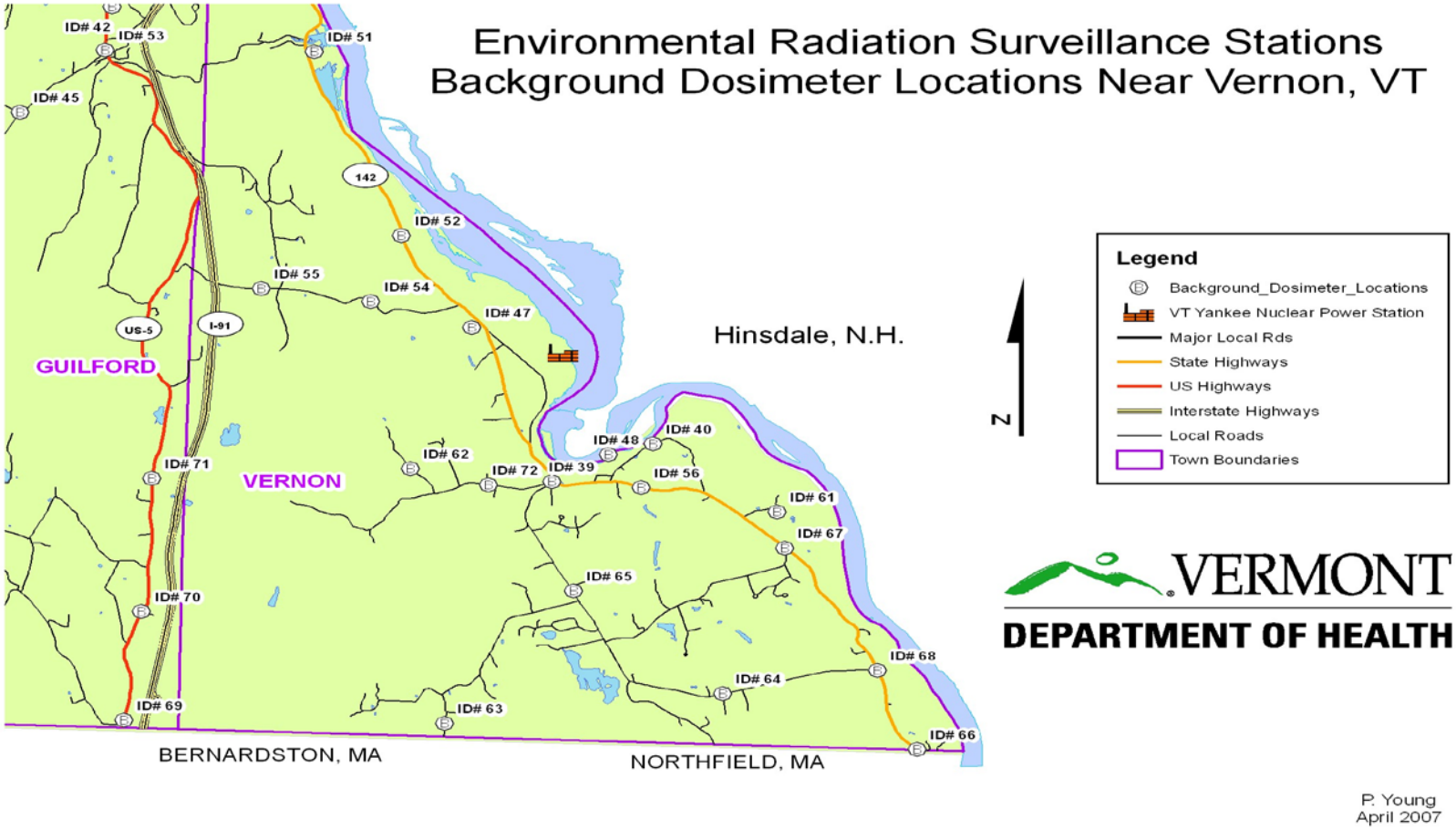
Environmental Radiation Surveillance Stations
Background Dosimeter Locations Near Vernon, VT
ID# 42
ID# 53
ID# 51
ID# 45
142
ID# 52
ID# 55
ID# 54
ID# 47
US-5
I-91
GUILFORD
Hinsdale, N.H.
ID# 48
ID# 40
ID# 62
ID# 71
VERNON
ID# 72
ID# 39
ID# 56
ID# 61
ID# 67
ID# 65
ID# 70
ID# 68
ID# 64
ID# 69
ID# 63
ID# 66
BERNARDSTON, MA
NORTHFIELD, MA
N
Legend
Background_Dosimeter_Locations
VT Yankee Nuclear Power Station
Major Local Rds
State Highways
US Highways
Interstate Highways
Local Roads
Town Boundaries
VERMONT
DEPARTMENT OF HEALTH
P. Young
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Table 11. 2013 Thermoluminescent Dosimeter Exposure Measurements and Net Gamma Radiation: Background Locations

2013 **Background** Dosimeter Exposure (milliroentgen)

Location	Map ID #	Qtr1 Gross	1SD Error	Avg Bkgrd	Qtr1 Net	Net >=0	2SD Error	Qrtr2 Gross	1SD Error	Avg Bkgrd	Qtr2 Net	Net >=0	2SD Error	Qrtr3 Gross	1SD Error	Avg Bkgrd	Qtr3 Net	Net >=0	2SD Error	Qrtr4 Gross	1SD Error	Avg Bkgrd	Qtr4 Net	Net >=0	2SD Error	Annual Net	2SD Error
142/Pond Road (N)	39	13.76	0.91	**14.1**	-0.4	0.0	1.8	13.64	0.61	14.4	-0.7	0.0	1.2	13.09	0.60	13.5	-0.4	0.0	1.2	14.67	0.68	14.8	-0.1	0.0	1.3	0.0	2.8
A&M Auto/Smead Rd	40	13.82	0.91	**14.1**	-0.3	0.0	1.8	13.62	0.58	14.4	-0.8	0.0	1.1	12.88	0.49	13.5	-0.6	0.0	1.0	13.74	0.80	14.8	-1.1	0.0	1.6	0.0	2.8
West Brattleboro State Police	41	13.15	1.04	**14.1**	-1.0	0.0	2.0	12.81	0.81	14.4	-1.6	0.0	1.6	11.90	0.66	13.5	-1.6	0.0	1.3	13.25	0.68	14.8	-1.5	0.0	1.3	0.0	3.2
D&E Tree, Rt 5, Guilford	42	13.22	0.85	**14.1**	-0.9	0.0	1.7	16.03	0.70	14.4	1.7	1.7	1.4	15.18	0.51	13.5	1.7	1.7	1.0	16.27	0.66	14.8	1.5	1.5	1.3	4.8	2.7
Dummerston AOT	43	14.71	1.00	**14.1**	0.6	0.6	2.0	14.48	0.63	14.4	0.1	0.1	1.2	14.35	0.73	13.5	0.9	0.9	1.4	15.24	0.74	14.8	0.4	0.4	1.4	2.0	3.1
Dummerston School	44	14.83	1.00	**14.1**	0.7	0.7	2.0	14.32	0.55	14.4	0.0	0.0	1.1	15.31	0.63	13.5	1.8	1.8	1.2	12.83	0.74	14.8	-2.0	0.0	1.4	2.5	2.9
Guilford Center Rd/Tater Rd	45	13.48	0.73	**14.1**	-0.7	0.0	1.4	14.12	0.59	14.4	-0.2	0.0	1.2	13.24	0.69	13.5	-0.2	0.0	1.3	14.49	0.58	14.8	-0.3	0.0	1.1	0.0	2.6
Guilford Town Garage	46	15.33	1.09	**14.1**	1.2	1.2	2.1	14.71	0.65	14.4	0.3	0.3	1.3	13.82	0.47	13.5	0.4	0.4	0.9	15.54	0.55	14.8	0.7	0.7	1.1	2.6	2.9
Miller Farm	47	12.76	1.00	**14.1**	-1.4	0.0	2.0	12.45	0.58	14.4	-1.9	0.0	1.1	11.81	0.51	13.5	-1.7	0.0	1.0	13.35	0.70	14.8	-1.4	0.0	1.4	0.0	2.8
Power Line River Crossing	48	14.22	0.92	**14.1**	0.1	0.1	1.8	14.29	0.64	14.4	-0.1	0.0	1.3	13.29	0.60	13.5	-0.2	0.0	1.2	14.72	0.78	14.8	-0.1	0.0	1.5	0.1	2.9
Putney Pole	49	15.24	1.02	**14.1**	1.1	1.1	2.0	15.15	0.66	14.4	0.8	0.8	1.3	13.95	0.61	13.5	0.5	0.5	1.2	15.66	0.76	14.8	0.9	0.9	1.5	3.2	3.1
Putney Town Clerk	50	13.50	1.09	**14.1**	-0.6	0.0	2.1	12.96	0.70	14.4	-1.4	0.0	1.4	11.94	0.81	13.5	-1.5	0.0	1.6	14.05	0.77	14.8	-0.7	0.0	1.5	0.0	3.3
Renaud Brothers	51	16.46	1.31	**14.1**	2.3	2.3	2.6	15.58	0.56	14.4	1.2	1.2	1.1	14.99	0.63	13.5	1.5	1.5	1.2	15.36	0.54	14.8	0.6	0.6	1.1	5.6	3.2
Rt 142 N Trans Line	52	13.85	0.94	**14.1**	-0.3	0.0	1.8	14.15	0.71	14.4	-0.2	0.0	1.4	12.96	0.58	13.5	-0.5	0.0	1.1	14.85	0.78	14.8	0.1	0.1	1.5	0.1	3.0
Rt 5/Guilford Ctr Rd	53	14.36	1.24	**14.1**	0.2	0.2	2.4	13.96	0.59	14.4	-0.4	0.0	1.2	12.80	0.62	13.5	-0.7	0.0	1.2	14.05	0.62	14.8	-0.7	0.0	1.2	0.2	3.2
Tyler Hill Road	54	13.91	1.04	**14.1**	-0.2	0.0	2.0	14.68	0.61	14.4	0.3	0.3	1.2	13.66	0.52	13.5	0.2	0.2	1.0	15.47	0.79	14.8	0.7	0.7	1.5	1.2	3.0
Tyler Rd/Franklin Rd	55	14.07	0.70	**14.1**	-0.1	0.0	1.4	14.98	1.00	14.4	0.6	0.6	2.0	13.71	0.56	13.5	0.2	0.2	1.1	15.29	0.75	14.8	0.5	0.5	1.5	1.3	3.0
Vernon Fire Station	56	13.07	0.70	**14.1**	-1.1	0.0	1.4	13.83	0.52	14.4	-0.5	0.0	1.0	12.79	0.81	13.5	-0.7	0.0	1.6	13.89	0.69	14.8	-0.9	0.0	1.4	0.0	2.7
Weatherhead Hollow Rd	57	12.60	0.90	**14.1**	-1.5	0.0	1.8	13.00	0.53	14.4	-1.4	0.0	1.0	11.55	0.53	13.5	-1.9	0.0	1.0	12.75	0.79	14.8	-2.0	0.0	1.5	0.0	2.8
Wilmington AOT Pole	58	13.66	0.87	**14.1**	-0.5	0.0	1.7	14.27	0.80	14.4	-0.1	0.0	1.6	14.24	0.92	13.5	0.8	0.8	1.8	16.27	0.70	14.8	1.5	1.5	1.4	2.3	3.2
Wilmington AOT (air sampler)	59	14.66	1.02	**14.1**	0.5	0.5	2.0	16.95	0.83	14.4	2.6	2.6	1.6	15.62	0.69	13.5	2.2	2.2	1.3	18.33	0.63	14.8	3.5	3.5	1.2	8.8	3.2
Windham County Court	60	15.71	1.03	**14.1**	1.6	1.6	2.0	15.03	0.67	14.4	0.7	0.7	1.3	14.43	0.53	13.5	1.0	1.0	1.0	16.04	0.67	14.8	1.3	1.3	1.3	4.4	2.9
Blodgett Farm	61	15.00	0.88	**14.1**	0.9	0.9	1.7	14.36	0.56	14.4	0.0	0.0	1.1	13.53	0.71	13.5	0.1	0.1	1.4	15.02	0.78	14.8	0.2	0.2	1.5	1.1	2.9
Fairman Road	62	13.71	0.92	**14.1**	-0.4	0.0	1.8	13.60	0.54	14.4	-0.8	0.0	1.1	12.93	0.65	13.5	-0.5	0.0	1.3	14.32	0.78	14.8	-0.5	0.0	1.5	0.0	2.9

Table 11. 2013 Thermoluminescent Dosimeter Exposure Measurements and Net Gamma Radiation: Background Locations (continued)

2013 **Background** Dosimeter Exposure (milliroentgen)

Location	Map ID #	Qtr1 Gross	1SD Error	Avg Bkgrd	Qtr1 Net	Net >=0	2SD Error	Qrtr2 Gross	1SD Error	Avg Bkgrd	Qtr2 Net	Net >=0	2SD Error	Qrtr3 Gross	1SD Error	Avg Bkgrd	Qtr3 Net	Net >=0	2SD Error	Qrtr4 Gross	1SD Error	Avg Bkgrd	Qtr4 Net	Net >=0	2SD Error	Annual Net	2SD Error
Huckle Hill Rd VT	63	15.64	0.92	**14.1**	1.5	1.5	1.8	16.57	0.89	14.4	2.2	2.2	1.7	15.78	0.57	13.5	2.3	2.3	1.1	17.37	0.92	14.8	2.6	2.6	1.8	8.6	3.3
Pond Rd & Houghton	64	13.57	0.75	**14.1**	-0.6	0.0	1.5	14.05	0.71	14.4	-0.3	0.0	1.4	12.65	0.52	13.5	-0.8	0.0	1.0			14.8	-14.8	0.0	0.0	0.0	2.3
Pond Rd/Vernon Rec	65	12.46	0.69	**14.1**	-1.7	0.0	1.4	12.31	0.52	14.4	-2.1	0.0	1.0	11.22	0.43	13.5	-2.3	0.0	0.8	13.34	0.52	14.8	-1.4	0.0	1.0	0.0	2.2
Rt 142 & Depot St	66	14.15	0.88	**14.1**	0.0	0.0	1.7	14.60	0.78	14.4	0.2	0.2	1.5	13.45	0.58	13.5	0.0	0.0	1.1	14.40	0.57	14.8	-0.4	0.0	1.1	0.2	2.8
Rt 142 & Newton Rd	67	12.54	0.83	**14.1**	-1.6	0.0	1.6	14.89	1.21	14.4	0.5	0.5	2.4	11.78	0.59	13.5	-1.7	0.0	1.2	12.94	0.72	14.8	-1.8	0.0	1.4	0.5	3.4
Rt 142 & Pond Rd (S)	68	15.81	1.99	**14.1**	1.7	1.7	3.9	14.18	0.66	14.4	-0.2	0.0	1.3	13.44	0.57	13.5	0.0	0.0	1.1	14.06	0.80	14.8	-0.7	0.0	1.6	1.7	4.5
Route 5/Wolosko Rd	69	15.56	0.95	**14.1**	1.4	1.4	1.9	16.03	0.66	14.4	1.7	1.7	1.3	15.42	0.60	13.5	1.9	1.9	1.2	16.55	0.92	14.8	1.8	1.8	1.8	6.8	3.1
Rt 5/Andrews Cmtry	70	13.64	0.72	**14.1**	-0.5	0.0	1.4	14.35	0.89	14.4	0.0	0.0	1.7	13.27	0.58	13.5	-0.2	0.0	1.1	14.41	0.53	14.8	-0.4	0.0	1.0	0.0	2.7
Rt 5/Tkaczyk Frm Rd	71	14.77	1.06	**14.1**	0.6	0.6	2.1	14.65	0.78	14.4	0.3	0.3	1.5	13.61	0.59	13.5	0.1	0.1	1.2	15.36	0.58	14.8	0.6	0.6	1.1	1.6	3.0
West Rd/Edgewood	72	13.37	0.97	**14.1**	-0.8	0.0	1.9	13.93	0.86	14.4	-0.4	0.0	1.7	13.46	0.60	13.5	0.0	0.0	1.2	14.22	0.62	14.8	-0.6	0.0	1.2	0.0	3.1
Average Background (Avg)		**14.1**						**14.4**						**13.5**						**14.8**						**56.8**	

Continuous Flow Air Sampling Results

The Health Department uses continuously operating air samplers to monitor the air near Vermont Yankee. They are located in Vernon, Guilford, Brattleboro, Dummerston and Wilmington. The locations of the air samplers are shown on Map 6. In 2011, to provide comparison, another air sampler was sited in Burlington at the Health Department.

Air filters are tested monthly for alpha- and beta-emitting materials and are then grouped quarterly to test for gamma-emitting materials. Air cartridges are collected and tested monthly for iodine-131 (I-131) and other gamma-emitting materials at the Health Department Laboratory. Data associated with the air filters are provided in Appendix A. For 2013:

- 120 air cartridges were tested for iodine-131 and gamma-emitting materials.
- 120 air filters were tested for total alpha and beta radioactivity.
- 4 sets of air filters were grouped and tested for gamma-emitting materials.

Air Filter Total Alpha and Beta Radioactivity Results

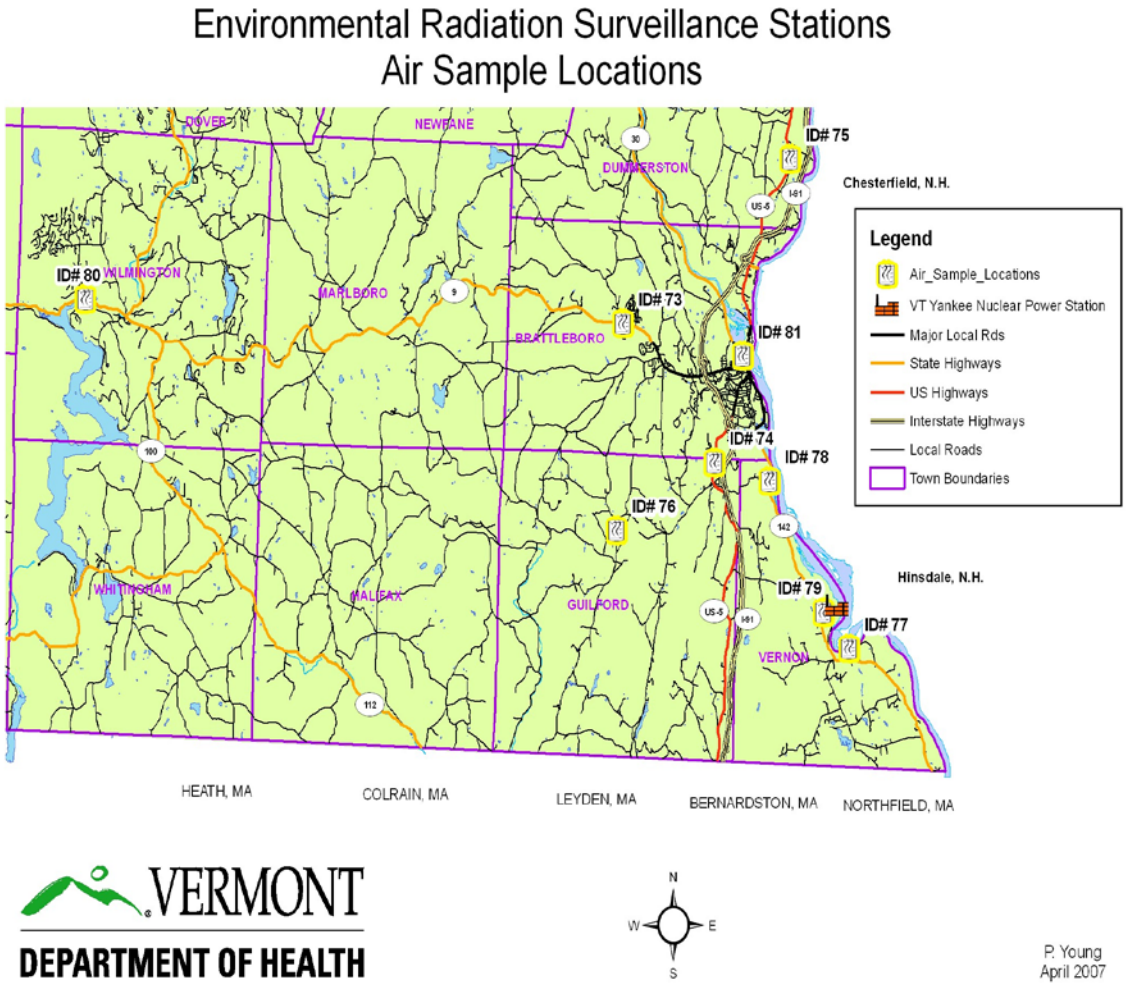
In 2013, the average result for total alpha radioactivity was 0.00144 picocuries per cubic meter (pCi/m^3). The 2013 average result for total beta radioactivity was 0.01276 pCi/m^3. The 2013 total alpha and beta radioactivity air filter results are presented in Appendix A.

Figures 2 and 3 show the average total alpha and beta radioactivity for the sample locations compared to the 2009, 2010, 2011 and 2012 results. Very low results that were uncertain because of noted collection problems were removed prior to calculating the average result. This is a conservative approach and results in an increased average.

Air Cartridge and Air Filter Gamma-Emitting Materials Results

No iodine-131 was detected in any air cartridge in 2013. Only naturally-occurring gamma-emitting materials were detected.

Map 6



Sample Location	Map ID	Sample Location	Map ID
D & E Tree	74	Vermont State Police-Brattleboro	73
Dummerston State Garage	75	Vernon Elementary School	79
Guilford Town Garage	76	Wilmington State Highway Garage	80
Power Line River Crossing	77	Windham County Courthouse	81
Renaud Brothers	78	108 Cherry St. Burlington	n/a

Figure 2. 2009-2013 Average Alpha Radioactivity in Air

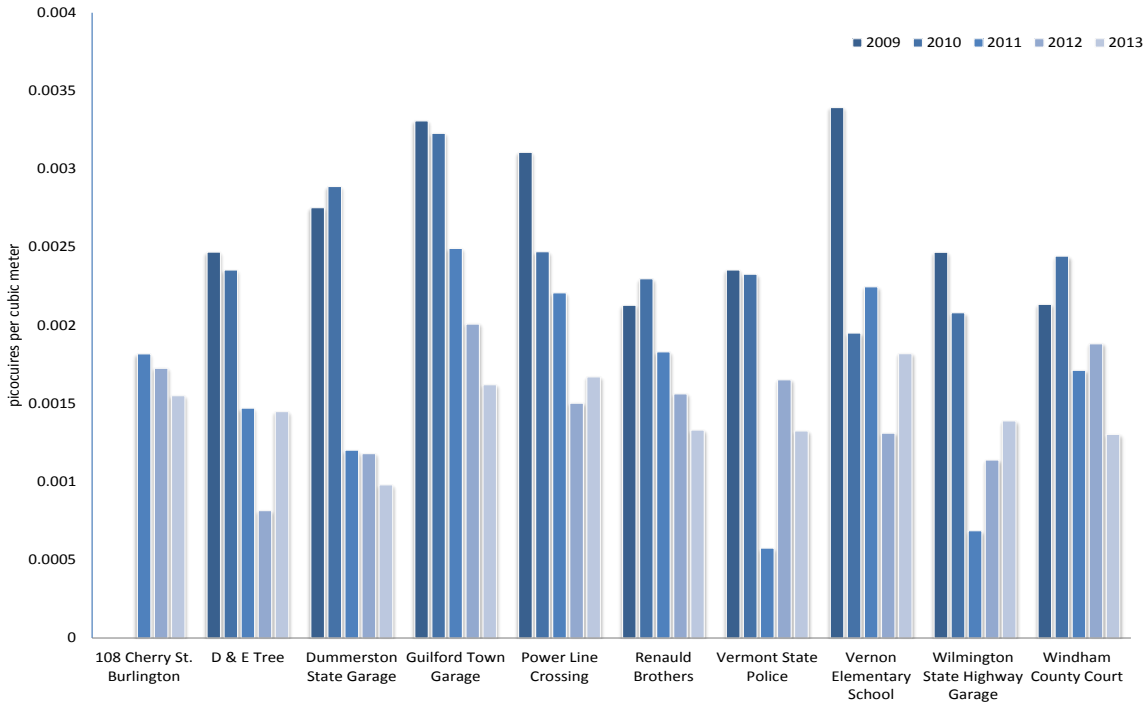


Figure 3. 2009-2013 Average Beta Radioactivity in Air

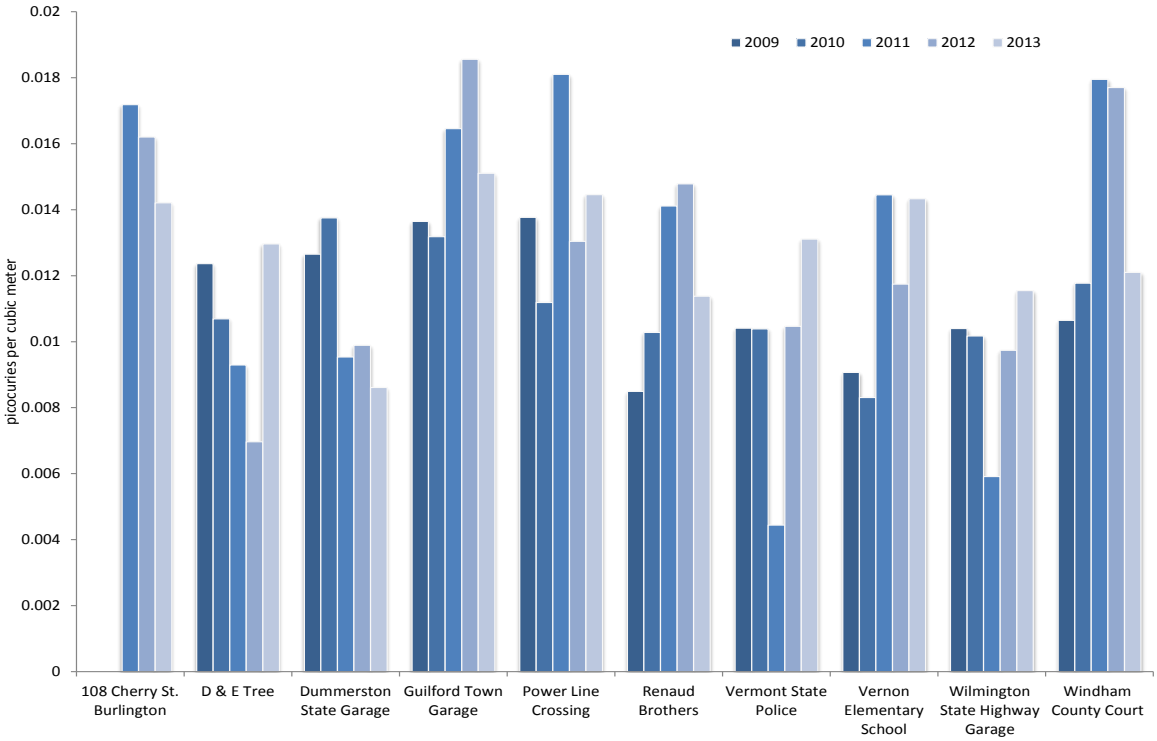


Table 12. 2013 Air Filter Composite Results (Gamma Spectroscopy)

Quarter	Last Date of Quarter	Element	Concentration +/- error (pCi)
1st Quarter	3/31/2013	Beryllium-7	2930 +/- 280
2nd Quarter	6/30/2013	Beryllium-7	4810 +/- 440
3rd Quarter	9/30/2013	Beryllium-7	5200 +/- 460
4th Quarter	12/31/2013	Beryllium-7	4540 +/- 420

In 2013, no alpha, beta or gamma radioactivity related to the operations of Vermont Yankee was identified in the continuous flow air samples. Results were within historical ranges.

Water Sampling Results

The Health Department has routinely collected off-site monthly water samples from six locations around Vermont Yankee. These routine water samples are tested for tritium, gamma-emitting materials, and total alpha and beta radioactivity. Collections are taken from drinking water wells (3), a public water supply (1) and the Connecticut River (2). These sample locations are shown on Map 7.

In addition, Vermont Yankee routinely collected at four Connecticut River sites monthly, stations 3-3, 3-4, 3-8 and the Discharge Forebay. These sample locations are shown in Map 8. Additional off-site samples are collected at private residences and a nursing home.

As a result of the tritium investigation, Vermont Yankee sampled on-site groundwater monitoring wells and on-site drinking water supplies. These on-site water sample sites are shown on Map 9. The Health Department received field duplicate water samples of these tritium-related monitoring sites.

Routine off-site water samples are tested for total alpha and beta radioactivity, gamma radioactivity and tritium. Water samples that were collected as a result of the tritium leak were tested by the Health Department for tritium and gamma-emitting materials. Other tests were performed by a contract laboratory and 124 water samples were also sent to the contract laboratory as a quality control check for tritium and gamma spectroscopy tests. For 2013:

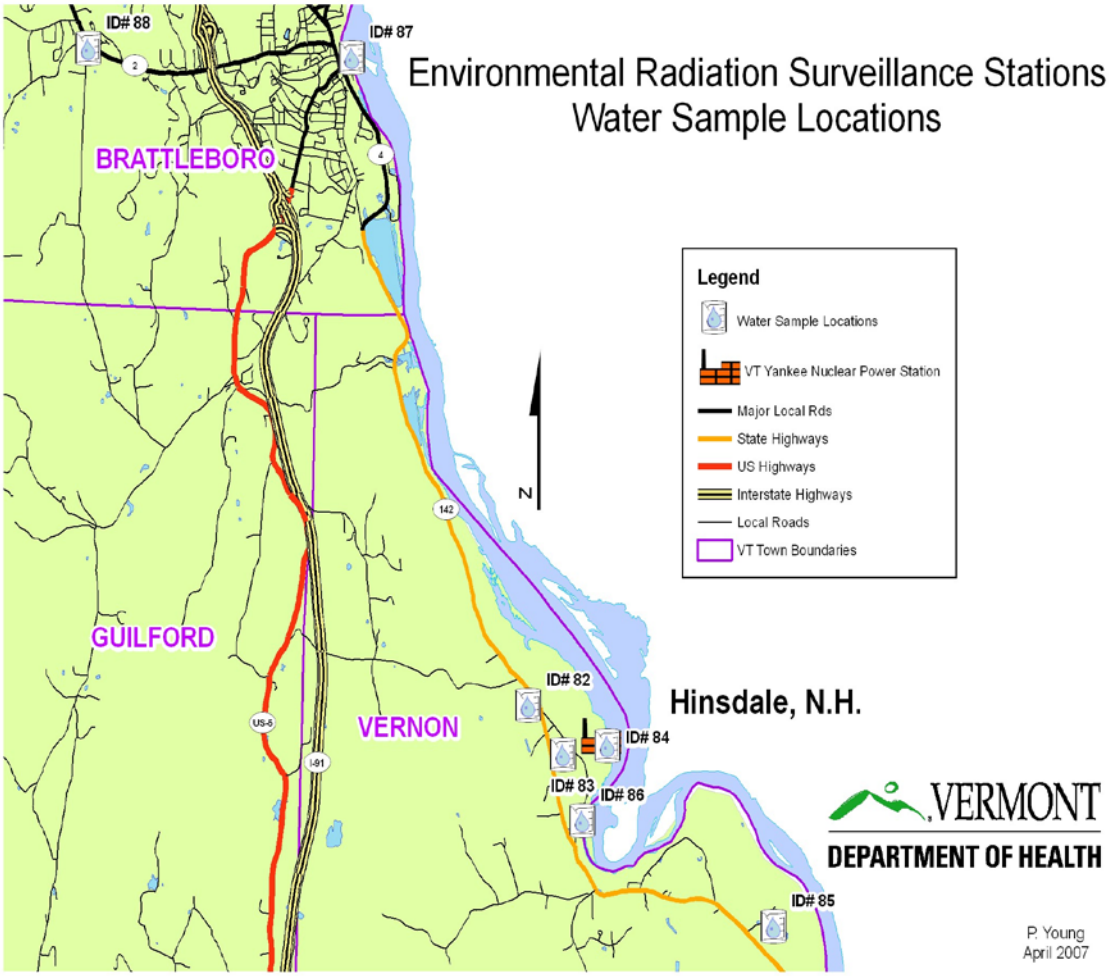
- 117 water samples were tested for total alpha and beta radioactivity.
- 603 water (ground, drinking, surface) samples were tested for tritium.
- 603 water samples were tested for gamma-emitting materials.
- 189 water samples were tested for hard-to-detect metals: iron-55, nickel-63, strontium-89, and strontium-90.

Due to the large number of results associated with tritium, gamma spectroscopy, and hard-to-detect analyses, the individual data for these tests are presented in Appendices B, C and D.

Water Total Alpha and Beta Radioactivity Results

The alpha and beta radioactivity measured in the water samples is within the historical range for both types of radioactivity. Water alpha and beta radioactivity measurements around Vermont Yankee have both historically ranged from below the lower limit of detection to 15 picocuries per liter (pCi/L). The 2013 range for alpha radioactivity is -1.34 to 9.2 pCi/L. The 2013 range for beta radioactivity is from -0.44 to 8.51 pCi/L. Results from 2013 are presented in Table 13. Comparisons of 2009-2013 data are presented in Figures 4 and 5. Trends for both alpha and beta results are similar to past years: Vernon Elementary School and Blodgett Farm have historically had higher levels of natural radioactivity in the water.

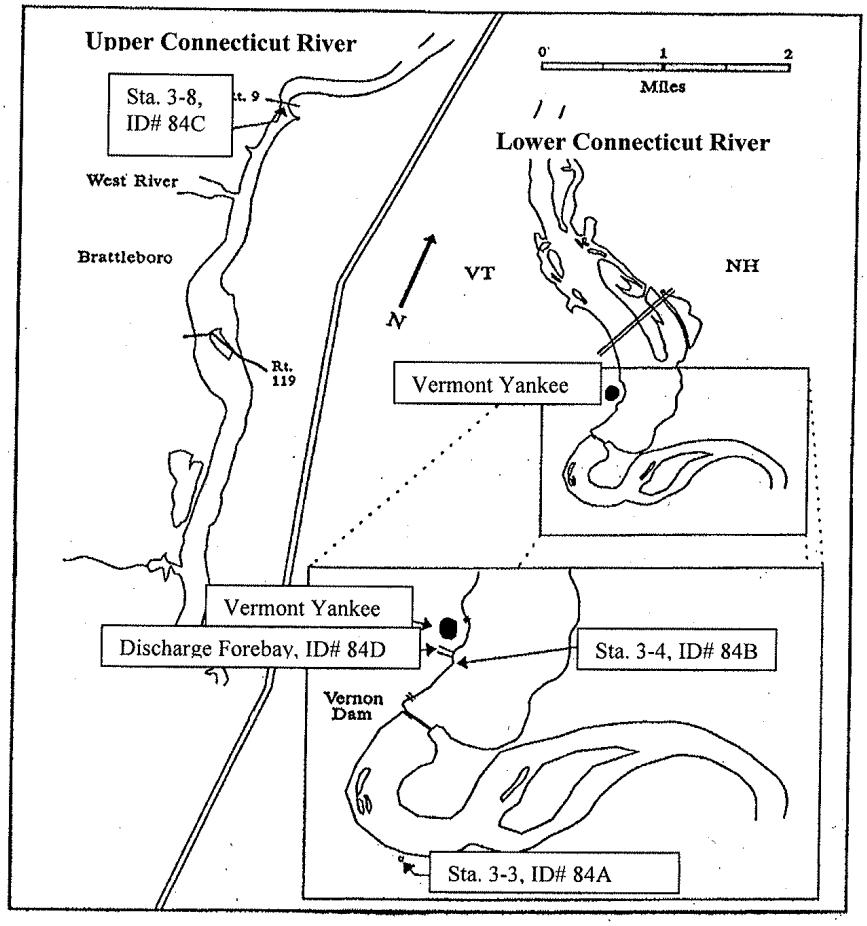
Map 7



Sample Location	Map ID
Miller Farm	82
Vernon Elementary School	83
Blodgett Farm	85
Connecticut River, Downstream	86
Connecticut River, Upstream	87
Brattleboro Fire Dept., West Station	88

Map 8

Routine Connecticut River Water Sample Locations



Sample Location	Map ID
3-3 Connecticut River Station	84A
3-4 Connecticut River Station	84B
3-8 Connecticut River Station	84C
Discharge Forebay	84D

Table 13. 2013 Total Alpha and Beta Radioactivity Water Results

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/L)	Total Beta Radioactivity +/- error (pCi/L)
3-3 Connecticut River Station	1/15/2013	2.40 +/- 1.33	0.48 +/- 1.36
	2/14/2013	-0.79 +/- 1.31	0.78 +/- 1.03
	3/13/2013	0.00 +/- 1.49	0.30 +/- 1.02
	4/16/2013	0.50 +/- 1.32	1.33 +/- 1.40
	5/13/2013	0.00 +/- 1.44	1.72 +/- 1.05
	6/17/2013	0.53 +/- 1.36	2.16 +/- 1.05
	7/16/2013	0.27 +/- 1.41	1.81 +/- 1.03
	8/14/2013	0.55 +/- 1.47	1.22 +/- 1.05
	9/16/2013	0.61 +/- 1.70	3.02 +/- 1.08
	10/16/2013	1.08 +/- 1.60	2.54 +/- 1.42
	11/13/2013	0.23 +/- 0.49	1.82 +/- 1.06
	12/16/2013	0.33 +/- 0.46	0.11 +/- 1.17
3-4 Connecticut River Station	1/15/2013	1.69 +/- 1.34	1.32 +/- 1.39
	2/14/2013	0.00 +/- 1.39	2.75 +/- 1.09
	3/13/2013	0.84 +/- 1.58	2.07 +/- 1.08
	4/16/2013	0.49 +/- 1.29	1.09 +/- 1.39
	5/13/2013	-0.79 +/- 1.37	1.91 +/- 1.06
	6/17/2013	0.76 +/- 1.33	3.13 +/- 1.08
	7/16/2013	-0.53 +/- 1.33	1.61 +/- 1.03
	8/14/2013	1.65 +/- 1.53	0.93 +/- 1.04
	9/16/2013	0.57 +/- 1.59	1.53 +/- 1.03
	10/16/2013	0.79 +/- 1.54	1.45 +/- 1.38
	11/13/2013	0.23 +/- 0.50	1.33 +/- 1.04
	12/16/2013	0.33 +/- 0.46	0.22 +/- 1.17
3-8 Connecticut River Station	1/15/2013	0.64 +/- 0.51	0.48 +/- 0.55
	2/14/2013	-0.13 +/- 0.66	0.54 +/- 0.52
	3/13/2013	0.18 +/- 0.50	0.72 +/- 0.36
	4/15/2013	0.51 +/- 0.69	0.72 +/- 0.70
	5/13/2013	-1.05 +/- 1.36	2.01 +/- 1.06
	6/17/2013	0.25 +/- 1.29	2.64 +/- 1.06
	7/16/2013	0.27 +/- 1.41	1.91 +/- 1.04
	8/14/2013	0.78 +/- 1.38	1.32 +/- 1.05
	9/16/2013	0.87 +/- 1.63	1.93 +/- 1.05
	10/16/2013	0.00 +/- 1.57	1.09 +/- 1.37
	11/13/2013	0.00 +/- 0.22	0.61 +/- 0.52
	12/16/2013	-0.05 +/- 0.18	0.60 +/- 0.60

Table 13. 2013 Total Alpha and Beta Radioactivity Water Results (continued)

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/L)	Total Beta Radioactivity +/- error (pCi/L)
Blodgett Farm	1/8/2013	4.51 +/- 1.12	4.12 +/- 1.48
	2/5/2013	4.90 +/- 1.15	3.49 +/- 1.12
	3/5/2013	4.27 +/- 1.17	4.30 +/- 1.16
	4/2/2013	4.57 +/- 0.94	4.76 +/- 1.51
	5/7/2013	3.98 +/- 0.91	4.74 +/- 1.16
	6/4/2013	3.90 +/- 0.87	6.07 +/- 1.18
	7/9/2013	4.67 +/- 0.97	5.30 +/- 1.15
	8/6/2013	7.21 +/- 1.14	3.52 +/- 1.13
	9/4/2013	4.82 +/- 0.94	3.86 +/- 1.12
	10/8/2013	4.85 +/- 0.93	2.69 +/- 1.43
	11/5/2013	3.62 +/- 0.84	6.11 +/- 1.19
	12/3/2013	3.53 +/- 0.81	3.00 +/- 1.28
Brattleboro Fire Dept, West Station	1/8/2013	1.28 +/- 1.20	1.80 +/- 1.40
	2/5/2013	0.26 +/- 1.37	3.43 +/- 1.11
	3/5/2013	1.05 +/- 1.49	1.57 +/- 1.06
	4/2/2013	1.54 +/- 1.42	1.33 +/- 1.40
	5/7/2013	-1.34 +/- 1.37	1.03 +/- 1.03
	6/4/2013	0.00 +/- 1.31	1.96 +/- 1.04
	7/9/2013	0.28 +/- 1.46	1.62 +/- 1.03
	8/6/2013	-0.26 +/- 1.35	2.59 +/- 1.09
	9/4/2013	-1.06 +/- 1.37	2.41 +/- 1.06
	10/8/2013	0.75 +/- 1.46	2.90 +/- 1.42
	11/5/2013	-0.43 +/- 0.35	1.52 +/- 1.04
	12/3/2013	0.32 +/- 0.45	0.11 +/- 1.17
Connecticut River Downstream	1/8/2013	2.72 +/- 1.37	1.92 +/- 1.41
	2/5/2013	0.79 +/- 1.41	1.28 +/- 1.04
	3/5/2013	0.57 +/- 1.56	1.68 +/- 1.07
	4/2/2013	1.12 +/- 1.52	2.78 +/- 1.44
	5/7/2013	-0.78 +/- 1.36	3.09 +/- 1.09
	6/4/2013	0.77 +/- 1.33	0.78 +/- 1.00
	7/9/2013	5.05 +/- 1.99	5.60 +/- 1.16
	8/6/2013	0.27 +/- 1.42	0.44 +/- 1.02
	9/4/2013	0.81 +/- 1.52	3.60 +/- 1.52
	10/8/2013	0.27 +/- 1.53	3.51 +/- 1.44
	11/5/2013	0.67 +/- 0.54	1.52 +/- 1.05
	12/3/2013	0.55 +/- 0.49	-0.44 +/- 1.15

Table 13. 2013 Total Alpha and Beta Radioactivity Water Results (continued)

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/L)	Total Beta Radioactivity +/- error (pCi/L)
Connecticut River Upstream	4/2/2013	1.34 +/- 1.47	2.18 +/- 1.42
	5/7/2013	-0.27 +/- 1.46	3.49 +/- 1.11
	6/4/2013	0.27 +/- 1.38	0.78 +/- 1.01
	7/9/2013	0.28 +/- 1.43	1.81 +/- 1.04
	8/6/2013	0.84 +/- 1.50	1.71 +/- 1.06
	9/4/2013	0.28 +/- 1.55	3.60 +/- 1.10
	10/8/2013	-0.27 +/- 1.52	3.39 +/- 1.44
	11/5/2013	0.96 +/- 0.62	3.20 +/- 1.10
	12/3/2013	0.34 +/- 0.47	0.33 +/- 1.18
Discharge Forebay	1/15/2013	2.61 +/- 1.44	2.16 +/- 1.42
	2/14/2013	0.26 +/- 1.33	2.45 +/- 1.08
	3/13/2013	-0.89 +/- 1.54	1.19 +/- 1.05
	4/16/2013	0.49 +/- 1.29	0.72 +/- 1.38
	5/13/2013	0.53 +/- 1.48	1.03 +/- 1.03
	6/17/2013	1.30 +/- 1.39	1.57 +/- 1.03
	7/16/2013	0.55 +/- 1.45	1.81 +/- 1.04
	8/14/2013	0.79 +/- 1.4	1.61 +/- 1.06
	9/16/2013	-0.29 +/- 1.56	2.52 +/- 1.07
	10/16/2013	1.88 +/- 1.65	1.82 +/- 1.39
	11/13/2013	0.46 +/- 0.53	1.72 +/- 1.05
	12/16/2013	0.55 +/- 0.50	0.44 +/- 1.18
Miller Farm	1/8/2013	0.24 +/- 0.75	6.87 +/- 1.55
	2/5/2013	1.50 +/- 0.89	3.15 +/- 1.10
	3/5/2013	0.00 +/- 0.84	4.05 +/- 1.14
	4/2/2013	0.31 +/- 0.75	2.66 +/- 1.44
	5/7/2013	0.34 +/- 0.52	4.19 +/- 1.13
	6/4/2013	0.49 +/- 0.5	2.07 +/- 1.05
	7/9/2013	0.58 +/- 0.56	4.98 +/- 1.14
	8/6/2013	0.46 +/- 0.51	5.07 +/- 1.17
	9/4/2013	1.07 +/- 0.55	7.81 +/- 1.23
	10/8/2013	0.76 +/- 0.53	8.51 +/- 1.58
	11/5/2013	0.92 +/- 0.53	8.26 +/- 1.25
	12/3/2013	1.33 +/- 0.57	7.86 +/- 1.44

Table 13. 2013 Total Alpha and Beta Radioactivity Water Results (continued)

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/L)	Total Beta Radioactivity +/- error (pCi/L)
Vernon Elementary School	1/8/2013	6.52 +/- 1.25	4.47 +/- 1.49
	2/5/2013	7.35 +/- 1.31	5.35 +/- 1.17
	3/5/2013	7.27 +/- 1.36	5.58 +/- 1.19
	4/2/2013	7.06 +/- 1.27	5.35 +/- 1.52
	5/7/2013	9.20 +/- 1.27	6.11 +/- 1.19
	6/4/2013	7.00 +/- 1.11	5.77 +/- 1.17
	7/9/2013	7.75 +/- 1.19	4.50 +/- 1.13
	8/6/2013	7.28 +/- 1.14	6.26 +/- 1.2
	9/4/2013	6.74 +/- 1.08	4.97 +/- 1.16
	10/8/2013	8.97 +/- 1.22	4.38 +/- 1.47
	11/5/2013	7.31 +/- 1.13	5.40 +/- 1.17
	12/3/2013	6.79 +/- 1.07	4.10 +/- 1.32

Figure 4. 2009-2013 Average Alpha Radioactivity in Water

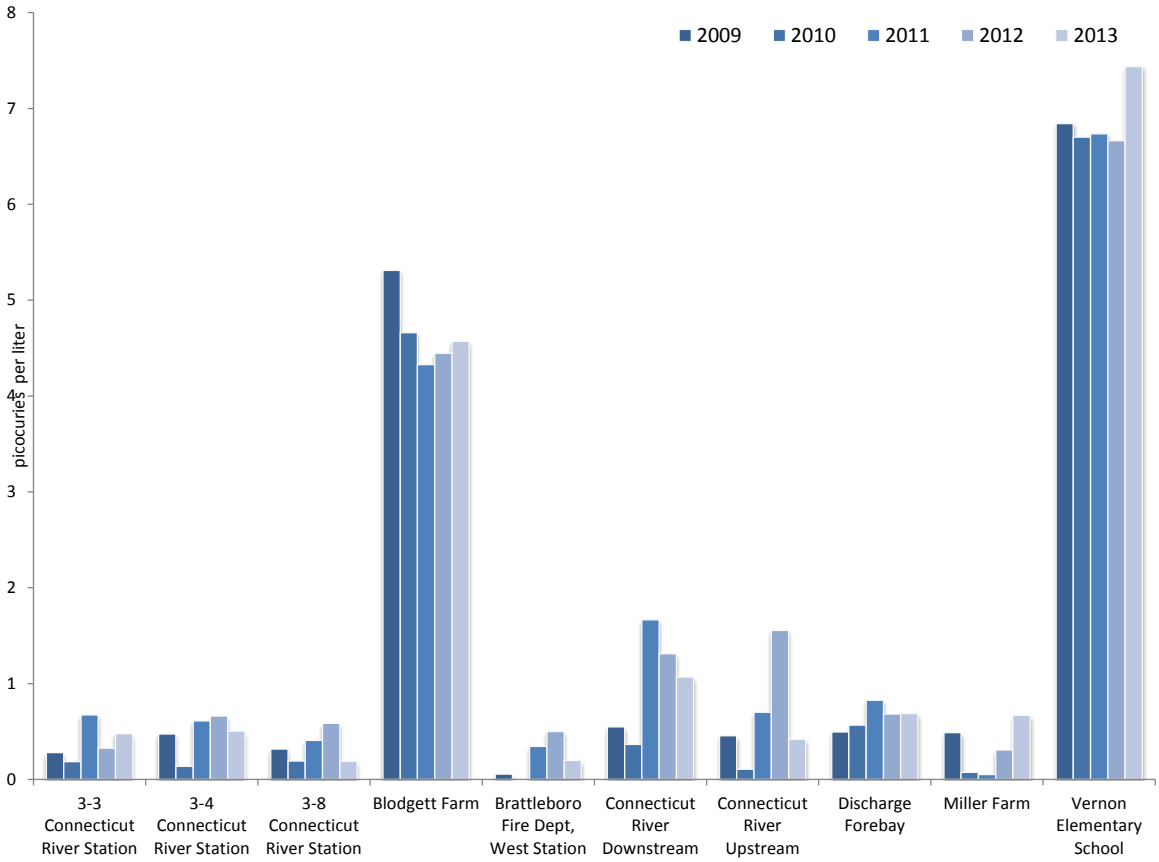
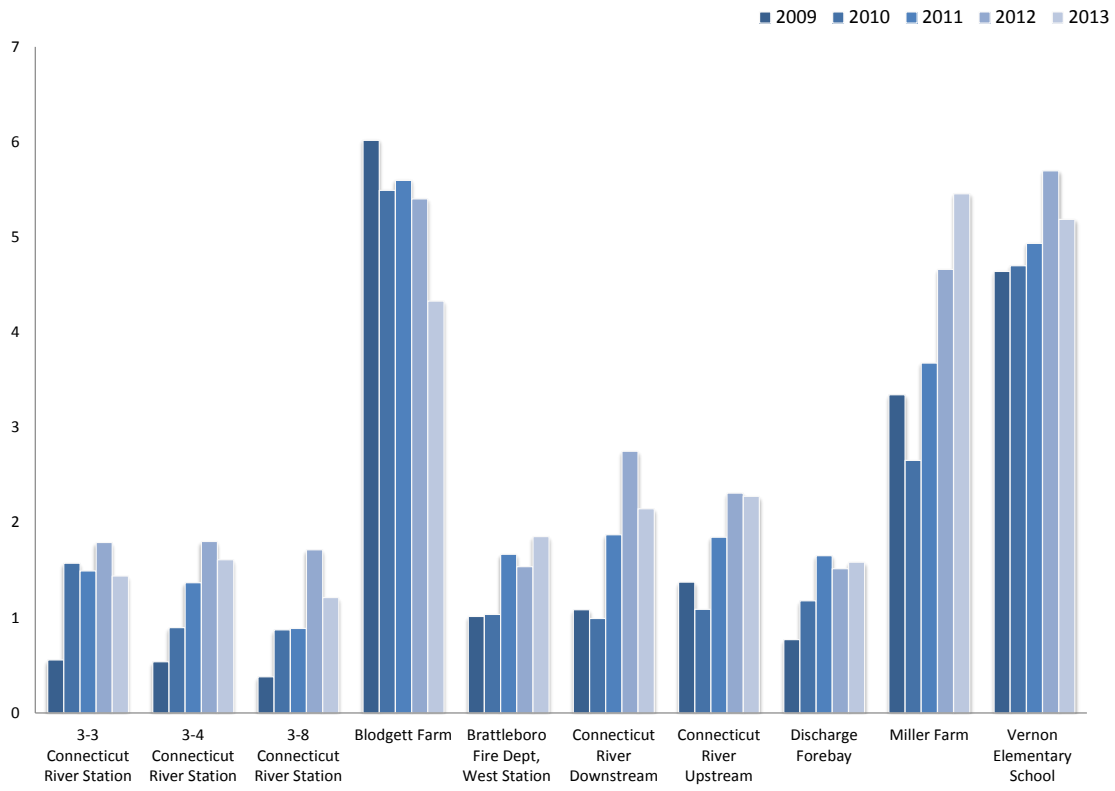


Figure 5. 2009-2013 Average Beta Radioactivity in Water



Water Gamma Spectroscopy Results

A total of 603 drinking, ground and surface (Connecticut River) water samples were collected from both on and off-site locations in 2013 for gamma-emitting materials. No radioactive materials other than naturally-occurring were identified in any water sample collected in 2013. The Health Department calculated limits of detection for gamma-emitting materials are listed in Table 8. All results are presented in Appendix C.

Water Tritium Results

In 2013, the Health Department had 603 drinking, ground and surface (Connecticut River) water samples tested from both on and off-site locations for tritium. The maximum tritium concentration measured was 74,200 picocuries per liter (pCi/L) in well GZ-15 in

April 2013. This well's tritium concentration declined to 21,700 pCi/L by December 2013.

Tritium concentrations over time, as measured by groundwater well results, generally decreased over the year. The highest concentration of tritium at the year's end was GZ-15.

No tritium was detected from any off-site water sample or any on-site active drinking water sample, or in any Connecticut River samples. The Health Department Laboratory's lower limit of detection for tritium is 500 picocuries per liter.

A brief summary of tritium results by each sampling location is presented in Table 14. Graphs demonstrating the trends in tritium concentrations in groundwater monitoring wells are presented in Figures 6-10. All tritium data are presented in Appendix B.

Map 9

Onsite Well Locations at Vermont Yankee

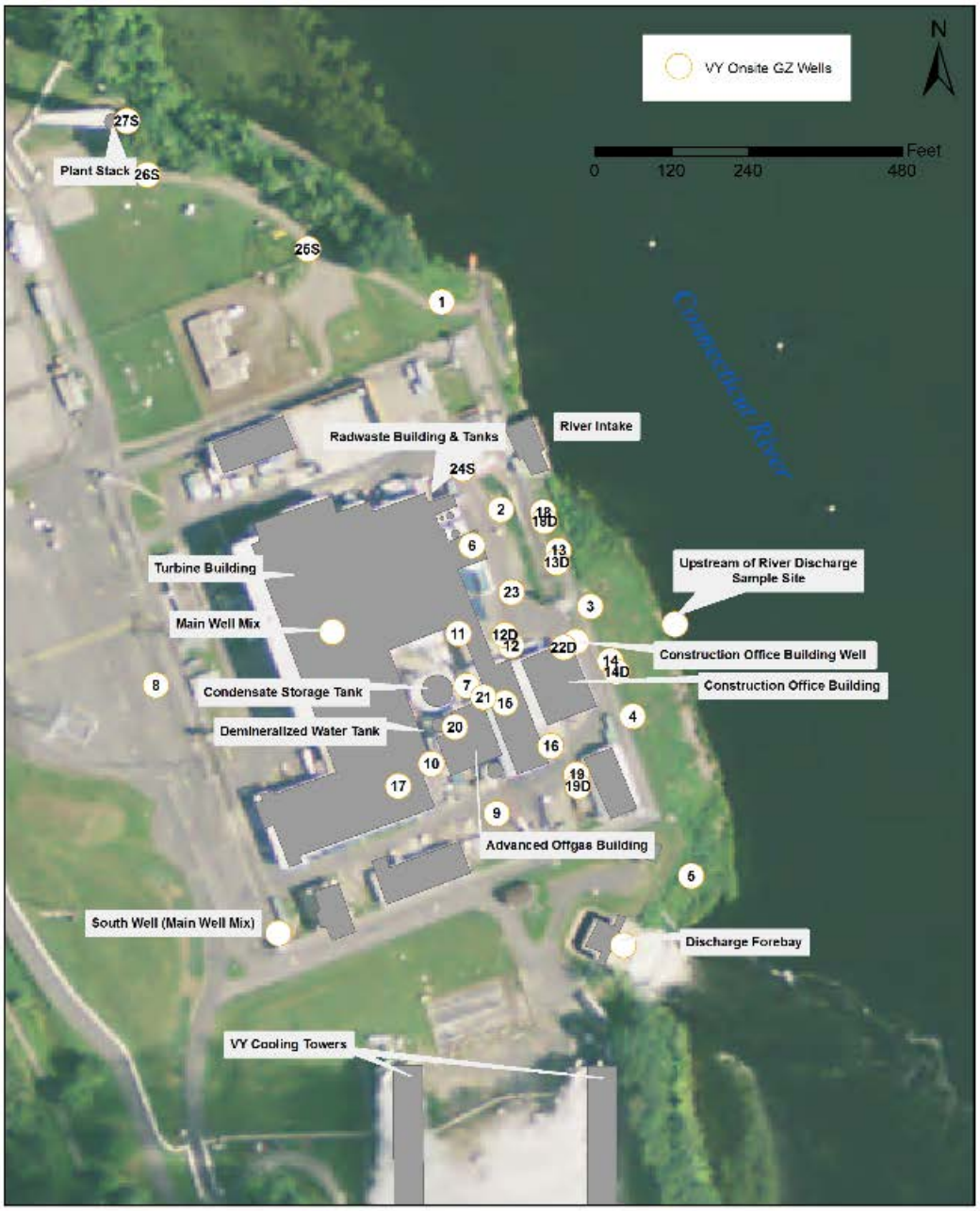


Table 14. 2013 Vermont Yankee Groundwater Wells, Tritium Detected

Monitoring Well	Range of tritium concentration in well (pCi/L)			Trend of Tritium Concentration in 2013
	Jan-2013		Dec-2013	
GZ-03	660	to	< 500	relatively steady
GZ-04	599	to	584	relatively steady
GZ-06	< 500	to	517	relatively steady
GZ-11	654	to	567	relatively steady
GZ-12S	2,340	to	1,530	decreased
GZ-12D	20,500	to	8,300	decreased
GZ-13D	923	to	690	slight decrease
GZ-14S	25,300	to	6560	decreased
GZ-14D	14,800	to	15,000	relatively steady
GZ-15	67,100	to	21,700	decreased
GZ-18D	614	to	< 500	relatively steady
GZ-21	686	to	1,520	increased
GZ-22D	27,900	to	15,600	decreased
GZ-23S	1,370	to	2,790	increased

[a] Ranges presented are from tests performed at the Health Department Laboratory.
< LLD means less than the laboratory's lower limit of detection

Table 15. 2013 Water Sample Locations, Number of TritiumTests

Wells near Vermont Yankee		Connecticut River Sample Sites	
Blodgett Farm	24	3-3 Connecticut River Station	12
Brattleboro Fire Department, West Station	24	3-4 Connecticut River Station	12
Miller Farm	24	3-8 Connecticut River Station	12
Residence - 1	23	Discharge Forebay	12
Vernon Elementary School	24	Connecticut River Upstream	18
Vernon Green Nursing Home	24	Connecticut River Downstream	24
White House	10		
On-site Wells			
GZ-01	4	GZ-19D	4
GZ-02	12	GZ-19S	4
GZ-03	12	GZ-20	12
GZ-04	11	GZ-21	12
GZ-05	4	GZ-22D	11
GZ-06	12	GZ-23S	11
GZ-07	12	GZ-24S	12
GZ-09	12	GZ-25S	12
GZ-10	9	GZ-26S	10
GZ-11	12	GZ-27S	12
GZ-12D	11	WVN0201	4
GZ-12S	11	WVN0202	4
GZ-13D	12	WVN0203	4
GZ-13S	12	WVN0204	4
GZ-14D	11	Main Well	11
GZ-14S	11	Plant Support Building	11
GZ-15	11	Southwest Well	3
GZ-16	12		
GZ-17	4		
GZ-18D	12	**Total number of samples tested for tritium**	
GZ-18S	12	**603**	

Figure 6. 2013 Tritium in Groundwater Monitoring Wells: GZ-03, GZ-04, GZ-14S

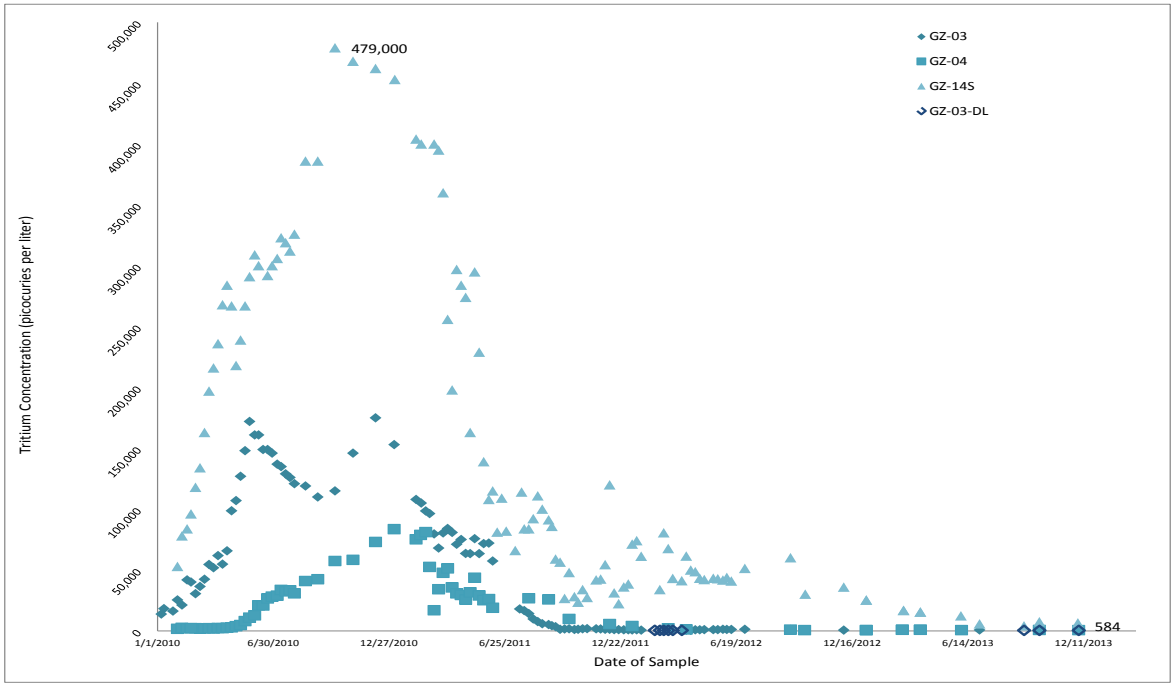


Figure 7. 2013 Tritium in Groundwater Monitoring Wells: GZ-07, GZ-15, GZ-21

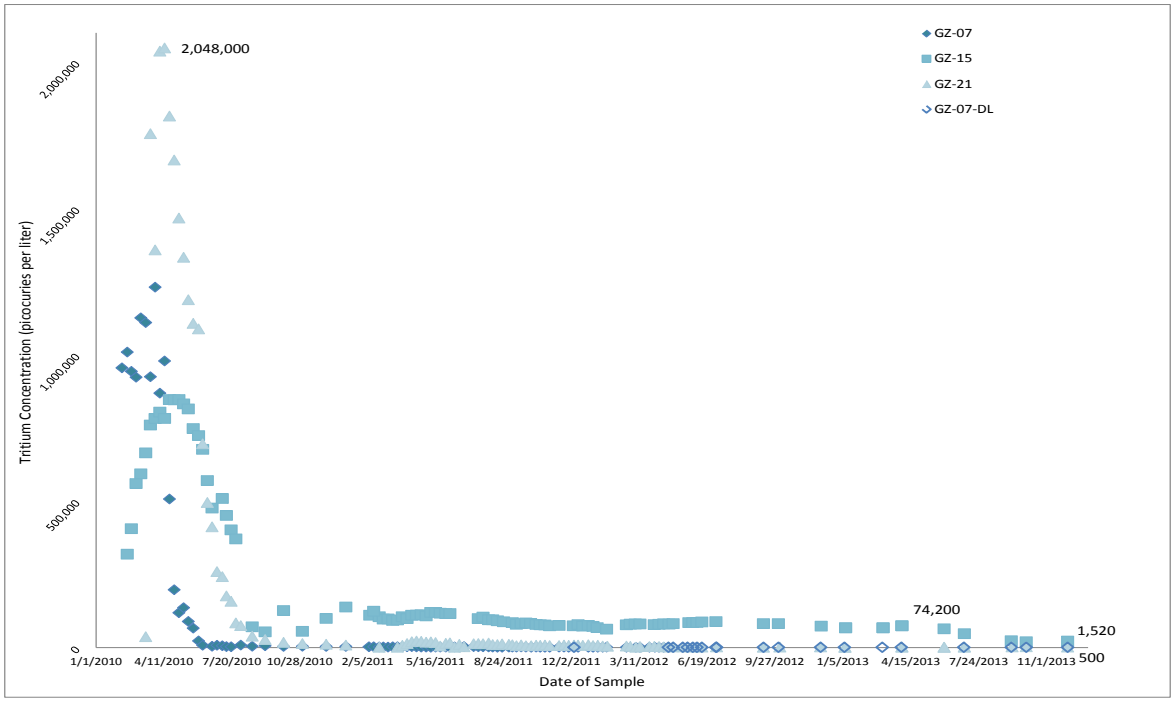


Figure 8. 2013 Tritium in Groundwater Monitoring Wells: GZ-12D, GZ-22D

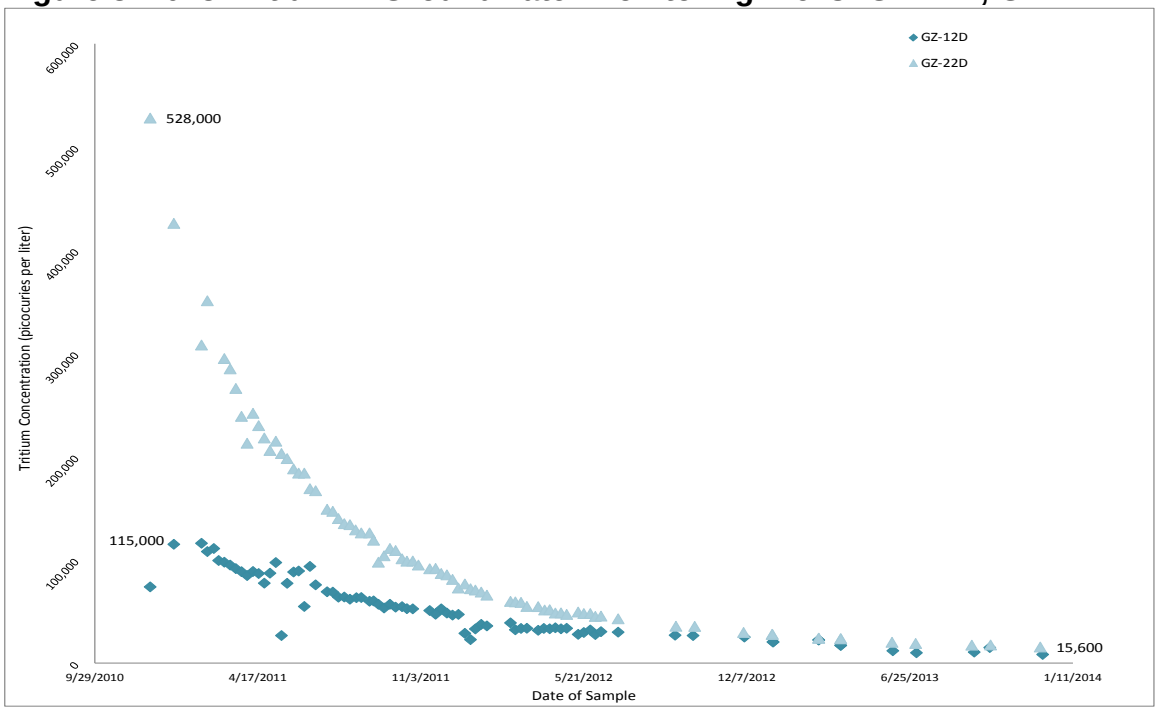


Figure 9. 2013 Tritium in Groundwater Monitoring Wells: GZ-12S, GZ-20

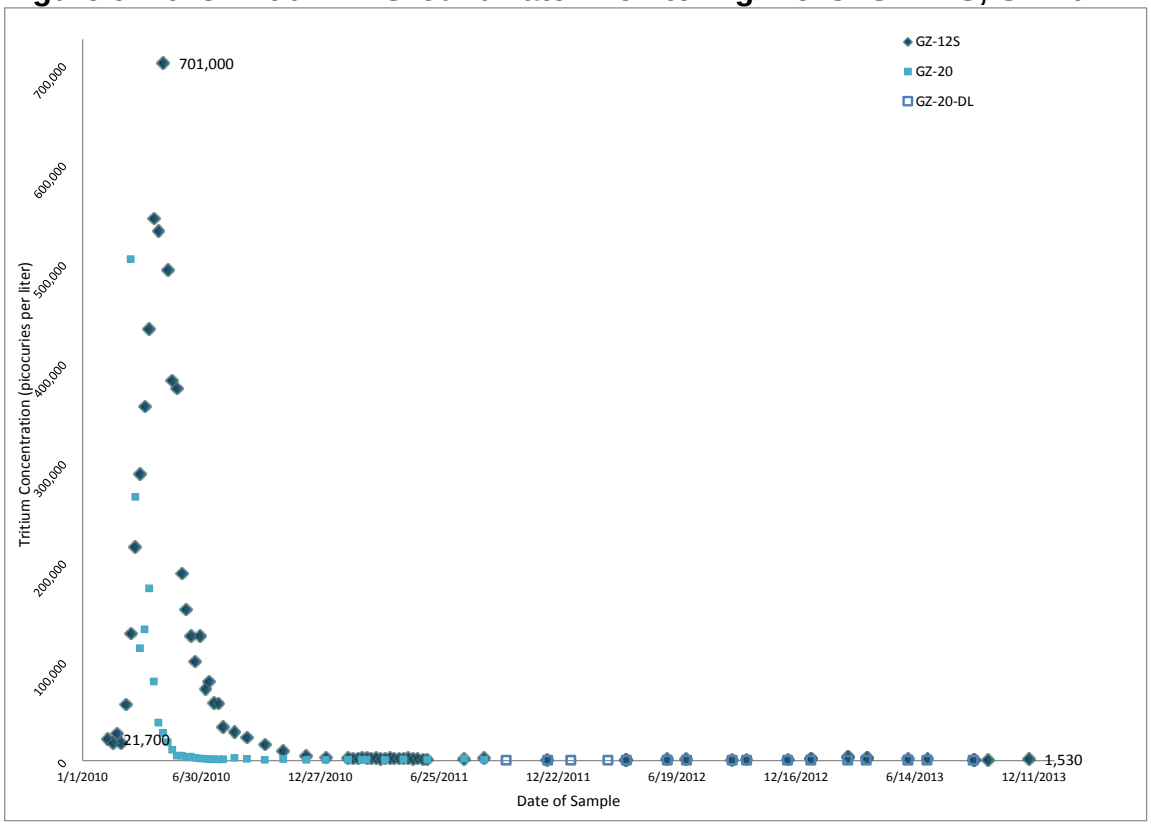
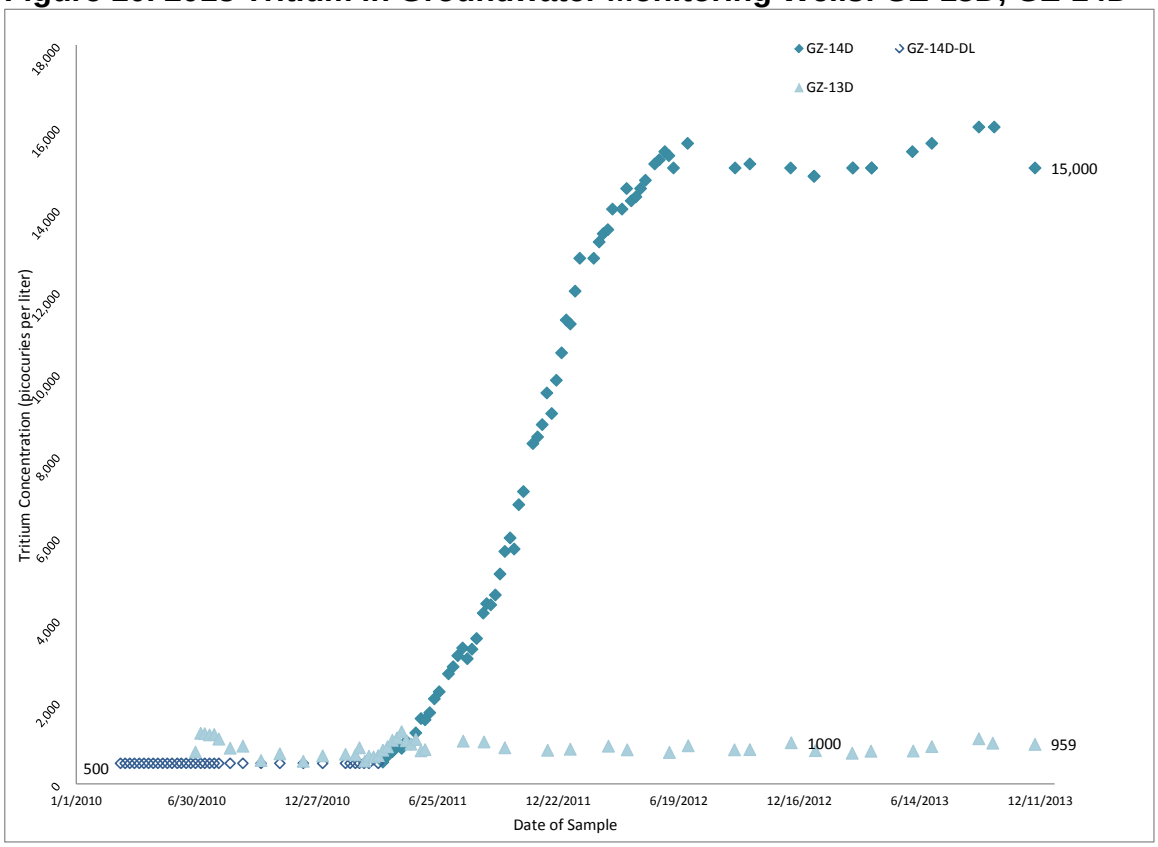


Figure 10. 2013 Tritium in Groundwater Monitoring Wells: GZ-13D, GZ-14D



Hard-to-Detect Results

This is the fourth year that tests for hard-to-detect metals, iron-55, nickel-63, strontium-89 and strontium-90, have been done by the Health Department. Quarterly water samples taken from each water sampling location were submitted to a contract laboratory for testing. Results for hard-to-detect samples are provided in Appendix D. Of the 189 water samples tested, no iron-55, nickel-63, strontium-89, or strontium-90 was detected.

In 2013, all off-site water sample locations showed no dose impact of operations at Vermont Yankee for total alpha, total beta, tritium, gamma spectroscopy, and hard-to-detect radioactive elements. In 2013, as in 2010, the one human-made radioactive element that has been measured in water samples is tritium from on-site water sources. The levels of tritium detected show a groundwater plume traveling from the source of the leaks to the Connecticut River. The dose associated with the tritium-contaminated plume

in 2013 at Vermont Yankee did not measurably increase the dose from liquid effluents (discharges) to any member of the general public.

Food Chain Sampling Results

Monitoring the food chain involves direct monitoring of some foods such as milk, cultivated vegetation and fish. It also involves testing the soil and sediment that support land and aquatic species, and natural vegetation like grass, ferns and fungi.

For 2013:

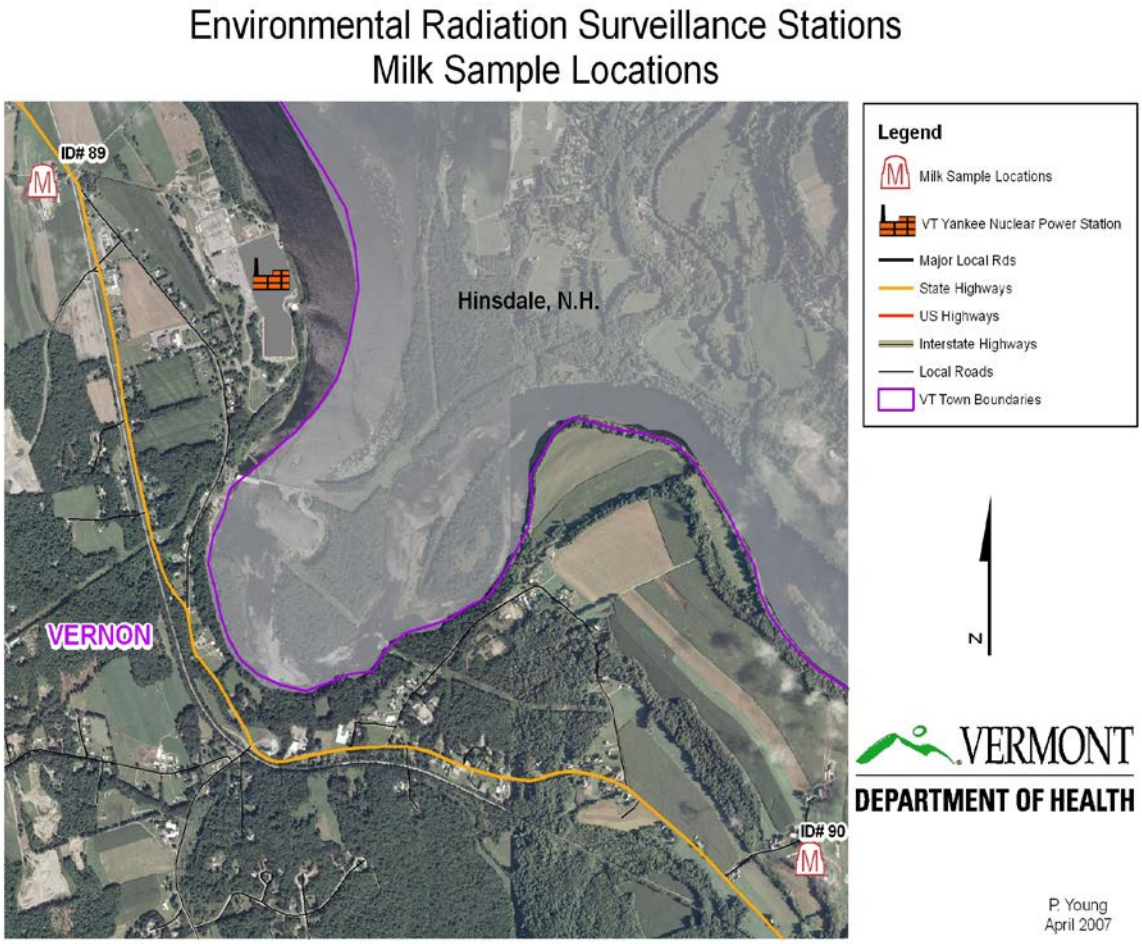
- 18 milk samples were tested for iodine-131 and gamma-emitting materials.
- 36 Connecticut River sediment samples were tested for gamma-emitting materials.
- 5 environmental soil samples were tested for gamma-emitting materials.
- 3 vegetation samples were tested for gamma-emitting materials.
- 8 fish samples collected in the Connecticut River were tested for gamma-emitting materials, iron-55, nickel-63, strontium-89 and strontium-90.

Milk Sample Results

Cows' raw milk is sampled monthly from two farms in Vernon. One farm is about one-half mile north of Vermont Yankee and the other is about three miles south of Vermont Yankee. Map 10 shows the location of these two dairy farms.

Potassium-40 (K-40) was the only radioactive material found in milk samples. Potassium-40 is a primordial radioactive material. Primordial radioactive materials are those created with the formation of the earth. Potassium-40 has a half-life of 1.28 billion years. In 2013 potassium-40 was detected in all milk samples. Results are shown in Table 16. The potassium-40 results for all milk samples ranged from 1,270 to 1,430 picocuries per liter (pCi/L), and fall within the historical range of 1,200 to 2,000 pCi/L. The average potassium-40 result in 2013 was 1,340 pCi/L. No iodine-131 was found in any milk sample in 2013.

Map 10



Sample Location	Map ID
Miller Farm	89
Blodgett Farm	90

Table 16. 2013 Milk Iodine-131 and Gamma Spectroscopy Results

Sample Location	Date of Sample	Iodine-131 Result	Gamma Spectrometry Result	Potassium-40 Result +/- error (pCi/L)
Blodgett Farm	1/8/2013	< LLD	Natural	1310 +/- 230
Miller Farm	1/8/2013	< LLD	Natural	1370 +/- 240
Blodgett Farm	2/5/2013	< LLD	Natural	1320 +/- 230
Miller Farm	2/5/2013	< LLD	Natural	1340 +/- 230
Blodgett Farm	3/5/2013	< LLD	Natural	1300 +/- 230
Blodgett Farm	4/2/2013	< LLD	Natural	1360 +/- 240
Miller Farm	4/2/2013	< LLD	Natural	1400 +/- 240
Blodgett Farm	5/7/2013	< LLD	Natural	1310 +/- 230
Miller Farm	5/7/2013	< LLD	Natural	1300 +/- 230
Blodgett Farm	6/4/2013	< LLD	Natural	1340 +/- 230
Miller Farm	6/4/2013	< LLD	Natural	1400 +/- 240
Miller Farm	7/9/2013	< LLD	Natural	1430 +/- 250
Miller Farm	8/6/2013	< LLD	Natural	1360 +/- 240
Miller Farm	9/4/2013	< LLD	Natural	1270 +/- 220
Blodgett Farm	10/8/2013	< LLD	Natural	1410 +/- 240
Blodgett Farm	11/5/2013	< LLD	Natural	1320 +/- 230
Blodgett Farm	12/3/2013	< LLD	Natural	1330 +/- 230
Miller Farm	12/3/2013	< LLD	Natural	1300 +/- 230

< LLD = Less than the laboratory's Lower Limit of Detection
Natural = gamma-emitting materials measured are not related to nuclear reactions

Vegetation and Soil Sample Results

Five soil samples were collected in the state. The results are shown in Table 17. The soil contained measurable amounts of potassium-40 and beryllium-7, at levels similar to historical values for Vermont and the area around Vermont Yankee. Potassium-40 and beryllium-7 are naturally-occurring. Human-made cesium-7 was not found in 2013 soil samples.

Table 17. 2013 Soil Sample Results

Sample Location	Date of Sample	Beryllium-7 +/- error (pCi/kg)	Potassium-40 +/- error (pCi/kg)	Cesium-137 +/- error (pCi/kg)
Washington County-1	11/13/2013	< LLD	13000 +/- 2400	< LLD
Washington County-2	11/13/2013	< LLD	17400 +/- 3200	< LLD
Washington County-3	11/13/2013	613 +/- 202	17000 +/- 3200	< LLD
Washington County-4	11/13/2013	550 +/- 182	17600 +/- 3200	< LLD
Washington County-5	11/13/2013	< LLD	13900 +/- 2600	< LLD
Windham County Historical Range	2009-2011	<LLD-512	7660-17400	<LLD-1090

< LLD = Less than the laboratory's Lower Limit of Detection

Vegetation samples were taken in November 2013. Results are presented in Table 18. Potassium-40 and beryllium-7 were detected in the vegetation samples, at levels within historical ranges for Vermont and the area around Vermont Yankee. Both are naturally-occurring. No other gamma-emitting materials were detected.

Table 18. 2013 Vegetation Sample Results

Sample Location	Date of Sample	Sample type	Beryllium-7 +/- error (pCi/kg)	Potassium-40 +/- error (pCi/kg)
Washington County-1	11/13/2013	Vegetation - Dry Grass	6690 +/- 840	4140 +/- 1100
Washington County-2	11/13/2013	Vegetation - Partially Dry Grass	4680 +/- 560	5700 +/- 1140
Washington County-3	11/13/2013	Vegetation - Dry Plants	3990 +/- 800	2130 +/- 920
Windham County Historical Range	2009-2011	Natural Vegetation	<LLD-6890	1620-7740

Sediment Sample Results

Sediment samples were collected from the bottom of the Connecticut River. The sediment samples were taken from four areas of the Connecticut River: Station 3-3 (south of Vernon Dam), Station 3-4 (near Vermont Yankee discharge), Station 3-8 (upstream near the Route 9 bridge) and the North Storm Drain area. In 1997, the North Storm Drain area was identified to have been contaminated with cobalt-60 from Vermont Yankee operations. The North Storm Drain area is sampled at 15 distinct locations: S-1, S-2, T-1, T-2, T-3, U-1, U-2, U-3, U-4, V-3, V-4, V-5, W-4, W-5 and X-5. These sample locations

are shown in Map 11. Cobalt-60 was last detected in a sediment sample obtained and tested in 2004.

All sediment locations are sampled each spring and fall. A sediment sample is taken with a mass ranging from 0.75 to 1.25 kilograms. Sediment samples are dried and tested by gamma spectroscopy. Tested sediments contained naturally-occurring potassium-40 (K-40) and beryllium-7 (Be-7), as well as fallout-related cesium-137 (Cs-137). The results are presented in Table 20. No cobalt-60 was detected in samples collected this year. Concentrations of beryllium-7, potassium-40 and cesium-137 were detected generally within historical ranges for Vermont. Comparisons to previous years' data are presented in Figures 11 and 12.

Table 19. 2013 Sediment Gamma Spectroscopy Ranges as Compared to Historical Ranges

Radioactive Element	2013 Sediment Concentration Range (pCi/kg)	Historical Sediment Concentration Range (pci/kg)
Beryllium-7	< LLD-2,100	< LLD-3,000
Potassium-40	10,400-30,500	6,000-30,400
Cesium-137	< LLD-125	< LLD-500
< LLD means less than the Laboratory's Lower Limit of Detection		

Map 11

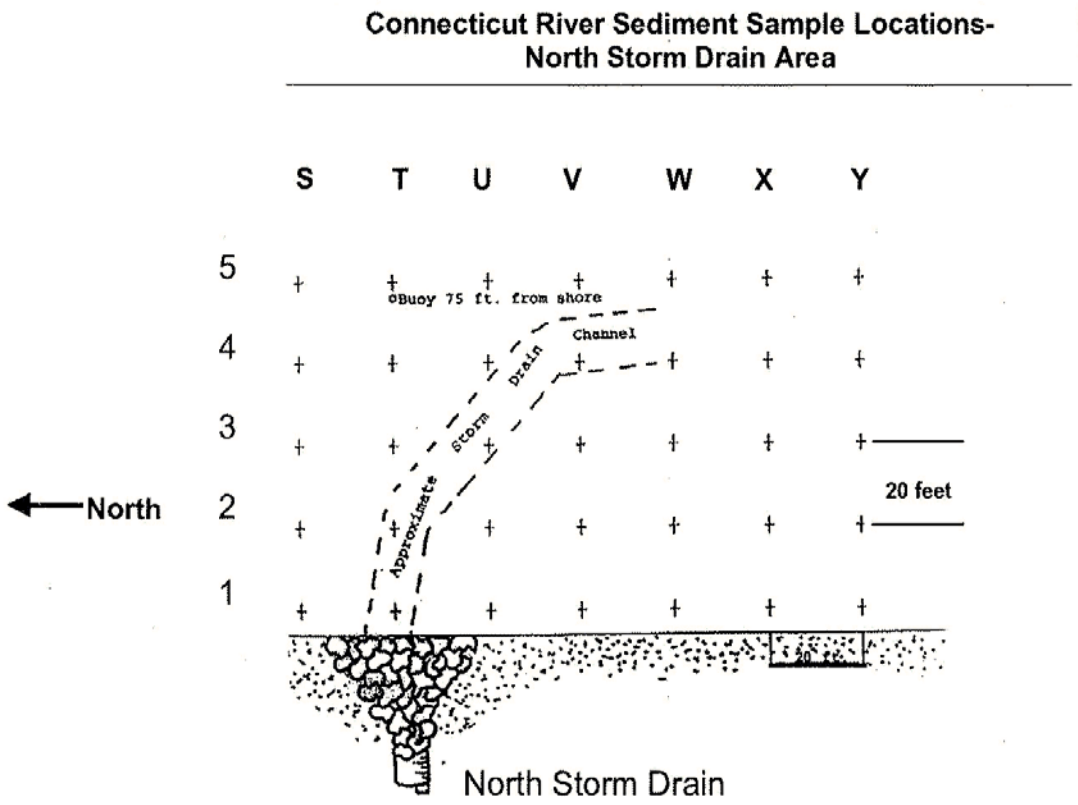

Connecticut River Sediment Sample Locations-
North Storm Drain Area
S
T
U
V
W
X
Y
5
4
3
2
1
North
Buoy 75 ft. from shore
Channel
Storm drain
Approximate
20 feet
North Storm Drain

Table 20. 2013 Sediment Gamma Spectroscopy Results

Sample Location	Date of Sample	Beryllium-7 Result +/- error (pCi/L)	Potassium-40 Result +/- error (pCi/L)	Cesium-137 Result +/- error (pCi/L)
3-3	5/7/2013	< LLD	10,400 +/- 2,000	62.6 +/- 18.2
3-4	5/7/2013	< LLD	20,100 +/- 3,800	104 +/- 39.0
3-8	5/7/2013	< LLD	12,800 +/- 2,400	< LLD
S-1	5/7/2013	< LLD	21,700 +/- 4,100	97.2 +/- 35.5
S-2	5/7/2013	< LLD	26,000 +/- 4,900	114 +/- 36.0
T-1	5/7/2013	< LLD	10,500 +/- 2,000	29.2 +/- 18.8
T-2	5/7/2013	< LLD	24,700 +/- 4,600	123 +/- 43.0
T-3	5/7/2013	< LLD	24,400 +/- 4,600	94.1 +/- 36.3
U-1	5/7/2013	< LLD	17,900 +/- 3,400	89.7 +/- 31.0
U-2	5/7/2013	< LLD	27,700 +/- 5,200	82.1 +/- 38.8
U-3	5/7/2013	< LLD	30,500 +/- 5,700	109 +/- 36.0
U-4	5/7/2013	< LLD	27,800 +/- 5,200	61.3 +/- 37.6
V-3	5/7/2013	< LLD	28,700 +/- 5,300	80.3 +/- 34.6
V-4	5/7/2013	< LLD	24,300 +/- 4,500	83.3 +/- 26.5
V-5	5/7/2013	< LLD	22,900 +/- 4,300	70.7 +/- 25.5
W-4	5/7/2013	< LLD	23,100 +/- 4,300	66.6 +/- 32.6
W-5	5/7/2013	< LLD	20,000 +/- 3,700	64.7 +/- 27.5
X-5	5/7/2013	< LLD	21,000 +/- 3,900	52.3 +/- 25.1
3-3	10/30/2013	< LLD	16,600 +/- 3,100	57.3 +/- 24.5
3-4	10/30/2013	< LLD	11,300 +/- 2,100	< LLD
3-8	10/30/2013	< LLD	11,400 +/- 2,200	47.7 +/- 19.8
S-1	10/30/2013	< LLD	22,500 +/- 4,200	121 +/- 43.0
S-2	10/30/2013	2100 +/- 500	17,000 +/- 3,200	40.1 +/- 34.5
T-1	10/30/2013	< LLD	21,400 +/- 4,000	92.6 +/- 28.7
T-2	10/30/2013	1500 +/- 440	19,100 +/- 3,600	89.1 +/- 36.5
T-3	10/30/2013	< LLD	24,000 +/- 4,400	119 +/- 36.0
U-1	10/30/2013	< LLD	17,600 +/- 3,300	95.9 +/- 40.6
U-2	10/30/2013	< LLD	24,000 +/- 4,500	125 +/- 39.0
U-3	10/30/2013	< LLD	24,800 +/- 4,600	98.9 +/- 29.7
U-4	10/30/2013	< LLD	25,600 +/- 4,800	87.8 +/- 38.9
V-3	10/30/2013	< LLD	26,900 +/- 5,000	68.8 +/- 30.4
V-4	10/30/2013	< LLD	26,500 +/- 4,900	74.8 +/- 37.0
V-5	10/30/2013	< LLD	25,600 +/- 4,700	81 +/- 28.2
W-4	10/30/2013	< LLD	25,300 +/- 4,700	88.3 +/- 28.0
W-5	10/30/2013	< LLD	25,000 +/- 4,600	98.9 +/- 29.3
X-5	10/30/2013	< LLD	25,000 +/- 4,700	76.2 +/- 31.6

< LLD = Less than the laboratory's Lower Limit of Detection

Figure 11. 2009-2013 Average Potassium-40 Levels in Sediment

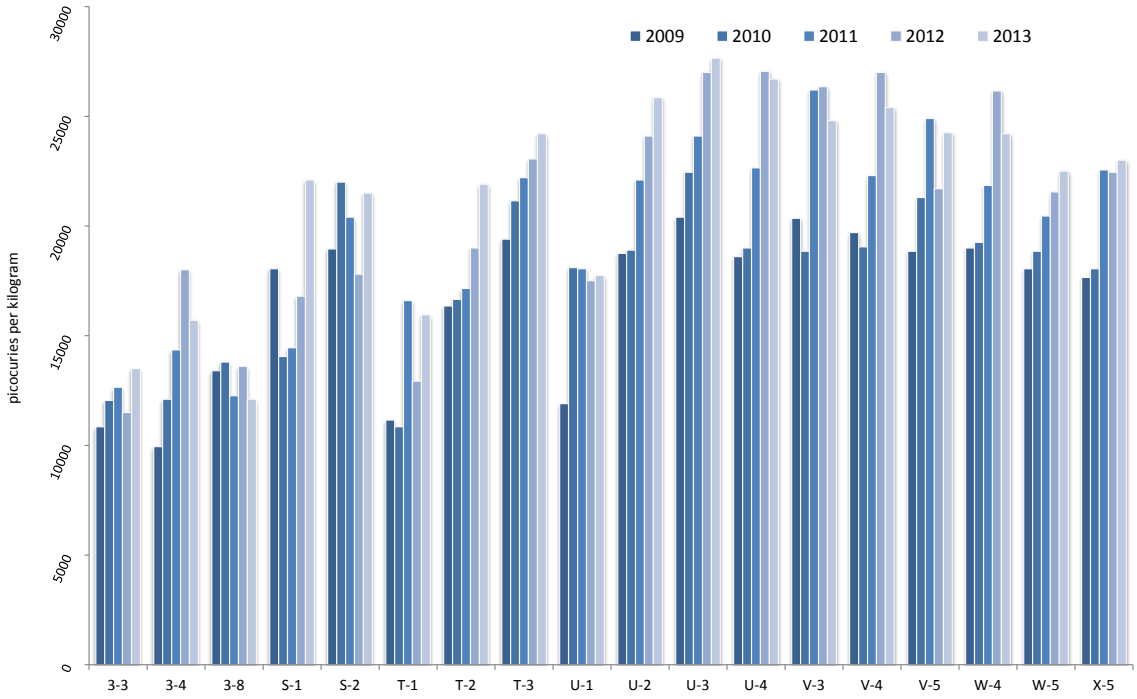
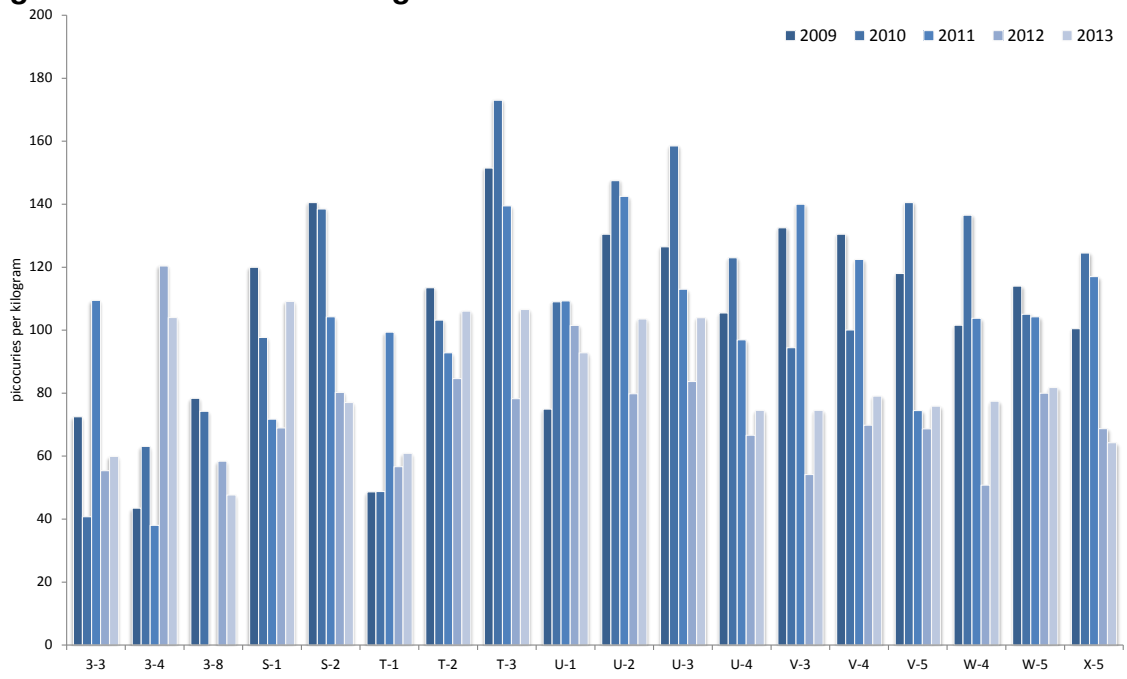


Figure 12. 2009-2013 Average Cesium-137 Levels in Sediment



Fish Sample Results

Connecticut River Fish Samples

Each year, fish are collected at two sites in the Connecticut River by an environmental contractor. One site is near the Vermont Yankee discharge and the other site is about nine miles upstream from Vermont Yankee, where the Route 9 bridge crosses the Connecticut River.

Fish samples were divided into edible and inedible portions and tested separately. The Health Department's contract laboratory tests for hard-to-detect radioactive metals and gamma-emitting materials. Fish types tested in 2013 included large and small mouth bass. Fish gamma spectroscopy results are presented in Table 21 and hard-to-detect metal results are in Table 22.

Potassium-40, cesium-137 and strontium-90 were measured in the Connecticut River fish in 2013. Potassium-40, a naturally-occurring radioactive material, was detected in all fish. The cesium-137 results are within the historical range of less than the lower limit of detection to 100 picocuries per kilogram (pCi/kg), and were only found in the inedible portion of fish. Strontium-90 was also only found in the inedible portion of fish in 2013. The levels of strontium-90 measured in these fish did not pose a health risk. The levels of cesium-137 and strontium-90 measured may be attributed to the fallout from above-ground weapons testing and global nuclear incidents like Chernobyl.

In 2013, no radioactivity in food chain inputs was measured above historical and background ranges. Radioactivity measured in the food chain inputs can be attributed to natural sources or human-made sources released in above-ground weapons testing or global nuclear incidents.

Table 21. 2013 Connecticut River Fish Gamma Spectroscopy Results

2013 Connecticut River Fish Gamma Spectroscopy Results					
Month Sample Collected	Sample Location	Edible (flesh) Potassium-40 +/- error (pCi/kg)	Edible (flesh) Cesium-137 +/- error (pCi/kg)	Inedible (bones, head, scales, guts) Potassium-40 +/- error (pCi/kg)	Inedible (bones, head, scales, guts) Cesium-137 +/- error (pCi/kg)
May 2013	Near VY Discharge	2,430 ± 439	< LLD	2,480 ± 325	< LLD
	Near VY Discharge	3,810 ± 779	< LLD	1,860 ± 620	< LLD
	Upstream of VY	2,730 ± 415	< LLD	2,420 ± 297	< LLD
	Upstream of VY	2,830 ± 529	< LLD	2,480 ± 303	15.4 ± 6.7
September 2013	Near VY Discharge	3,150 ± 564	< LLD	1,250 ± 512	< LLD
	Near VY Discharge	3,450 ± 466	<LLD	1,890 ±280	< LLD
	Upstream of VY	3,550 ± 424	< LLD	1,880 ± 262	< LLD
	Upstream of VY	2,780 ± 611	< LLD	2,200 ± 326	< LLD
< LLD means less than the Laboratory's Lower Limit of Detection					

Table 22. 2013 Connecticut River Fish Hard-to-Detect Results

2013 Connecticut River Fish Hard-to-Detect Results									
Month Sample Collected	Sample Location	Edible (flesh)				Inedible (bones, head, scales, guts)			
		Iron-55 +/- error (pCi/kg)	Nickel-63 +/- error (pCi/kg)	Strontium-89 +/- error (pCi/kg)	Strontium-90 +/- error (pCi/kg)	Iron-55 +/- error (pCi/kg)	Nickel-63 +/- error (pCi/kg)	Strontium-89 +/- error (pCi/kg)	Strontium-90 +/- error (pCi/kg)
May 2013	Near VY Discharge	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
	Near VY Discharge	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
	Upstream of VY	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	101 ± 40.5
	Upstream of VY	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
September 2013	Near VY Discharge	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
	Near VY Discharge	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
	Upstream of VY	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
	Upstream of VY	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD	< LLD
< LLD means less than the Laboratory's Lower Limit of Detection									

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Appendix A

2013 Air Filter Data for Total Alpha & Beta Radioactivity

- 2013 Air Filter Results for Total Alpha & Beta Radioactivity

- **2013 Air Filter Results for Total Alpha & Beta Radioactivity**

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/m^3)	Total Beta Radioactivity +/- error (pCi/m^3)
108 Cherry St Burlington	1/8/2013	0.002 +/- 0.00029	0.0164 +/- 0.0006
D & E Tree	1/8/2013	0.00371 +/- 0.00041	0.0203 +/- 0.0008
Dummerston IFO	1/8/2013	0.00106 +/- 0.00024	0.00928 +/- 0.00055
Guilford Town Garage	1/8/2013	0.00169 +/- 0.00031	0.0169 +/- 0.0007
Power Line Crossing	*1/8/2013*	*0.000392 +/- 0.000288*	*0.00507 +/- 0.00072*
Renaud/Puffer	1/8/2013	0.0015 +/- 0.000294	0.0125 +/- 0.0007
Vermont State Police	1/8/2013	0.00177 +/- 0.00028	0.0163 +/- 0.0007
Vermont State Police	1/8/2013	0.00167 +/- 0.00029	0.0172 +/- 0.0007
Vernon Elementary School	1/8/2013	0.00073 +/- 0.000195	0.00467 +/- 0.0004
Wilmington State Highway Garage	1/8/2013	0.000684 +/- 0.000177	0.00759 +/- 0.00044
108 Cherry St Burlington	2/5/2013	0.00162 +/- 0.0003	0.0143 +/- 0.0007
D & E Tree	2/5/2013	0.00184 +/- 0.00032	0.0172 +/- 0.0008
Dummerston IFO	2/5/2013	0.000752 +/- 0.00024	0.00848 +/- 0.00062
Guilford Town Garage	2/5/2013	0.00181 +/- 0.00036	0.0199 +/- 0.0009
Power Line Crossing	2/5/2013	0.00226 +/- 0.00038	0.0175 +/- 0.0008
Renaud/Puffer	2/5/2013	0.00165 +/- 0.00035	0.0149 +/- 0.0008
Vermont Courthouse	2/5/2013	0.00176 +/- 0.00033	0.0181 +/- 0.0008
Vermont State Police	2/5/2013	0.00172 +/- 0.00031	0.0185 +/- 0.0008
Vernon Elementary School	2/5/2013	0.000817 +/- 0.000237	0.00694 +/- 0.00055
Wilmington State Highway Garage	2/5/2013	0.00137 +/- 0.00027	0.0131 +/- 0.0006
108 Cherry St Burlington	3/5/2013	0.00207 +/- 0.00033	0.0149 +/- 0.0007
D & E Tree	3/5/2013	0.00138 +/- 0.00028	0.0137 +/- 0.0007
Dummerston IFO	3/5/2013	0.00126 +/- 0.00028	0.00856 +/- 0.00059
Guilford Town Garage	3/5/2013	0.00179 +/- 0.00035	0.0163 +/- 0.0008
Power Line Crossing	3/5/2013	0.00188 +/- 0.00032	0.0157 +/- 0.0007
Renaud/Puffer	3/5/2013	0.00136 +/- 0.00032	0.0115 +/- 0.0007
Vermont Courthouse	3/5/2013	0.00165 +/- 0.00032	0.0131 +/- 0.0007
Vermont State Police	3/5/2013	0.00174 +/- 0.00031	0.0137 +/- 0.0007
Vernon Elementary School	*3/5/2013*	*0.000378 +/- 0.000194*	*0.0023 +/- 0.00044*
Wilmington State Highway Garage	3/5/2013	0.000878 +/- 0.000216	0.00812 +/- 0.00052
108 Cherry St Burlington	4/2/2013	0.0014 +/- 0.00029	0.0109 +/- 0.0006
D & E Tree	4/2/2013	0.00139 +/- 0.00029	0.0103 +/- 0.0006
Dummerston IFO	4/2/2013	0.00172 +/- 0.00033	0.0108 +/- 0.0006
Guilford Town Garage	4/2/2013	0.00128 +/- 0.00031	0.0122 +/- 0.0007
Power Line Crossing	4/2/2013	0.00155 +/- 0.0003	0.0109 +/- 0.0006
Renaud/Puffer	4/2/2013	0.00125 +/- 0.00031	0.0091 +/- 0.00063
Vermont Courthouse	4/2/2013	0.00132 +/- 0.00029	0.0108 +/- 0.0006
Vermont State Police	4/2/2013	0.00111 +/- 0.00027	0.0107 +/- 0.0006
Vernon Elementary School	4/2/2013	0.00396 +/- 0.00046	0.0177 +/- 0.0008
Wilmington State Highway Garage	4/2/2013	0.00131 +/- 0.00027	0.00844 +/- 0.00053

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/m^3)	Total Beta Radioactivity +/- error (pCi/m^3)
108 Cherry St Burlington	5/7/2013	0.00143 +/- 0.00027	0.0145 +/- 0.0006
D & E Tree	5/7/2013	0.00122 +/- 0.00025	0.0118 +/- 0.0006
Dummerston IFO	5/7/2013	0.00191 +/- 0.00031	0.0147 +/- 0.0007
Guilford Town Garage	5/7/2013	0.00177 +/- 0.00032	0.0164 +/- 0.0007
Power Line Crossing	5/7/2013	0.00193 +/- 0.00031	0.0146 +/- 0.0006
Renaud/Puffer	5/7/2013	0.0013 +/- 0.00027	0.0117 +/- 0.0006
Vermont Courthouse	*5/7/2013*	*0.00304 +/- 0.00096*	*0.0234 +/- 0.002*
Vermont State Police	5/7/2013	0.00133 +/- 0.00027	0.0147 +/- 0.0006
Vernon Elementary School	5/7/2013	0.00218 +/- 0.00032	0.0172 +/- 0.0007
Wilmington State Highway Garage	5/7/2013	0.00131 +/- 0.00025	0.00977 +/- 0.00051
108 Cherry St Burlington	6/4/2013	0.000906 +/- 0.000246	0.0117 +/- 0.0007
D & E Tree	6/4/2013	0.00103 +/- 0.00025	0.0125 +/- 0.0007
Dummerston IFO	6/4/2013	0.00113 +/- 0.00028	0.0132 +/- 0.0007
Guilford Town Garage	6/4/2013	0.00146 +/- 0.00032	0.0128 +/- 0.0007
Power Line Crossing	6/4/2013	0.00157 +/- 0.00031	0.0144 +/- 0.0007
Renaud/Puffer	6/4/2013	0.00106 +/- 0.00027	0.00767 +/- 0.00058
Vermont Courthouse	6/4/2013	0.0013 +/- 0.00035	0.0126 +/- 0.0008
Vermont State Police	*6/4/2013*	*0.000671 +/- 0.000219*	*0.00709 +/- 0.00054*
Vernon Elementary School	6/4/2013	0.00157 +/- 0.0003	0.0122 +/- 0.0007
Wilmington State Highway Garage	6/4/2013	0.00046 +/- 0.000188	0.00356 +/- 0.00042
108 Cherry St Burlington	7/9/2013	0.00171 +/- 0.00028	0.0125 +/- 0.0006
D & E Tree	7/9/2013	0.00155 +/- 0.00026	0.0125 +/- 0.0006
Dummerston IFO	7/9/2013	0.000627 +/- 0.000191	0.00697 +/- 0.0005
Guilford Town Garage	7/9/2013	0.00131 +/- 0.00026	0.0118 +/- 0.0006
Power Line Crossing	7/9/2013	0.00155 +/- 0.00027	0.014 +/- 0.0006
Renaud/Puffer	7/9/2013	0.00107 +/- 0.00023	0.00752 +/- 0.00051
Vermont Courthouse	7/9/2013	0.00056 +/- 0.000181	0.00453 +/- 0.00043
Vermont State Police	7/9/2013	0.00132 +/- 0.00025	0.0121 +/- 0.0006
Vernon Elementary School	7/9/2013	0.00186 +/- 0.00029	0.0139 +/- 0.0006
Wilmington State Highway Garage	7/9/2013	0.000247 +/- 0.000127	0.0019 +/- 0.00031
108 Cherry St Burlington	8/6/2013	0.00129 +/- 0.00028	0.0134 +/- 0.0007
D & E Tree	8/6/2013	0.00137 +/- 0.00028	0.0144 +/- 0.0007
Dummerston IFO	8/6/2013	0.000528 +/- 0.000215	0.00504 +/- 0.00054
Guilford Town Garage	8/6/2013	0.00148 +/- 0.00032	0.0146 +/- 0.0008
Power Line Crossing	8/6/2013	0.0015 +/- 0.00031	0.0161 +/- 0.0008
Renaud/Puffer	8/6/2013	0.00108 +/- 0.00027	0.0138 +/- 0.0008
Vermont Courthouse	8/6/2013	0.000386 +/- 0.000192	0.00383 +/- 0.00049
Vermont State Police	8/6/2013	0.0011 +/- 0.00026	0.0154 +/- 0.0008
Vernon Elementary School	8/6/2013	0.00172 +/- 0.00032	0.0166 +/- 0.0008
Wilmington State Highway Garage	8/6/2013	0.00295 +/- 0.00039	0.0199 +/- 0.008

Sample Location	Date of Sample	Total Alpha Radioactivity +/- error (pCi/m^3)	Total Beta Radioactivity +/- error (pCi/m^3)
108 Cherry St Burlington	9/4/2013	0.00193 +/- 0.00033	0.0189 +/- 0.0008
D & E Tree	9/4/2013	0.00147 +/- 0.00028	0.0158 +/- 0.0007
Dummerston IFO	9/4/2013	0.000883 +/- 0.000253	0.00631 +/- 0.00057
Guilford Town Garage	9/4/2013	0.00168 +/- 0.00031	0.0161 +/- 0.0008
Power Line Crossing	9/4/2013	0.00171 +/- 0.00035	0.0168 +/- 0.0009
Renaud/Puffer	9/4/2013	0.00144 +/- 0.00031	0.0108 +/- 0.0007
Vermont Courthouse	9/4/2013	0.000721 +/- 0.000225	0.00724 +/- 0.00058
Vermont State Police	9/4/2013	0.00137 +/- 0.00028	0.0136 +/- 0.0007
Vernon Elementary School	9/4/2013	0.00167 +/- 0.0003	0.0184 +/- 0.0008
Wilmington State Highway Garage	9/4/2013	0.00215 +/- 0.00033	0.0195 +/- 0.0008
108 Cherry St Burlington	10/8/2013	0.00155 +/- 0.00027	0.0135 +/- 0.0006
D & E Tree	10/8/2013	0.00091 +/- 0.000212	0.0112 +/- 0.0006
Dummerston IFO	10/8/2013	0.000607 +/- 0.000193	0.00526 +/- 0.00047
Guilford Town Garage	10/8/2013	0.00129 +/- 0.00027	0.0137 +/- 0.0007
Power Line Crossing	10/8/2013	0.00133 +/- 0.00031	0.0122 +/- 0.0007
Renaud/Puffer	10/8/2013	0.00148 +/- 0.00028	0.0137 +/- 0.0007
Vermont Courthouse	10/8/2013	0.00173 +/- 0.00029	0.016 +/- 0.0007
Vermont State Police	10/8/2013	0.00113 +/- 0.00024	0.00904 +/- 0.00054
Vernon Elementary School	10/8/2013	0.00152 +/- 0.00026	0.0148 +/- 0.0006
Wilmington State Highway Garage	10/8/2013	0.00175 +/- 0.00027	0.0151 +/- 0.0006
108 Cherry St Burlington	11/5/2013	0.00169 +/- 0.00032	0.0161 +/- 0.0007
D & E Tree	11/5/2013	0.00105 +/- 0.00026	0.0102 +/- 0.0006
Dummerston IFO	11/5/2013	0.000831 +/- 0.000275	0.00984 +/- 0.00067
Guilford Town Garage	11/5/2013	0.00229 +/- 0.0004	0.0169 +/- 0.0008
Power Line Crossing	11/5/2013	0.00155 +/- 0.00043	0.0145 +/- 0.001
Renaud/Puffer	11/5/2013	0.00162 +/- 0.00034	0.0135 +/- 0.0008
Vermont Courthouse	11/5/2013	0.0021 +/- 0.00037	0.0193 +/- 0.0009
Vermont State Police	11/5/2013	0.000861 0.000253	0.00939 0.0006
Vernon Elementary School	11/5/2013	0.00231 +/- 0.00036	0.0195 +/- 0.0008
Wilmington State Highway Garage	11/5/2013	0.00188 +/- 0.00032	0.0182 +/- 0.0007
108 Cherry St Burlington	12/3/2013	0.00101 +/- 0.00027	0.0134 +/- 0.00073
D & E Tree	12/3/2013	0.00046 +/- 0.000188	0.00564 +/- 0.00049
Dummerston IFO	12/3/2013	0.000456 +/- 0.000216	0.00491 +/- 0.00054
Guilford Town Garage	12/3/2013	0.0016 +/- 0.00034	0.0136 +/- 0.0008
Power Line Crossing	12/3/2013	0.00155 +/- 0.00039	0.0123 +/- 0.0009
Renaud/Puffer	12/3/2013	0.00116 +/- 0.00029	0.00985 +/- 0.00067
Vermont Courthouse	12/3/2013	0.0015 +/- 0.00029	0.0155 +/- 0.0007
Vermont State Police	12/3/2013	0.000775 +/- 0.00023	0.0067 +/- 0.00053
Vernon Elementary School	12/3/2013	0.00168 +/- 0.00031	0.0157 +/- 0.0007
Wilmington State Highway Garage	12/3/2013	0.00168 +/- 0.00029	0.0134 +/- 0.0006

pCi/m^3 is picocurie per cubic meter of air volume
Data in italics were qualified due to sampling issues.

Appendix B

2013 Tritium Water Data

Tritium results for all water samples tested by the Health Department in 2013 are provided in this appendix. Results are presented in order by sample location and by sampling date based on the following categories:

- Connecticut River samples
- On-site groundwater monitoring wells
- Off-site drinking water wells
- On-site drinking water wells

The Health Department's Lower Limit of Detection for tritium is 500 picocuries per liter (pCi/L).

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
3-3 Connecticut River Station	1/15/2013	< 500
	2/14/2013	< 500
	3/13/2013	< 500
	4/16/2013	< 500
	5/13/2013	< 500
	6/17/2013	< 500
	7/16/2013	< 500
	8/14/2013	< 500
	9/16/2013	< 500
	10/16/2013	< 500
	11/13/2013	< 500
	12/16/2013	< 500
3-4 Connecticut River Station	1/15/2013	< 500
	2/14/2013	< 500
	3/13/2013	< 500
	4/16/2013	< 500
	5/13/2013	< 500
	6/17/2013	< 500
	7/16/2013	< 500
	8/14/2013	< 500
	9/16/2013	< 500
	10/16/2013	< 500
	11/13/2013	< 500
	12/16/2013	< 500
3-8 Connecticut River Station	1/15/2013	< 500
	2/14/2013	< 500
	3/13/2013	< 500
	4/15/2013	< 500
	5/13/2013	< 500
	6/17/2013	< 500
	7/16/2013	< 500
	8/14/2013	< 500
	9/16/2013	< 500
	10/16/2013	< 500
	11/13/2013	< 500
	12/16/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Connecticut River, Downstream	1/8/2013	< 500
	2/5/2013	< 500
	3/5/2013	< 500
	4/2/2013	< 500
	5/7/2013	< 500
	6/4/2013	< 500
	7/9/2013	< 500
	8/6/2013	< 500
	9/4/2013	< 500
	10/8/2013	< 500
	11/5/2013	< 500
	12/3/2013	< 500
	1/22/2013	< 500
	2/19/2013	< 500
	3/19/2013	< 500
	4/16/2013	< 500
	5/21/2013	< 500
	6/18/2013	< 500
	7/23/2013	< 500
	8/20/2013	< 500
	9/17/2013	< 500
	10/22/2013	< 500
	11/19/2013	< 500
	12/17/2013	< 500
Connecticut River, Upstream	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Discharge Forebay	1/15/2013	< 500
	2/14/2013	< 500
	3/13/2013	< 500
	4/16/2013	< 500
	5/13/2013	< 500
	6/17/2013	< 500
	7/16/2013	< 500
	8/14/2013	< 500
	9/16/2013	< 500
	10/16/2013	< 500
	11/13/2013	< 500
	12/16/2013	< 500
GZ-02	1/8/2013	< 500
	3/5/2013	< 500
	4/2/2013	< 500
	6/4/2013	< 500
	7/2/2013	< 500
	9/11/2013	< 500
	10/3/2013	< 500
	12/3/2013	< 500
GZ-03	1/7/2013	660 +/- 207
	3/4/2013	608 +/- 210
	4/1/2013	593 +/- 212
	6/3/2013	879 +/- 147
	7/2/2013	740 +/- 145
	9/9/2013	< 500
	10/3/2013	< 500
	12/3/2013	< 500
GZ-04	1/7/2013	599 +/- 139
	3/4/2013	947 +/- 142
	4/1/2013	912 +/- 141
	6/4/2013	559 +/- 144
	7/2/2013	< 500
	9/9/2013	< 500
	10/3/2013	804 +/- 143
	12/3/2013	584 +/- 149

Sample Location	Date of Sample	Tritium Result (pCi/L)	+/- error
GZ-06	1/9/2013	< 500	
	3/5/2013	549	137
	4/2/2013	737	139
	6/6/2013	< 500	
	7/3/2013	542	136
	9/13/2013	< 500	
	10/2/2013	< 500	
	12/3/2013	517	148
GZ-07	1/7/2013	< 500	
	3/4/2013	< 500	
	4/1/2013	< 500	
	6/3/2013	< 500	
	7/2/2013	< 500	
	9/10/2013	< 500	
	10/2/2013	< 500	
	12/2/2013	< 500	
GZ-09	1/7/2013	< 500	
	3/4/2013	< 500	
	4/1/2013	< 500	
	6/4/2013	< 500	
	7/8/2013	< 500	
	9/9/2013	< 500	
	10/2/2013	< 500	
	12/2/2013	< 500	
GZ-10	1/7/2013	< 500	
	6/3/2013	< 500	
	7/3/2013	< 500	
	9/9/2013	< 500	
	10/2/2013	< 500	
	12/2/2013	< 500	
GZ-11	1/7/2013	654	137
	3/4/2013	795	139
	4/1/2013	565	137
	6/3/2013	< 500	
	7/2/2013	< 500	
	9/10/2013	< 500	
	10/2/2013	< 500	
	12/2/2013	567	149

Sample Location	Date of Sample	Tritium Result (pCi/L)	+/- error
GZ-12D	1/8/2013	20500	+/- 300
	3/5/2013	22400	+/- 300
	4/1/2013	17200	+/- 300
	6/4/2013	12000	+/- 200
	7/3/2013	9930	+/- 220
	9/12/2013	10600	+/- 200
	10/1/2013	15100	+/- 300
	12/5/2013	8300	+/- 220
GZ-12S	1/8/2013	2340	+/- 160
	3/5/2013	3720	+/- 170
	4/2/2013	2520	+/- 160
	6/4/2013	2100	+/- 160
	7/3/2013	1980	+/- 160
	9/11/2013	575	+/- 137
	10/2/2013	752	+/- 139
	12/3/2013	1530	+/- 160
GZ-13D	1/9/2013	923	+/- 140
	3/5/2013	853	+/- 141
	4/2/2013	812	+/- 140
	6/4/2013	567	+/- 136
	7/2/2013	761	+/- 138
	9/10/2013	643	+/- 138
	10/1/2013	741	+/- 139
	12/3/2013	690	+/- 151
GZ-13S	1/9/2013	< 500	
	3/5/2013	< 500	
	4/2/2013	< 500	
	6/4/2013	< 500	
	7/2/2013	< 500	
	9/10/2013	< 500	
	10/1/2013	< 500	
	12/3/2013	< 500	

Sample Location	Date of Sample	Tritium Result (pCi/L)	+/- error
GZ-14D	1/7/2013	14800	300
	3/6/2013	15000	300
	4/3/2013	15000	300
	6/3/2013	15400	300
	7/2/2013	15600	300
	9/10/2013	16000	300
	10/3/2013	16000	300
	12/3/2013	15000	300
GZ-14S	1/7/2013	25300	300
	3/6/2013	16800	300
	4/1/2013	15500	300
	6/3/2013	12300	200
	7/2/2013	5740	190
	9/9/2013	4090	170
	10/3/2013	7460	200
	12/2/2013	6560	200
GZ-15	1/9/2013	67100	500
	3/5/2013	67000	500
	4/2/2013	74200	500
	6/3/2013	63500	500
	7/3/2013	46900	400
	9/10/2013	22800	300
	10/2/2013	19800	300
	12/2/2013	21700	300
GZ-16	1/7/2013	< 500	
	3/4/2013	< 500	
	4/1/2013	< 500	
	6/4/2013	< 500	
	7/3/2013	< 500	
	9/11/2013	< 500	
	10/2/2013	< 500	
	12/3/2013	< 500	
GZ-17	9/12/2013	< 500	
	10/3/2013	< 500	
	12/4/2013	< 500	

Sample Location	Date of Sample	Tritium Result (pCi/L)	+/- error
GZ-18D	1/9/2013	614	137
	3/5/2013	< 500	
	4/2/2013	< 500	
	6/4/2013	< 500	
	7/2/2013	< 500	
	9/9/2013	< 500	
	10/1/2013	< 500	
	12/5/2013	< 500	
GZ-18S	1/9/2013	< 500	
	3/5/2013	< 500	
	4/2/2013	< 500	
	6/4/2013	< 500	
	7/2/2013	< 500	
	9/9/2013	< 500	
	10/1/2013	< 500	
	12/3/2013	< 500	
GZ-20	1/7/2013	< 500	
	3/4/2013	< 500	
	4/1/2013	< 500	
	6/3/2013	< 500	
	7/2/2013	< 500	
	9/10/2013	< 500	
	10/2/2013	< 500	
	12/2/2013	< 500	
GZ-21	1/8/2013	686	140
	3/4/2013	< 500	
	4/2/2013	1190	140
	6/3/2013	818	139
	7/3/2013	1040	140
	9/11/2013	2000	160
	10/2/2013	2190	160
	12/2/2013	1520	160

Sample Location	Date of Sample	Tritium Result (pCi/L)	+/- error
GZ-22D	1/7/2013	27900	+/- 300
	3/5/2013	24100	+/- 300
	4/1/2013	23500	+/- 300
	6/3/2013	20100	+/- 300
	7/2/2013	18900	+/- 300
	9/9/2013	17400	+/- 300
	10/2/2013	17500	+/- 300
	12/2/2013	15600	+/- 300
GZ-23S	1/9/2013	1370	+/- 150
	3/5/2013	1490	+/- 150
	4/2/2013	1370	+/- 150
	6/4/2013	1500	+/- 150
	7/3/2013	1450	+/- 150
	9/10/2013	2010	+/- 160
	10/2/2013	1740	+/- 150
	12/3/2013	2790	+/- 170
GZ-24S	1/9/2013	< 500	
	3/5/2013	< 500	
	4/2/2013	< 500	
	6/6/2013	< 500	
	7/3/2013	< 500	
	9/13/2013	< 500	
	10/2/2013	< 500	
	12/31/2013	< 500	
GZ-25S	1/8/2013	< 500	
	3/4/2013	< 500	
	4/1/2013	< 500	
	6/3/2013	< 500	
	7/2/2013	< 500	
	9/10/2013	< 500	
	10/2/2013	< 500	
	12/3/2013	< 500	

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
GZ-26S	3/4/2013	< 500
	4/1/2013	< 500
	6/4/2013	< 500
	7/2/2013	< 500
	9/10/2013	< 500
	10/2/2013	< 500
	12/3/2013	< 500
GZ-27S	1/8/2013	< 500
	3/4/2013	< 500
	4/1/2013	< 500
	6/4/2013	< 500
	7/2/2013	< 500
	9/10/2013	< 500
	10/2/2013	< 500
	12/3/2013	< 500
WVN0201	2/6/2013	< 500
	5/10/2013	< 500
	8/13/2013	< 500
	11/6/2013	< 500
WVN0202	2/6/2013	< 500
	5/10/2013	< 500
	8/13/2013	< 500
	11/6/2013	< 500
WVN0203	2/6/2013	< 500
	5/10/2013	< 500
	8/13/2013	< 500
	11/6/2013	< 500
WVN0204	2/6/2013	< 500
	5/10/2013	< 500
	8/13/2013	< 500
	11/6/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Blodgett Farm	1/8/2013	< 500
	1/22/2013	< 500
	2/5/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500
Brattleboro Fire Dept, West Station	1/8/2013	< 500
	1/22/2013	< 500
	2/5/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Brattleboro Fire Dept, West Station (continued)	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500
Miller Farm	1/8/2013	< 500
	1/22/2013	< 500
	2/5/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Residence - 1	1/8/2013	< 500
	1/22/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500
Vernon Elementary School	1/8/2013	< 500
	1/22/2013	< 500
	2/5/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
Vernon Elementary School (continued)	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500
Vernon Green Nursing Home	1/8/2013	< 500
	1/22/2013	< 500
	2/5/2013	< 500
	2/19/2013	< 500
	3/5/2013	< 500
	3/19/2013	< 500
	4/2/2013	< 500
	4/16/2013	< 500
	5/7/2013	< 500
	5/21/2013	< 500
	6/4/2013	< 500
	6/18/2013	< 500
	7/9/2013	< 500
	7/23/2013	< 500
	8/6/2013	< 500
	8/20/2013	< 500
	9/4/2013	< 500
	9/17/2013	< 500
	10/8/2013	< 500
	10/22/2013	< 500
	11/5/2013	< 500
	11/19/2013	< 500
	12/3/2013	< 500
	12/17/2013	< 500

Sample Location	Date of Sample	Tritium Result +/- error (pCi/L)
White House	1/23/2013	< 500
	3/5/2013	< 500
	4/16/2013	< 500
	6/4/2013	< 500
	9/10/2013	< 500
	10/8/2013	< 500
Main Well	1/15/2013	< 500
	3/5/2013	< 500
	4/16/2013	< 500
	6/12/2013	< 500
	7/16/2013	< 500
	9/11/2013	< 500
	10/8/2013	< 500
PSB Well	1/15/2013	< 500
	3/5/2013	< 500
	4/16/2013	< 500
	6/4/2013	< 500
	7/16/2013	< 500
	9/10/2013	< 500
	10/10/2013	< 500
Southwest Well	1/9/2013	< 500
	7/17/2013	< 500
pCi/L = picocuries per liter		

Appendix C

2013 Gamma Spectroscopy Water Data

Gamma spectroscopy data for all water samples tested by the Health Department in 2013 are provided in this appendix. Results are presented in order by sample location and by sampling date based on the following categories:

- Connecticut River samples
- On-site groundwater monitoring wells
- Off-site drinking water wells
- On-site drinking water wells

"Natural" means that gamma-emitting materials detected are not related to nuclear power stations or above-grounds weapons testing.

< LLD means less than the Laboratory's Lower Limit of Detection.

Sample Location	Date of Sample	Gamma Spectroscopy Result
3-3 Connecticut River Station	1/15/2013	< LLD
	2/14/2013	< LLD
	3/13/2013	< LLD
	4/16/2013	< LLD
	5/13/2013	< LLD
	6/17/2013	< LLD
	7/16/2013	< LLD
	8/14/2013	< LLD
	9/16/2013	< LLD
	10/16/2013	< LLD
	11/13/2013	< LLD
	12/16/2013	< LLD
3-4 Connecticut River Station	1/15/2013	< LLD
	2/14/2013	< LLD
	3/13/2013	< LLD
	4/16/2013	< LLD
	5/13/2013	< LLD
	6/17/2013	< LLD
	7/16/2013	< LLD
	8/14/2013	< LLD
	9/16/2013	< LLD
	10/16/2013	< LLD
	11/13/2013	< LLD
	12/16/2013	< LLD
3-8 Connecticut River Station	1/15/2013	< LLD
	2/14/2013	< LLD
	3/13/2013	< LLD
	4/15/2013	< LLD
	5/13/2013	< LLD
	6/17/2013	< LLD
	7/16/2013	< LLD
	8/14/2013	< LLD
	9/16/2013	< LLD
	10/16/2013	< LLD
	11/13/2013	< LLD
	12/16/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
Connecticut River Downstream	1/8/2013	< LLD
	1/22/2013	< LLD
	2/5/2013	< LLD
	2/19/2013	< LLD
	3/5/2013	< LLD
	3/19/2013	< LLD
	4/2/2013	< LLD
	4/16/2013	< LLD
	5/7/2013	< LLD
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	< LLD
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	< LLD
	9/17/2013	< LLD
	10/8/2013	< LLD
	10/22/2013	< LLD
	11/5/2013	< LLD
	11/19/2013	< LLD
	12/3/2013	< LLD
	12/17/2013	< LLD
Connecticut River Upstream	3/19/2013	< LLD
	4/2/2013	< LLD
	4/16/2013	< LLD
	5/7/2013	< LLD
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	< LLD
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	< LLD
	9/17/2013	< LLD
	10/8/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
Connecticut River Upstream continued	10/22/2013	< LLD
	11/5/2013	< LLD
	11/19/2013	< LLD
	12/3/2013	< LLD
Discharge Forebay	1/15/2013	Natural
	2/14/2013	< LLD
	3/13/2013	< LLD
	4/16/2013	< LLD
	5/13/2013	< LLD
	6/17/2013	< LLD
	7/16/2013	< LLD
	8/14/2013	< LLD
	9/16/2013	< LLD
	10/16/2013	< LLD
	11/13/2013	< LLD
	12/16/2013	< LLD
GZ-02	1/8/2013	< LLD
	3/5/2013	Natural
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/11/2013	< LLD
	10/3/2013	< LLD
	12/3/2013	< LLD
GZ-03	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/3/2013	< LLD
	12/3/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-04	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/3/2013	< LLD
	12/3/2013	< LLD
GZ-06	1/9/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/6/2013	< LLD
	7/3/2013	< LLD
	9/13/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
GZ-07	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD
GZ-09	1/7/2013	< LLD
	3/4/2013	Natural
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/8/2013	< LLD
	9/9/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD
GZ-10	1/7/2013	< LLD
	6/3/2013	< LLD
	7/3/2013	< LLD
	9/9/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-11	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD
GZ-12D	1/8/2013	< LLD
	3/5/2013	< LLD
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/3/2013	< LLD
	9/12/2013	< LLD
	10/1/2013	< LLD
	12/5/2013	< LLD
GZ-12S	1/8/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/3/2013	< LLD
	9/11/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
GZ-13D	1/9/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/1/2013	< LLD
	12/3/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-13S	1/9/2013	Natural
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/1/2013	< LLD
	12/3/2013	< LLD
GZ-14D	1/7/2013	< LLD
	3/6/2013	< LLD
	4/3/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/3/2013	< LLD
	12/3/2013	< LLD
GZ-14S	1/7/2013	< LLD
	3/6/2013	< LLD
	4/1/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/3/2013	< LLD
	12/2/2013	< LLD
GZ-15	1/9/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/3/2013	< LLD
	7/3/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-16	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/3/2013	< LLD
	9/11/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
GZ-17	9/12/2013	< LLD
	10/3/2013	< LLD
	12/4/2013	< LLD
GZ-18D	1/9/2013	< LLD
	3/5/2013	Natural
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/1/2013	< LLD
	12/5/2013	< LLD
GZ-18S	1/9/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/1/2013	< LLD
	12/3/2013	< LLD
GZ-20	1/7/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-21	1/8/2013	< LLD
	3/4/2013	< LLD
	4/2/2013	< LLD
	6/3/2013	< LLD
	7/3/2013	< LLD
	9/11/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD
GZ-22D	1/7/2013	< LLD
	3/5/2013	Natural
	4/1/2013	< LLD
	6/3/2013	Natural
	7/2/2013	< LLD
	9/9/2013	< LLD
	10/2/2013	< LLD
	12/2/2013	< LLD
GZ-23S	1/9/2013	< LLD
	3/5/2013	< LLD
	4/2/2013	< LLD
	6/4/2013	< LLD
	7/3/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
GZ-24S	1/9/2013	Natural
	3/5/2013	< LLD
	4/2/2013	Natural
	6/6/2013	< LLD
	7/3/2013	< LLD
	9/13/2013	< LLD
	10/2/2013	< LLD
	12/31/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
GZ-25S	1/8/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	Natural
	6/3/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	Natural
	12/3/2013	Natural
GZ-26S	3/4/2013	< LLD
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
GZ-27S	1/8/2013	< LLD
	3/4/2013	< LLD
	4/1/2013	< LLD
	6/4/2013	< LLD
	7/2/2013	< LLD
	9/10/2013	< LLD
	10/2/2013	< LLD
	12/3/2013	< LLD
WVN0201	2/6/2013	< LLD
	5/10/2013	< LLD
	8/13/2013	< LLD
	11/6/2013	< LLD
WVN0202	2/6/2013	< LLD
	5/10/2013	< LLD
	8/13/2013	< LLD
	11/6/2013	< LLD
WVN0203	2/6/2013	< LLD
	5/10/2013	< LLD
	8/13/2013	< LLD
	11/6/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
WVN0204	2/6/2013	Natural
	5/10/2013	< LLD
	8/13/2013	< LLD
	11/6/2013	< LLD
Blodgett Farm	1/8/2013	Natural
	1/22/2013	Natural
	2/5/2013	Natural
	2/19/2013	Natural
	3/5/2013	Natural
	3/19/2013	Natural
	4/2/2013	Natural
	4/16/2013	Natural
	5/7/2013	Natural
	5/21/2013	< LLD
	6/4/2013	Natural
	6/18/2013	< LLD
	7/9/2013	Natural
	7/23/2013	< LLD
	8/6/2013	Natural
	8/20/2013	< LLD
	9/4/2013	Natural
	9/17/2013	Natural
	10/8/2013	Natural
	10/22/2013	Natural
	11/5/2013	Natural
	11/19/2013	Natural
	12/3/2013	Natural
	12/17/2013	Natural
Brattleboro Fire Dept, West Station	1/8/2013	< LLD
	1/22/2013	< LLD
	2/5/2013	< LLD
	2/19/2013	< LLD
	3/5/2013	< LLD
	3/19/2013	< LLD
	4/2/2013	< LLD
	4/16/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
Brattleboro Fire Dept, West Station continued	5/7/2013	< LLD
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	< LLD
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	< LLD
	9/17/2013	< LLD
	10/8/2013	< LLD
	10/22/2013	< LLD
	11/5/2013	< LLD
	11/19/2013	< LLD
	12/3/2013	< LLD
	12/17/2013	< LLD
Miller Farm	1/8/2013	Natural
	1/22/2013	Natural
	2/5/2013	Natural
	2/19/2013	Natural
	3/5/2013	Natural
	3/19/2013	< LLD
	4/2/2013	Natural
	4/16/2013	< LLD
	5/7/2013	Natural
	5/21/2013	< LLD
	6/4/2013	Natural
	6/18/2013	< LLD
	7/9/2013	Natural
	7/23/2013	< LLD
	8/6/2013	Natural
	8/20/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
Miller Farm	9/4/2013	Natural
continued	9/17/2013	Natural
	10/8/2013	Natural
	10/22/2013	Natural
	11/5/2013	Natural
	11/19/2013	Natural
	12/3/2013	Natural
	12/17/2013	Natural
Residence - 1	1/8/2013	< LLD
	1/22/2013	< LLD
	2/19/2013	Natural
	3/5/2013	Natural
	3/19/2013	Natural
	4/2/2013	< LLD
	4/16/2013	< LLD
	5/7/2013	Natural
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	< LLD
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	< LLD
	9/17/2013	Natural
	10/8/2013	Natural
	10/22/2013	Natural
	11/5/2013	Natural
	11/19/2013	Natural
	12/3/2013	Natural
	12/17/2013	Natural

Sample Location	Date of Sample	Gamma Spectroscopy Result
Vernon Elementary School	1/8/2013	Natural
	1/22/2013	Natural
	2/5/2013	Natural
	2/19/2013	Natural
	3/5/2013	Natural
	3/19/2013	Natural
	4/2/2013	Natural
	4/16/2013	< LLD
	5/7/2013	Natural
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	< LLD
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	Natural
	9/17/2013	Natural
	10/8/2013	Natural
	10/22/2013	Natural
	11/5/2013	Natural
	11/19/2013	Natural
	12/3/2013	Natural
	12/17/2013	Natural

Sample Location	Date of Sample	Gamma Spectroscopy Result
Vernon Green Nursing Home	1/8/2013	< LLD
	1/22/2013	Natural
	2/5/2013	Natural
	2/19/2013	Natural
	3/5/2013	Natural
	3/19/2013	Natural
	4/2/2013	< LLD
	4/16/2013	< LLD
	5/7/2013	Natural
	5/21/2013	< LLD
	6/4/2013	< LLD
	6/18/2013	< LLD
	7/9/2013	Natural
	7/23/2013	< LLD
	8/6/2013	< LLD
	8/20/2013	< LLD
	9/4/2013	Natural
	9/17/2013	Natural
	10/8/2013	Natural
	10/22/2013	Natural
	11/5/2013	Natural
	11/19/2013	Natural
	12/3/2013	Natural
	12/17/2013	Natural
White House	1/23/2013	< LLD
	3/5/2013	< LLD
	4/16/2013	< LLD
	6/4/2013	< LLD
	9/10/2013	< LLD
	10/8/2013	< LLD

Sample Location	Date of Sample	Gamma Spectroscopy Result
Main Well	1/15/2013	< LLD
	3/5/2013	< LLD
	4/16/2013	Natural
	6/12/2013	< LLD
	7/16/2013	< LLD
	9/11/2013	< LLD
	10/8/2013	< LLD
PSB Well	1/15/2013	< LLD
	3/5/2013	< LLD
	4/16/2013	Natural
	6/4/2013	< LLD
	7/16/2013	< LLD
	9/10/2013	< LLD
	10/10/2013	< LLD
Southwest Well	1/9/2013	< LLD
	7/17/2013	< LLD
< LLD means less than the Laboratory's Lower Limit of Detection		

Appendix D

2013 Hard-to-Detect Water Results

Hard-to-detect metal results for all water samples tested by the Health Department in 2013 are provided in this appendix. Results are presented in alphabetical order by sample location and by sampling date based on the following categories:

- Connecticut River samples
- On-site groundwater monitoring wells
- Off-site drinking water wells
- On-site drinking water wells

Lower limits of detection (LLDs) for water samples:

Iron-55: 50 pCi/L

Nickel-63: 5.0 pCi/L

Strontium-90[1]: 2.0 pCi/L

[1] Strontium-89 lower limit of detection varied due to shorter half-life.

Sample Location	Sample Date	Hard-to Detect Results	Sample Date	Hard-to Detect Results
3-3 Connecticut River Station	2/14/2013	< LLD	5/13/2013	< LLD
	8/14/2013	< LLD	11/13/2013	< LLD
3-4 Connecticut River Station	2/14/2013	< LLD	5/13/2013	< LLD
	8/14/2013	< LLD	11/13/2013	< LLD
3-8 Connecticut River Station	2/14/2013	< LLD	5/13/2013	< LLD
	8/14/2013	< LLD	11/13/2013	< LLD
Connecticut River Downstream	2/5/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Connecticut River Upstream			5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Discharge Forebay	2/14/2013	< LLD	5/13/2013	< LLD
	8/14/2013	< LLD	11/13/2013	< LLD
GZ-01	2/4/2013	< LLD	5/10/2013	< LLD
	8/7/2013	< LLD	11/5/2013	< LLD
GZ-02	2/5/2013	< LLD	5/09/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-03	2/4/2013	< LLD	5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-04			5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-05	2/4/2013	< LLD	5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-06	2/5/2013	< LLD	5/10/2013	< LLD
	8/8/2013	< LLD	11/6/2013	< LLD
GZ-07	2/4/2013	< LLD	5/8/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-09	2/4/2013	< LLD	5/10/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-10			5/10/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-11	2/4/2013	< LLD	5/8/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-12D			5/8/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD

Sample Location	Sample Date	Hard-to Detect Results	Sample Date	Hard-to Detect Results
GZ-12S			5/8/2013	< LLD
	8/8/2013	< LLD	11/6/2013	< LLD
GZ-13D	2/5/2013	< LLD	5/9/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-13S	2/5/2013	< LLD	5/9/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-14D			5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-14S			5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-15			5/8/2013	< LLD
	8/8/2013	< LLD	11/6/2013	< LLD
GZ-16	2/5/2013	< LLD	5/10/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-17	11/6/2013	< LLD		
GZ-18D	2/5/2013	< LLD	5/9/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-18S	2/5/2013	< LLD	5/9/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-19D	2/4/2013	< LLD	5/9/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-19S	2/4/2013	< LLD	5/9/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-20	2/4/2013	< LLD	5/8/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-21	2/4/2013	< LLD	5/8/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-22D			5/10/2013	< LLD
	8/7/2013	< LLD	11/4/2013	< LLD
GZ-23S			5/9/2013	< LLD
	8/8/2013	< LLD	11/5/2013	< LLD
GZ-24S	2/5/2013	< LLD	5/10/2013	< LLD
	8/8/2013	< LLD	11/6/2013	< LLD
GZ-25S	2/4/2013	< LLD	5/10/2013	< LLD
	8/7/2013	< LLD	11/5/2013	< LLD

Sample Location	Sample Date	Hard-to Detect Results	Sample Date	Hard-to Detect Results
GZ-26S	2/4/2013	< LLD		
	8/7/2013	< LLD	11/5/2013	< LLD
GZ-27S	2/4/2013	< LLD	5/10/2013	< LLD
	8/7/2013	< LLD	11/5/2013	< LLD
WVN0201	2/6/2013	< LLD	5/10/2013	< LLD
	8/13/2013	< LLD	11/6/2013	< LLD
WVN0202	2/6/2013	< LLD	5/10/2013	< LLD
	8/13/2013	< LLD	11/6/2013	< LLD
WVN0203	2/6/2013	< LLD	5/10/2013	< LLD
	8/13/2013	< LLD	11/6/2013	< LLD
WVN0204	2/6/2013	< LLD	5/10/2013	< LLD
	8/13/2013	< LLD	11/6/2013	< LLD
Blodgett Farm	2/5/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Brattleboro Fire Department, West Station	2/5/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Miller Farm	2/5/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Residence-1	2/19/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Vernon Elementary School	2/5/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Vernon Green Nursing Home	2/19/2013	< LLD	5/7/2013	< LLD
	8/6/2013	< LLD	11/5/2013	< LLD
Main well	2/14/2013	< LLD	5/16/2013	< LLD
	8/19/2013	< LLD	11/18/2013	< LLD
PSB Well	2/5/2013	< LLD	5/16/2013	< LLD
	8/19/2013	< LLD	11/12/2013	< LLD
Southwest Well	1/9/2013	< LLD	5/16/2013	< LLD
	7/17/2013	< LLD		
White House	2/5/2013	< LLD	5/16/2013	< LLD
	8/19/2013	< LLD	11/12/2013	< LLD