Environmental Radionuclide Concentrations in the Vicinity of the Calvert Cliffs Nuclear Power Plant and Peach Bottom Atomic Power Station 2020-2021

MARYLAND POWER PLANT RESEARCH PROGRAM

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FOREWORD

This report, *Environmental Radionuclide Concentrations in the Vicinity of the Calvert Cliffs Nuclear Power Plant and The Peach Bottom Atomic Power Station: 2020–2021*, contains the results of monitoring and research conducted by the Maryland Department of Natural Resources, Power Plant Assessment Division (PPAD), to evaluate the fate and effects of radionuclides released from the Calvert Cliffs Nuclear Power Plant and the Peach Bottom Atomic Power Station during 2020 and 2021. This is the 25th in a series of radiological assessment reports detailing PPAD's monitoring efforts since 1975. This report was prepared under Contract Numbers K00B8400006 and K00B4600017 between PPAD and Versar Global Solutions (Versar).

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Brent Hood and István Turcsányi of the PPAD Radioecology Laboratory assisted with preparing samples, analyzing sediment particle size, and preparing tables and graphics from accumulated radiological data, under the direction of Thomas S. Jones, Laboratory Director and Project Manager. The Radiation Chemistry Laboratory of the Maryland Department of Health (MDH) assisted with analyzing air, water, and milk samples. Allison Brindley contributed to the preparation and technical editing of the report. István Turcsányi, Brent Hood, Marc Molé, and Laura Rojas-Wiltsee assisted with analytical data compilation. Nancy Wilkins supervised the production of this report.

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ABSTRACT

The Maryland Power Plant Assessment Division monitors concentrations of radionuclides in samples collected from the vicinity of the Calvert Cliffs Nuclear Power Plant (CCNPP) and the vicinity of Peach Bottom Atomic Power Station (PBAPS) to further understand the effects of the electric generating industry on human and ecological health. The radioactivity in the material could derive from power plant operations, historic weapons testing, medical procedures, and natural sources. The purpose of the monitoring program is to estimate the fate and transport of radionuclides released from the two power plants and to apply the results to risk models to estimate potential consequences to the environment and human health. The 2020–2021 report describes monitoring activities and data collected during the 2020 and 2021 calendar years; it is the 25th in a series that documents the results of monitoring studies conducted at CCNPP since 1975 and PBAPS since 1979.

Scientists used high-resolution gamma spectrometry, liquid scintillation spectrometry, and proportional counting to measure the concentrations of radionuclides (measured as radioactivity per unit weight or volume) in samples of shellfish, finfish, aquatic vegetation, sediment, air, rain, drinking water, and milk. Radionuclides in environmental samples originate from both man-made and natural sources.

Most samples of sediment collected from the vicinity of the two power plants contained measurable concentrations of radionuclides that had also been released during plant operations at CCNPP and PBAPS. The radionuclide ^{137}Cs was found in 86 percent of the samples collected from CCNPP and 100 percent of the samples collected from PBAPS. Although both power plants released measureable amounts of ^{137}Cs through the aqueous pathways during the 2020–2021 reporting period, the majority of the concentrations of the radionuclide found in the sediment samples was likely due to remnants of legacy power plant releases and fallout from historic weapons testing. A power plant-related radionuclide, an isotope of cobalt (^{60}Co), was released by both power plants during the 2020–2021 reporting period but was not detected in sediments collected from stations at PBAPS or CCNPP. Radionuclides likely solely attributable to power plant functions at CCNPP and PBAPS represented a very small fraction of the total radioactivity measured in sediments and biota collected from the regions around the two power plants. Naturally occurring radionuclides were responsible for more than 99% of the gamma-emitting radionuclides found in most sediment samples collected during the 2020–2021 reporting period.

The radionuclide ^{137}Cs was the only radionuclide associated with the fallout from weapons testing (i.e., historic atmospheric tests of nuclear weapons) detected in environmental samples collected in 2020 and 2021 A naturally occurring radioactive isotope of potassium (^{40}K) and decay products of uranium and thorium were detected in all samples of biota and sediment collected during the monitoring period. Background levels of the naturally occurring isotope of beryllium (^{7}Be) were detected in the majority of the samples of air and precipitation. Alpha and beta radiation were detected in the majority of the samples of air and in some of the samples of precipitation. Concentrations of naturally occurring radionuclides detected in samples were typically orders of magnitude greater than those of radionuclides released from power plants during the reporting period.

Concentrations of radionuclides detected during the 2020–2021 reporting period would not represent a risk to the ecological health of the Chesapeake Bay or the Susquehanna River or humans that come into contact with the media monitored. The additional increment of radioactivity and radiation dose attributable to the operation of CCNPP and PBAPS is minimal when compared with natural levels of radioactivity and the associated natural radioactive dose. The incremental increase in the dose to humans that could result from the consumption of biota from the vicinity of CCNPP and PBAPS, and which may be attributable to nuclear power production operations, was no more than 0.3% of the dose attributable to natural and other man-made sources, according to model results. All quantities released resulted in estimated doses that were no more than 0.2% of the regulatory limits set by the United States Nuclear Regulatory Commission.

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ACRONYMS

CCNPP	Calvert Cliffs Nuclear Power Plant
LLD	Lower limit of detection
MDH	Maryland Department of Health
PBAPS	Peach Bottom Atomic Power Station
PPAD	Power Plant Assessment Division
PPRP	Power Plant Research Program
PSEG	Public Service Enterprise Group
USEPA	United States Environmental Protection Agency
USNRC	United States Nuclear Regulatory Commission

ELEMENTS AND RADIONUCLIDES

Ag	silver
^{110m}Ag	silver-110m
Ac	actinium
Be	beryllium
^{7}Be	beryllium-7
Bi	bismuth
C	carbon
^{14}C	carbon-14
Ce	cerium
Co	cobalt
^{58}Co	cobalt-58
^{60}Co	cobalt-60
Cr	chromium
H	hydrogen
Cs	cesium
^{137}Cs	cesium-137
Cu	copper
Fe	iron
Ge	germanium
^{3}H	tritium
I	iodine
^{131}I	iodine-131
K	potassium
^{40}K	potassium-40
La	lanthanum
Li	lithium
Na	sodium
Nb	niobium
P	phosphorus
Pb	lead
Ra	radium
Ru	ruthenium
Sb	antimony
Se	selenium
Sr	strontium
^{89}Sr	strontium-89
^{90}Sr	strontium-90
Th	thorium
Tl	thallium
U	uranium
Xe	xenon
Zn	zinc
^{65}Zn	zinc-65
Zr	zirconium

UNITS OF MEASUREMENT

Bq	becquerel
Ci	curie
cm	centimeters
fCi	femtocurie (10^{-15} Ci)
ft^3/s	cubic feet per second
GWe-yr	gigawatt electrical-year
GWh	gigawatt hour
keV	kiloelectronvolt
kg	kilogram (10^3 grams)
km	kilometer
L	liter
m	meter
m^3	cubic meter
m^3/s	cubic meter per second
mCi	millicurie (10^{-3} Ci)
mm	millimeter
mrem	millirem
pCi	picocurie (10^{-12} Ci)
TBq	terabecquerel (27.027 Ci)
yr	year

RADIOLOGICAL DEFINITIONS AND REPORT TERMS

Absorbed dose. The amount of radiation absorbed by a material. The unit of absorbed dose is the radiation absorbed dose (rad).

Activity. The quantification of the rate of decay of radioactive material.

Becquerel (Bq). One of three units that define the quantity of radioactivity in a sample. One becquerel is defined as one disintegration per second.

Chain. A radionuclide (parent) and all of the atomic transformations that it undergoes (daughters; decay products) as it decays.

Curie (Ci). One of three units that define the quantity of radioactivity in a sample. One curie is defined as 3.7×10^{10} disintegrations per second.

Decay. The spontaneous transformation of one radionuclide into a different radioactive or non-radioactive nuclide, or into a different energy state of the same nuclide.

Dose commitment. The absorbed dose that an organ or tissue would accumulate during a specified period of time as a result of intake (e.g., by ingestion or inhalation) of one or more radionuclides.

Effective dose. A measure of the damage to a tissue or quality factor as a result of exposure to radiation. The unit for effective dose is the roentgen equivalent man (rem).

Environmentally significant. Radionuclides that are known to be assimilated (bioaccumulated) by biological organisms do not decay rapidly to stable forms and are discharged in detectable amounts.

Half-life. The time required for a radioactive substance to lose half of its activity by decay.

Ionizing radiation. Any electromagnetic or particulate radiation capable of producing ions (electrically charged atoms or atomic particles), directly or indirectly in its passage through matter.

Maximally exposed individual. A hypothetical individual who remains in an uncontrolled area and would receive the greatest possible dose when all potential routes of exposure from a facility's operations are considered.

Photopeak. A full-energy peak in the spectrum resulting from the unimpeded interaction of source photons on the detector as they release all of their energy.

Rad. A measurement unit for the amount of radiation energy deposited in a medium from the radiation source as it passes through the medium (see absorbed dose).

Radionuclide. An unstable nuclide capable of spontaneous transformation into other nuclides by changing its nuclear configuration or energy level. This transformation is accompanied by the emission of photons or particles.

Rem. A measurement unit for the effective dose (see effective dose).

Stable. Not radioactive or not easily decomposed or otherwise modified chemically.

1.0 INTRODUCTION

The Maryland Power Plant Assessment Division (PPAD) sponsors research on the effects of the electric generating industry on human and ecological health. To contribute to these efforts to understand complex interactions, PPAD monitors radionuclide concentrations in environmental samples that have the potential for affecting human and ecological resources in Maryland. The Power Plant Assessment Division has conducted research and monitoring to assess the effects of radioactive material released from Calvert Cliffs Nuclear Power Plant (CCNPP) since 1975 and Peach Bottom Atomic Power Station (PBAPS) since 1979 on Maryland's environmental resources and to estimate potential exposure risks to humans, specifically via ingestion of foods and drinking water obtained from the regions of the two power plants that may contain traces of radionuclides.

The two target facilities, CCNPP and PBAPS, generate minimal gaseous and liquid radioactive wastes, which are discharged into the atmosphere and surface waters adjacent to the facilities, respectively. Calvert Cliffs Nuclear Power Plant is located in southeastern Calvert County, Maryland, on the western shore of the Chesapeake Bay. Peach Bottom Atomic Power Station is located in southeastern York County, Pennsylvania, on the western shore of the lower Susquehanna River. Both power plants draw cooling water from the adjacent bodies of water; the cooling water absorbs radioactivity as it passes through the plants' nuclear reactor chambers. The power plants return the irradiated cooling water to the same bodies of water in the form of aqueous discharge, as a function of normal plant operations; the facilities release by-products of the cooling process to the air as water vapor through the cooling towers. The atmospheric discharges disperse through the ambient air as a plume from each facility. As the plume interacts with the surrounding air and precipitation, some of the particles from the plume settle on exposed surfaces in the region around the power plants (e.g., soil and plants). These particles can then be assimilated into the groundwater or consumed by omnivores and herbivores. The aqueous discharges to the Chesapeake Bay and the Susquehanna River may contain radionuclides that can become associated with sediments and accumulated by biota. Ultimately, these radionuclides may contribute to a radiation dose to humans by being transported through the food chain.

The 2020–2021 Radionuclide Monitoring Report provides summaries of the results of monitoring programs conducted in the vicinities of CCNPP and PBAPS, and nearby areas of the Chesapeake Bay and the lower Susquehanna River, respectively, in the 2020 and 2021 calendar years by the Maryland Department of Natural Resources, PPAD. The report provides the following qualitative and quantitative information, which is relevant to the 2020–2021 period or the duration of the monitoring program through 2021, as applicable:

- quantities of environmentally significant radionuclides discharged from the nuclear power plants to the atmosphere, Chesapeake Bay, and Susquehanna River;

- descriptions of procedures for collecting, preparing, and analyzing environmental samples;
- concentrations of radionuclides measured in samples of aquatic vegetation, shellfish, finfish, and sediment collected from the lower Susquehanna River and the Chesapeake Bay in 2020 and 2021;
- concentrations of radionuclides measured in samples of air, precipitation, water, and milk collected from the vicinities of CCNPP and PBAPS in 2020 and 2021; and
- an assessment of the potential risks to the environment and human health that might be associated with exposure to radionuclides from the discharges from CCNPP and PBAPS as detected in samples from the Susquehanna River, Chesapeake Bay, and other target areas near CCNPP and PBAPS that were collected during the 2020–2021 monitoring period.

1.1 MONITORING OBJECTIVES

The radionuclide monitoring aspect of the overall program is designed for two purposes: 1) to provide information concerning the fate and transport of radionuclides released by the power plants CCNPP and PBAPS to the Chesapeake Bay and the Susquehanna River, and 2) to estimate the concentrations of radionuclides absorbed by sediments and representative biota from individual trophic levels of the ecosystems of the Chesapeake Bay and the Susquehanna River in the vicinities of the two power plants. The monitoring tracks the aqueous pathway from each power plant to its receiving waterway. To monitor the aqueous pathway in the receiving waterbody, PPAD collects samples of sediment (i.e., material that settles at the bottom of the waterway) from locations in a predetermined sampling grid that is spatially relevant to the discharge points and representative samples of biota from several trophic levels (producers and primary and secondary consumers) in the vicinities of the two power plants.

The two target power plants, CCNPP and PBAPS, release radionuclides to the atmospheric pathway through airborne effluent from the cooling towers. To monitor the behavior of radionuclides in the atmospheric environment, PPAD continuously monitors levels of gaseous and particulate radionuclides in the air and indirectly monitors transport and uptake of airborne radioactivity by periodically collecting samples of precipitation and processed milk. Additionally, PPAD periodically collects drinking water from the vicinity of CCNPP to monitor infiltration of radionuclides into groundwater.

1.1.1 Sediment

Sediment sampling and corresponding analysis provide an estimate of the areal extent of deposition of radionuclides discharged from the respective power plants' cooling-water outfalls. Such deposition serves as a confirmatory indicator of the power plants' radionuclide discharge reports. Quantified radionuclide deposition in the sediment layer informs an assessment of long-term storage of radionuclides from human activities compared to naturally occurring radionuclides and an estimate of their potential availability to the food web and potential dose to humans.

1.1.2 Tray Oysters

The Power Plant Assessment Division mounts trays of oysters (*Crassostrea virginica*) in the Chesapeake Bay near the discharge port of CCNPP to expose the oysters to the effluent for a variety of predefined exposure periods. The program monitors the amounts of radionuclides present in the oysters collected from the trays at different times to assess the effects of repeated uptake and elimination (if the radionuclides are not bioaccumulated) of radionuclides by the organisms over time. Oysters are sessile; therefore, oysters in the vicinity of CCNPP are more likely than mobile biota such as finfish and crabs to be exposed to aqueous releases of radioactive material. Oysters filter large amounts of particulate material and plankton that may have adsorbed radionuclides and bioaccumulated heavy metals and radionuclides (McLean et al. 1987). Uptake of radionuclides by oysters is governed by physical, chemical, and environmental conditions.

1.1.3 Finfish

Finfish are exposed to radionuclides in the water column. In the vicinity of PBAPS, finfish represent a target for monitoring similar to the tray oysters placed near the CCNPP discharge port. Measurements of radionuclides in the muscle and gut contents of finfish help to identify the pathway of radionuclides through the food web.

1.1.4 Submerged Aquatic Vegetation

The monitoring aspect of the program includes collecting samples of submerged aquatic vegetation (SAV) in the vicinity of PBAPS and measuring the concentrations of radionuclides in the samples. The results provide a determination of radionuclide uptake in these aquatic plants.

1.1.5 Air and Air Particulates

The monitoring aspect of the program includes continuous air sampling in the regions surrounding CCNPP and PBAPS to monitor the distribution of airborne radiation from the two power plants. Air monitoring can also detect the presence in Maryland of radioactive particles or gases from sources other than CCNPP or PBAPS; thus, the continuous readings may inform emergency management systems of potential threats to human or ecological health in the region.

1.1.6 Potable Water

Samples of drinking water collected from municipal tap sources and wells in Calvert County near CCNPP are analyzed for the presence of radionuclides solely as a gauge of the continued passive protections of the County's drinking water by routine operations at CCNPP. The sampling and analysis of potable water is not a required element of nuclear power plant monitoring.

1.1.7 Precipitation

Scientists collect samples of rainfall at a fixed location in Baltimore, MD, and analyze the samples for the levels of radionuclides present. The results provide information about radionuclide deposition through precipitation and auxiliary information about the airborne radiation originating from nuclear power generation. Precipitation monitoring has been used as an indicator of radioactive fallout during active, above-ground nuclear weapons testing; thus, precipitation data are currently used to estimate levels of man-made radionuclides that did not derive from the two regional power plants.

1.1.8 Milk

Airborne radioactivity may be deposited on pastures, be ingested by cows, and become part of cow's milk. The monitoring aspect of the program includes collecting samples of raw and processed milk from dairy farms in the vicinities of CCNPP and PBAPS and analyzing the samples for radionuclides. The results contribute to understanding the behavior of radionuclides in the trophic ecosystem and provide an estimate of dose to humans through uptake of radiostrontium (i.e., ^{89}Sr or ^{90}Sr), which has similar chemical characteristics to calcium and targets human bone.

1.2 RISK ASSESSMENT OBJECTIVES

The Power Plant Assessment Division uses models to estimate the potential effects of radionuclides on individuals that may be exposed to radioactive materials in the vicinities of the two power plants, CCNPP and PBAPS, during the reporting period. The data collected for the radionuclide monitoring program contribute to human risk assessment models as input to the exposure components of the models. Each model accounts for concentrations of radionuclides in the medium of interest (e.g., finfish) as a factor of the pathway from environmental presence to biological absorption. The models also account for the duration of the individual's exposure to each of the affected media. The results of the models estimate the potential risks of exposure to the levels of radionuclides in the environment as documented during the relevant two-year portion of the study.

Quantified radionuclide deposition in the sediment layer informs an assessment of long-term storage of plant-released radionuclides compared to naturally occurring radionuclides. In an integrated exposure model scenario, the results could also serve as a component of estimates of the potential availability of radionuclides to the food web and the potential dose to humans through ingestion or dermal exposure.

The monitoring program includes collections of consumables that are likely to be exposed to radionuclides released from the facilities through the aqueous or gaseous pathways; for instance, oysters and milk. Despite the decline in the region's commercial oyster fishery, oysters are still an important indicator of potential radionuclide uptake in humans. Results from the analysis of the radionuclide content of oysters suspended in water on trays provide data that contribute to models of the potential for a dose to humans. The estimated dose from oyster consumption is one of the factors used to verify that CCNPP complies with dose limits as required by its license (see Section 3.3.2). The results from the analysis of the radioactive content of milk samples, collected from dairy farms in the vicinities of the power plants, also contribute to an understanding of the ingestion pathway for power plant-related radionuclide emissions.

Measurements of radionuclides in samples of the muscle and gut contents of finfish, from fish collected from the waters near PBAPS, inform a component of the pathway of radionuclides through the food web that is specific to the receiving waters near the facility. Currently, the estimated exposure dose to humans through ingestion of fish that is reported in the biennial environmental assessments published by PPAD is used to verify that PBAPS complies with dose limits as required by its license (see Section 3.3.2).

1.3 DESCRIPTION OF POWER PLANTS AND STUDY SITES

1.3.1 Calvert Cliffs Nuclear Power Plant

Constellation Energy Corporation owns and operates CCNPP in Calvert County, Maryland, on the western shore of Chesapeake Bay (Exelon Generation Company owned the facility during the 2020-2021 reporting period). Each of CCNPP's two electricity-generating units is a pressurized water reactor; the combined operating capacity is 1829 megawatts (Power Plant Research Program [PPRP] 2017). Unit 1 is licensed to operate until the year 2034, and Unit 2 until 2036. Controlled releases of radionuclides through the heat dissipation system are permitted at levels defined in CCNPP's license (issued July 31, 1974, for Unit 1 and November 30, 1976, for Unit 2; renewed March 23, 2000) from the United States Nuclear Regulatory Commission (USNRC; Standards for Protection Against Radiation, NRC 10 CFR, Part 20 [1991]). During routine operations, CCNPP withdraws cooling water from the Chesapeake Bay at a rate of approximately 2.3 million gallons per minute (PPRP 2017).

The western shore of Chesapeake Bay is scoured by tides, wind, and waves. The bay in this area is approximately 4.5 kilometers (km) wide and relatively shallow. Water depth gradually increases from 10 meters (m) to 15 m approximately 0.8 km from the shoreline. This depth extends approximately 3 km and increases to 20 m at mid-bay. The area is tidally influenced and has a mean tidal range of 0.3 m to 0.6 m. The velocity of the current in the vicinity ranges between 5 centimeters per second (cm/sec) and 60 cm/sec (Lacy and Zeger 1979). Salinity varies seasonally and normally ranges from 7 to 17 practical salinity units. Bottom sediments are characterized by medium-coarse sands at depths ranging between 0 m and 6 m, fine sands and clays at depths of 6 m to 9 m, and clays and organic silt at depths greater than 10 m (Domotor and McLean 1988). A detailed description of the Calvert Cliffs area can be found in the *Final Environmental Statement Related to the Operation of Calvert Cliffs Nuclear Power Plant, Units 1 and 2* (United States Atomic Energy Commission 1973) and in Baltimore Gas and Electric Company's license renewal application (USNRC 1999).

The Calvert Cliffs region of Chesapeake Bay supports an abundant and diverse macrobenthic assemblage (Llansó et al. 2015) and populations of commercially important finfish and shellfish (Lippson and Lippson 2006). Oysters are present near CCNPP and are commercially harvested from the area. Blue crabs also are abundant throughout the region and are harvested commercially and recreationally. This area of Chesapeake Bay supports a diverse finfish community, including forage species (e.g., menhaden, anchovies, and silversides) and commercially important predatory species (e.g., weakfish, striped bass, and bluefish), and abundant migratory waterfowl that dive in the vicinity of the power plant in search of food (Swarth and Llansó 2012).

1.3.2 Peach Bottom Atomic Power Station

Constellation Energy Corporation and Public Service Enterprise Group (PSEG) Nuclear LLC of New Jersey jointly own PBAPS in York County, Pennsylvania (Exelon Generation Company co-owned the facility with PSEG during the reporting period). The power plant, located approximately 5 km north of the Pennsylvania-Maryland border, on the western shore of Conowingo Pond, began operations in 1974. Each of PBAPS's two electricity-generating units is a boiling water reactor with a combined capacity of 2,770 megawatts (Constellation Energy Corporation 2024). Controlled releases of radionuclides are permitted at levels defined in PBAPS's license (issued October 25, 1973, for Unit 2 and July 2, 1974, for Unit 3; renewed May 7, 2003, for 30 years) from the USNRC (USNRC 1991, 10 CFR Part 20, Appendix B).

During normal operations, PBAPS withdraws cooling water from the area of the Susquehanna River known as Conowingo Pond at a maximum rate of 1.5 million gallons per minute (3,342 cubic feet per second [ft^3/s] or 95 cubic meters per second [m^3/s]; Peach Bottom Atomic Power Station, Units 2 and 3, 2014). Conowingo Pond receives radionuclides in aqueous discharges from the plant during normal operations. Conowingo Pond is an impoundment created by Conowingo Hydroelectric Dam (13 km downstream from PBAPS). Holtwood Dam (10 km upstream of PBAPS) is upstream of PBAPS, near the northern reach of Conowingo Pond. Conowingo Pond has an average surface area of approximately 3,700 hectares (14 square miles) and ranges in depth from about 3 m in upriver sections to a maximum of about 27 m at the face of Conowingo

Dam. The annual average river flow at the Conowingo Dam is approximately 1,171 m^3/s (41,350 ft^3/s; U.S. Geological Survey 2020). Downriver flow may be affected by the withdrawal and discharge of cooling water for PBAPS; periodic cycling of water at the Muddy Run Pumped Storage Facility on the eastern shore, north of the plant; and operation of the turbines at Conowingo Dam.

The Susquehanna River enters the tidal portion of Chesapeake Bay approximately 6 km downstream from Conowingo Dam. The location of the resulting interface between fresh water and salt water fluctuates at the river mouth (Susquehanna Flats) or the upper Chesapeake Bay and is controlled principally by river volume. The transition from fresh to brackish water is accompanied by changes in physical and chemical factors that affect the degree to which metals and radionuclides become or remain associated with particles suspended in the water column (Olsen et al. 1989). These factors influence the dispersion and distribution of radionuclides in the Susquehanna River-Chesapeake Bay system.

The Susquehanna River-Chesapeake Bay system supports an abundant and diverse macrobenthic assemblage and populations of recreationally and commercially important finfish (PPRP 1998, Llansó et al. 2015). Conowingo Pond contains largemouth and smallmouth bass, walleye, sunfish, channel catfish, carp, and hybrids of white and striped bass, which are principal components of the recreational fishery downstream of Conowingo Dam. Further downstream, white perch, channel catfish, blueback herring, American shad, and American eels are commercially fished on Susquehanna Flats. The Susquehanna Flats area supports seasonal stands of SAV, primarily Eurasian milfoil (*Myriophyllum spicatum*), and is an important early wintering ground for migratory waterfowl (White 1989, Lippson and Lippson 2006).

2.0 METHODS AND MATERIALS

2.1 SAMPLE COLLECTION PROCEDURES

Teams of scientists collected environmental samples for radiological analysis from the vicinities of CCNPP and PBAPS and in control areas (i.e., not directly affected by operations at the power plants) during 2020 and 2021. The sample types included sediment, biota (oysters, finfish, and submerged aquatic vegetation), air and air particulates, potable water, precipitation (rain), and milk. The sample types, collection frequency, and number and distribution of collection sites are summarized in Table 2-1.

2.1.1 Sediments

Field teams collected sediments periodically from the series of transects shown in Figure 2-1 and Figure 2-2. Station coordinates are given in Appendix A. Each team used a hydraulic box-grab to collect sediments in the vicinity of CCNPP (planned quarterly). At stations surrounding PBAPS (planned semi-annually), teams used a hand-operated Young grab to collect sediments. For each sample, the teams recovered the top 10 cm (or less) of sediment from each grab. The teams repeatedly collected surface sediment samples, as needed, at each station and compiled the results to amass approximately 3,000 cubic centimeters of sediment for a successful sample. Teams delivered the sediment samples to the PPAD Radioecology Laboratory for radionuclide analysis.

2.1.2 Biota

For the tray oyster study at CCNPP, scientists placed mature oysters into partitioned trays (Abbe 1981) and submerged the trays at indicator (test) and control locations for a variety of exposure periods (Figure 2-1). Oysters destined for the tray study were dredged from the Patuxent River at the Gatton natural oyster bar near St. Thomas Creek (coordinates: 38 23.43516, -76 33.5025). The primary indicator site was near the CCNPP outfall (Plant Outfall Indicator; coordinates: 38 23.640, -76 26.537) to evaluate radionuclide concentrations in oysters exposed to discharges from CCNPP. The control site for the 2020–2021 reporting period was in St. Leonard Creek at Morgan State University's Patuxent Environmental and Aquatic Research Laboratory (coordinates: 38 23.640, -76 30.203). Prior to 2010, the control site was north of the CCNPP cooling water outfall at Kenwood Beach (coordinates: 38 30.0105, -76 29.11066), but the control location was moved in December 2009 due to low dissolved oxygen, dermo disease, and high mortality of oysters at the Kenwood site. Trays were supported by a platform resting approximately 0.5 m from the bottom (approximately 5 m to 5.5 m from the surface). Each tray had four compartments designed to hold 50 oysters each. Scientists retrieved and restocked the oysters from individual compartments (50 per group) on an approximate schedule: 3, 6, 9, and 12 months. In addition, field teams under contract to Exelon Generation Company harvested oysters at a natural bar site near Camp Conoy (Camp Conoy Indicator; coordinates: 38 26.133, -76 25.75).

Table 2-1. Environmental samples for radiological analysis collected in the 2020–2021 period from the vicinities of CCNPP, PBAPS, and at control locations

Sample Medium	Collection Frequency Planned	Number of Sampling Locations Planned	Description of Target Sampling Locations
Sediment	Quarterly[1]	28	Chesapeake Bay in the vicinity of CCNPP along eight transects (Fig. 2-1)
Sediment	Spring and Fall[2]	19	Conowingo Pond (12 stations); Susquehanna Flats (6 stations); Upper Chesapeake Bay (1 station)
Oysters	Quarterly	3	St. Leonard Creek, CCNPP Plant Outfall, and Camp Conoy (oyster trays; Fig. 2-1)
Finfish	Spring and Fall	1	Conowingo Pond, on the western shore downstream of the PBAPS discharge at Station Little Yellow House (Fig. 2-2)
Submerged Aquatic Vegetation (SAV)	Summer and Fall[3] (as per sampling plan)	3	SAV samples were collected from the Susquehanna Flats at Fishing Battery station during Spring and Fall 2020 (Fig. 2-2)
Glass Fiber Filter (air particulates)	Continuously (exchanged weekly)[4]	8	Long Beach, Lusby, and Cove Point (Calvert Co.) Baltimore City Rising Sun and Dempsey's Farm (Cecil Co.) Whiteford (Harford Co.) Horn Point (Dorchester Co.)
Charcoal Filter (air)	Continuously (exchanged weekly)[4]	8	Same sampling locations as for air particulates (see above)
Potable Water	Monthly to Quarterly[5]	8	Seven public drinking establishments in Calvert Co. (Fig 2-4); Baltimore City
Precipitation	Weekly to Monthly	1	Baltimore City, on the roof of the building at 301 West Preston St.
Processed Milk	Quarterly[6]	1	Baltimore City
Raw Milk	Quarterly	1	Kilby Farm (Cecil Co.)

Notes:
1 During 2020, one sediment collection was omitted due to difficulties with boat scheduling.
2 During 2021, there were no samples collected in the Conowingo Pond region due to contract negotiations with Exelon Corporation regarding access to the area.
3 During 2021, SAV was not present or was out of reach (water too deep).
4 The weekly exchange schedule was disrupted due to access restrictions during the COVID-19 pandemic
5 There were only three or four samples collected at stations in Calvert County during the 2020–2021 reporting period; there were only three samples collected during the last three collection periods (approximately monthly) during 2020 at the station in Baltimore City; reasons for the missed smples include access restrictions during the COVID-19 pandemic, staffing issues, and scheduling issues.
6 During 2020, there were only two samples of processed milk (Summer and Fall) taken due to include access restrictions during the COVID-19 pandemic.

Field teams shucked the oysters, transferred the oyster flesh to a freezer, and delivered the oyster samples (frozen) to the PPAD Radioecology Laboratory and the Radiation Chemistry Laboratory of the Maryland Department of Health (MDH) for analysis. The results of the analysis of oysters from Camp Conoy are provided in the 2020–2021 radionuclide report as indicator data, for comparison purposes.

Biota for radiological analysis collected from the PBAPS study site included forage finfish, recreationally and commercially important finfish, and SAV (Figure 2-2). Field teams collected edible and forage finfish by electrofishing or by gill net (1-, 2-, and 4-inch experimental mesh) near the outfall of the PBAPS facility. Teams collected samples of SAV by hand at the Susquehanna Flats Fishing Battery Station. The Conowingo Pond station and the Susquehanna River Interstate 95 Bridge Station SR-3 did not contain SAV that could be harvested for samples in 2020 or 2021. Teams delivered the finfish and SAV samples to the PPAD Radioecology Laboratory for analysis.

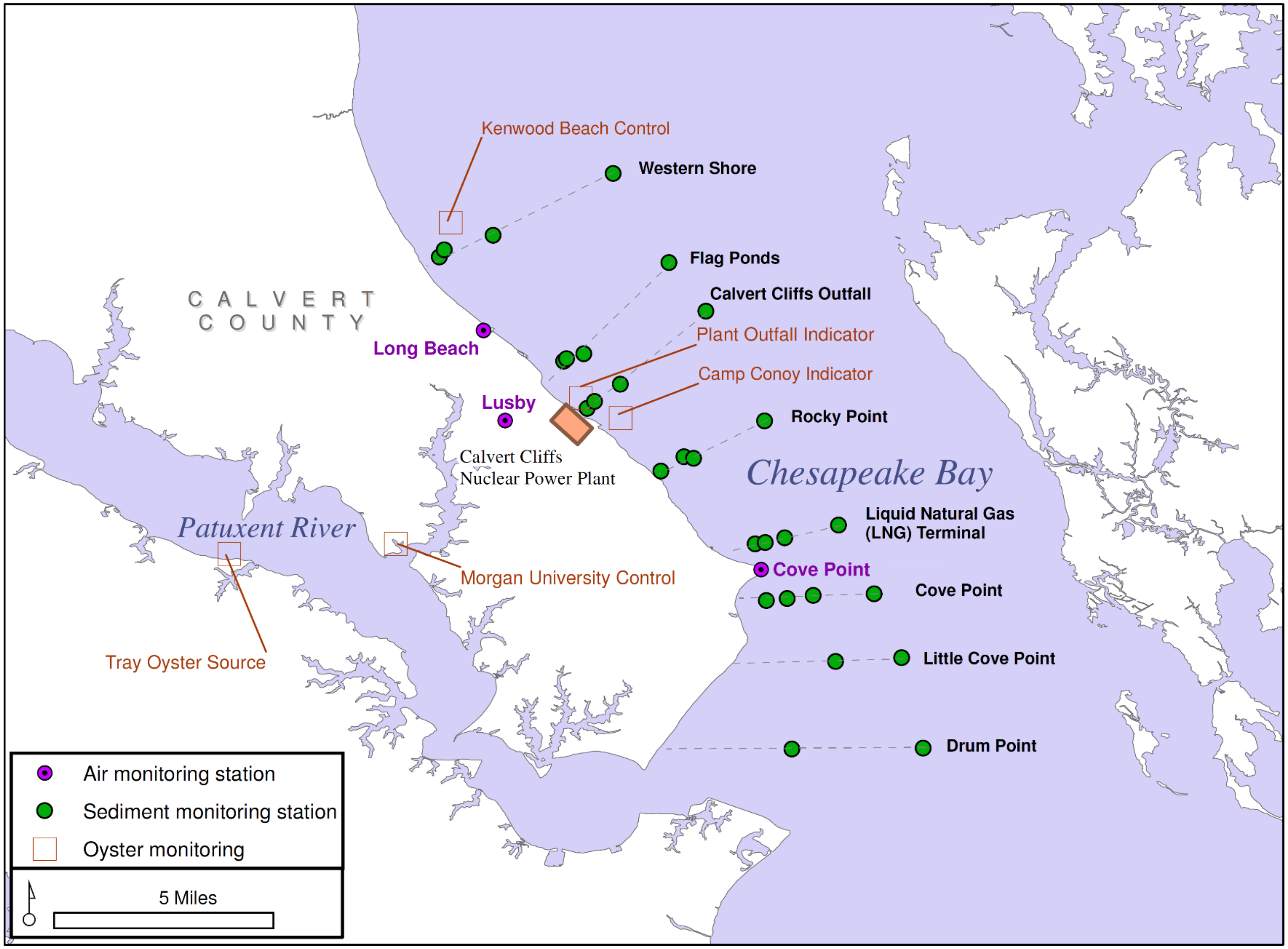

Figure 2-1. Transects and stations for samples collected from the Chesapeake Bay near the Calvert Cliffs Nuclear Power Plant

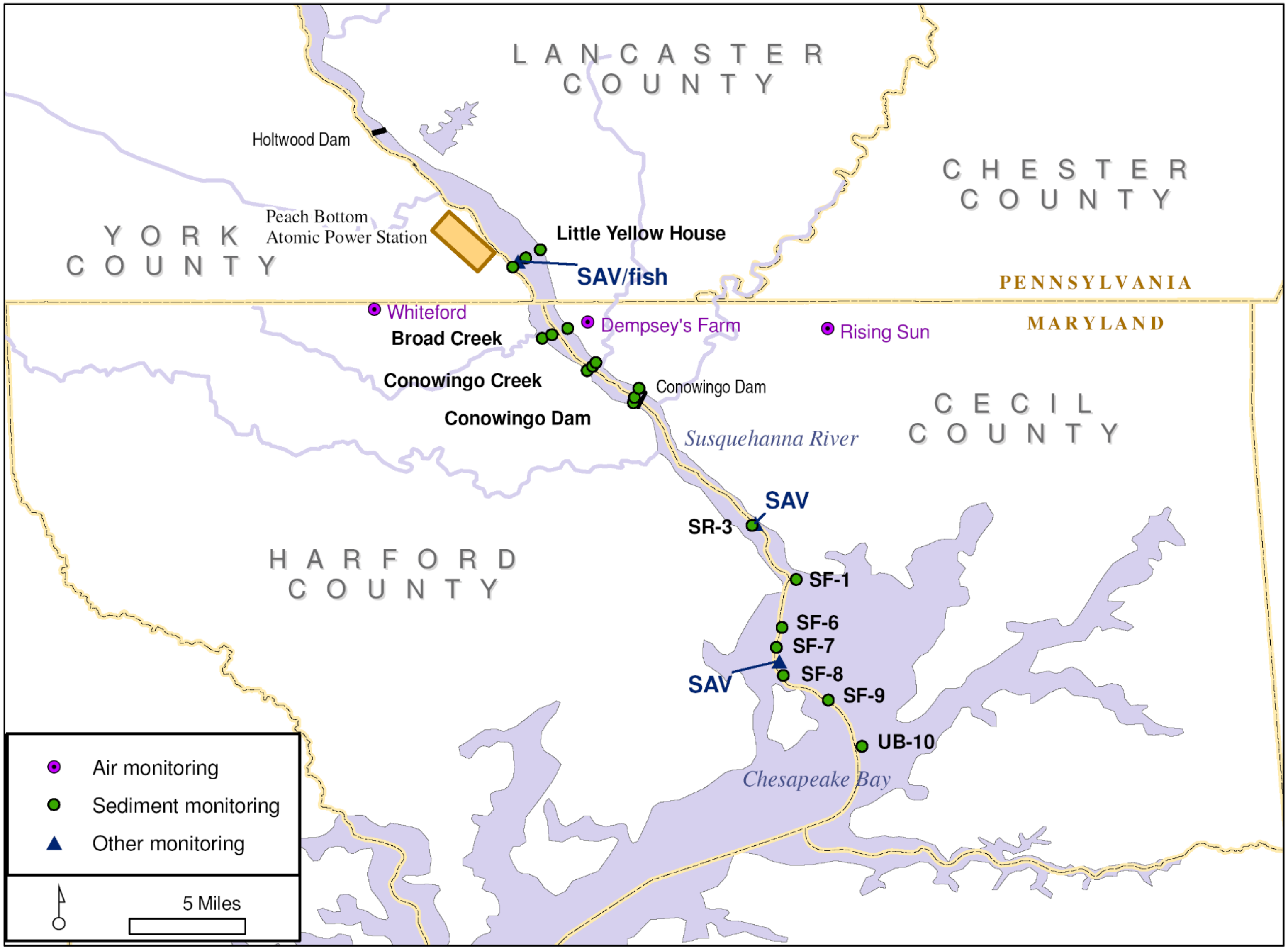

Figure 2-2. Transects and stations for samples collected from the lower Susquehanna River and upper Chesapeake Bay near the Peach Bottom Nuclear Power Plant

2.1.3 Air and Air Particulates

Field teams collected samples of air and air particulates near CCNPP and PBAPS from permanently mounted air samplers (Figure 2-3). The continuously operating samplers were either an AVS-28A Portable Constant Flow Air Sampler or an HD-28A Portable Air Sampler manufactured by RADēCO (Plainfield, CT). The air samplers were mounted inside weatherproof housing affixed to utility poles or other permanent fixtures and connected to an alternating current electric power source. The samplers were fitted with holders for open-face cartridges and filters and calibrated to pump at a continuous air flow rate of one cubic foot per minute. Sampling media for monitoring air and air particulates were charcoal canisters that had the dimensions 57.7 millimeters (mm) in diameter by 26.4 mm in thickness and glass fiber filters that were 47 mm in diameter, respectively. Field teams exchanged the sampling media for both sample types weekly and delivered the sample media to the MDH Radiation Chemistry Laboratory for analysis.

2.1.4 Potable Water

Field teams collected samples of potable water quarterly from establishments (e.g., schools or government buildings) in the vicinity of CCNPP, north and south of the plant (Figure 2-4). Field personnel collected water from public drinking water fountains into 1-liter plastic containers. Staff collected the control samples monthly into 1-gallon cubitainers (i.e., a cube-shaped flexible plastic container with a screw-on cap). Teams delivered the potable water samples to the MDH Radiation Chemistry Laboratory for analysis. Baltimore City tap water (collected as a sample from within the MDH Radiation Chemistry Laboratory) served as a control for radioactive content in drinking water.

2.1.5 Precipitation

Field teams collected samples of precipitation weekly to monthly (when sufficient rain had been collected) from a 20-gallon carboy (i.e., a large, rigid jug) positioned below an aluminum funnel that was permanently mounted on the roof of the Maryland State Office Building at 301 West Preston Street in Baltimore (Figure 2-3). If sufficient precipitation had been collected in the carboy, the team documented the amount of rainfall measured by the analog rain gauge and transferred the accumulated sample to a 1-gallon cubitainer. Teams delivered the precipitation samples to the MDH Radiation Chemistry Laboratory for analysis.

2.1.6 Milk

Field teams collected samples of processed milk quarterly from Cloverland/Green Spring Dairy in Baltimore. Teams collected samples of raw milk quarterly from Kilby Farm in Cecil County (Figure 2-3). Teams delivered the milk samples to the MDH Radiation Chemistry Laboratory for analysis.

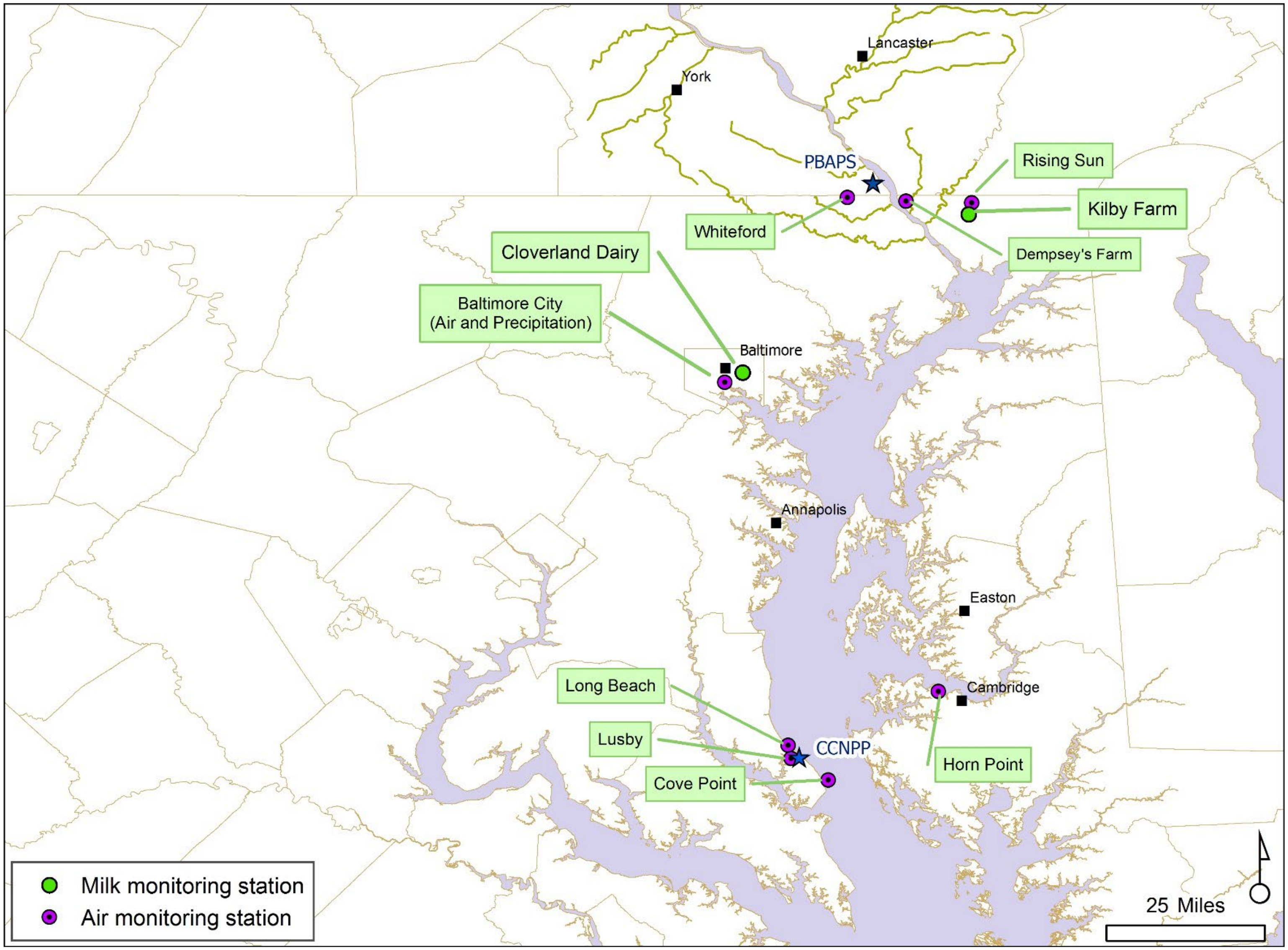

Figure 2-3. Air and milk monitoring stations monitored during the 2020–2021 reporting period

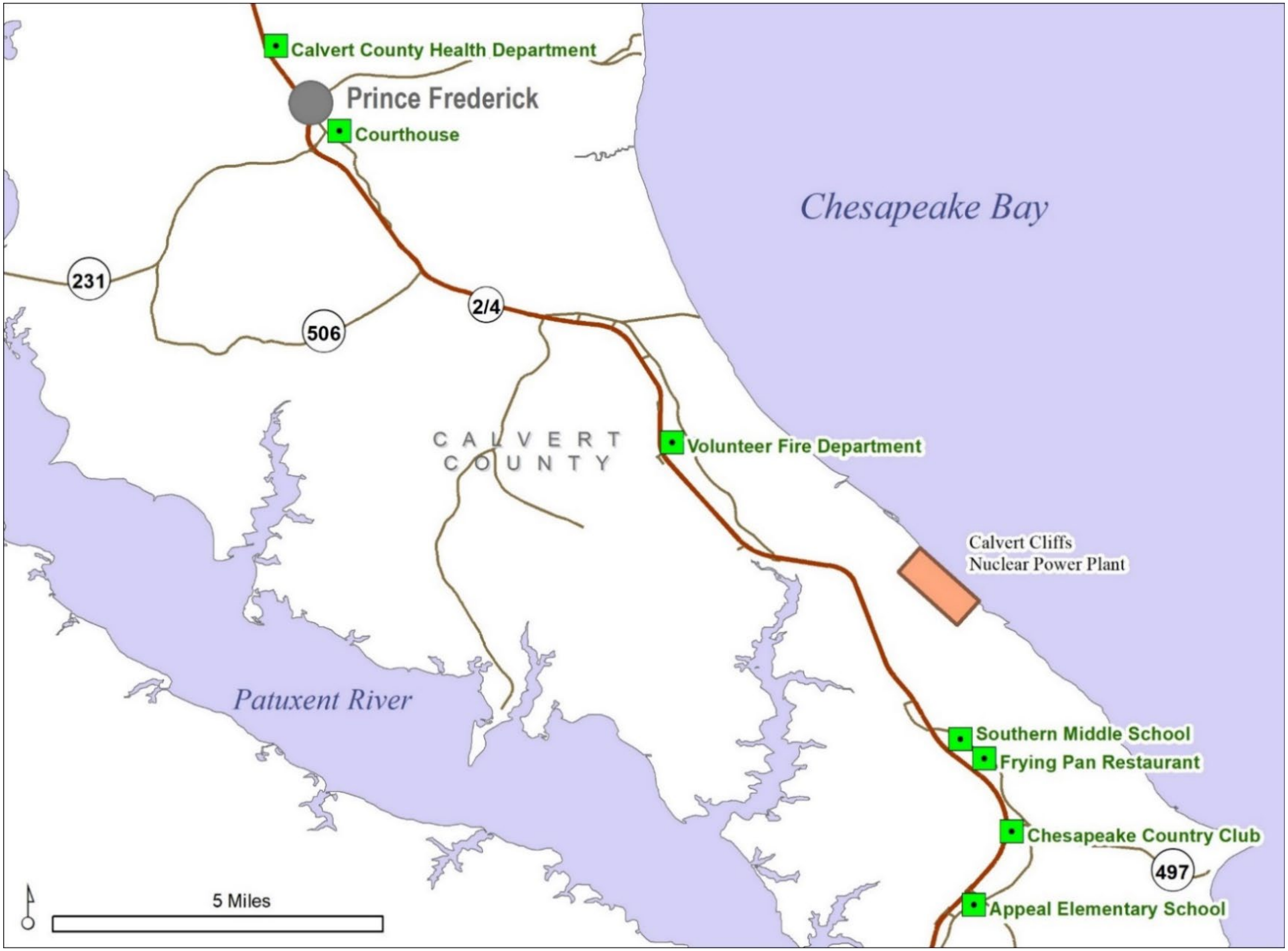

Figure 2-4. Potable water monitoring stations in Calvert County, Maryland

2.2 SAMPLE PREPARATION AND ANALYSIS PROCEDURES

The sample preparation and analysis procedures described below apply to sediment and biota samples analyzed by staff with the PPAD Radioecology Laboratory during the 2020–2021 reporting period. Staff with the MDH Radiation Chemistry Laboratory analyzed the other samples (i.e., air, air particulates, water, and milk) using a variety of methods of sample preparation (e.g., evaporating to dryness, wet chemistry), sample analysis (e.g., gas-flow proportional counting, liquid scintillation analysis, and gamma spectrometry), and data analysis. Both laboratories received oyster samples to be analyzed. Descriptions of portions of the methods used can be found in Jones (1994), Krieger and Whittaker (1980), and United States Department of Energy (1990).

2.2.1 Sample Preparation

To prepare a sediment sample for analysis of radionuclide content, staff at the PPAD Radioecology Laboratory transferred the sample to a 2-liter Marinelli beaker and placed the beaker into the analysis chamber of a gamma spectrometer. To analyze a sediment sample for particle size, staff dried and weighed the sample before conducting the analysis for particle size (see Section 2.3) to determine its composition type (e.g., sand, silt, or clay).

Biota samples were prepared for analysis as follows:

Oyster flesh: Staff thawed the oyster flesh, homogenized the flesh in a blender, transferred the material to a Marinelli beaker, and diluted the material with deionized water to 1 or 2 liters (as appropriate for the sample).

Edible fish flesh and forage fish: Staff filleted the fish, diced the flesh into 3-cm cubes, and packed the cubes in a Marinelli beaker to a total volume of 1 or 2 liters (as appropriate for the sample).

Fish guts: Staff removed the guts from the collected finfish, transferred the material to a Marinelli beaker, wet-digested the material in a solution of octanol and nitric acid, and diluted the material with deionized water to a total volume of 1 or 2 liters (as appropriate for the sample).

SAV: Staff packed the vegetation samples into a Marinelli beaker and added deionized water to a total volume of 1 or 2 liters (as appropriate for the sample).

Staff with the MDH Radiation Chemistry Laboratory analyzed the individual (weekly) air and air particulate filters for gross alpha radiation, gross beta radiation, and radiation from a radioisotope of iodine (^{131}I). Staff also combined the air particulate filters into monthly sets and analyzed the samples for the radionuclides beryllium-7 (^{7}Be) and cesium-137 (^{137}Cs).

2.2.2 Gamma Spectrometry

Staff with the PPAD Radioecology Laboratory analyzed the sediment and biota samples for radionuclides using a gamma-ray counting system, which consisted of high-resolution, intrinsic germanium detectors. Two detectors were operating at the laboratory during the 2020–2021 reporting period: one manufactured by Ortec (Oak Ridge, TN) and the other manufactured by Canberra Industries, Inc. (Meriden, CT). The detectors were 25 percent (%) and 23% efficient[1], respectively, and were coupled to a Canberra Genie-2000 spectrum acquisition and analysis system (Stanek et al. 1996a).

Laboratory staff applied the appropriate nuclide library data and counting efficiency curves to the interim counting results by sample to produce reports of the concentrations of radionuclides in the samples. Gamma-ray energy and intensity values used in energy-to-channel calibration and in data reduction were based on library data incorporated into the Genie-2000 software, which were referenced to the National Nuclear Data Center of the Brookhaven National Laboratory (Stanek et al. 1996b). Staff determined counting efficiency curves using custom multi-gamma standards commercially purchased from Eckert and Ziegler Analytics, Atlanta, GA, which were traceable to the National Institute of Science and Technology. For each sample, staff set the counting system to acquire all spectra for 1,000 minutes. Staff then used nuclide identification software to determine the radionuclide concentrations in the interim results referenced to the sample collection date and time. Laboratory staff stored spectra and interim results for all samples in electronic format for future reference.

For sediment and biota, analysts post-processed radionuclide concentrations and pertinent sample-collection information and analysis parameters using the R programming language to perform quality control reviews, determine dry weight concentrations, and to organize the results. Staff also used the R programming language to mass-compile the results of the air, air particulates, milk, and water analysis. After quality control review, analysts entered the results into a Microsoft Access database to assist in organizing and presenting the data.

2.2.3 Quality Assurance

In 2009, the Radioecology Laboratory implemented a formal Quality Assurance Plan (Plan); laboratory protocols for the 2020–2021 reporting period followed the guidance in the Plan. Plan elements are described in Jones (2010); examples include the use and frequency of analysis of control samples, standard samples, and performance samples. Relevant to the 2020–2021 reporting period, laboratory staff tested laboratory performance (March 2020 and June 2021) by analyzing a spiked intercomparison (also known as a cross-check) sample from Eckert and Ziegler Analytics; laboratory results and

[1] Detector efficiency refers to the rated sensitivity of the detector using a standard method of measurement; actual sample counting efficiencies can be higher or lower, depending on the radionuclide, the shape of the sample, and the material analyzed.

known values for the intercomparison study sample are presented in Appendix B. There were two laboratory intercomparison tests conducted during the reporting period: March 12, 2020, and June 3, 2021. In general, laboratory results for gamma emitters in the intercomparison sample were within ten percent of the known results; the two measurements with less accurate results were for ^{141}Ce and ^{65}Zn (14% and 13% difference from the known result, respectively) in the sample from March 2020.

2.3 DETERMINATION OF SEDIMENT CHARACTERISTICS

Laboratory staff with the Radioecology Laboratory determined the sediment particle size index value for each sediment sample to provide a basis for comparing radionuclide concentrations detected in sediments of different composition type categories (e.g., sand versus clay). Sediment particle size analysis accounts for composition differences that may affect measured radionuclide concentrations at a collection site. For each sample, staff measured the proportion of the material that was trapped within each of several sieves that had different standard micrometer-scale mesh sizes, and material that passed through all of the sieves, and derived a mean particle size for the entire sample. Staff compared the results of the computations of particle size to the Wentworth scale, as published in Buchanan and Kain (1971), to assign each sediment sample to a composition type category; see Table 2-2 for examples of the possible assignment categories. Staff classified sediments as silt-clay if the mean grain size was less than 63 μm and sand if the mean grain size was greater than 63 μm.

Table 2-2. Select grain size ranges corresponding to Wentworth size classes

Grain size range (micrometers)	Wentworth Size Class
250 – 500	Medium sand
125 – 250	Fine sand
63 – 125	Very fine sand
< 63	Silt and clay types

Notes: The table presents an excerpt of the Wentworth grain size classifications specific to the grain size ranges included in the particle size analysis. All sizes smaller than 63 micrometers are classified as silt clay for the particle size analysis. Grain sizes larger than 250 micrometers are the coarsest particles and include all particles larger than fine sand. Information source: Buchanan and Kain 1971.

The process to determine mean sediment grain size index values involved several steps. Staff wet- or dry-sieved 50-gram (g; dry weight) aliquots through a series of mesh screens with 250-micrometer (µm), 125-µm, and 63-µm mesh sizes. Staff dried and weighed the material that remained in each sieve; staff derived the amount of sample that passed through the 63-µm screen by subtracting the summed result of the sieved contents from the original dry weight of the sample (50 grams). Staff then calculated the particle-size index values for each sample by multiplying the fraction (percent) of the total weight retained on the 250-µm-mesh screen by 4, the fraction retained on 125-µm-mesh screen by 5, the fraction retained on the 63-µm-mesh screen by 6, and the fraction that passed through the 63-µm-mesh screen by 7. The sum of these products was the relative particle-size index value for the sediment sample. Possible particle size index values could range from the coarsest (400), in which all material was retained on the 250-µm-mesh screen, to the finest (700) in which all material passed through the 63-µm-mesh screen.

2.4 DATA ANALYSIS

Laboratory staff calculated interim analytical results using gamma spectrum analysis software. The software matched any photopeaks that were distinguished from background readings to radionuclide species in a defined library and quantified the peaks based on factors such as instrument conditions, sample volume, and radioactive decay. The concentration of a radionuclide of interest was reported as a value with a 2-sigma uncertainty (i.e., a 95.4% confidence level).

Staff calculated the lower limit of detection (LLD) for radionuclides of interest that were not detected. The equation given in Table 2-3 defines the LLD for data included in the 2020–2021 radionuclide report. Common LLD quantities produced by sample analyses are given in Table 2-4. Analysts disregarded LLD quantities when summarizing yearly averages of activity values.

Table 2-3. Determination of the lower limit of detection

The lower limit of detection is given by the following formula:

$$LLD = \frac{L_D}{VEBTK_w}$$

where

- V = The mass or volume of sample
- E = The counting efficiency for the peak of interest
- B = The branching ratio of the gamma ray peak
- T = The sample counting time (live) in seconds
- K_w = The decay correction factor

$$K_w = e^{-\frac{ln(2)t_w}{T_{1/2}}}$$

- $T_{1/2}$ = The half-life of the nuclide
- t_w = The elapsed clock time from the time the sample was taken to the beginning of the measurement
- L_D = The uncertainty in the continuum count rate at the peak of interest

$$L_D = K^2 + 2L_c$$

$$L_c = K\sigma_O = K\sqrt{\mu_F + \mu_I + \sigma_F^2 + \sigma_I^2}$$

- L_C = Critical level, below which a net signal cannot reliably be detected
- σ_0 = Variance of a null net signal
- K = 2.327 (based on a Poisson distribution at a confidence level of 99%)
- μ_F = The "true" calculated continuum under the peak
- μ_I = The "true" measured background interference -- net peak area
- σ_F = The variance of F (calculated continuum under the peak due to Compton scattering)
- σ_I = The variance of I (measured background interference -- net peak area)

Note: The source of these formulae is Canberra Industries 1998.

Table 2-4. Approximate lower limits (99%) of detection for selected counting geometries

Radionuclide	Energy (keV)*	Matrix			
		Biota	Biota	Sand	Clay
		Marinelli Beaker Size (liters)			
		1	2	2	2
		Approximate Wet Sample Mass (kg)			
		1	2	3	1.5
		Lower Limit of Detection (pCi/kg)			
^{7}Be	478	27	17	15	56
^{58}Co	811	3	2	3	6
^{60}Co	1333	4	2	3	7
^{65}Zn	1116	7	6	8	19
^{95}Nb	766	3	3	3	8
^{95}Zr	757	5	4	5	12
^{103}Ru	497	3	2	3	6
^{106}Ru	622	28	21	23	55
^{110m}Ag	885	3	2	3	8
^{125}Sb	601	8	6	7	17
^{134}Cs	605	3	2	3	8
^{137}Cs	662	3	2	2	5
^{144}Ce	134	19	13	26	52

* keV = 1000 electron-volts

Notes: A seven-day decay period between sample collection and counting is assumed.

kg = kilograms; pCi = picoCurie

2.5 IDENTIFICATION OF ^{137}Cs FROM POWER PLANTS

The radionuclide ^{137}Cs is a constituent of fallout from historic weapons tests and aqueous effluent from nuclear power plants. The amounts of ^{137}Cs released in the power plants' effluents have historically been substantially higher than the quantities that the facilities are currently releasing. It is believed that the majority of ^{137}Cs found in sediments near the power plants would be primarily attributable to the long-standing and continued influence of legacy power plant operations and atmospheric fallout from historic weapons testing; thus, the relatively small amount of ^{137}Cs currently released by power plants is unlikely to have a demonstrable effect on the amounts of the radionuclide found in samples collected near the power plants.

2.6 DATA PRESENTATION

Appendix C contains concentration data records for samples collected in the vicinity of CCNPP and PBAPS during the 2020–2021 monitoring period. The radioactivity levels reported in these tables include those of specific radionuclides, gross alpha and gross beta radiation from natural sources, remnants of historical weapons test fallout, and contributions from power plant effluent. Separate tables are provided for samples of sediment, oysters, finfish, SAV, air, air particulates, potable water, precipitation, and milk. Within each table, labels for specific sample stations are arranged approximately from north to south, based on the stations' relative locations, and data are presented by individual sampling date and summarized as the yearly and overall means for the monitoring period.

Radiation concentration data presented in the 2020–2021 monitoring report are decay-corrected to the date of sample collection. The counting uncertainty is reported as plus or minus (±) two standard deviations (SD). Concentrations for alpha-, beta-, and specific gamma-emitting radionuclides of interest that were not detected in specific samples were recorded as less than (<) the lower limit of detection for the relevant sample.

3.0 RESULTS AND DISCUSSION

Scientists used the data related to documented power plant discharges and laboratory analysis results for samples collected during the 2020–2021 reporting period to identify and quantify sources of radionuclides, determine the concentrations of radionuclides in environmental samples, and estimate potential radiological risks to ecological resources and humans that were relevant to the operations of each of the target power plants, CCNPP and PBAPS. The results of these assessments are presented in separate sections below.

The analysis team identified the origins of the more commonly observed radionuclides in environmental samples and used this information to determine the magnitude of the contribution of radionuclides from each power plant relative to radionuclides derived from fallout from weapons testing and natural sources. The team compared the quantities of individual radionuclides released from CCNPP and PBAPS during the 2020–2021 period with the quantities detected in environmental samples collected during the same period.

3.1 SOURCES OF RADIONUCLIDES

Discharges from the two nuclear power plants, past atmospheric tests of nuclear weapons, and natural occurrences are the three primary sources of radioactive material in the Chesapeake Bay and the Susquehanna River in the vicinities of CCNPP and PBAPS. Samples of biota and sediment collected during the 2020–2021 reporting period contained radionuclides that were attributable to each of these sources.

3.1.1 Radionuclides from CCNPP and PBAPS

3.1.1.1 Total Radionuclides

Radionuclides released from nuclear power plants generally correspond to one of three classes: noble gases, tritium, or iodines and particulates. The quantities and proportions of material in these three classes of radionuclides released into the atmosphere and waterways vary based on plant design. During the 2020–2021 monitoring period, the most common radioactive component of the combined (atmospheric and aqueous) discharges from CCNPP was tritium (99.96% of total releases); less common components included noble gases (0.04%) and a group of radionuclides that are considered to have environmentally significant consequences that included radioactive iodines and particulates (0.001%; Figure 3-1A). During the same period, the most common radioactive component of the combined discharges released by PBAPS was a combination of radionuclides in the category of noble gases (73.29% of total releases); less common components included tritium (26.70%) and the group of environmentally significant radionuclides (0.002%; Figure 3-1B). Note that the two charts shown in the figure do not show contributions of a radioactive isotope of Carbon, ^{14}C; the two power plants only released ^{14}C in atmospheric discharges. In the environment, noble gases are chemically inert, are not readily incorporated into biological tissues, and are not bioconcentrated. They disperse in the environment and generally have short half-lives (e.g., less than 5.3 days), which facilitates a rapid decay to a stable form. Tritium, as a form of hydrogen, can bond with oxygen to form water and thus can disperse readily in an aquatic environment. Tritium also occurs naturally in the environment, and releases from nuclear power plants are estimated to represent less than 0.1 percent of the estimated typical total dose to humans from background sources (National Commission on Radiation Protection and Measurement, 2009, as reported by the USNRC at https://www.nrc.gov/reading-rm/doc-collections/fact-sheets/tritium-radiation-fs.html).

During the reporting period, CCNPP released 73% of the combined (i.e., both target power plants) radionuclides through the air and liquid pathways; PBAPS released approximately 27% of the total to the two pathways (Table 3-1). The releases to the aqueous pathway from CCNPP during the reporting period constituted 97.9% of the total releases from the power plant; the releases to the atmospheric pathway constituted 2.1% of the total. In contrast, the releases to the aqueous pathway from PBAPS during the reporting period constituted 1.7% of the total releases from the power plant; the releases to the atmospheric pathway constituted 98.3% of the total.

Both power plants released ^{14}C in air emissions, exclusively, during the 2020–2021 reporting period, according to data provided by Exelon Generation Company and Constellation Energy Corporation (see Table 3-1). The CCNPP release of 40.5 Curies (Ci) of ^{14}C into the atmosphere during the period represented 1.5% of total releases. The PBAPS release of 77.6 Ci of ^{14}C into the atmosphere represented 7.9% of the plant's total releases for the period. The average annual release of ^{14}C from PBAPS (38.78 Ci) for the period was below the range of annual production rates expected for boiling water reactors: approximately 1 terabecquerel per gigawatt electrical year (TBq/GWe-yr) from coolant water, and up to 2 TBq/GWe-yr from coolant water and fuel (Yim and Caron 2006). At CCNPP, net power generation in 2020 was 15,081 gigawatt hour (GWh; U.S. Energy Information Administration 2023); this is equivalent to 1.72 GWe-yr (1 GWe-yr = 8,760 GWh); thus, the expected production rate would have been between 1.72 and 3.44 TBq, or 46 to 93 Ci. At PBAPS, net power generation in 2020 was 21,792 GWh (U.S. Energy Information Administration 2023); this is equivalent to 2.49 GWe-yr; thus, the expected production rate would have been between 2.49 and 4.98 TBq, or 67 to 135 Ci. The contribution to the global ^{14}C inventory from the two power plants' emissions is negligible (Yim and Caron 2006). According to estimates from the U.S. Environmental Protection Agency (USEPA; 1981), the risk of cancer from ^{14}C emissions to the atmosphere by light water reactors is very small, approximately three orders of magnitude lower than the risk from natural background radiation.

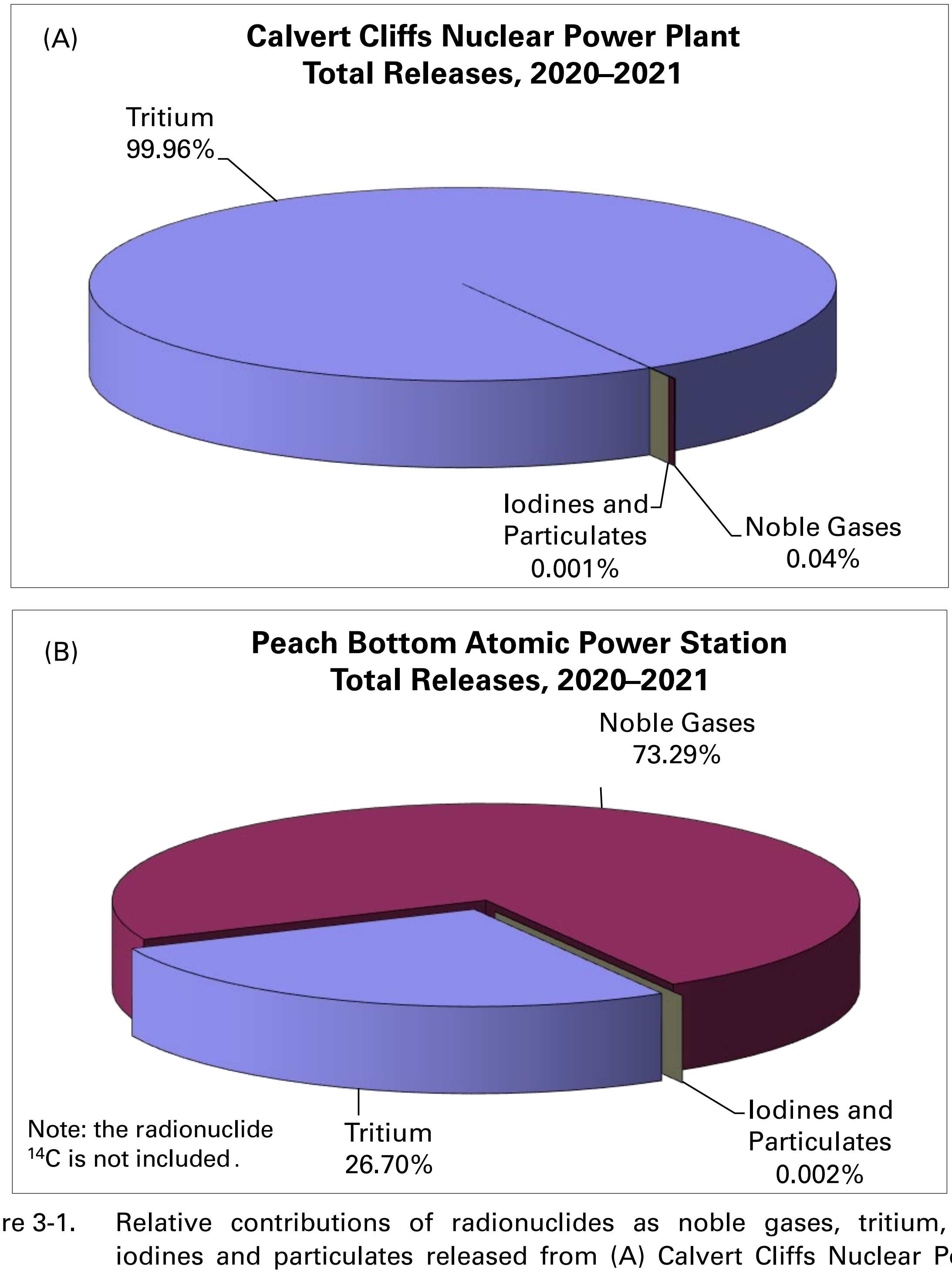

Figure 3-1. Relative contributions of radionuclides as noble gases, tritium, and iodines and particulates released from (A) Calvert Cliffs Nuclear Power Plant and (B) Peach Bottom Atomic Power Station in 2020–2021, including air and liquid pathways

Table 3-1. Total releases of radionuclides as noble gases, tritium, iodines and particulates, and ^{14}C from CCNPP and PBAPS through the air and aqueous effluent pathways during 2020–2021, derived from values as reported by Exelon Generation Company and Constellation Energy Corporation

Type	CCNPP Releases (Curies)			PBAPS Releases (Curies)		
	Air	Liquid	Total	Air	Liquid	Total
Noble Gases	1.1	0.0003	1.1	661.6	0.00009	661.6
Tritium	15.2	2,610	2,625	224.1	17.0	241.0
Iodines and Particulates	0.0	0.026	0.026	0.008	0.010	0.018
^{14}C	40.5	0	40.5	77.6	0	77.6

3.1.1.2 Environmentally Significant Radionuclides

Certain radioiodines and radioactive particulates (i.e., metal isotopes) are considered environmentally significant. Environmentally significant radionuclides are those that have a strong tendency to adsorb onto particles, can accumulate in biological tissues, and can be concentrated through trophic transfer. The concentrations and distributions of these materials have a particular influence, therefore, in the duration and magnitude of the potential environmental consequences and bodily risk of exposure to radioactive releases from power plants.

During the 2020–2021 reporting period, each power plant released several radionuclides, other than ^{14}C, that are considered to have environmentally significant consequences; these types of radioactive elements are known to be assimilated (bioaccumulated) by biological organisms, are discharged in detectable amounts, and do not decay rapidly to stable forms. The most common environmentally significant radionuclide released by CCNPP during the period was Cobalt-60 (^{60}Co; 41.0%); other radionuclides in the category included Cobalt-58 (^{58}Co; 31.1%), Cesium-137 (^{137}Cs; 14.7%), and Iron-55 (^{55}Fe; 9.7%); the remainder constituted 3.5% (Figure 3-2A). The most common environmentally significant radionuclide released by PBAPS during the period was ^{60}Co (40.3%); other radionuclides in the category included Iodine-133 (^{133}I; 29.6%), ^{131}I (8.1%), Manganese-54 (^{54}Mn; 5.5%), ^{135}I (3.8%), and ^{89}Sr (3.0%); the remainder constituted 9.8% (Figure 3-2B).

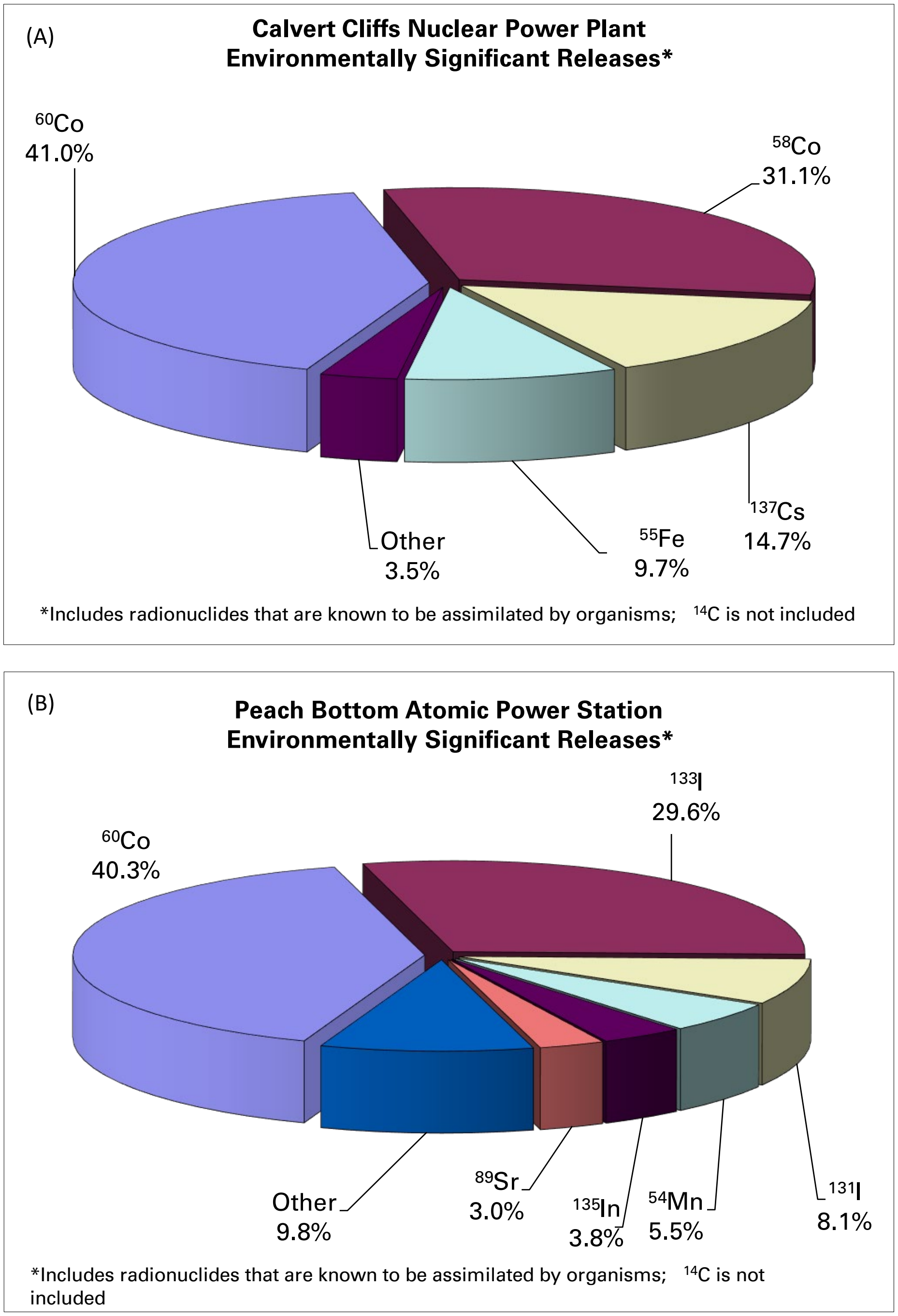

Figure 3-2. Environmentally significant radionuclides (percent) released from (A) Calvert Cliffs Nuclear Power Plant, and (B) Peach Bottom Atomic Power Station, 2020–2021, including air and liquid pathways

Total annual releases of ^{137}Cs and ^{60}Co from both power plants to the aqueous pathway have been variable since 2000. Releases of ^{137}Cs from CCNPP during the span of the past 22 years peaked in 2015 (525 millicurie [mCi]); releases in 2020 and 2021 were 0.43 mCi (0.09% of the sum of ^{137}Cs releases at CCNPP since 2000) and 3.31 mCi (0.54%), respectively (Figure 3-3). Releases of ^{137}Cs from PBAPS during the span of the past 22 years peaked in 2006 (3.05 mCi); releases in 2020 and 2021 were 0.002 mCi (0.014% of the sum of ^{137}Cs releases at PBAPS since 2000) and 0.002 mCi (0.0016%), respectively (Figure 3-4). Releases of ^{60}Co from CCNPP peaked in 2000 (19.5 mCi); releases in 2020 and 2021 were 1.7 mCi (1.67% of the sum of ^{60}Co releases at CCNPP since 2000) and 9.02 mCi (8.87%), respectively (Figure 3-5). Releases of ^{60}Co from PBAPS peaked in 2006 (354 mCi); releases in 2020 and 2021 were 7.13 mCi (0.57% of the sum of ^{60}Co releases at PBAPS since 2000) and 0.02 mCi (0.002%), respectively (Figure 3-6). All releases of radionuclides from PBAPS and CCNPP were the result of normal operation and maintenance at the plants, were within regulatory limits established by the USNRC and USEPA[2], and resulted in negligible effects on the environment. Quantities of releases from CCNPP and PBAPS were obtained from Exelon Generation and Constellation Energy Corporation Annual Radioactive Effluent Release reports to the USNRC (Exelon Generation 2021a, 2021b, Constellation Energy Corporation 2022a, 2022b).

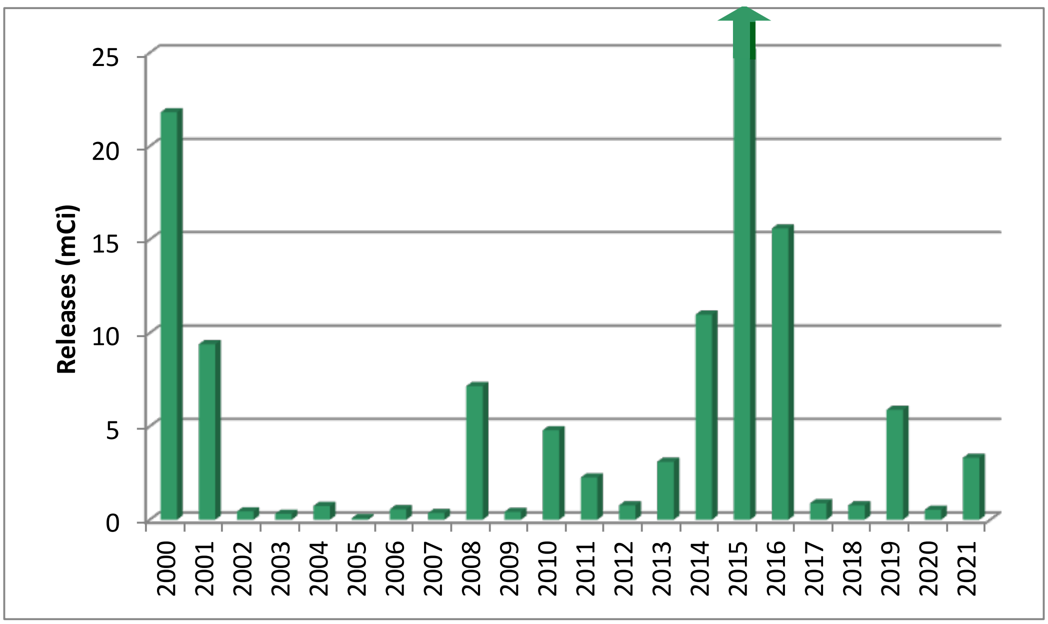

Figure 3-3. Annual aqueous releases of ^{137}Cs from CCNPP, 2000–2021, as reported by Exelon Generation Company and Constellation Energy Corporation; the 2015 release was 525 mCi

[2] USEPA 40CFR190 limits: 25 millirem (mrem) whole body or individual organ; USNRC 10CFR50 limits: 3 mrem whole body and 10 mrem individual organ.

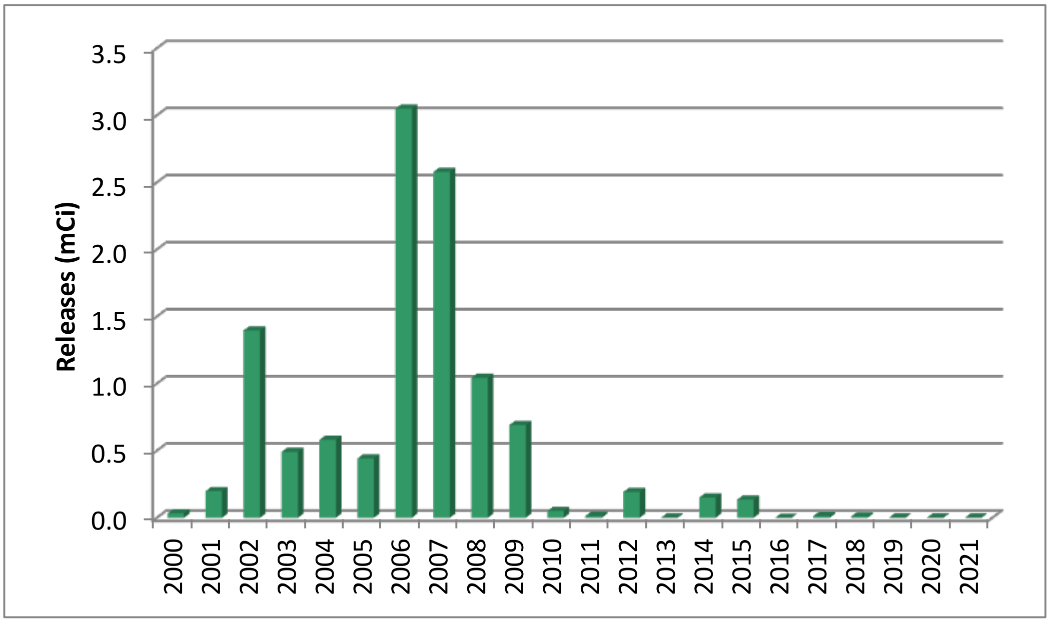

Figure 3-4. Annual aqueous releases of ^{137}Cs from PBAPS, 2000–2021, as reported by Exelon Generation Company and Constellation Energy Corporation

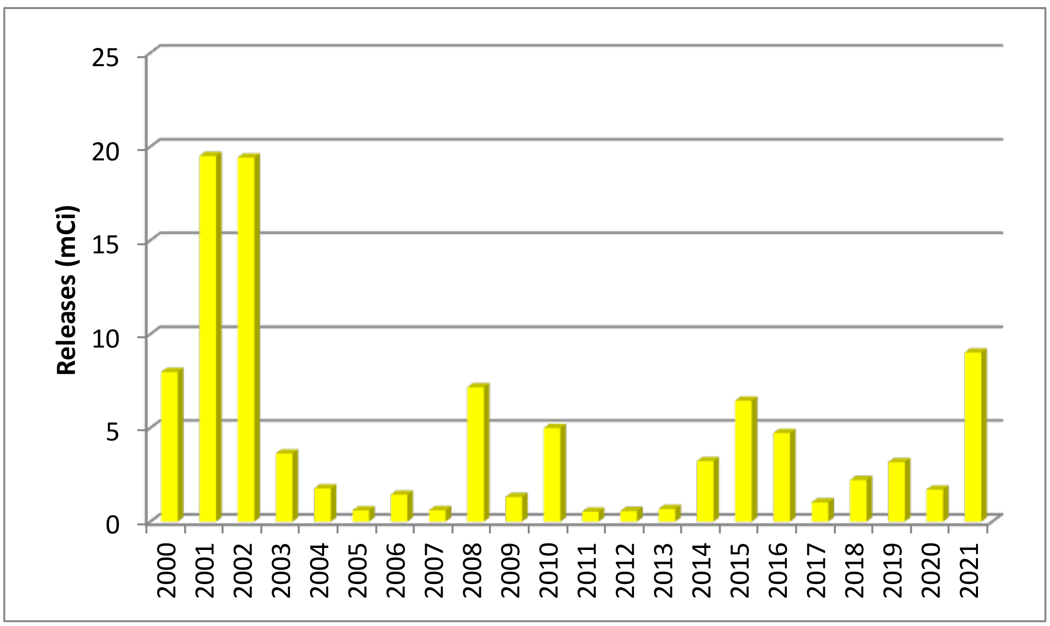

Figure 3-5. Annual aqueous releases of ^{60}Co from CCNPP, 2000–2021, as reported by Exelon Generation Company and Constellation Energy Corporation

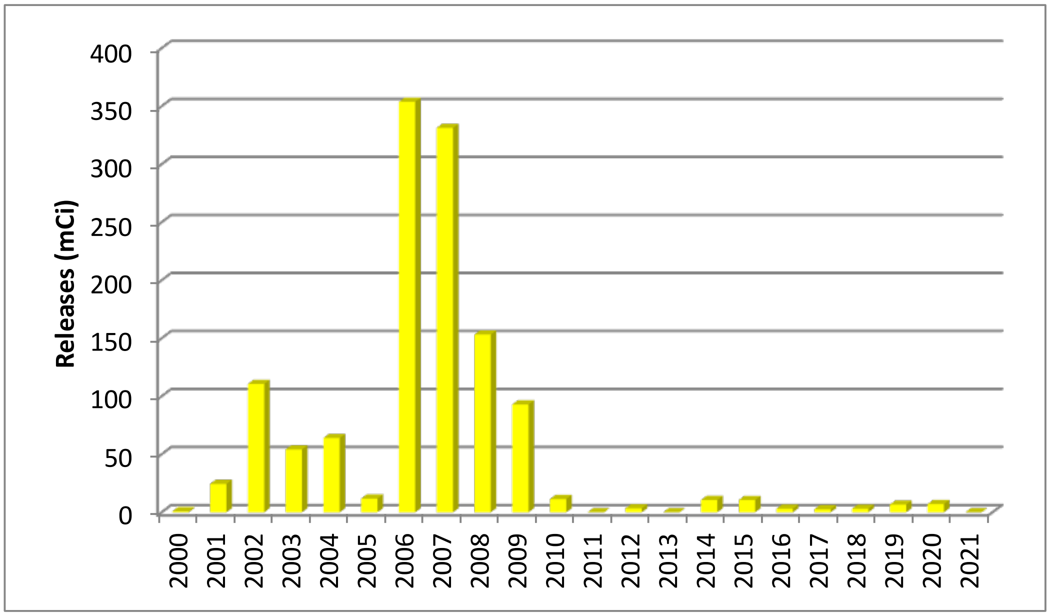

Figure 3-6. Annual aqueous releases of ^{60}Co from PBAPS, 2000–2021, as reported by Exelon Generation Company and Constellation Energy Corporation

Releases of environmentally significant radionuclides through the aqueous pathway vary annually (Table 3-2) due to changes in maintenance procedures, operating conditions, and waste filtration technology at the plants (R. Conatser, Constellation Energy Nuclear Group, LLC, personal communication, August 17, 2005). Outages, minor leaks, and component maintenance and replacement efforts also affect annual release totals at CCNPP and PBAPS (B. Nuse, Constellation Energy Nuclear Group, LLC, personal communication, May 24, 2010; L. Lucas, Exelon Nuclear Company, personal communication, June 17, 2010). During the 2020–2021 period, CCNPP released approximately 26 mCi (less than 0.001% of total liquid releases) of environmentally significant radionuclides (iodines and particulates) to the Chesapeake Bay through the aqueous pathway. PBAPS released 10 mCi (less than 0.001% of total liquid releases) of environmentally significant radionuclides to the Susquehanna River during the same period. The overall relatively low release rate in recent years is due, in part, to improved ion-exchange technologies at the cooling water intake and more efficient use of existing methods for reducing radioactive waste.

At CCNPP, liquid radioactive wastes are discharged through the cooling-water outfall, which is approximately 0.3 km offshore, and subsequently diluted in the receiving water. At PBAPS, the cooling-water outfall is located at the extreme downstream end of the power plant site along the western shore (near Station LYH-1).

Table 3-2. Total releases of environmentally significant radionuclides (iodine and particulates) from CCNPP and PBAPS to the aqueous pathway as summarized by two-year reporting periods, 1996–2021

Period	Combined Radionuclides as Iodines and Particulates in Aqueous Releases (mCi)	
	CCNPP	PBAPS
1996–1997	1028	13
1998–1999	958	25
2000–2001	990	57
2002–2003	342	324
2004–2005	138	182
2006–2007	78	1,290
2008–2009	107	382
2010–2011	155	53
2012–2013	19	6
2014–2015	684	28
2016–2017	102	8
2018–2019	23	15
2020–2021	26	10

Gaseous radioactive effluent is captured and stored on site until it has decayed to lower levels. Air monitoring in the vicinity of PBAPS indicates that the effluent is diluted and disperses to less than detectable levels in the environment (PPRP 2017); this is also confirmed by the results of monitoring during the reporting period (see Appendices C-6 and C-7). The consistent results support the finding that radioiodines and particulates released to the atmosphere are not considered environmentally significant.

3.1.2 Radionuclides from Weapons Tests

Atmospheric tests of nuclear weapons conducted until 1980 introduced a variety of man-made radionuclides into the environment. Both power plants released the radionuclide ^{137}Cs during the monitoring period, but its presence in the sediments can likely be primarily attributed to continued radioactivity from substantial legacy facility releases of ^{137}Cs to the environment and fallout from weapons testing (see Sections 3.2.1.1 and 3.2.1.3 below). Due to its relatively long half-life (approximately 30 years), ^{137}Cs has persisted in the environment; other testing-related radionuclides have decayed to stable states or are present at non-detectible concentrations.

3.1.3 Natural Radionuclides

Naturally occurring radionuclides are present everywhere in the environment. The principal naturally occurring radionuclides that result in measurable radiological doses to human populations include potassium-40 (^{40}K) and radionuclides in the thorium (^{232}Th) and uranium (^{235}U, ^{238}U) decay series. All samples of sediment, biota, and milk collected during the reporting period had detectable levels of ^{40}K. During the two-year reporting period, ^{40}K was detected in relatively greater concentrations in samples of oysters and fish guts than in other types of samples. Specific gamma-emitting daughter radionuclides from the uranium and thorium decay series were detected less frequently.

Interactions between cosmic rays and the oxygen and nitrogen in the Earth's atmosphere produce several radionuclides (Whicker and Schultz 1982). One of these, Beryllium-7 (^{7}Be), was detected occasionally in sediments from CCNPP (40%) and more frequently in samples from PBAPS (77%) during the reporting period; results also indicate that ^{7}Be was found more often in sand samples than in clay samples. The radionuclide was also detected in one of the eleven oyster samples collected near CCNPP and all of the SAV samples (six) collected near PBAPS. The natural production of ^{7}Be (which has a half-life of 53 days) in the atmosphere contributes only a small portion of the total radiation dose to humans from natural background sources (see Section 3.2.1.3).

3.2 RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

The environmentally significant radionuclides detected in samples from the CCNPP and PBAPS study areas during the 2020–2021 reporting period other than ^{14}C consisted principally of ^{137}Cs. This has been the trend since the early 1990s, and during the 2018–2019 monitoring period, the environmentally significant radionuclide ^{60}Co was also occasionally found in samples. Reductions in radionuclide releases from both power plants correlate with reductions in detection frequency and declines in concentrations of plant-related, environmentally significant radionuclides.

3.2.1 Sediments

Sediments serve as sinks (e.g., storage) for stable and radioactive metals. Suspended particulate material can scavenge metals through flocculation and adsorption, or the surface layer of bottom sediments may adsorb metals directly from the water column (Santschi et al. 1983); consequently, sediments can accumulate metal radionuclides over time. Measurements of spatial and temporal patterns in the concentrations of radionuclides in sediments collected from the Chesapeake Bay and the Susquehanna River have been used to track the physical transport of radionuclides and intra-annual variability in the release of radionuclides from the two nuclear power plants since 1975 at CCNPP and 1979 at PBAPS. The results for monitoring radionuclides in sediment collected during the 2020–2021 reporting period are summarized below.

Concentrations of selected environmentally significant radionuclides detected in the sediment samples collected during the 2020–2021 period are provided in Appendix C.

Many factors influence the concentrations of radionuclides in sediments, including the rate of input; spatial location in relation to the power plant discharge points (e.g., distance, if applicable); the half-life of the radionuclide; natural processes, such as sedimentation, circulation, and bioturbation; and physical factors, such as depth of the sediment layer from the water surface and sediment grain size. Of the numerous influences, PPAD chose to focus on the results of the analysis of sediment grain size as the representative factor for reporting. Sediments collected at inshore stations of Chesapeake Bay near CCNPP were composed predominantly of sand (particle size index values between 400 and 500; see Section 2.3); sediments from offshore stations of Chesapeake Bay, which were collected from depths greater than eight meters, were mostly clay (particle size index values between 600 and 700). In the vicinity of PBAPS, sediments collected at Susquehanna Flats were typically sand, and sediments from Conowingo Pond were generally clay. The particle size index results for sediments collected from the Chesapeake Bay and the Susquehanna River, respectively, during the 2020–2021 period are illustrated in the graphs in Figure 3-7 and Figure 3-8.

Sample analysis included the identification of radionuclides of natural origin (^{7}Be, ^{40}K, and the Th and U decay series) and ^{137}Cs derived from fallout from former weapons tests and historical releases from power plants. Analysis results for the reporting period show that clay sediments generally had greater concentrations of ^{7}Be, ^{40}K, and ^{137}Cs than sand sediments, and sand tended to have greater amounts of the elements in the Th and U decay series than clay. Metal radionuclides have a greater affinity for clay than for sand due to the fine crystalline structure, greater surface area, and the higher cation exchange capacity of clay particles (Eisenbud 1987). Sandy sediments are coarser and less able to adsorb radionuclides (Olsen et al. 1989).

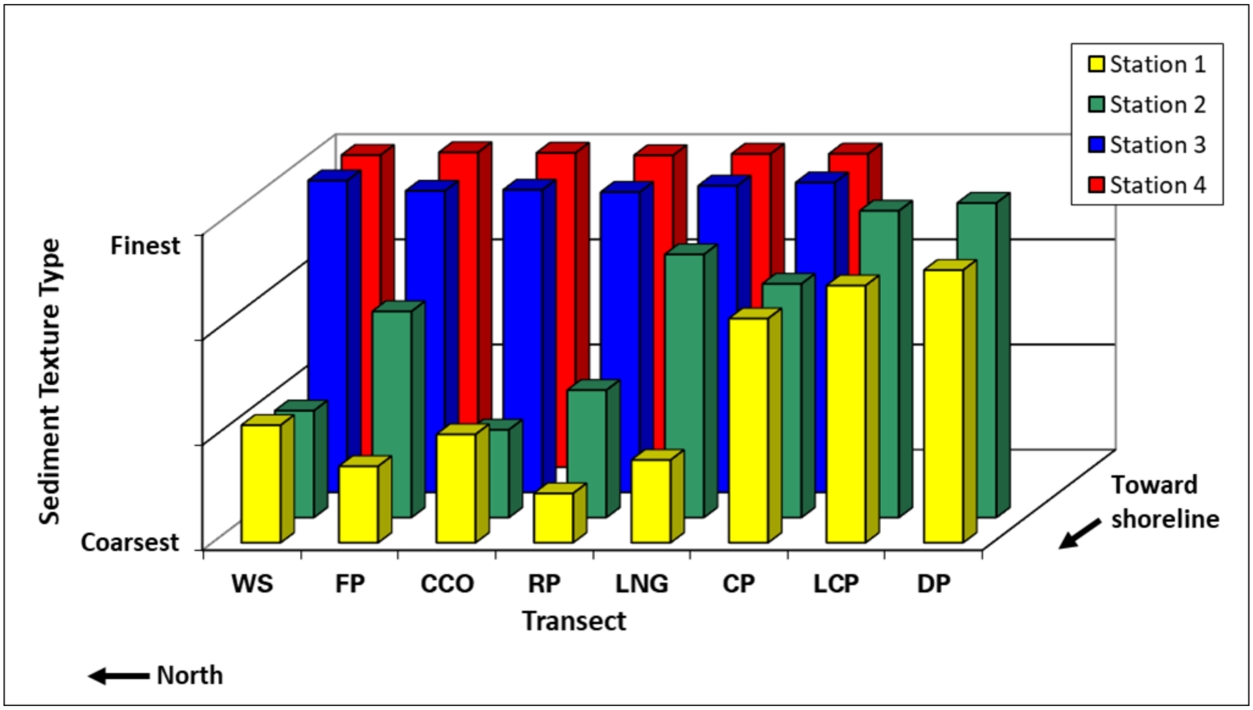

Figure 3-7. Mean particle size index values of sediments collected from the vicinity of CCNPP, 2020–2021

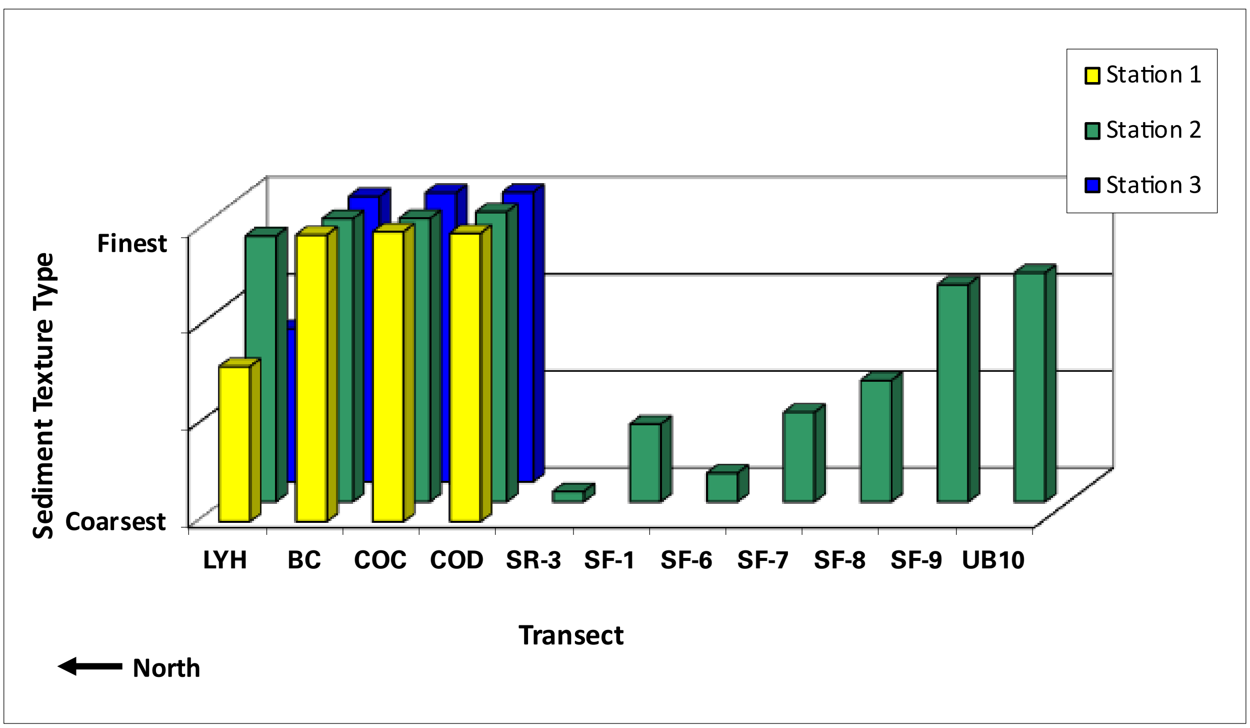

Figure 3-8. Mean particle size index values of sediments collected from the vicinity of PBAPS, 2020–2021

3.2.1.1 Radionuclides from Power Plants in Sediment

The predominant environmentally significant radionuclide detected in the sediment samples collected in the vicinities of the two power plants was ^{137}Cs. Most of the sediment samples contained detectable amounts of ^{137}Cs (86% from CCNPP and 100% from PBAPS). Although both power plants released ^{137}Cs through the aqueous pathways during the 2020–2021 reporting period, the majority of the concentrations of the radionuclide found in the sediments were likely remnants of legacy power plant releases and fallout from historic weapons testing.

The sediment samples collected during the 2020–2021 reporting period did not contain detectable levels of ^{60}Co; sediments collected in some of the previous years near the two facilities had detectable levels of the radionuclide (Table 3-3). Decreases in ^{60}Co quantities in sediment reflect decreased input of radiocobalt-labeled sediment, decay of legacy ^{60}Co, and burial. The detection rates of ^{60}Co in sediments collected near PBAPS are generally positively correlated with the amounts of the radionuclide that are released by the facility through the aqueous pathway; since peaking during the 2001–2009, period, the levels of ^{60}Co released by the facility have been less than 22 mCi per two-year period (see Figure 3-6). During the 2020–2021 period, PBAPS released 7.15 mCi of ^{60}Co, as reported by Exelon Generation Company and Constellation Energy Corporation.

Table 3-3. Detection frequency of ^{60}Co in sediments from CCNPP and PBAPS for the period 1996 through 2021

Monitoring Period	Detection Frequency of ^{60}Co in Sediment Samples (percent)	
	CCNPP	PBAPS
1996–1997	25.0	5.0
1998–1999	12.5	2.6
2000–2001	6.3	6.6
2002–2003	3.6	15.8
2004–2005	0	18.4
2006–2007	0	31.6
2008–2009	1.3	41.3
2010–2011	2.2	19.7
2012–2013	0	6.6
2014–2015	0	18.4
2016–2017	0	13.2
2018–2019	0	2.6
2020–2021	0	0

3.2.1.2 Radionuclides from Weapons Tests in Sediments

Concentrations of ^{137}Cs detected in sediments are likely remnants of fallout from atmospheric atomic weapons testing, which ended approximately four decades ago, or from legacy releases of the radionuclide from power plants to the environment. Most sediment samples collected from the vicinities of CCNPP and PBAPS during the 2020–2021 reporting period contained detectable levels of ^{137}Cs; 86% and 100%, respectively. New inputs to the local ecosystem related to weapons testing are insignificant (Prăvălie 2014); therefore, PPAD will likely continue to consider and report ^{137}Cs as the only relevant gamma ray-emitting radionuclide to be related to fallout from former weapons testing.

The concentrations of ^{137}Cs in sediments collected near PBAPS and CCNPP generally have decreased gradually since 1990 due to reductions in discharges, decay of the inventory of ^{137}Cs present in the sediment, and dilution by sedimentation (Figure 3-9 and Figure 3-10). Compared to the five-year period prior to 1990, the power plants reduced the amounts of ^{137}Cs in effluents by an average of 52% at CCNPP and 98% at PBAPS by 1990; in the subsequent six years (1990–1995), the reductions continued such that, by 1996, the power plants had further reduced the amounts of ^{137}Cs in releases by 99% at CCNPP and 75% at PBAPS. At most stations within the representative study area transects (i.e., Flag Ponds at CCNPP and Broad Creek at PBAPS), average concentrations of ^{137}Cs increased slightly during the 2006–2007 monitoring period but decreased afterward. At the Broad Creek stations, there were further decreases in 2011. At the Flag Ponds stations, average annual concentrations of ^{137}Cs in sediments have decreased by between approximately 66% and 97% since 1981 (Table 3-4). Concentrations at Broad Creek stations have decreased by between approximately 65% and 87% since the initiation of monitoring at PBAPS (Table 3-4). Note that sediment was not collected at the Broad Creek stations during 2021; data in the table reflect results from the samples collected within the transect during 2020.

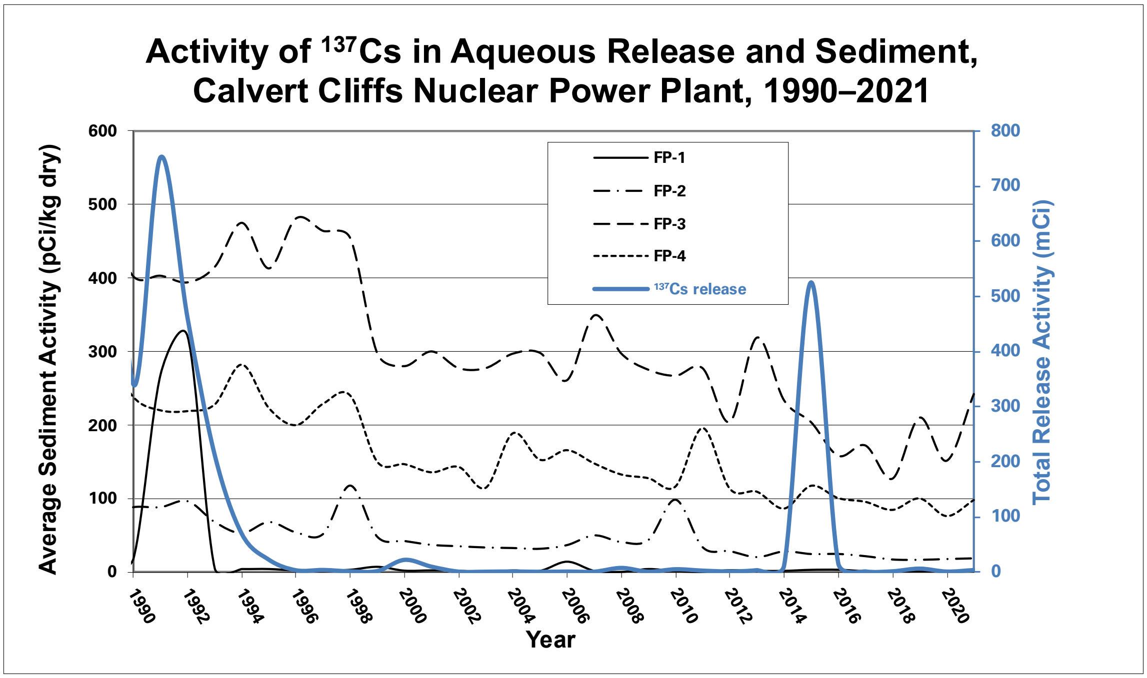

Figure 3-9. Annual liquid release of ^{137}Cs from CCNPP and average annual activity of ^{137}Cs in CCNPP sediments at Flag Ponds stations, 1990–2021

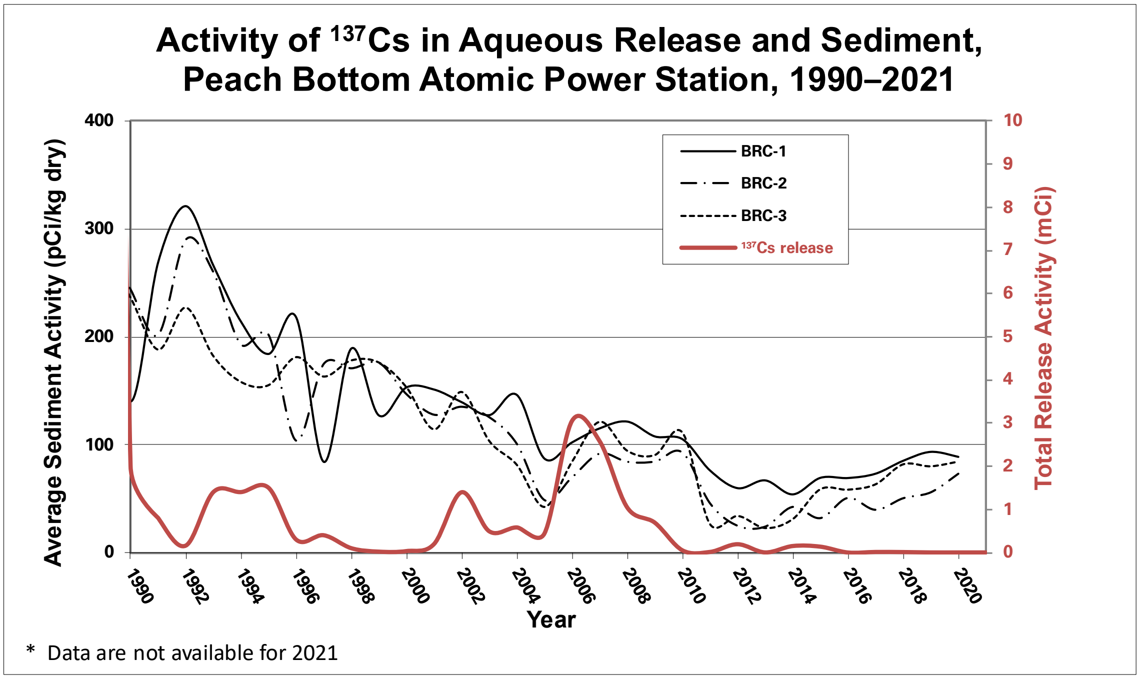

Figure 3-10. Annual liquid release of ^{137}Cs from PBAPS and average annual activity of ^{137}Cs in PBAPS sediments at Broad Creek stations, 1990–2021

Table 3-4. Percent reduction between 1981 and 2020 or 2021 of ^{137}Cs released from CCNPP (2021) and PBAPS (2020) and of ^{137}Cs activities in sediment at Flag Ponds and Broad Creek stations

	1981[1]	2020–2021	Reduction (percent)
CCNPP ^{137}Cs release (mCi) during 2021	103	3.31	96.8
Activity of ^{137}Cs in Sediment (pCi/kg) at Flag Ponds Monitoring Stations during 2021			
FP-1	7	2.4	66.3
FP-2	98	6	93.6
FP-3	522	14	97.4
FP-4	361	18	95.0
PBAPS ^{137}Cs release (mCi) during 2020	170	0.002	99.9
Activity of ^{137}Cs in Sediment (pCi/kg) at Broad Creek Monitoring Stations during 2020			
BRC-1	707	89	87.4
BRC-2	232	73	68.5
BRC-3	243	84	65.4

Units: kg, kilograms; mCi, millicuries; pCi, picocuries
[1] The year 1981, the initial year of monitoring at PBAPS, was chosen to facilitate side-by-side comparisons between the two plants

3.2.1.3 Natural Radionuclides in Sediment

The predominant components of sediment radioactivity detected in samples collected during the 2020–2021 reporting period were the naturally occurring radionuclides of potassium (^{40}K) and the thorium (Th) and uranium (U) decay chains. In a sediment sample collected from a representative station for CCNPP, Flag Ponds Station 2, the relative proportion of naturally occurring radionuclides was dominated by ^{40}K (42.6%), ^{238}U (35.8%), and ^{232}Th (19.4%; Figure 3-11). In a sediment sample collected from a representative station for PBAPS, Broad Creek Station 1, the relative proportion of naturally occurring radionuclides was dominated by ^{40}K (49.1%), ^{238}U (27%), and ^{232}Th (22.9%; Figure 3-12). Naturally occurring radionuclides were responsible for more than 99% of the gamma-emitting radionuclides found in the above example sediment samples collected during the 2020–2021 reporting period.

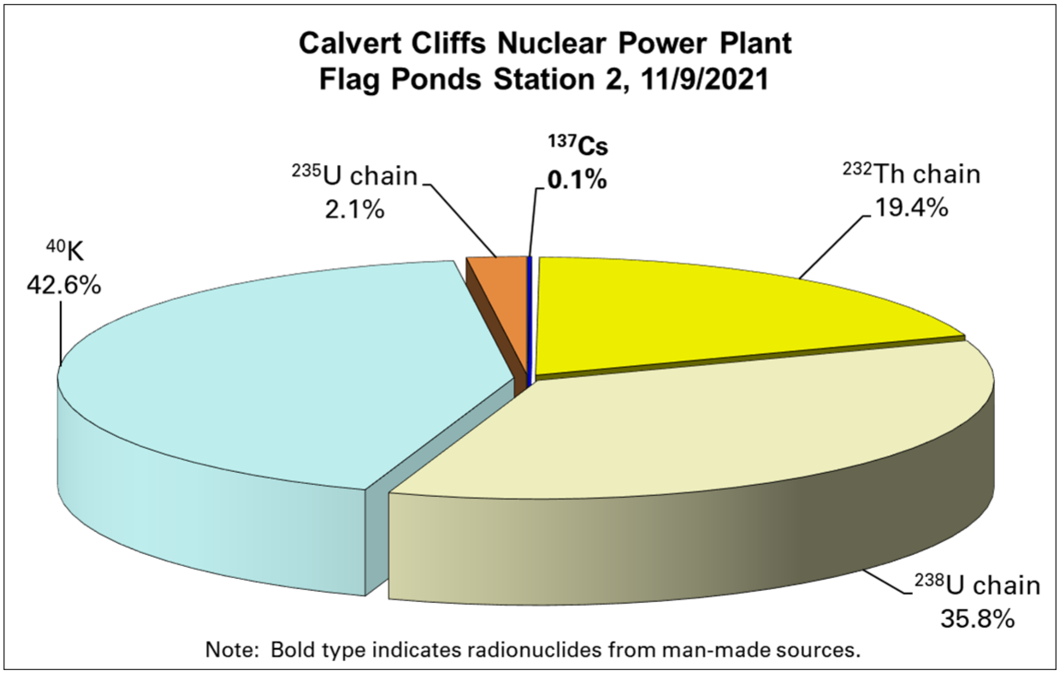

Figure 3-11. The proportion of gamma-emitting radionuclides in a sediment sample collected from Flag Ponds Station 2

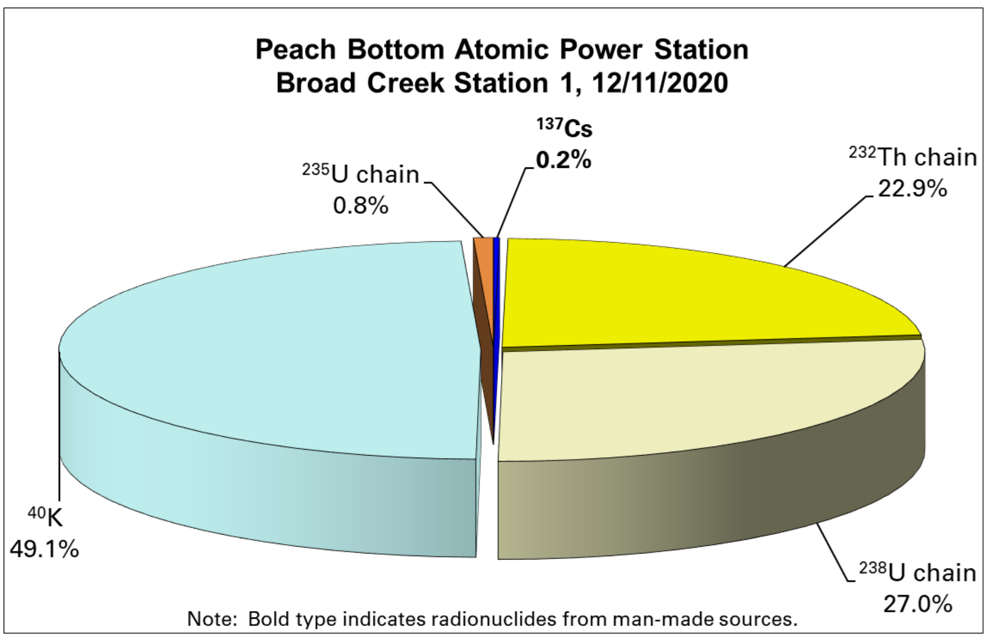

Figure 3-12. The proportion of gamma-emitting radionuclides in a sediment sample collected from Broad Creek Station 1

<u>Thorium and Uranium</u>. Nuclear decay of naturally occurring thorium (^{232}Th) and natural uranium (^{238}U) produces gamma-emitting daughter species (e.g., thorium: ^{228}Ac, ^{208}Tl, ^{212}Pb; uranium: ^{226}Ra, ^{214}Bi, ^{214}Pb). The three parent elements, ^{232}Th, ^{235}U, and ^{238}U, and their associated decay products generally accounted for most of the radionuclides detected in sediment samples during the reporting period. The radioactivity emitted by the daughter radionuclides tended to be higher in the samples with fine-grained sediment that had been collected from stations located relatively further offshore.

<u>Potassium.</u> The radionuclide ^{40}K is a primordial, naturally occurring element. Concentrations of radioactive ^{40}K in nature are proportional to stable potassium content (0.0118%; CRC Handbook 1979). All sediment samples collected during the 2020–2021 reporting period had detectable levels of ^{40}K; concentrations were highest in predominantly fine-grained sediments (i.e., more clay characteristics than sand characteristics).

<u>Beryllium</u>. The radionuclide ^{7}Be is naturally produced by the interaction of cosmic rays with atmospheric oxygen and nitrogen. It is scavenged from the atmosphere by precipitation and deposited on water and soil surfaces; runoff from land can then also transfer the element to down-gradient water systems. Particles suspended in the water column rapidly adsorb ^{7}Be, and the radionuclide settles in sediments as a result of particulate deposition. Beryllium-7 was detected in 38% and 75% of sediment samples collected at CCNPP and PBAPS during the reporting period, respectively. Concentrations of ^{7}Be in sediments were generally lower at CCNPP (mean = 159 pCi/kg; range = 19–1,125 pCi/kg) than at PBAPS (mean = 397 pCi/kg; range = 53–2,646 pCi/kg). Beryllium-7 concentrations near PBAPS were generally greater in samples with greater proportions of clay particles, particularly those collected from stations in Conowingo Pond and near Conowingo Dam (Broad Creek, Conowingo Creek, and Conowingo Dam transects). Concentrations in samples from stations below Conowingo Dam (e.g., Susquehanna Flats) tended to be lower than from stations located above the dam with comparable particle sizes, possibly due to station depth and corresponding longer settlement times relative to half-life. Concentrations of ^{7}Be at CCNPP were generally greatest (when detected) in near-shore sediments, where most particles were silt-sized (e.g., LNG Plant Pipeline Station 2). In contrast, offshore stations with clay sediments rarely had detectable levels of ^{7}Be. This disparity with results for clay sediments from the PBAPS study area may be due to a longer average settlement time at the offshore stations near CCNPP in relation to half-life.

3.2.2 Radionuclides in Biota

The ability of biota to absorb environmentally significant radionuclides differs by organism species, age, and gender; habitat; availability of radionuclides; and sensitivity of the organism to radionuclides. The radionuclide monitoring program measures the levels of radioactive elements in oysters from the vicinity of CCNPP, and finfish and submerged aquatic vegetation (SAV) from the vicinity of PBAPS, in samples routinely collected during the two-year reporting periods. The monitoring results for biota collected during the 2020–2021 reporting period are summarized in the subsections below. At CCNPP, test oysters are confined in trays placed in the immediate vicinity of the power plant discharge for periods of three months to one year; other oyster trays are placed near the power plant and at a site that is not directly affected by the power plant discharge. For each specified interval during the sampling year, field teams collect the oysters from the tray, shuck the oysters, and combine the extracted flesh to constitute one sample that represents the sample location and the interval. Near PBAPS, many finfish are resident and may be found near the plant outfall and in the zone of maximum effluent concentrations. Some forage finfish (e.g., shiners and silversides) and juveniles of other species (e.g., sunfish and gizzard shad) are important food sources for predatory finfish (e.g., smallmouth bass, largemouth bass, and striped bass). After the fish are collected, field teams create separate samples of flesh and guts of fish of each species caught, as applicable. The types of biota that contribute to the some of the samples are relevant to potential radioactivity doses to humans via ingestion. The larger fishfish and the oysters are animals that could be harvested for consumption by humans.

Radionuclides derived from man-made sources are infrequently detected in biological samples collected from the vicinities of CCNPP and PBAPS. During the 2020–2021 monitoring period, ^{60}Co, ^{137}Cs, ^{131}I were generally not detected in biota; the exceptions included a low level of ^{137}Cs detected in one sample of finfish flesh collected from PBAPS (Appendix Table C-4), two samples of SAV containing detectable levels of ^{137}Cs, and one sample of SAV containing a detectable level of ^{131}I (Appendix Table C-5). In previous years, ^{131}I was consistently detected in SAV. The sources of ^{131}I in SAV, however, were likely diagnostic and therapeutic medical procedures that result in discharges of ^{131}I to the sanitary sewer system through the patients' excreta (Larsen et al. 2001).

3.2.2.1 Radionuclides from CCNPP in Oysters

Natural oyster populations in the vicinity of CCNPP have historically been found to accumulate fluctuating levels of ^{58}Co, ^{60}Co, ^{65}Zn, and ^{110m}Ag (McLean et al. 1987). Radioactive silver (^{110m}Ag) concentrations in oysters decrease rapidly through radioactive decay and biological excretion (McLean et al. 1987). During the 2020–2021 monitoring period, ^{110m}Ag was not detected in tray oysters placed in the vicinity of the cooling water discharge, in oysters from Camp Conoy near the plant site, or in continually exposed oysters at the control location (St. Leonard Creek). The absence of detectable levels of ^{110m}Ag in samples of tray-oysters since the spring of 2001 reflects very small releases of ^{110m}Ag from CCNPP compared to historical levels. The radionuclides ^{60}Co, ^{137}Cs, and ^{65}Zn were not detected in any oyster samples during the reporting period.

Uptake of radionuclides, particularly ^{110m}Ag, by oysters is governed by physical, chemical, and environmental conditions (e.g., plant releases, water temperature, and season of exposure). McLean et al. (1987) and Rose et al. (1988, 1989) provided detailed descriptions of the tray oyster study and statistical modeling of radionuclide concentrations in tray oysters.

3.2.2.2 Radionuclides from PBAPS in Finfish

During the 2020–2021 reporting period, one sample of finfish flesh had a detectable level of the radionuclide ^{137}Cs (13.5 pCi/kg; Appendix Table C-4). The radionuclides ^{60}Co and ^{65}Zn were not detected in any finfish samples in the reporting period. Historically, ^{137}Cs has been detected in samples of finfish flesh at low concentration levels and detection frequencies, and ^{60}Co has rarely been detected.

3.2.2.3 Radionuclides from PBAPS in SAV

The radionuclide ^{137}Cs was detected at low levels in two SAV samples collected during the 2020–2021 reporting period (21.5 pCi/kg and 41.3 pCi/kg). Cesium-137 was not found in any SAV samples collected during the 2018–2019 reporting period. In earlier monitoring periods, ^{137}Cs was detected in SAV samples, albeit at very low concentrations. Radioactive iodine (^{131}I) was present in one SAV sample collected during the 2020–2021 reporting period (80.3 pCi/kg), was not detected during the 2018–2019 period, and was also present in SAV collected during monitoring periods prior to 2018.

Historically, the source of concentrations of ^{131}I found in SAV had likely been from releases of ^{131}I into the sanitary sewer system by patients undergoing nuclear medicine treatment (Larsen et al. 2001, Jones 2003). The study prepared by Jones (2003) was conducted by ISCORS (Interagency Steering Committee on Radiation Standards) and reported a widespread presence of ^{131}I in samples of sewage sludge collected from sewage treatment plants across the U.S. Therapeutic doses of ^{131}I administered in nuclear medicine can be typically as high as several hundred mCi (National Council on Radiation Protection and Measurements [NCRPM] 1996). Releases of ^{131}I from PBAPS were typically less than 2 mCi; therefore, the contributions of medicinal radioactive iodine in the waterway likely led to the relatively insignificant accumulations of ^{131}I in SAV.

Other studies have suggested that ^{131}I is present in wastewater, surficial sediments, and suspended particle matter in New York Harbor (Smith et al. 2008), in mussels and fish of the Tagus River estuary (Malta et al. 2013), in sewage effluent from a Stony Brook (NY) wastewater treatment plant (Rose et al. 2012), and in water and sediments of the Potomac River estuary (Rose et al. 2013). The ^{131}I in each of these studies was thought to be medically derived; for instance, from thyroid cancer treatment facilities and cancer patients undergoing treatment at home. The Potomac River study suggested a relatively continuous source of this radionuclide.

Another possible source of ^{131}I is hydraulic fracturing. Gamma-emitting tracer isotopes are used in hydraulic fracturing to trace the movement of materials and determine the extent of fracturing (International Atomic Energy Agency 2003). To date, there is no evidence that ^{131}I is being used in the exploration and extraction of natural gas in the Marcellus Shale Formation (generally occurring in an arc along the Appalachian Basin west and north of Maryland); thus, this is not a likely source of ^{131}I that may affect the results in the radionuclide monitoring study.

3.2.2.4 Radionuclides from Natural Sources in Biota

In all of the 17 tray oyster samples collected from the CCNPP region and analyzed during the 2020–2021 reporting period, there were detectable levels of the naturally occurring radionuclide ^{40}K (Appendix Table C-2). Oyster samples also contained measurable amounts of other naturally occurring radionuclides (e.g,. ^{7}Be and derivatives from naturally occurring thorium natural uranium). Examples of levels of ^{40}K measured in oyster samples collected during the reporting period include CCNPP Outfall station, average 12,750 pCi/kg dry weight; Camp Conoy station, average 1,913 pCi/kg wet weight; and Control station, average 12,181 pCi/kg dry weight).

Biota samples collected from the PBAPS area had detectable levels of the naturally occurring radionuclide ^{40}K, and the vegetation samples also had measurable concentrations of ^{7}Be. The six SAV samples collected from the Fishing Battery station during 2020 had ^{40}K in every sample (average 32,885 pCi/kg) and ^{7}Be in every sample (average 2,369 pCi/kg). The radionuclide ^{40}K was detected in every finfish sample (flesh and guts) processed and analyzed during the period (flesh average 15,738 pCi/kg; guts average 4,816 pCi/kg). The radionuclide ^{7}Be was not detected in any finfish sample analyzed for the reporting period.

3.2.3 Air, Potable Water, Precipitation, and Milk

Samples of air particulates exhibited detectable radioactivity of naturally occurring ^{7}Be and undifferentiated, naturally occurring alpha and beta emitters trapped on air-particulate filters for most samples; one sample (Baltimore City station, 2020) exhibited a detectable level of ^{137}Cs during the monitoring period (Table 3-5 and Appendix Table C-6). Test results for ^{131}I in samples of air did not indicate detectable levels of the radionuclide (Table 3-5 and Appendix Table C-7).

Table 3-5. Analytical results from air monitoring stations, 2020–2021						
Releasing Power Plant	**Station**	**Gross Alpha (fCi/m^3; mean ± 2 SD)[a]**	**Gross Beta (fCi/m^3; mean ± 2 SD)[a]**	**^{131}I[b]**	**^{7}Be (fCi/m^3; mean ± 2 SD)[a]**	**^{137}Cs[a]**
CCNPP	Long Beach	1±0.3	19±1	ND	77±7	ND
CCNPP	Lusby	0.9±0.5	19±5	ND	105±78	ND
CCNPP	Cove Point	1±0.5	20±1	ND	75±10	ND
CCNPP	Horn Point	1±1.1	16±5	ND	74±1	ND
NA: Control	Baltimore City	0.9±0.3	19±2	ND	76±17	2±1
PBAPS	Rising Sun	1.1±0.7	16±3	ND	80±5	ND
PBAPS	Whiteford	1±0.9	16±5	ND	75±8	ND
PBAPS	Dempsey Farm	1.4±0.2	18±1	ND	75±8	ND

Note: Only samples where radioactivity was detected were used to calculate the mean. [a] = results from air particulate sampling. [b] = results from air (gas) sampling. CCNPP = Calvert Cliffs Nuclear Power Plant. PBAPS = Peach Bottom Atomic Power Station. SD = standard deviation. NA = not applicable. ND = not detected at the applicable detection limit.

Laboratory analysis of potable water samples collected during the 2020–2021 reporting period indicated that alpha-emitting radiation was rare and beta-emitting radiation was common. Naturally occurring alpha-emitting radioactivity was detected in two samples of potable water collected at two different stations in the region around CCNPP; alpha radiation was also detected in two samples from the control station in Baltimore City (Table 3-6 and Appendix Table C-8). Beta-emitting radioactivity was found in two samples collected from the control station (13.3%) and 24 of the samples (92.3%) of potable water collected near CCNPP (Table 3-6 and Appendix Table C-8). All of the positive gross beta results indicated levels of 29 picoCuries per liter (pCi/L) or less.

Samples of precipitation collected from the Baltimore City station during the reporting period contained gross alpha radioactivity (15 samples; 34%), gross beta radioactivity (10 samples; 23%), tritium (4 samples; 7%), and ^{7}Be (34 samples; 76%; Appendix Table C-9). Gross alpha levels ranged from 0.9 pCi/L to 4.1 pCi/L. Gross beta levels ranged from 1.4 pCi/L to 8.3 pCi/L. Tritium levels ranged from 127 pCi/L to 199 pCi/L.

Laboratory analysis indicated detectable levels of radiostrontium in processed and raw milk samples during the 2020–2021 reporting period. One sample of composite milk had a measured amount of ^{89}Sr (average 1.9 pCi/L), and three samples of raw milk had ^{89}Sr (average 1.2 pCi/L; Appendix Table C-10). Three samples of composite milk had detectable amounts of ^{90}Sr (average 0.9 pCi/L), and four samples of raw milk had ^{90}Sr (average 0.4 pCi/L; Appendix Table C-10).

Station	Concentrations in Potable Water (pCi/L; mean ± 2 SD)		
	Gross Alpha	Gross Beta	Tritium
Baltimore City (control)	2.6±1	6±1	ND
Chesapeake Country Club	2.7±1.5	7±3	134±87
Calvert County Courthouse	ND	15±10	125±86
Appeal Elementary School	ND	11.4±0.4	107±89
Calvert County Health Department	ND	9±7	141±87
Southern Middle School	4±2	9±1	145±87
Frying Pan Restaurant	ND	12±3	ND
Volunteer Fire Department	ND	12±1	ND

Table 3-6. Analytical results from potable water monitoring stations, 2020–2021

Notes: Only samples where radioactivity was detected were used to calculate the mean.

Codes: pCi/L = picocuries per liter. SD = standard deviation. ND = not detected at the detection limit.

3.3 RADIOLOGICAL EFFECTS ON THE ENVIRONMENT AND HUMAN HEALTH

3.3.1 Effect on the Environment

Although small concentrations of radionuclides attributable to fallout from weapons tests (i.e., ^{137}Cs) were detected in a few samples of biota collected during the 2020–2021 reporting period, the maximum detected concentrations of radioactive material from man-made sources were orders of magnitude smaller than concentrations of natural radionuclides. Radiation doses to aquatic organisms attributable to discharges from power plants are insignificant compared to the doses derived from natural radionuclides (Whicker and Schultz 1982). Living organisms normally receive most of their external and internal doses of radiation from naturally occurring radionuclides such as ^{40}K.

3.3.2 Potential Effect on Human Health

Radioactive substances are ubiquitous in the human environment. The USNRC estimates that humans receive approximately 0.31 rem of radiation each year from natural sources. Humans accumulate most of the annual radiation dose from radon in the air; other sources include the cosmos (i.e., the sun and stars), soil, food, water, and naturally derived ^{14}C and ^{40}K constantly shared among humans. According to the USNRC, annual doses at twice this level (i.e., 0.62 rem) do not cause harmful effects in humans (USNRC, 2022).

Humans come into contact with air, food, water, and soil every day, and these types of materials contain radionuclides from natural and man-made sources. The radionuclide monitoring studies that PPAD conducts every year evaluate samples of these media, in part to derive estimates of potential human exposure risk through direct contact with several target interactions, which coincide with the aqueous and gaseous pathways. Relevant to the 2020–2021 reporting year, the results of the analyses to estimate human risk comprise the remainder of this sub-section.

Analysts applied measured concentrations of radionuclides in edible finfish and processed and raw milk, from test results compiled during the 2020–2021 reporting period, to simple models to estimate the potential radiation doses to human consumers of these materials as dietary intake. The outputs of the models were expressed as dose commitment, which referred to the total dose to a tissue or organ after a period of 50 years following ingestion of finfish or processed milk containing the maximum concentrations of radionuclides, after allowing for the metabolic processes of excretion and radioactive decay. The dose commitment calculations are based on three variables: (1) the estimated maximum quantity of finfish or milk consumed by an individual according to age (i.e., child = 6.9 kg/yr; teenager = 16 kg/yr; adult = 21 kg/yr; USNRC 1977); (2) the dose to the target organ per quantity of radionuclide ingested (USNRC 1977), and (3) the maximum, or worst-case, estimated concentration of power plant-related radionuclides in finfish collected from Conowingo Pond or processed and raw milk produced locally, respectively. For the purposes of the 2020–2021 report, the target organs for each age group were bone, liver, kidney, and lower large intestine; the whole body was also a model target. The model could accommodate input from analysis of oyster samples, but the dose commitment was not calculated for an oyster diet because radionuclides from man-made sources were not detected in oyster samples collected during 2020 and 2021. The formula for the model had the following units and structure:

Calculation variable: 1 2 3

$$\text{Dose commitment} = \frac{\text{kg}}{\text{yr}} \times \frac{\text{mrem}}{\text{pCi}} \times \frac{\text{pCi}}{\text{kg}}$$

where kg is kilograms, yr is year, mrem is millirem, and pCi is picocuries.

Analysts conducted the model processing to derive estimated dose commitments for adults, teenagers, and children, based on a diet of finfish, which included the radionuclide ^{137}Cs. Analysis results only showed relevant doses for ^{137}Cs based on the one occurrence of its presence in a fish tissue sample during the period (Table 3-7). The maximum estimated organ-specific dose commitment to a child, associated with ^{137}Cs in dietary finfish, was 0.0092 mrem/yr in the bone target. The estimated maximum dose to a teenager was 0.0097 mrem/yr in the liver. The estimated maximum dose to an adult was 0.0093 mrem/yr in the liver. The maximum total body dose was 0.0061 mrem/yr, which was calculated for an adult.

Analysts performed a similar model processing to derive estimated dose commitments for adults, teenagers, and children, based on a diet of milk, which included the radionuclides ^{89}Sr and ^{90}Sr, when detected (Table 3-8). The maximum estimated organ-specific dose commitment, associated with radiostrontium in dietary milk, was 7.6 mrem/yr, 4.3 mrem/yr and 3.0 mrem/yr to a child, a teenager, and an adult, respectively, in the bone. The maximum total body dose was 1.7 mrem/yr, which was calculated for a child. The calculated maximum dose commitment to humans who consume milk is high in the range of acceptable doses, as defined by the USNRC regulatory limits; however, the concentrations of ^{89}Sr and ^{90}Sr in milk that contributed to this estimated dose are likely the result of legacy deposition from weapons testing and not from a release from PBAPS. The total release from the power plant per two-year period since 2012 has been zero for ^{90}Sr and less than 1 mCi for ^{89}Sr.

Table 3-7. Estimated maximum dose commitments for ^{137}Cs to humans who consume finfish from Conowingo Pond, 2020–2021, by age group

Affected Body Target	**Maximum Dose Commitments from Finfish Consumption: 2020–2021 (mrem/yr)**		
	Age Group		
	Adult	**Teenager**	**Child**
Total Body	0.0061	0.0034	0.0013
Bone	0.0068	0.0073	0.0092
Liver	0.0093	0.0097	0.0088
Kidney	0.0032	0.0033	0.0029
Gastrointestinal Tract; lower large intestine	0.0002	0.0001	0.0001

Note: The recommended consumption values and conversion factors were derived from USNRC 1977.

Table 3-8. Estimated maximum dose commitments for ^{89}Sr and ^{90}Sr to humans who consume processed and raw milk in the Baltimore area, 2020–2021, by age group

Affected Body Target	**Maximum Dose Commitments from Milk Consumption: 2020–2021 (mrem/yr)**		
	Age Group		
	Adult	**Teenager**	**Child**
Total Body	0.6971	0.9936	1.7304
Bone	3.0012	4.3184	7.5596
Gastrointestinal Tract; lower large intestine	0.1106	0.1517	0.1227

Note: The recommended consumption values and conversion factors were derived from USNRC 1977.

The two target power plants are required, by specifications in their permits, to maintain concentrations of radioactive materials released by the power plants (through the aqueous or gaseous pathways) within acceptable limits, as specified by the USNRC. The owners of the power plants are required to monitor the levels of radionuclides released in the facilities' effluents to maintain compliance with dose limits to individual members of the human population. The maximum annual effective dose equivalent allowed to the general population as a result of a licensee's activities involving the use of radioactive material is 100 mrem above background levels, exclusive of the dose contribution from the licensee's disposal of radioactive material (USNRC 1991). Plant-design objectives to maintain effective dose equivalents resulting from the release of radioactive material during normal operations to levels "as low as reasonably achievable" are stated in the USNRC's report, (1996), 10 CFR Part 50 Appendix I:

> The calculated annual total quantity of all radioactive material above background to be released from each light-water-cooled nuclear power reactor to unrestricted areas will not result in an estimated annual dose or dose commitment from liquid effluents for any individual in an unrestricted area from all pathways of exposure in excess of 3 millirems to the total body or 10 millirems to any organ.

The USEPA has set maximum permissible dose rules as part of the regulation of the uranium fuel cycle, which includes the mining of ore in addition to the operation of nuclear power plants (40 CFR Part 190 Subpart B; USEPA 1979):

> Operations covered by this subpart shall be conducted in such a manner as to provide reasonable assurance that: A) The annual dose equivalent does not exceed 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public as the result of exposures to planned

discharges of radioactive materials, radon and its daughters excepted, to the general environment from uranium fuel cycle operations and to radiation from these operations.

Human dose commitments calculated from radionuclide concentrations in consumable biota vary with annual fluctuations in the measured concentrations. The model results from the 2020–2021 reporting period, compared to the industry expectations, as stated by the USNRC, show that the quantities of radionuclides found in biota during the period, and which may be attributable to nuclear power plant operations, would not pose a potential threat to human health, as estimated by their consequent effective dose equivalent as they migrate through trophic layers to humans. All quantities released to the aqueous pathway resulted in estimated doses that were no more than 0.2% of the regulatory limits set by the USNRC (Table 3-9).

Table 3-9. Comparison of maximum estimated radiation doses to humans from nuclear power plant operations and applicable regulatory limits				
Exposure Route	**Maximum Dose Estimate (2020)**	**Maximum Dose Estimate (2021)**	**EPA Regulatory Limit (40CFR190 Subpart B)**	**NRC Regulatory Limit (10CFR50 Appendix I)**
Ingestion (mrem)				
Oyster ingestion, whole-body dose (from CCNPP)	NC		25	3
Oyster ingestion, other organ dose (from CCNPP)	NC		25	10
Finfish ingestion, whole-body dose (from PBAPS)	0.0061 (adult)		25	3
Finfish ingestion, other organ dose (from PBAPS)	0.0097 (teenager liver)		25	10
Milk ingestion, whole-body dose	1.7 (child)		25	3
Milk ingestion, other organ dose	7.6 (child bone)		25	10
Gaseous Pathway (mrem)				
Whole-body dose (gaseous, from CCNPP)	0.00085 (child)[a]	0.00035 (child)[a]	25	NA
Other organ dose (gaseous, from CCNPP)	0.00077 (child skin)[a]	0.00031 (child skin)[a]	25	NA
Whole-body dose (gaseous, from PBAPS)	0.155 (any age class)[b]	0.114 (any age class)[b]	25	NA
Other organ dose (gaseous, from PBAPS)	0.204 (any age class, skin)[b]	0.149 (any age class, skin)[b]	25	NA

[a] Source: Barnett and Ihnacik 2021, Barnett and Grimmig 2022
[b] Source: Exelon Generation 2021c, Constellation Energy Corporation 2022c
NC = Not Calculated because no man-made radionuclides were detected in the samples
NA = Not Applicable because the quantity limit for atmospheric effluents is 10 millirads

4.0 CONCLUSIONS

During the 2020–2021 monitoring period, CCNPP and PBAPS released radionuclides to the environment as a normal consequence of routine operations. The only radionuclide released from CCNPP that was detected in sediment samples collected from Chesapeake Bay was ^{137}Cs; it was detected in the majority of the samples, but most of the influence on the concentrations in the sediment was due to radioactive decay of ^{137}Cs that was released many years ago and the fallout from weapons testing. No radionuclides from facility discharges were detected in oysters collected near the CCNPP outfall. In the PBAPS study area, the plant-produced radionuclide^{137}Cs was detected in all of the sediment samples. The radionuclide ^{137}Cs was detected in one sample of finfish (flesh) that was collected near the PBAPS outfall; the concentration was very low. Radiostrontium was detected in four samples (67%) of processed milk (Maryland composite) and six samples (75%) of raw milk (Peach Bottom region) samples.

Radionuclides from nuclear power plant operations, nuclear weapons testing, medical procedures, and natural sources contribute to the total radioactivity measured in environmental samples. Generally, radionuclides from natural sources (primarily radionuclides from the uranium and thorium decay series, ^{40}K, and ^{7}Be) constituted more than 99% of the total radioactivity of environmental samples.

As noted in Whalen and Jones (2000), and as was the case in 2020–2021, the levels of radionuclides from man-made sources detected in sediment samples continue to be evident at historically low levels and show a significant downward trend in radionuclide activity. The radionuclide ^{60}Co was not detected in any samples collected during the 2020–2021 monitoring period; the reductions in the presence of the radionuclide in environmental samples reflect continued reductions in power plant discharges, decay of inventory present in the sediment layer, and dilution by sedimentation. Tray oysters have not exhibited detectible levels of ^{110m}Ag since 2001, due to a reduction in available ^{110m}Ag released from CCNPP (compared to historical levels). The radionuclide ^{131}I was detected in one SAV sample during the current monitoring period. The source of ^{131}I in the waterways is believed to originate in medical treatments; however, the amount of the waste that is accumulated by the plants appears to be very small, relative to the typical amounts in medicine dosages.

Concentrations of radionuclides in sediments and biota do not represent a risk to the ecological health of the Chesapeake Bay or the Susquehanna River. The additional increment of radioactivity and radiation dose attributable to the operation of CCNPP and PBAPS is minimal when compared with natural levels of radioactivity and the associated natural radioactive dose (approximately 625 mrem/yr; NCRPM 2009).

The incremental increase in the dose to humans that could result from the consumption of biota from the vicinity of CCNPP and PBAPS, and which may be attributable to nuclear power production operations, was no more than 0.3% (NCRPM 2009) during the 2020–2021 period, according to model results. This increase is insignificant when compared to the total dose attributable to natural background and other sources, which varies according to geographic region and elevation, kind of habitat (e.g., construction material used in residences), personal choices (e.g., smoking, occupation), routine medical procedures, and other sources of background radiation.

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APPENDIX A

COORDINATES OF SEDIMENT SAMPLING STATIONS

Table A-1. Coordinates of sediment sampling stations in the vicinity of CCNPP and PBAPS

Chesapeake Bay Calvert Cliffs Region			
Transect Name/Location	**Station**	**North Latitude**	**West Longitude**
Western Shores	WS-1	38° 29.321′	76° 29.336′
	WS-2	38° 29.460′	76° 29.239′
	WS-3	38° 29.752′	76° 28.272′
	WS-4	38° 30.975′	76° 25.897′
Flag Ponds	FP-1	38° 27.254′	76° 26.873′
	FP-2	38° 27.302′	76° 26.820′
	FP-3	38° 27.402′	76° 26.476′
	FP-4	38° 29.211′	76° 24.790′
Calvert Cliffs Outfall	CCO-1	38° 26.316′	76° 26.412′
	CCO-2	38° 26.455′	76° 26.266′
	CCO-3	38° 26.795′	76° 25.753′
	CCO-4	38° 28.245′	76° 24.055′
Rocky Point	RP-1	38° 25.074′	76° 24.949′
	RP-2	38° 28.356′	76° 24.490′
	RP-3	38° 25.327′	76° 24.300′
	RP-4	38° 26.068′	76° 22.896′
Liquid Natural Gas Terminal	LNG-1	38° 22.625′	76° 23.083′
	LNG-2	38° 23.652′	76° 22.882′
	LNG-3	38° 23.745′	76° 22.495′
	LNG-4	38° 23.997′	76° 21.431′
Cove Point	CP-1	38° 22.500′	76° 22.859′
	CP-2	38° 22.541′	76° 22.446′
	CP-3	38° 22.601′	76° 21.934′
	CP-4	38° 22.635′	76° 20.725′
Little Cove Point	LCP-1	38° 21.292′	76° 21.490′
	LCP-2	38° 21.368′	76° 20.180′
Drum Point	DP-1	38° 19.553′	76° 22.354′
	DP-2	38° 19.574′	76° 19.757′

Table A-1. (Continued)			
Lower Susquehanna River and Upper Chesapeake Bay			
Transect Name/Location	**Station***	**North Latitude**	**West Longitude**
Little Yellow House	LYH-1	39°44.592′	76°15.120'
	LYH-2	39°44.929′	76°14.635'
	LYH-3	39°45.242'	76°14.082'
Broad Creek	BC-1	39°41.909'	76°14.017'
	BC-2	39°42.044'	76°13.657'
	BC-3	39°42.280'	76°13.063'
Conowingo Creek	COC-1	39°40.690'	76°12.327'
	COC-2	39°40.848'	76°12.124'
	COC-3	39°40.997'	76°11.996'
Conowingo Dam	COD-1	39°39.475'	76°10.591'
	COD-2	39°39.675'	76°10.546'
	COD-3	39°40.026'	76°10.383'
Susquehanna River Rt. 95 Bridge	SR-3	39°34.858'	76°06.127'
Susquehanna Flats River Mouth	SF-1	39°32.827'	76°04.467'
Susquehanna Flats Buoy R "14"	SF-6	39°31.027'	76°05.007'
Susquehanna Flats Buoy N "12"	SF-7	39°30.274'	76°05.216'
Susquehanna Flats Buoy N "8"	SF-8	39°29.215'	76°04.955'
Susquehanna Flats Buoy N "2"	SF-9	39°28.294'	76°03.261'
Upper Bay Buoy RB "A"	UB-10	39°26.555'	76°01.997'

*Note:
Station 1, West of Reservoir
Station 2, Center of Reservoir
Station 3, East of Reservoir

APPENDIX B

LABORATORY INTERCOMPARISON RESULTS

Table B-1. Results of Laboratory Intercomparison Program.

Sample Date	Sample Type and Units	Radionuclide	Laboratory Results average ± 1 SD	Analytical Results average ± 1 SD
3/12/2020	Water-pCi/L	Mn-54	235 ± 9	216 ± 4
		Co-58	206 ± 10	196 ± 3
		Fe-59	175 ± 14	168 ± 3
		Co-60	254 ± 8	236 ± 4
		Zn-65	296 ± 13	261 ± 4
		Cs-134	140± 5	154 ± 3
		Cs-137	192 ± 7	185 ± 3
		Ce-141	163 ± 30	190 ± 3
6/3/2021	Water-pCi/L	Cr-51	548 ± 29	533 ± 9
		Mn-54	264 ± 9	249 ± 4
		Co-58	190 ± 7	179 ± 3
		Fe-59	200 ± 8	183 ± 3
		Co-60	223 ± 7	215 ± 4
		Zn-65	330 ± 12	300 ± 5
		Cs-134	195 ± 6	213 ± 4
		Cs-137	198 ± 8	188 ± 3
		Ce-141	188 ± 7	180 ± 3

APPENDIX C

CONCENTRATIONS OF RADIONUCLIDES IN ENVIRONMENTAL SAMPLES

INTRODUCTION

This appendix contains data for most of the radionuclides detected in the environmental samples collected in the vicinity of the Calvert Cliffs Nuclear Power Plant and the Peach Bottom Atomic Power Station during the 2020-2021 monitoring period. The radionuclides reported in these tables include the naturally occurring radionuclides ^{7}Be and ^{40}K, the weapons test fallout radionuclides ^{137}Cs and ^{90}Sr, and the power plant produced radionuclides ^{89}Sr, ^{110m}Ag, ^{58}Co, ^{60}Co, ^{131}I, and ^{65}Zn. Radionuclide concentrations in sediments and biological samples are reported as pCi/kg dry weight, except for finfish gut samples and Camp Conoy oysters which are reported as pCi/kg wet weight. Data are organized in the following tables:

Page

Within each table, specific sample stations are arranged approximately north to south and data are presented by date along with the mean for the monitoring period. Radionuclide data are decay corrected to the date of sample collection. Counting error is reported as ± 2 standard deviations. Concentrations for radionuclides that were not detected in specific samples are recorded as less than (<) the lower level of detection for that sample as determined by spectrum analysis programs. Annual means were calculated as a simple arithmetic average of concentrations and variability was expressed as 2 standard deviation units. Lower limits of detection were excluded from mean calculations.

Table C-1. Radionuclide Concentrations in Sediments at Calvert Cliffs (pCi/kg ± 2 SD).

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCWES010 - Calvert Cliffs Western Shore Station 1					
8/25/2020	88±44	1237±145	<4	<3	1±1
10/22/2020	50±33	1193±143	<7	<4	<4
12/21/2020	81±33	1591±185	<4	<3	4±1
2020 Average	**73±40**	**1340±436**	**--**	**--**	**3±4**
3/24/2021	<50	1164±138	<4	<3	<3
6/16/2021	<73	1041±129	<7	<4	2±1
10/5/2021	44±17	934±116	<3	<3	<4
11/9/2021	43±18	1138±134	<6	<3	<3
2021 Average	**71±34**	**1069±209**	**--**	**--**	**2±1**
Overall	**72±33**	**1185±411**	**--**	**--**	**2±3**
Station CCWES020 - Calvert Cliffs Western Shore Station 2					
8/25/2020	51±32	714±89	<4	<3	4±1
10/22/2020	348±98	3552±357	<9	<5	15±2
12/21/2020	199±51	2564±298	<6	<4	12±2
2020 Average	**199±297**	**2277±2881**	**--**	**--**	**10±11**
3/24/2021	77±27	5561±636	<11	<7	26±4
6/16/2021	61±30	1518±176	<5	<3	6±1
10/5/2021	106±16	2003±231	<3	<3	7±1
11/9/2021	59±43	846±104	<6	<3	6±1
2021 Average	**76±43**	**2482±4214**	**--**	**--**	**11±20**
Overall	**129±219**	**2394±3419**	**--**	**--**	**11±15**
Station CCWES030 - Calvert Cliffs Western Shore Station 3					
8/25/2020	<208	19605±1932	<20	<16	187±23
10/22/2020	306±158	18299±1805	<22	<15	151±17
12/21/2020	<182	19394±1913	<19	<15	141±18
2020 Average	**306±158**	**19099±1402**	**--**	**--**	**160±48**
3/24/2021	<243	20251±1987	<21	<14	303±31
6/16/2021	<349	19893±1979	<36	<22	285±31
10/5/2021	<146	18973±1862	<17	<12	293±32
11/9/2021	<291	19297±1891	<26	<13	355±36
2021 Average	**--**	**19604±1152**	**--**	**--**	**309±63**
Overall	**306±158**	**19387±1268**	**--**	**--**	**245±168**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCWES040 - Calvert Cliffs Western Shore Station 4					
8/25/2020	<185	19006±1871	<18	<15	103±12
10/22/2020	<212	19562±1929	<22	<15	83±11
12/21/2020	92±74	19939±1968	<20	<16	74±13
2020 Average	**92±74**	**19502±939**	**--**	**--**	**87±30**
3/24/2021	<195	18321±1801	<19	<13	102±12
6/16/2021	<271	20562±2022	<26	<16	108±13
10/5/2021	<138	19038±1871	<16	<12	85±13
11/9/2021	<412	18531±1852	<39	<20	66±17
2021 Average	**--**	**19113±2024**	**--**	**--**	**90±38**
Overall	**92±74**	**19280±1586**	**--**	**--**	**89±32**
Station CCFLP010 - Calvert Cliffs Flag Ponds Station 1					
8/25/2020	85±30	690±83	<3	<2	<3
10/22/2020	150±37	1488±173	<4	<3	2±1
12/21/2020	51±21	626±77	<3	<2	1±1
2020 Average	**95±101**	**935±961**	**--**	**--**	**2±1**
3/24/2021	44±11	820±98	<3	<2	<3
6/16/2021	<34	546±67	<3	<2	1±1
10/5/2021	102±31	1702±196	<3	<2	3±1
11/9/2021	55±45	889±109	<5	<3	1±1
2021 Average	**67±62**	**989±995**	**--**	**--**	**2±2**
Overall	**81±81**	**966±898**	**--**	**--**	**2±2**
Station CCFLP020 - Calvert Cliffs Flag Ponds Station 2					
8/25/2020	232±66	5346±611	<8	<6	17±3
10/22/2020	357±69	5718±569	<10	<7	20±3
12/21/2020	181±55	5955±591	<8	<6	18±3
2020 Average	**257±181**	**5673±614**	**--**	**--**	**18±3**
3/24/2021	<89	5511±629	<10	<6	18±3
6/16/2021	231±116	6340±724	<12	<8	21±3
10/5/2021	120±31	5387±616	<10	<6	19±3
11/9/2021	78±38	5755±651	<8	<5	19±3
2021 Average	**143±158**	**5748±846**	**--**	**--**	**19±3**
Overall	**200±197**	**5716±700**	**--**	**--**	**19±3**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCFLP030 - Calvert Cliffs Flag Ponds Station 3					
8/25/2020	<141	15949±1562	<14	<11	247±25
10/22/2020	153±112	15193±1495	<17	<12	103±12
12/21/2020	69±40	16157±1594	<16	<14	103±12
2020 Average	**111±119**	**15766±1015**	**--**	**--**	**151±166**
3/24/2021	<178	17456±1711	<17	<12	297±30
6/16/2021	<284	16768±1665	<28	<18	286±30
10/5/2021	<117	15812±1552	<14	<10	182±20
11/9/2021	<248	16003±1585	<24	<15	204±22
2021 Average	**--**	**16510±1508**	**--**	**--**	**242±115**
Overall	**111±119**	**16191±1453**	**--**	**--**	**203±159**
Station CCFLP040 - Calvert Cliffs Flag Ponds Station 4					
8/25/2020	<211	18294±1819	<23	<19	95±17
10/22/2020	<250	17865±1784	<27	<20	65±14
12/21/2020	<230	19368±1940	<25	<22	70±15
2020 Average	**--**	**18509±1548**	**--**	**--**	**77±32**
3/24/2021	<271	19154±1909	<29	<20	101±13
6/16/2021	<319	18691±1866	<34	<21	83±16
10/5/2021	<249	17883±1775	<27	<18	111±21
11/9/2021	<231	19307±1894	<21	<13	99±12
2021 Average	**--**	**18759±1280**	**--**	**--**	**99±23**
Overall	**--**	**18652±1300**	**--**	**--**	**89±34**
Station CCCCO010 - Calvert Cliffs Outfall Station 1					
8/25/2020	75±18	1161±143	<6	<4	<5
10/22/2020	94±20	1324±158	<6	<4	2±1
12/21/2020	63±14	1301±157	<5	<4	2±1
2020 Average	**77±31**	**1262±176**	**--**	**--**	**2±0**
3/24/2021	<56	1209±147	<6	<4	<4
6/16/2021	<47	1205±146	<5	<4	2±1
10/5/2021	<39	994±121	<6	<3	<4
11/9/2021	<53	1406±163	<5	<3	2±1
2021 Average	**--**	**1204±337**	**--**	**--**	**2±0**
Overall	**77±31**	**1229±266**	**--**	**--**	**2±0**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCCCO020 - Calvert Cliffs Outfall Station 2					
8/25/2020	76±25	1130±132	<3	<2	2±1
10/22/2020	489±61	3156±360	<6	<4	7±2
12/21/2020	579±77	2963±339	<4	<4	10±2
2020 Average	**381±536**	**2416±2236**	**--**	**--**	**6±8**
3/24/2021	83±35	2662±304	<5	<3	9±2
6/16/2021	27±11	1228±146	<4	<3	3±1
10/5/2021	83±30	2042±235	<3	<2	5±1
11/9/2021	130±49	1642±194	<6	<4	5±1
2021 Average	**81±84**	**1894±1221**	**--**	**--**	**6±5**
Overall	**210±450**	**2118±1651**	**--**	**--**	**6±6**
Station CCCCO030 - Calvert Cliffs Outfall Station 3					
8/25/2020	<197	17402±1733	<22	<18	126±16
10/22/2020	<155	17159±1689	<17	<13	119±14
12/21/2020	<150	17816±1755	<16	<14	119±14
2020 Average	**--**	**17459±664**	**--**	**--**	**121±8**
3/24/2021	<159	16723±1640	<15	<12	253±29
6/16/2021	<186	17401±1727	<22	<18	172±22
10/5/2021	<227	16476±1635	<23	<16	311±32
11/9/2021	<223	17468±1731	<23	<17	182±25
2021 Average	**--**	**17017±987**	**--**	**--**	**230±130**
Overall	**--**	**17206±926**	**--**	**--**	**183±148**
Station CCCCO040 - Calvert Cliffs Outfall Station 4					
8/25/2020	<132	18944±1860	<15	<14	119±14
10/22/2020	<201	18811±1870	<23	<19	109±14
12/21/2020	<173	18889±1878	<20	<19	92±19
2020 Average	**--**	**18881±134**	**--**	**--**	**107±27**
3/24/2021	<204	17717±1757	<23	<16	120±14
6/16/2021	<179	19082±1891	<22	<18	203±25
10/5/2021	<229	19188±1898	<23	<18	269±28
11/9/2021	<191	19197±1881	<18	<12	202±21
2021 Average	**--**	**18796±1442**	**--**	**--**	**199±122**
Overall	**--**	**18833±1027**	**--**	**--**	**159±132**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCROP010 - Calvert Cliffs Rocky Point Station 1					
8/25/2020	19±13	617±75	<2	<2	<2
10/22/2020	90±23	1056±125	<3	<2	<3
12/21/2020	64±22	651±83	<3	<3	<3
2020 Average	**58±72**	**775±488**	**--**	**--**	**--**
3/24/2021	46±26	530±69	<4	<3	1±1
6/16/2021	34±17	743±89	<2	<2	<2
10/5/2021	53±27	631±77	<3	<2	1±1
11/9/2021	<22	904±107	<2	<2	<2
2021 Average	**44±19**	**702±321**	**--**	**--**	**1±0**
Overall	**51±49**	**733±370**	**--**	**--**	**1±0**
Station CCROP020 - Calvert Cliffs Rocky Point Station 2					
8/25/2020	70±47	9122±908	<11	<10	63±8
10/22/2020	98±27	765±94	<3	<3	<3
12/21/2020	129±25	915±109	<3	<2	4±1
2020 Average	**99±59**	**3601±9564**	**--**	**--**	**34±83**
3/24/2021	<29	505±63	<3	<2	<2
6/16/2021	27±21	722±89	<3	<3	2±1
10/5/2021	<34	599±79	<4	<3	1±1
11/9/2021	<39	450±61	<4	<3	<3
2021 Average	**27±21**	**569±238**	**--**	**--**	**2±1**
Overall	**81±87**	**1868±6405**	**--**	**--**	**18±61**
Station CCROP030 - Calvert Cliffs Rocky Point Station 3					
8/25/2020	<118	17022±1674	<13	<13	117±14
10/22/2020	<135	16805±1653	<15	<13	88±11
12/21/2020	124±122	16944±1690	<19	<18	81±18
2020 Average	**124±122**	**16924±220**	**--**	**--**	**95±38**
3/24/2021	<206	15839±1581	<24	<18	102±18
6/16/2021	<191	17928±1790	<24	<21	116±22
10/5/2021	<163	16226±1596	<16	<12	91±15
11/9/2021	<177	17220±1693	<18	<13	131±15
2021 Average	**--**	**16803±1898**	**--**	**--**	**110±35**
Overall	**124±122**	**16855±1354**	**--**	**--**	**104±37**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCROP040 - Calvert Cliffs Rocky Point Station 4					
8/25/2020	<157	18602±1840	<18	<18	132±22
10/22/2020	<164	18345±1814	<19	<17	149±17
12/21/2020	<133	19615±1923	<14	<13	136±15
2020 Average	**--**	**18854±1343**	**--**	**--**	**139±18**
3/24/2021	<153	17571±1723	<15	<12	148±16
6/16/2021	<161	18590±1836	<19	<17	191±21
10/5/2021	<111	18494±1811	<14	<11	86±14
11/9/2021	<212	18287±1804	<22	<16	206±26
2021 Average	**--**	**18236±921**	**--**	**--**	**158±108**
Overall	**--**	**18501±1209**	**--**	**--**	**150±79**
8/25/2020	<157	18602±1840	<18	<18	132±22
Station CCLNG010 - Calvert Cliffs LNG Plant Pipeline Station 1					
8/25/2020	78±14	1170±140	<4	<3	3±1
10/22/2020	72±29	687±87	<3	<3	<3
12/21/2020	<24	532±66	<2	<2	<2
2020 Average	**75±8**	**796±666**	**--**	**--**	**3±1**
3/24/2021	<28	617±75	<3	<2	<2
6/16/2021	<32	1047±127	<4	<3	<3
10/5/2021	40±22	550±71	<3	<3	<3
11/9/2021	43±23	1034±126	<4	<3	<4
2021 Average	**42±4**	**812±531**	**--**	**--**	**--**
Overall	**58±39**	**805±537**	**--**	**--**	**3±1**
Station CCLNG020 - Calvert Cliffs LNG Plant Pipeline Station 2					
8/25/2020	142±51	11408±1119	<9	<9	54±7
10/22/2020	1125±138	12895±1268	<11	<10	63±8
12/21/2020	490±90	11952±1191	<14	<14	53±7
2020 Average	**586±997**	**12085±1505**	**--**	**--**	**57±11**
3/24/2021	<111	9690±960	<13	<10	42±5
6/16/2021	130±60	9961±979	<9	<8	43±5
10/5/2021	305±90	11056±1086	<10	<9	45±6
11/9/2021	<59	9912±972	<7	<6	40±5
2021 Average	**218±247**	**10155±1225**	**--**	**--**	**43±4**
Overall	**438±821**	**10982±2401**	**--**	**--**	**49±17**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCLNG030 - Calvert Cliffs LNG Plant Pipeline Station 3					
8/25/2020	<120	17613±1734	<14	<14	100±12
10/22/2020	<58	17991±1776	<15	<15	95±12
12/21/2020	<178	17456±1749	<21	<21	98±13
2020 Average	**--**	**17687±550**	**--**	**--**	**98±5**
3/24/2021	<204	16733±1672	<23	<18	74±15
6/16/2021	<126	17354±1708	<14	<13	81±13
10/5/2021	<172	17793±1755	<18	<14	75±13
11/9/2021	<98	17914±1760	<12	<11	90±14
2021 Average	**--**	**17449±1068**	**--**	**--**	**80±15**
Overall	**--**	**17551±858**	**--**	**--**	**88±22**
Station CCLNG040 - Calvert Cliffs LNG Plant Pipeline Station 4					
8/19/2020	<103	18880±1846	<13	<12	5±3
10/22/2020	<121	18668±1836	<14	<15	27±5
12/21/2020	<109	19694±1925	<12	<12	44±6
2020 Average	**--**	**19081±1083**	**--**	**--**	**25±39**
3/24/2021	<100	18539±1805	<11	<9	8±2
6/16/2021	<119	19396±1901	<15	<13	14±4
10/5/2021	<109	18911±1851	<14	<13	<12
11/9/2021	<126	18634±1826	<14	<12	<13
2021 Average	**--**	**18870±769**	**--**	**--**	**11±8**
Overall	**--**	**18960±859**	**--**	**--**	**20±32**
Station CCCOV010 - Calvert Cliffs Cove Point Station 1					
8/17/2020	162±35	5053±576	<7	<6	16±3
10/22/2020	252±56	5663±645	<6	<6	17±3
12/21/2020	200±43	5393±610	<5	<5	14±2
2020 Average	**205±90**	**5370±611**	**--**	**--**	**16±3**
3/24/2021	66±56	5441±620	<7	<6	16±3
6/16/2021	107±20	5023±572	<6	<6	13±2
10/5/2021	123±24	5312±606	<7	<6	15±3
11/9/2021	261±66	4796±547	<7	<6	11±2
2021 Average	**139±169**	**5143±580**	**--**	**--**	**14±4**
Overall	**167±148**	**5240±593**	**--**	**--**	**15±4**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCCOV020 - Calvert Cliffs Cove Point Station 2					
8/19/2020	233±51	7594±745	<6	<6	28±4
10/22/2020	390±45	7708±756	<6	<6	29±4
12/21/2020	312±73	8266±818	<9	<9	30±4
2020 Average	**312±157**	**7856±719**	**--**	**--**	**29±2**
3/24/2021	108±63	7378±733	<10	<8	24±4
6/16/2021	286±60	7667±752	<6	<6	25±3
10/5/2021	253±58	7766±762	<7	<6	25±4
11/9/2021	317±55	7315±719	<5	<5	26±4
2021 Average	**241±185**	**7532±438**	**--**	**--**	**25±2**
Overall	**271±176**	**7671±623**	**--**	**--**	**27±5**
Station CCCOV030 - Calvert Cliffs Cove Point Station 3					
8/17/2020	<171	17712±1769	<21	<21	92±12
10/22/2020	167±111	16746±1673	<18	<18	73±16
12/21/2020	<148	18352±1814	<16	<16	92±12
2020 Average	**167±111**	**17603±1617**	**--**	**--**	**86±22**
3/24/2021	<155	17767±1749	<16	<14	105±12
6/16/2021	<168	18048±1802	<21	<20	92±20
10/5/2021	<103	18847±1845	<14	<13	7±3
11/9/2021	<186	17158±1711	<22	<18	100±13
2021 Average	**--**	**17955±1402**	**--**	**--**	**76±93**
Overall	**--**	**17804±1413**	**--**	**--**	**80±68**
Station CCCOV040 - Calvert Cliffs Cove Point Station 4					
8/17/2020	<91	19878±1936	<11	<10	7±3
10/22/2020	<89	18634±1816	<10	<10	16±3
12/21/2020	<119	19477±1913	<14	<15	23±5
2020 Average	**--**	**19330±1270**	**--**	**--**	**15±16**
3/24/2021	<136	18941±1857	<16	<13	<14
6/16/2021	<88	19859±1936	<10	<10	15±3
10/5/2021	<161	17797±1757	<17	<15	91±12
11/9/2021	<65	19529±1900	<9	<8	<7
2021 Average	**--**	**19032±1813**	**--**	**--**	**53±107**
Overall	**--**	**19159±1511**	**--**	**--**	**30±69**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
Station CCLCP010 - Calvert Cliffs Little Cove Point Station 1					
8/17/2020	<72	12853±1257	<8	<8	82±9
10/22/2020	<129	18360±1810	<14	<15	87±15
12/21/2020	<157	17717±1768	<19	<20	92±12
2020 Average	**--**	**16310±6022**	**--**	**--**	**87±10**
3/24/2021	<116	17303±1701	<13	<13	109±13
6/16/2021	<98	17191±1691	<11	<13	113±13
10/5/2021	<121	17187±1687	<13	<12	167±18
11/9/2021	<87	17969±1761	<11	<11	95±14
2021 Average	**--**	**17413±750**	**--**	**--**	**121±63**
Overall	**--**	**16940±3709**	**--**	**--**	**106±58**
Station CCLCP020 - Calvert Cliffs Little Cove Point Station 2					
8/17/2020	<148	18730±1858	<18	<19	142±17
10/22/2020	<138	18379±1826	<17	<18	97±12
12/21/2020	<125	19855±1950	<14	<14	110±13
2020 Average	**--**	**18988±1542**	**--**	**--**	**116±46**
3/24/2021	<168	18317±1823	<20	<20	127±22
6/16/2021	<149	18723±1865	<18	<19	114±19
10/5/2021	<155	18448±1832	<17	<17	111±14
11/9/2021	<147	17453±1720	<16	<14	140±17
2021 Average	**--**	**18235±1097**	**--**	**--**	**123±27**
Overall	**--**	**18558±1429**	**--**	**--**	**120±33**
Station CCDRP010 - Calvert Cliffs Drum Point Station 1					
8/17/2020	<86	11074±1094	<10	<11	80±9
10/22/2020	156±61	10794±1069	<10	<11	63±8
12/21/2020	168±57	16755±1643	<11	<12	83±10
2020 Average	**162±17**	**12874±6727**	**--**	**--**	**75±22**
3/24/2021	<42	10787±1067	<11	<11	67±8
6/16/2021	<92	12204±1210	<11	<12	65±8
10/5/2021	<97	12300±1217	<11	<11	66±9
11/9/2021	<97	9805±969	<11	<9	61±7
2021 Average	**--**	**11274±2398**	**--**	**--**	**65±5**
Overall	**--**	**11960±4570**	**--**	**--**	**69±17**

Table C-1. (Continued)

Sample Date	Be-7	K-40	Co-58	Co-60	Cs-137
		Station CCDRP020 - Calvert Cliffs Drum Point Station 2			
8/17/2020	<116	19492±1915	<14	<14	112±18
10/22/2020	<130	19292±1903	<15	<15	97±12
12/21/2020	<177	19676±1970	<21	<21	96±13
2020 Average	**--**	**19487±384**	**--**	**--**	**102±18**
3/24/2021	<121	18243±1794	<14	<14	101±16
6/16/2021	<111	20243±1991	<13	<15	124±15
10/5/2021	<132	20140±1979	<14	<15	156±18
11/9/2021	<95	19168±1885	<12	<13	113±16
2021 Average	**--**	**19449±1877**	**--**	**--**	**124±47**
Overall	**--**	**19465±1346**	**--**	**--**	**114±42**

Table C-2. Radionuclide Concentrations in Tray Oysters (pCi/kg± 2 SD). Exposure in days. Concentrations in dry weight (St. Leonard Creek, Outfall) and wet weight (Camp Conoy). NA = Not Available. NT = Not Tested.

Sample Date	Exposure	Be-7	K-40	Ag-110m	Co-60	Cs-137
Station CCSTL000 - St. Leonard Creek Control Station						
5/14/2021	997	<547	11697±1543	<56	<62	<59
7/2/2021	997	<809	15328±1886	<73	<79	<75
10/7/2021	997	<1638	9462±1333	<78	<64	<72
12/9/2021	997	<487	12237±1389	<41	<39	<43
2021 Average		**--**	**12181±4835**	**--**	**--**	**--**
Overall		**--**	**12181±4835**	**--**	**--**	**--**
Station CCPLS000 - Calvert Cliffs Plant Outfall Indicator Station						
5/14/2021	90	<167	11498±1330	<38	<42	<41
7/2/2021	90	<568	11620±1415	<50	<58	<54
7/2/2021	120	<749	14366±1784	<65	<68	<69
10/7/2021	98	<1400	15782±1876	<71	<69	<65
10/7/2021	349	<1039	10355±1313	<56	<56	<51
12/9/2021	63	<554	11979±1480	<52	<52	<56
12/9/2021	412	<437	13650±1566	<42	<50	<47
2021 Average		**--**	**12750±3811**	**--**	**--**	**--**
Overall		**--**	**12750±3811**	**--**	**--**	**--**
Calvert Cliffs Camp Conoy Indicator Station						
3/10/2020	NA	NT	2600±120	<16	<8	NT
6/8/2020	NA	NT	1700±100	<5	<6	NT
2020 Average			**2150±1273**	**--**	**--**	**--**
3/24/2021	NA	NT	1460±131	<9	<9	NT
6/23/2021	NA	NT	1390±81	<3	<4	NT
8/24/2021	NA	NT	2050±127	<6	<6	NT
10/26/2021	NA	NT	1800±130	<6	<8	NT
2021 Average		**--**	**1675±615**	**--**	**--**	**--**
Overall		**--**	**1913±672**	**--**	**--**	**--**

Table C-3. Radionuclide Concentrations in Sediments at Peach Bottom (pCi/kg ± 2 SD).

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBLYH010 - Peach Bottom Little Yellow House Station 1					
6/9/2020	176±62	8102±911	<5	14±2	<16
12/11/2020	<191	14557±1416	<8	106±11	<31
2020 Average	**176±62**	**11329±9129**	**--**	**60±130**	**--**
Overall	**176±62**	**11329±9129**	**--**	**60±130**	**--**
Station PBLYH020 - Peach Bottom Little Yellow House Station 2					
6/9/2020	1194±212	15122±1480	<11	60±7	<40
12/11/2020	<527	30545±2991	<24	123±15	<91
2020 Average	**1194±212**	**22834±21811**	**--**	**91±89**	**--**
Overall	**1194±212**	**22834±21811**	**--**	**91±89**	**--**
Station PBLYH030 - Peach Bottom Little Yellow House Station 3					
6/9/2020	59±52	11329±1113	<10	34±5	<34
12/11/2020	<179	8466±960	<8	22±4	<32
2020 Average	**59±52**	**9898±4050**	**--**	**28±17**	**--**
Overall	**59±52**	**9898±4050**	**--**	**28±17**	**--**
Station PBBRC010 - Peach Bottom Broad Creek Station 1					
6/9/2020	515±136	19604±1926	<16	93±11	<57
12/11/2020	258±157	18085±1764	<11	84±10	<40
2020 Average	**386±363**	**18844±2147**	**--**	**89±13**	**--**
Overall	**386±363**	**18844±2147**	**--**	**89±13**	**--**
Station PBBRC020 - Peach Bottom Broad Creek Station 2					
6/9/2020	1226±182	17042±1672	<14	78±9	<48
12/11/2020	275±159	16237±1595	<14	69±9	<49
2020 Average	**751±1344**	**16639±1138**	**--**	**73±12**	**--**
Overall	**751±1344**	**16639±1138**	**--**	**73±12**	**--**
Station PBBRC030 - Peach Bottom Broad Creek Station 3					
6/9/2020	627±162	19342±1885	<11	83±10	<38
12/11/2020	<206	18948±1850	<12	86±10	<44
2020 Average	**627±162**	**19145±558**	**--**	**84±4**	**--**
Overall	**627±162**	**19145±558**	**--**	**84±4**	**--**

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBCOC010 - Peach Bottom Conowingo Creek Station 1					
6/9/2020	307±115	20531±2002	<13	95±11	<40
12/11/2020	574±240	18823±1850	<16	83±10	<55
2020 Average	**441±378**	**19677±2415**	**--**	**89±16**	**--**
Overall	**441±378**	**19677±2415**	**--**	**89±16**	**--**
Station PBCOC020 - Peach Bottom Conowingo Creek Station 2					
6/9/2020	1367±239	18161±1788	<16	86±11	<54
12/11/2020	<83	17864±1744	<11	73±9	<40
2020 Average	**1367±239**	**18012±419**	**--**	**80±18**	**--**
Overall	**1367±239**	**18012±419**	**--**	**80±18**	**--**
Station PBCOC030 - Peach Bottom Conowingo Creek Station 3					
6/9/2020	677±123	20337±1984	<12	98±11	<38
12/11/2020	<260	20290±1995	<18	95±12	<60
2020 Average	**677±123**	**20313±67**	**--**	**96±4**	**--**
Overall	**677±123**	**20313±67**	**--**	**96±4**	**--**
Station PBCOD010 - Peach Bottom Conowingo Dam Station 1					
6/9/2020	2646±345	18669±1842	<18	90±11	<58
12/11/2020	488±170	20086±1965	<14	94±11	<48
2020 Average	**1567±3052**	**19377±2004**	**--**	**92±5**	**--**
Overall	**1567±3052**	**19377±2004**	**--**	**92±5**	**--**
Station PBCOD020 - Peach Bottom Conowingo Dam Station 2					
6/9/2020	665±116	21083±2055	<12	102±12	<38
12/11/2020	343±191	21845±2144	<18	103±12	<60
2020 Average	**504±456**	**21464±1078**	**--**	**102±1**	**--**
Overall	**504±456**	**21464±1078**	**--**	**102±1**	**--**
Station PBCOD030 - Peach Bottom Conowingo Dam Station 3					
6/9/2020	424±140	21403±2100	<16	98±12	<54
12/11/2020	<208	22426±2188	<13	101±12	<48
2020 Average	**424±140**	**21915±1446**	**--**	**99±4**	**--**
Overall	**424±140**	**21915±1446**	**--**	**99±4**	**--**

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBSRV030 - Peach Bottom Susquehanna River Station 3					
6/9/2020	98±39	2923±336	<4	3±1	<13
12/15/2020	95±46	4094±465	<4	8±2	<13
2020 Average	**96±5**	**3509±1656**	**--**	**5±6**	**--**
7/12/2021	94±34	2957±336	<3	5±1	<9
12/15/2021	53±40	2925±332	<3	4±1	<10
2021 Average	**74±59**	**2941±46**	**--**	**4±1**	**--**
Overall	**85±32**	**3225±803**	**--**	**5±2**	**--**
Station PBSFL010 - Peach Bottom Susquehanna Flats Station 1					
6/9/2020	56±39	8437±950	<5	14±2	<17
12/15/2020	<115	9306±1055	<8	15±3	<28
2020 Average	**56±39**	**8871±1228**	**--**	**14±2**	**--**
7/12/2021	158±88	9528±938	<9	7±2	<32
12/15/2021	179±131	8610±846	<7	5±2	<29
2021 Average	**168±30**	**9069±1298**	**--**	**6±2**	**--**
Overall	**112±160**	**8970±280**	**--**	**10±12**	**--**
Station PBSFL060 - Peach Bottom Susquehanna Flats Station 6					
6/9/2020	96±41	3237±371	<4	5±1	<13
12/15/2020	67±33	3165±360	<3	4±1	<11
2020 Average	**82±41**	**3201±102**	**--**	**5±2**	**--**
7/12/2021	55±34	3140±357	<3	4±1	<11
12/15/2021	65±39	3151±358	<3	4±1	<11
2021 Average	**60±14**	**3146±15**	**--**	**4±1**	**--**
Overall	**71±31**	**3173±79**	**--**	**4±1**	**--**
Station PBSFL070 - Peach Bottom Susquehanna Flats Station 7					
6/9/2020	<75	11531±1128	<8	157±16	<27
12/15/2020	101±24	3562±410	<5	5±2	<19
2020 Average	**101±24**	**7546±11271**	**--**	**81±215**	**--**
7/12/2021	<125	10189±1001	<9	129±13	<34
12/15/2021	64±24	3726±426	<5	4±1	<18
2021 Average	**64±24**	**6957±9140**	**--**	**66±176**	**--**
Overall	**83±52**	**7252±833**	**--**	**74±21**	**--**

Table C-3. (Continued)

Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
Station PBSFL080 - Peach Bottom Susquehanna Flats Station 8					
6/9/2020	136±49	6261±712	<6	11±2	<22
12/15/2020	271±82	6937±787	<7	17±3	<24
2020 Average	**204±191**	**6599±957**	--	**14±9**	--
7/12/2021	274±61	6141±693	<5	13±2	<17
12/15/2021	227±82	5944±671	<5	10±2	<18
2021 Average	**250±67**	**6043±279**	--	**11±5**	--
Overall	**227±66**	**6321±787**	--	**13±3**	--
Station PBSFL090 - Peach Bottom Susquehanna Flats Station 9					
6/9/2020	<66	11847±1156	<7	41±5	<24
12/15/2020	<107	11908±1163	<8	42±5	<28
2020 Average	--	**11877±87**	--	**41±1**	--
7/12/2021	293±138	14483±1424	<13	50±7	<47
12/15/2021	605±230	15072±1484	<13	53±7	<51
2021 Average	**449±442**	**14778±832**	--	**52±5**	--
Overall	**449±442**	**13327±4101**	--	**46±15**	--
Station PBUPB100 - Peach Bottom Upper Bay Station 10					
6/9/2020	83±45	10704±1054	<10	39±5	<33
12/15/2020	145±96	12436±1223	<11	47±6	<38
2020 Average	**114±88**	**11570±2450**	--	**43±12**	--
7/12/2021	195±84	12728±1243	<8	52±6	<31
12/15/2021	<177	11696±1152	<10	46±6	<40
2021 Average	**195±84**	**12212±1459**	--	**49±8**	--
Overall	**155±115**	**11891±908**	--	**46±9**	--

Table C-4. Radionuclide Concentrations in Finfish at Peach Bottom (pCi/kg ± 2 SD). *C. carpio* = *Cyprinus carpio*; *I. punctatus* = *Ictalurus punctatus*; *D. cepedianum* = *Dorosoma cepedianum*; *Lepomis* spp. = *Lepomis gibbosus & Lepomis macrochirus; M. saxatilis* = *Morone saxatilis*; *M. dolomieu* = *Micropterus dolomieu.*

Species	Tissue	Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
		Station PBLYH010 - Peach Bottom Little Yellow House Station 1					
C. carpio	flesh	6/15/2020	<203	11068±1130	<15	<13	<39
C. carpio	flesh	6/15/2020	<183	10468±1071	<14	<12	<38
C. carpio	flesh	11/16/2020	<437	14802±1546	<27	<21	<76
C. carpio	flesh	11/16/2020	<391	16612±1683	<21	<18	<61
I. punctatus	flesh	6/15/2020	<256	17632±1780	<20	<17	<54
I. punctatus	flesh	11/16/2020	<544	19654±2041	<32	<25	<85
Ictalurus sp.	flesh	6/15/2020	<199	11637±1211	<19	<16	<51
Ictalurus sp.	flesh	6/15/2020	<206	14140±1428	<17	<14	<44
Moxostama sp.	flesh	11/16/2020	<909	19413±2051	<40	<30	<115
M. salmoides	flesh	11/16/2020	<440	18861±1905	<22	<19	<65
Mixed freshwater fish	flesh	6/15/2020	<305	19243±1942	<21	<19	<61
Mixed freshwater fish	flesh	11/16/2020	<501	16946±1708	<19	<16	<59
S. vitreum	flesh	11/16/2020	<537	17613±1806	<26	<20	<81
		2020 Average	--	**16007±6560**	--	--	--
C. carpio	flesh	5/12/2021	<202	17084±1772	<26	<21	<69
C. carpio	flesh	5/12/2021	<138	12750±1294	<15	<14	<38
C. carpio	flesh	5/12/2021	<162	12224±1277	<20	<16	<49
C. carpio	flesh	11/17/2021	<798	11821±1246	<20	<18	<68
C. carpio	flesh	11/17/2021	<719	13539±1384	<17	<17	<56
C. carpio	flesh	11/17/2021	<711	10352±1082	<16	13±10	<59
D. cepedianum	flesh	5/12/2021	<260	20112±2028	<23	<18	<59
I. punctatus	flesh	5/12/2021	<137	12069±1227	<15	<13	<37
I. punctatus	flesh	5/12/2021	<186	15045±1559	<22	<18	<61
I. punctatus	flesh	5/12/2021	<156	14280±1447	<16	<15	<41
I. punctatus	flesh	11/17/2021	<1040	21836±2221	<24	<24	<84
Ictalurus sp.	flesh	5/12/2021	<336	20163±2028	<22	<19	<60
Ictalurus sp.	flesh	11/17/2021	<936	15660±1593	<17	<19	<61
M. saxatalis and M. chrysops	flesh	11/17/2021	<870	12295±1283	<19	<18	<69
Mixed freshwater fish	flesh	11/17/2021	<1015	11257±1179	<17	<15	<58
Moxostama sp.	flesh	5/12/2021	<309	18182±1836	<22	<18	<58
Moxostama sp.	flesh	5/12/2021	<299	18362±1853	<21	<7	<57
Moxostama sp.	flesh	11/17/2021	<1191	16274±1664	<21	<20	<72
Moxostama sp.	flesh	5/12/2021	<553	20600±2151	<35	<33	<96
		2021 Average	--	**15469±7174**	--	**13±10**	--
		Overall	--	**15738±761**	--	**13±10**	--

Table C-4. (Continued)

Species	Tissue	Sample Date	Be-7	K-40	Co-60	Cs-137	Zn-65
C. carpio	gut	6/15/2020	<814	5009±751	<52	<52	<127
C. carpio	gut	6/15/2020	<936	4968±826	<62	<58	<140
C. carpio	gut	6/15/2020	<908	4766±748	<56	<53	<131
C. carpio	gut	11/16/2020	<2578	5060±896	<74	<67	<213
C. carpio	gut	11/16/2020	<1970	4507±772	<56	<50	<168
D. cepedianum	gut	6/15/2020	<1114	6187±1010	<74	<69	<197
I. punctatus	gut	6/15/2020	<777	4157±639	<51	<49	<115
I. punctatus	gut	11/16/2020	<1852	3963±649	<51	<50	<158
Ictalurus sp.	gut	6/15/2020	<903	2896±712	<72	<70	<190
Ictalurus sp.	gut	6/15/2020	<676	2419±478	<49	<49	<118
M. dolomieu	gut	6/15/2020	<68529	12192±2373	<228	<212	<1139
M. dolomieu	gut	11/16/2020	<2565	4421±761	<65	<61	<193
M. dolomieu	gut	11/16/2020	<3011	3334±682	<76	<66	<228
M. salmoides	gut	11/16/2020	<2885	4166±838	<77	<72	<233
Moxostama sp.	gut	11/16/2020	<1974	4465±701	<52	<50	<166
S. vitreum	gut	11/16/2020	<2992	3515±806	<80	<70	<218
		2020 Average	**--**	**4752±4370**	**--**	**--**	**--**
C. carpio	gut	5/12/2021	<633	5902±1019	<71	<67	<156
C. carpio	gut	5/12/2021	<499	6499±913	<50	<53	<113
C. carpio	gut	5/12/2021	<540	5788±951	<63	<51	<135
C. carpio	gut	11/17/2021	<2048	5312±803	<55	<53	<180
C. carpio	gut	11/17/2021	<2995	6849±1108	<84	<76	<228
D. cepedianum	gut	5/12/2021	<634	5264±807	<49	<54	<121
D. cepedianum	gut	11/17/2021	<4131	4976±947	<77	<67	<239
I. punctatus	gut	5/12/2021	<599	4856±790	<55	<59	<132
I. punctatus	gut	5/12/2021	<628	3747±755	<70	<61	<152
I. punctatus	gut	5/12/2021	<446	3073±545	<40	<41	<87
I. punctatus	gut	11/17/2021	<2950	3730±797	<74	<61	<221
I. punctatus	gut	11/17/2021	<2388	4058±700	<59	<55	<179
Ictalurus sp.	gut	5/12/2021	<569	3422±668	<58	<51	<133
Ictalurus sp.	gut	11/17/2021	<2515	4462±720	<58	<54	<180
M. dolomieu	gut	5/12/2021	<1236	5276±841	<63	<56	<156
		2021 Average	**--**	**4881±2250**	**--**	**--**	**--**
		Overall	**--**	**4816±183**	**--**	**--**	**--**

Table C-5. Radionuclide Concentrations in Submerged Aquatic Vegetation (pCi/kg ± 2 SD) at Peach Bottom. *M. spicatum* = *Myriophyllum spicatum*

Species	Sample Date	Be-7	K-40	Co-60	Cs-137	I-131
Station PBFBT000 - Peach Bottom Susquehanna Flats Fishing Battery Station						
M. spicatum	11/16/2020	3038±677	41494±4412	<95	<110	<113
M. spicatum	11/16/2020	3011±563	36598±3753	<58	<67	<78
M. spicatum	11/16/2020	2807±617	41339±4330	<75	<86	<303
M. spicatum	11/16/2020	2553±769	38117±4118	<97	<104	<322
M. spicatum	6/15/2020	1522±357	20161±2143	<44	22±21	<130
M. spicatum	6/15/2020	1285±401	19600±2153	<49	41±34	80±57
	2020 Average	**2369±1543**	**32885±20497**	**--**	**31±28**	**80±57**
	Overall	**2369±1543**	**32885±20497**	**--**	**31±28**	**80±57**

Table C-6. Radionuclide Concentrations in Air Particulate and Air (fCi/m^3) ± 2 SD. Sample volume is in m^3. NA = data not available due to mechanical/power failure. NT = Not Tested.

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Long Beach Station					
12/30/2019	1/7/2020	313	<0.4	20±1	<7
1/7/2020	1/14/2020	285	1.3±0.2	12±1	<7
1/14/2020	1/21/2020	285	1.7±0.3	27±1	<7
1/21/2020	1/27/2020	227	1.3±0.3	14±1	<9
1/26/2020	2/4/2020	344	1.3±0.4	19±1	<6
2/4/2020	2/11/2020	245	<0.4	11±1	<7
2/9/2020	2/18/2020	324	1.2±0.4	23±1	<6
2/18/2020	2/25/2020	287	1.8±0.4	25±1	<7
2/25/2020	3/3/2020	284	0.6±0.4	16±1	<7
3/3/2020	3/10/2020	284	1.6±0.3	15±1	<8
3/10/2020	3/17/2020	282	0.8±0.7	17±1	<7
3/17/2020	3/23/2020	256	4.2±0.3	13±1	NT
6/9/2020	6/16/2020	285	0.8±0.3	14±1	<9
6/16/2020	6/23/2020	285	0.6±0.3	11±1	<7
6/23/2020	6/30/2020	286	<0.4	19±1	<8
6/30/2020	7/7/2020	308	1.2±0.2	20±1	<7
7/8/2020	7/14/2020	262	0.9±0.4	16±1	<9
7/14/2020	7/21/2020	309	0.6±0.3	23±1	<6
7/21/2020	7/27/2020	245	<0.4	18±1	<8
7/27/2020	8/3/2020	278	<0.4	16±1	<9
8/3/2020	8/10/2020	277	0.5±0.4	15±1	<7
8/10/2020	8/17/2020	298	0.9±0.4	22±1	<7
8/17/2020	8/25/2020	320	1±0.3	29±1	<6
8/25/2020	9/1/2020	198	1.3±0.3	18±1	<7
9/1/2020	9/8/2020	325	0.9±0.4	23±1	<6
9/8/2020	9/15/2020	283	1.3±0.3	16±1	<7
9/15/2020	9/22/2020	263	0.6±0.3	18±1	<8
9/22/2020	9/29/2020	304	1±0.4	34±1	<6
9/29/2020	10/5/2020	249	<0.3	15±1	<6
10/5/2020	10/13/2020	303	1.3±0.4	25±1	<6
10/13/2020	10/20/2020	284	0.8±0.4	17±1	<6
10/20/2020	10/26/2020	269	<0.4	11±1	<6
10/28/2020	11/3/2020	303	0.8±0.3	17±1	<6
11/3/2020	11/10/2020	303	2.5±0.2	30±1	<6
11/10/2020	11/17/2020	273	1.1±0.3	24±1	<9
11/17/2020	11/25/2020	325	0.7±0.4	26±1	<6
11/25/2020	12/1/2020	245	1.1±0.3	20±1	<11
12/1/2020	12/8/2020	285	0.5±0.3	15±1	<8
12/8/2020	12/16/2020	331	1.7±0.3	37±1	<7
12/16/2020	12/22/2020	238	0.9±0.2	17±1	<8
12/22/2020	12/29/2020	285	0.7±0.3	19±1	<8
12/28/2020	1/5/2021	286	<0.3	15±1	<8
	2020 Average		**0.9±1.5**	**19±12**	--

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Long Beach Station (Continued)					
1/5/2021	1/12/2021	285	<0.4	19±1	<8
1/12/2021	1/19/2021	286	0.5±0.3	28±1	<7
1/19/2021	1/26/2021	292	0.3±0.2	12±1	<9
1/26/2021	2/3/2021	319	<0.3	11±1	<7
2/3/2021	2/10/2021	286	1.4±0.2	28±1	<7
2/10/2021	2/17/2021	285	0.9±0.3	21±1	<9
2/17/2021	2/23/2021	245	1±0.3	27±1	<8
2/23/2021	3/3/2021	326	1.1±0.1	17±1	<7
3/3/2021	3/8/2021	226	0.6±0.3	16±1	<12
3/8/2021	3/16/2021	305	1.9±0.4	30±1	<10
3/16/2021	3/23/2021	304	1.4±0.3	19±1	<7
3/23/2021	3/30/2021	274	0.5±0.3	14±1	<7
3/23/2021	3/30/2021	274	0.5±0.3	14±1	<7
3/30/2021	4/5/2021	243	1.2±0.3	19±1	<10
4/5/2021	4/12/2021	292	1.2±0.2	16±1	<8
4/12/2021	4/19/2021	296	<0.4	9±1	<8
4/19/2021	4/26/2021	284	1.1±0.3	26±1	<8
4/26/2021	5/4/2021	304	1.6±0.3	28±1	<6
5/4/2021	5/11/2021	285	1±0.2	10±1	<8
5/11/2021	5/18/2021	306	1.1±0.2	18±1	<7
5/18/2021	5/25/2021	267	1.6±0.3	22±1	<7
5/25/2021	6/2/2021	324	0.6±0.3	17±1	<6
6/2/2021	6/8/2021	245	0.4±0.3	12±1	<10
6/8/2021	6/14/2021	268	0.6±0.3	9±1	<8
6/14/2021	6/22/2021	303	0.9±0.3	20±1	<7
6/22/2021	6/29/2021	286	0.9±0.3	11±1	<7
6/29/2021	7/7/2021	327	<0.3	17±1	<6
7/7/2021	7/13/2021	245	0.5±0.3	11±1	<8
7/13/2021	7/20/2021	286	1.2±0.3	18±1	<9
7/20/2021	7/27/2021	284	2.4±0.3	22±1	<7
7/27/2021	8/3/2021	285	1.9±0.2	22±1	<8
8/3/2021	8/10/2021	287	1.1±0.3	17±1	<7
8/10/2021	8/16/2021	244	0.7±0.4	18±1	<5
8/16/2021	8/24/2021	326	1.2±0.3	17±1	<8
8/24/2021	8/31/2021	286	1.6±0.4	27±1	<9
8/31/2021	9/7/2021	291	<0.5	17±1	<7
9/7/2021	9/14/2021	281	0.5±0.4	22±1	<7
9/14/2021	9/21/2021	284	1±0.3	19±1	<7
9/21/2021	9/26/1927	287	0.8±0.3	16±1	<7
9/28/2021	10/5/2021	285	0.8±0.3	22±1	<7
10/5/2021	10/12/2021	284	<0.4	11±1	<9
10/12/2021	10/19/2021	286	<0.4	17±1	<7
10/19/2021	10/27/2021	326	0.9±0.3	20±1	<8
10/27/2021	11/3/2021	286	0.4±0.3	13±1	<7
11/3/2021	11/10/2021	287	0.7±0.3	21±1	<8

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Long Beach Station (Continued)					
11/10/2021	11/16/2021	NA	1.6±0.1	22±1	<9
11/16/2021	11/23/2021	282	0.5±0.3	18±0.5	<7
11/23/2021	11/30/2021	284	1.7±0.3	14±1	<10
11/30/2021	12/7/2021	286	2.6±0.3	25±1	<10
12/7/2021	12/14/2021	284	3.8±0.3	20±1	NT
12/14/2021	12/21/2021	287	3.1±0.4	20±1	NT
12/21/2021	12/28/2021	286	8.3±0.3	37±1	NT
	2021 Average		**1.1±2.6**	**19±12**	--
	Overall		**1±0.3**	**19±1**	--
Calvert Cliffs Lusby Station					
12/30/2019	1/7/2020	313	1.4±0.3	16±1	<7
1/7/2020	1/14/2020	285	0.6±0.3	11±1	<7
1/14/2020	1/21/2020	285	1±0.2	22±1	<7
1/21/2020	1/27/2020	227	<0.4	10±1	<9
1/26/2020	2/4/2020	344	0.7±0.4	17±1	<6
2/4/2020	2/11/2020	246	1.1±0.3	13±1	<7
2/9/2020	2/18/2020	326	0.5±0.4	22±1	<6
2/18/2020	2/25/2020	287	1.2±0.4	22±1	<7
2/25/2020	3/3/2020	284	1±0.3	12±1	<7
3/3/2020	3/10/2020	286	1±0.2	11±1	<8
3/10/2020	3/17/2020	281	<0.4	15±1	<7
3/17/2020	3/23/2020	257	4.5±0.4	15±1	NT
6/9/2020	6/16/2020	285	0.4±0.3	15±1	<9
6/16/2020	6/23/2020	285	0.6±0.3	10±1	<7
6/23/2020	6/30/2020	286	0.7±0.3	22±1	<8
6/30/2020	7/7/2020	309	1.1±0.3	21±1	<7
7/8/2020	7/14/2020	261	<0.5	16±1	<9
7/14/2020	7/21/2020	309	1.1±0.4	22±1	<6
7/21/2020	7/27/2020	245	0.8±0.3	15±1	<8
7/27/2020	8/3/2020	278	0.6±0.4	16±1	<9
8/3/2020	8/10/2020	276	<0.4	13±1	<7
8/10/2020	8/17/2020	298	0.7±0.5	22±1	<7
8/17/2020	8/25/2020	320	0.6±0.4	11±1	<6
8/25/2020	9/1/2020	255	1.2±0.2	17±1	<7
9/1/2020	9/8/2020	325	1.1±0.4	19±1	<6
9/8/2020	9/15/2020	283	0.9±0.3	13±1	<7
9/15/2020	9/22/2020	264	1.2±0.4	12±1	<8
9/22/2020	9/29/2020	304	<0.5	26±1	<6
9/29/2020	10/5/2020	249	0.7±0.2	10±1	<6
10/5/2020	10/13/2020	303	0.5±0.4	21±1	<6
10/13/2020	10/20/2020	284	<0.4	14±1	<6
10/20/2020	10/26/2020	269	<0.4	7±1	<6
10/26/2020	11/3/2020	303	0.6±0.4	12±1	<6
11/3/2020	11/10/2020	303	1.2±0.3	27±1	<6

Table C-6. (Continued)

Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Lusby Station (Continued)					
11/10/2020	11/17/2020	270	0.8±0.3	19±1	<9
11/17/2020	11/25/2020	326	1.2±0.4	25±1	<6
11/25/2020	12/1/2020	245	0.7±0.3	20±1	<11
12/1/2020	12/8/2020	285	<0.4	14±1	<8
12/8/2020	12/16/2020	332	1.4±0.3	31±1	<7
12/16/2020	12/22/2020	237	<0.4	12±1	<8
12/22/2020	12/29/2020	286	<0.4	24±1	<8
12/28/2020	1/5/2021	286	0.4±0.3	16±1	<8
	2020 Average		**0.8±1.5**	**17±11**	--
1/5/2021	1/12/2021	285	0.7±0.4	20±1	<8
1/12/2021	1/19/2021	286	1.7±0.3	28±1	<7
1/19/2021	1/26/2021	292	<0.4	10±1	<9
1/26/2021	2/3/2021	319	<0.4	11±1	<7
2/3/2021	2/10/2021	286	0.6±0.4	27±1	<7
2/10/2021	2/17/2021	285	1.1±0.3	23±1	<9
2/17/2021	2/23/2021	244	0.7±0.4	26±1	<8
2/23/2021	3/3/2021	326	0.7±0.4	21±1	<7
3/3/2021	3/8/2021	226	0.6±0.3	19±1	<12
3/8/2021	3/16/2021	304	2.2±0.4	28±1	<10
3/16/2021	3/23/2021	306	0.9±0.3	22±1	<7
3/23/2021	3/30/2021	274	<0.5	14±1	<7
3/30/2021	4/5/2021	243	1.1±0.3	22±1	<10
4/5/2021	4/12/2021	292	1.2±0.3	18±1	<8
4/12/2021	4/19/2021	296	<0.4	12±1	<8
4/19/2021	4/26/2021	284	1.5±0.3	22±1	<8
4/26/2021	5/4/2021	303	1.1±0.3	24±1	<6
5/4/2021	5/11/2021	286	<0.4	10±1	<8
5/11/2021	5/18/2021	306	0.8±0.4	18±1	<7
5/18/2021	5/25/2021	266	1.1±0.3	18±1	<7
5/25/2021	6/2/2021	325	0.7±0.4	16±1	<6
6/2/2021	6/8/2021	245	<0.4	13±1	<10
6/8/2021	6/14/2021	269	<0.4	9±1	<8
6/14/2021	6/22/2021	302	0.9±0.3	21±1	<7
6/22/2021	6/29/2021	286	0.4±0.3	10±1	<7
6/29/2021	7/7/2021	324	0.7±0.4	16±1	<6
7/7/2021	7/13/2021	245	<0.4	13±1	<8
7/13/2021	7/20/2021	285	1±0.5	15±1	<9
7/20/2021	7/27/2021	285	1.7±0.4	17±1	<7
7/27/2021	8/3/2021	285	1.3±0.3	16±1	<8
8/3/2021	8/10/2021	285	1.2±0.4	24±1	<7
8/10/2021	8/16/2021	244	1.1±0.4	21±1	<5
8/16/2021	8/24/2021	326	<0.4	19±1	<8
8/24/2021	8/31/2021	286	1.4±0.4	34±1	<9
8/31/2021	9/7/2021	293	<0.5	26±1	<7
9/7/2021	9/14/2021	279	1.3±0.3	29±1	<7

Table C-6. (Continued)

Sample Date					
Start	**End**	**Volume**	**Gross Alpha**	**Gross Beta**	**I-131**
		Calvert Cliffs Lusby Station (Continued)			
9/14/2021	9/21/2021	285	1.6±0.3	25±1	<7
9/21/2021	9/28/2021	287	1±0.4	19±1	<7
9/28/2021	10/5/2021	284	1.4±0.3	30±1	<7
10/5/2021	10/12/2021	285	0.5±0.3	17±1	<9
10/12/2021	10/19/2021	285	1.3±0.3	22±1	<7
10/19/2021	10/27/2021	326	0.8±0.2	28±1	<8
10/27/2021	11/3/2021	286	<0.3	16±1	<7
11/3/2021	11/10/2021	287	0.9±0.3	25±0.3	<8
11/10/2021	11/16/2021	NA	1.4±0.1	27±1	<9
11/16/2021	11/23/2021	281	0.6±0.3	22±1	<7
11/23/2021	11/30/2021	286	1.5±0.3	18±1	<10
11/30/2021	12/7/2021	285	3.4±0.2	29±1	<10
12/7/2021	12/14/2021	287	6.2±0.4	22±1	NT
12/14/2021	12/21/2021	284	3.2±0.4	17±1	NT
12/21/2021	1/4/2022	572	5.3±0.2	21±1	NT
	2021 Average		**1.1±2.4**	**20±12**	--
	Overall		**0.9±0.5**	**19±5**	--
		Calvert Cliffs Cove Point Station			
12/30/2019	1/7/2020	315	0.5±0.3	16±1	<7
1/7/2020	1/14/2020	285	<0.4	11±1	<7
1/14/2020	1/21/2020	285	0.8±0.3	21±1	<7
1/21/2020	1/27/2020	227	0.7±0.4	11±1	<9
1/26/2020	2/4/2020	344	1.3±0.3	17±1	<6
2/4/2020	2/11/2020	246	<0.2	9±1	<7
2/9/2020	2/18/2020	324	0.4±0.3	22±1	<6
2/18/2020	2/25/2020	287	1.3±0.3	21±1	<7
2/25/2020	3/3/2020	284	0.7±0.3	15±1	<7
3/3/2020	3/10/2020	285	<0.4	14±1	<8
3/10/2020	3/17/2020	281	<0.4	15±1	<7
3/17/2020	3/23/2020	257	4±0.3	15±1	<
6/9/2020	6/16/2020	285	<0.4	13±1	<9
6/16/2020	6/23/2020	285	1.1±0.1	11±1	<7
6/23/2020	6/30/2020	286	1.3±0.3	23±1	<8
6/30/2020	7/7/2020	309	1±0.3	21±1	<7
7/8/2020	7/14/2020	261	1±0.3	18±1	<9
7/14/2020	7/21/2020	309	0.7±0.4	27±1	<6
7/21/2020	7/27/2020	245	<0.3	17±1	<8
7/27/2020	8/3/2020	278	0.8±0.4	16±1	<9
8/3/2020	8/10/2020	277	<0.4	15±1	<7
8/10/2020	8/17/2020	298	1.5±0.2	21±1	<7
8/17/2020	8/25/2020	319	0.6±0.3	26±1	<6

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Cove Point Station (Continued)					
8/25/2020	9/1/2020	256	0.8±0.4	19±1	<7
9/1/2020	9/8/2020	325	0.5±0.4	26±1	<6
9/8/2020	9/15/2020	283	<0.4	16±1	<7
9/15/2020	9/22/2020	264	0.6±0.3	17±1	<8
9/22/2020	9/29/2020	304	1.8±0.3	37±1	<6
9/29/2020	10/5/2020	249	0.4±0.3	16±1	<6
10/5/2020	10/13/2020	303	0.8±0.4	28±1	<6
10/13/2020	10/20/2020	284	0.9±0.4	20±1	<6
10/20/2020	10/26/2020	269	0.7±0.2	12±1	<6
10/26/2020	11/3/2020	303	0.8±0.3	16±1	<6
11/3/2020	11/10/2020	303	1.3±0.3	33±1	<6
11/10/2020	11/17/2020	271	1.1±0.3	23±1	<9
11/17/2020	11/25/2020	325	1±0.3	29±1	<6
11/25/2020	12/1/2020	245	0.8±0.3	25±1	<11
12/1/2020	12/8/2020	285	0.8±0.4	17±1	<8
12/8/2020	12/16/2020	332	1.2±0.2	44±1	<7
12/16/2020	12/22/2020	240	0.4±0.2	17±1	<8
12/22/2020	12/29/2020	285	0.8±0.2	19±1	<8
12/28/2020	1/5/2021	286	0.7±0.3	17±1	<8
	2020 Average		**0.8±1.4**	**20±14**	**--**
1/5/2021	1/12/2021	285	0.8±0.3	22±1	<8
1/12/2021	1/19/2021	31	1.5±0.2	27±1	<7
1/19/2021	1/26/2021	292	<0.3	13±1	<9
1/26/2021	2/3/2021	319	<0.3	12±1	<7
2/3/2021	2/10/2021	286	0.5±0.3	23±1	<7
2/10/2021	2/17/2021	285	0.7±0.3	24±1	<9
2/17/2021	2/23/2021	244	0.5±0.4	24±1	<8
2/23/2021	3/3/2021	326	<0.4	15±1	<7
3/3/2021	3/8/2021	226	0.8±0.2	17±1	<12
3/8/2021	3/16/2021	304	1±0.3	26±1	<10
3/16/2021	3/23/2021	306	1.1±0.2	19±1	<7
3/23/2021	3/30/2021	274	0.5±0.2	13±1	<7
3/30/2021	4/5/2021	243	0.4±0.3	19±1	<10
4/5/2021	4/12/2021	292	1±0.3	16±1	<8
4/12/2021	4/19/2021	296	0.9±0.2	10±1	<8
4/19/2021	4/26/2021	284	0.8±0.3	26±1	<8
4/26/2021	5/4/2021	303	0.9±0.3	24±1	<6
5/4/2021	5/11/2021	286	0.9±0.3	12±1	<8
5/11/2021	5/18/2021	306	0.7±0.3	22±1	<7
5/18/2021	5/25/2021	266	1.3±0.3	23±1	<7
5/25/2021	6/2/2021	325	0.7±0.2	18±1	<6
6/2/2021	6/8/2021	245	1±0.2	15±1	<10
6/8/2021	6/14/2021	268	<0.4	12±1	<8
6/14/2021	6/22/2021	302	1.1±0.3	25±1	<7

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Cove Point Station (Continued)					
6/22/2021	6/29/2021	286	0.6±0.3	12±1	<7
6/29/2021	7/7/2021	327	0.5±0.3	17±1	<6
7/7/2021	7/13/2021	244	<0.3	14±1	<8
7/13/2021	7/20/2021	285	1.1±0.3	20±1	<9
7/20/2021	7/27/2021	285	1.2±0.4	23±1	<7
7/27/2021	8/3/2021	285	1.7±0.3	24±1	<8
8/3/2021	8/10/2021	286	<0.3	2±1	<7
8/10/2021	8/16/2021	NA	<0.2	<1	<5
8/16/2021	8/24/2021	326	1±0.3	21±1	<8
8/24/2021	8/31/2021	NA	2.2±0.2	29±1	<9
8/31/2021	9/7/2021	290	1.1±0.3	23±1	<7
9/7/2021	9/14/2021	281	0.8±0.3	29±1	<7
9/14/2021	7/2/1927	284	0.6±0.3	24±1	<7
9/21/2021	9/28/2021	287	0.7±0.3	21±1	<7
9/28/2021	10/5/2021	285	1.6±0.2	30±1	<7
10/5/2021	10/12/2021	284	0.5±0.3	16±1	<9
10/12/2021	10/19/2021	285	1±0.3	21±1	<7
10/19/2021	10/27/2021	326	0.5±0.3	28±1	<8
10/27/2021	11/3/2021	286	<0.4	16±1	<7
11/3/2021	11/10/2021	287	1.1±0	25±1	<8
11/10/2021	11/16/2021	NA	0.8±0.3	27±1	<9
11/10/2021	11/16/2021	NA	0.8±0.3	27±1	<9
11/16/2021	11/30/2021	569	2.8±0.1	20±1	<3
11/30/2021	12/7/2021	283	3.1±0.3	28±1	<10
12/7/2021	12/14/2021	288	6.7±0.2	23±1	NT
12/14/2021	12/21/2021	283	3.8±0.2	19±1	NT
12/21/2021	12/28/2021	286	7.2±0.2	33±1	NT
	2021 Average		**1.1±2.8**	**20±14**	--
	Overall		**1±0.5**	**20±1**	--
Calvert Cliffs Horn Point Station					
12/29/2019	1/5/2020	278	0.6±0.2	10±1	<13
1/5/2020	1/12/2020	291	<0.3	10±1	<10
1/12/2020	1/19/2020	285	0.4±0.3	16±1	<11
1/19/2020	1/26/2020	283	0.8±0.3	14±1	<11
1/26/2020	2/2/2020	288	0.8±0.2	10±1	<11
2/2/2020	2/9/2020	281	<0.2	6±1	<10
2/7/2020	2/16/2020	293	0.7±0.2	15±1	<11
2/16/2020	2/23/2020	285	0.5±0.2	18±1	<11
2/23/2020	3/2/2020	329	0.9±0.2	16±1	<9
3/2/2020	3/9/2020	285	<0.2	12±1	<10
3/9/2020	3/16/2020	274	<0.3	12±1	<9
3/16/2020	3/23/2020	295	2.6±0.3	14±1	NT
6/8/2020	6/15/2020	288	0.7±0.2	10±1	<12
6/15/2020	6/22/2020	287	0.5±0.1	8±1	<10

Table C-6. (Continued)

Sample Date					
Start	**End**	**Volume**	**Gross Alpha**	**Gross Beta**	**I-131**
		Calvert Cliffs Horn Point Station (Continued)			
6/22/2020	6/29/2020	275	1±0.2	17±1	<0
6/29/2020	7/6/2020	294	0.4±0.1	13±1	<11
7/6/2020	7/13/2020	290	1±0.2	13±1	<10
7/13/2020	7/19/2020	236	0.5±0.3	12±1	<13
7/19/2020	7/27/2020	343	0.8±0.2	18±1	<8
7/27/2020	8/2/2020	222	0.4±0.3	9±1	<14
8/2/2020	8/9/2020	295	<0.3	9±1	<7
8/9/2020	8/17/2020	337	1±0.2	19±1	<9
8/17/2020	8/24/2020	289	0.9±0.2	18±1	<11
8/24/2020	8/31/2020	286	0.9±0.3	15±1	<10
8/31/2020	9/8/2020	325	0.7±0.3	15±1	<8
9/8/2020	9/14/2020	244	<0.3	10±1	<13
9/14/2020	9/21/2020	291	<0.2	12±1	<10
9/21/2020	9/28/2020	284	0.9±0.2	21±1	<10
9/28/2020	10/5/2020	281	0.5±0.2	11±1	<11
10/5/2020	10/12/2020	287	<0.3	17±1	<10
10/12/2020	10/19/2020	287	<0.3	11±1	<10
10/19/2020	10/26/2020	282	0.8±0.2	15±1	<10
10/28/2020	11/2/2020	291	0.6±0.2	11±1	<10
11/2/2020	11/9/2020	285	0.6±0.2	18±1	<12
11/9/2020	11/16/2020	283	0.8±0.2	18±1	<12
11/16/2020	11/23/2020	283	0.5±0.2	15±1	<11
11/23/2020	11/30/2020	287	0.9±0.2	19±1	<9
11/30/2020	12/7/2020	284	<0.3	13±1	<7
12/7/2020	12/14/2020	273	1.2±0.1	25±1	<11
12/14/2020	12/21/2020	305	0.5±0.2	12±1	<11
12/21/2020	12/28/2020	268	1±0.1	14±1	<10
12/29/2020	1/3/2021	261	0.4±0.2	14±1	<14
	2020 Average		**0.6±1**	**14±8**	**--**
1/3/2021	1/10/2021	286	<0.2	13±1	<12
1/10/2021	1/17/2021	283	0.7±0.1	20±1	<10
1/17/2021	1/24/2021	287	0.4±0.2	10±1	<12
1/24/2021	1/31/2021	288	0.4±0.2	10±1	<13
1/31/2021	2/7/2021	283	0.7±0.2	11±1	<11
2/7/2021	2/14/2021	287	1.2±0.2	22±1	<9
2/14/2021	2/22/2021	322	0.7±0.3	20±1	<10
2/22/2021	2/28/2021	246	<0.3	10±1	<13
2/28/2021	3/8/2021	326	0.3±0.2	4±1	<11
3/8/2021	3/15/2021	284	1.2±0.2	26±1	<15
3/15/2021	3/23/2021	323	1.1±0.2	23±1	<8
3/23/2021	3/30/2021	275	0.6±0.2	9±1	<9
3/30/2021	4/6/2021	288	2.1±0.2	21±1	<10
4/6/2021	4/12/2021	248	1.5±0.2	13±1	<12
4/12/2021	4/19/2021	296	1.5±0.2	12±1	<10
4/19/2021	4/26/2021	284	1.5±0.2	24±1	<10
4/26/2021	5/4/2021	286	2±0.2	24±1	<9

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Calvert Cliffs Horn Point Station (Continued)					
5/3/2021	5/10/2021	286	1.4±0.2	13±1	<10
5/10/2021	5/17/2021	287	1.2±0.2	17±1	<8
5/17/2021	5/24/2021	275	1.2±0.2	19±1	<7
5/24/2021	6/1/2021	321	1.3±0.2	16±1	<9
6/1/2021	6/7/2021	251	1.3±0.2	14±1	<6
6/7/2021	6/14/2021	293	0.6±0.3	13±1	<10
6/14/2021	6/22/2021	279	1.4±0.2	18±1	<8
6/21/2021	6/28/2021	288	1.3±0.2	15±1	<7
6/28/2021	7/6/2021	313	0.9±0.2	10±1	<7
7/6/2021	7/12/2021	244	1.9±0.2	15±1	<8
7/12/2021	7/19/2021	285	1.6±0.2	16±1	<7
7/19/2021	7/26/2021	285	1.8±0.3	18±1	<8
7/26/2021	8/2/2021	286	1.5±0.2	14±1	<7
8/2/2021	8/9/2021	286	1.6±0.2	14±1	<10
8/9/2021	8/17/2021	326	1.8±0.2	18±1	<9
8/15/2021	8/23/2021	245	1.5±0.2	9±1	<7
8/23/2021	8/30/2021	303	1.1±0.2	20±1	<8
8/30/2021	9/7/2021	325	1±0.2	19±1	<9
9/7/2021	9/13/2021	243	2.1±0.4	29±1	<11
9/13/2021	9/20/2021	290	1.6±0.3	26±1	<7
9/20/2021	9/27/2021	285	1.4±0.3	22±1	<11
9/27/2021	10/4/2021	287	1.2±0.2	26±1	<10
10/4/2021	10/11/2021	285	<0.3	15±1	<8
10/11/2021	10/18/2021	286	0.6±0.3	18±1	<8
10/18/2021	10/25/2021	287	0.8±0.3	28±1	<8
10/25/2021	11/1/2021	261	<0.4	12±1	<11
11/1/2021	11/8/2021	286	0.8±0.1	17±1	<11
11/8/2021	11/15/2021	NA	0.8±0.3	22±1	<11
11/15/2021	11/22/2021	282	1.4±0.1	16±1	<9
11/22/2021	11/28/2021	251	2.8±0.3	19±1	<12
11/28/2021	12/5/2021	283	3.4±0.3	27±1	<10
12/5/2021	12/12/2021	282	5±0.2	24±1	NT
12/12/2021	12/20/2021	335	3.6±0.2	18±1	NT
12/20/2021	12/27/2021	259	4.1±0.2	23±1	NT
	2021 Average		**1.4±2**	**18±11**	--
	Overall		**1±1.1**	**16±5**	--
Baltimore City Station					
12/30/2019	1/7/2020	324	0.4±0.3	16±1	<7
1/7/2020	1/14/2020	249	0.5±0.2	8±1	<7
1/14/2020	1/21/2020	286	0.8±0.3	22±1	<7
1/21/2020	1/27/2020	282	1.2±0.3	12±1	<9
1/26/2020	2/4/2020	289	0.9±0.3	13±1	<6
2/4/2020	2/11/2020	281	0.9±0.3	11±1	<7
2/9/2020	2/18/2020	290	1.1±0.3	17±1	<6

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Baltimore City Station (Continued)					
2/18/2020	2/25/2020	286	1.3±0.3	18±1	<7
2/25/2020	3/3/2020	285	0.7±0.3	12±1	<7
3/3/2020	3/10/2020	282	0.8±0.2	14±1	<8
3/10/2020	3/17/2020	281	0.8±0.3	14±1	<7
3/17/2020	3/23/2020	NA	NA	NA	NA
6/9/2020	6/16/2020	NA	NA	NA	NA
6/16/2020	6/23/2020	285	0.4±0.2	14±1	<7
6/23/2020	6/30/2020	286	1.2±0.3	22±1	<8
6/30/2020	7/8/2020	323	0.5±0.3	25±1	<7
7/8/2020	7/14/2020	247	<0.3	16±1	<9
7/14/2020	7/22/2020	320	1.5±0.4	30±1	<6
7/21/2020	7/27/2020	246	0.8±0.3	22±1	<8
7/27/2020	8/3/2020	286	1.3±0.2	22±1	<9
8/3/2020	8/10/2020	291	0.8±0.3	25±1	<7
8/10/2020	8/17/2020	286	1.4±0.3	29±1	<7
8/17/2020	8/25/2020	316	1.1±0.3	33±1	<6
8/26/2020	9/2/2020	284	0.4±0.3	19±1	<7
9/2/2020	9/9/2020	286	<0.4	23±1	<6
9/9/2020	9/16/2020	286	1±0.2	19±1	<7
9/16/2020	9/23/2020	285	1.1±0.3	23±1	<8
9/23/2020	9/30/2020	286	1.3±0.4	32±1	<6
9/30/2020	10/7/2020	286	1.1±0.3	21±1	<6
10/7/2020	10/14/2020	285	1±0.3	20±1	<6
10/13/2020	10/20/2020	285	0.7±0.3	21±1	<6
10/21/2020	10/28/2020	287	<0.3	13±1	<6
10/28/2020	11/4/2020	287	0.7±0.3	21±1	<6
11/4/2020	11/12/2020	326	1.5±0.3	38±1	<6
11/10/2020	11/17/2020	214	0.8±0.3	20±1	<9
11/17/2020	11/25/2020	324	0.7±0.4	24±1	<6
11/25/2020	12/1/2020	245	0.9±0.3	20±1	<11
12/1/2020	12/8/2020	285	<0.3	16±1	<8
12/8/2020	12/16/2020	320	1.3±0.3	37±1	<7
12/16/2020	12/22/2020	241	0.7±0.3	16±1	<8
12/22/2020	12/29/2020	283	0.5±0.3	18±1	<8
12/28/2020	1/5/2021	287	0.7±0.3	15±1	<8
	2020 Average		**0.8±0.9**	**19±16**	**--**
1/5/2021	1/12/2021	286	0.4±0.3	17±1	<8
1/12/2021	1/19/2021	286	0.9±0.3	24±1	<7
1/19/2021	1/26/2021	322	<0.3	8±1	<5
1/27/2021	2/3/2021	290	<0.3	7±1	<5
2/3/2021	2/10/2021	286	0.7±0.3	22±1	<7
2/10/2021	2/17/2021	286	0.8±0.3	18±1	<9
2/17/2021	2/23/2021	244	0.6±0.3	24±1	<8
2/23/2021	3/3/2021	326	<0.3	15±1	<7

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Baltimore City Station (Continued)			
3/3/2021	3/10/2021	277	0.5±0.3	18±1	<5
3/10/2021	3/16/2021	237	1±0.3	20±1	<6
3/16/2021	3/24/2021	317	1.2±0.3	16±1	<4
3/24/2021	3/31/2021	285	0.3±0.2	9±1	<4
3/31/2021	4/7/2021	285	0.7±0.3	20±1	<4
4/7/2021	4/14/2021	286	<0.3	8±1	<5
4/14/2021	4/21/2021	293	<0.3	10±1	<4
4/21/2021	4/27/2021	243	0.8±0.2	16±1	<8
4/27/2021	5/4/2021	288	1.1±0.2	17±1	<3
5/4/2021	5/11/2021	285	0.6±0.2	7±1	<8
5/11/2021	5/19/2021	322	1.1±0.2	15±1	<4
5/19/2021	5/25/2021	251	0.7±0.3	17±1	<6
5/25/2021	6/2/2021	324	0.7±0.2	11±1	<6
6/2/2021	6/8/2021	246	0.4±0.2	13±1	<10
6/8/2021	6/15/2021	280	0.4±0.3	8±1	<5
6/14/2021	6/22/2021	290	0.4±0.3	15±1	<4
6/22/2021	6/29/2021	286	<0.3	6±1	<7
6/29/2021	7/7/2021	326	1.1±0.2	12±1	<6
7/7/2021	7/13/2021	245	<0.4	12±1	<8
7/13/2021	7/20/2021	286	0.9±0.3	16±1	<9
7/20/2021	7/27/2021	284	1.5±0.4	17±1	<7
7/27/2021	8/3/2021	286	0.4±0.3	16±1	<8
8/3/2021	8/10/2021	287	1.2±0.3	17±1	<7
8/10/2021	8/16/2021	245	0.4±0.3	12±1	<5
8/16/2021	8/24/2021	326	0.7±0.3	12±1	<8
8/24/2021	8/31/2021	286	1.1±0.2	22±1	<9
8/31/2021	9/8/2021	323	0.7±0.3	21±1	<9
9/7/2021	9/14/2021	249	0.9±0.3	28±1	<5
9/14/2021	9/21/2021	284	1.3±0.3	25±1	<7
9/21/2021	9/29/2021	341	0.4±0.2	20±1	<4
9/29/2021	10/5/2021	252	0.8±0.3	24±1	<10
10/5/2021	10/12/2021	285	0.6±0.3	74±1	<9
10/12/2021	10/19/2021	284	1.2±0.3	23±1	<7
10/19/2021	10/27/2021	327	0.7±0.1	20±1	<8
10/27/2021	11/3/2021	287	1.3±0.1	17±1	<7
11/3/2021	11/10/2021	287	1.3±0	28±0.4	<8
11/10/2021	11/17/2021	NA	1±0.3	23±1	<9
11/17/2021	11/23/2021	250	1.3±0.1	7±1	<5
11/23/2021	11/30/2021	286	2.5±0.3	20±1	<10
11/30/2021	12/7/2021	284	3.2±0.3	25±1	<10
12/7/2021	12/14/2021	288	5.1±0.3	26±1	NT
12/14/2021	12/21/2021	284	3.2±0.4	17±1	NT
12/21/2021	12/28/2021	286	6.1±0.2	31±1	NT
	2021 Average		**1±2.3**	**18±20**	--
	Overall		**0.9±0.3**	**19±2**	--

Table C-6. (Continued)

Sample Date					
Start	**End**	**Volume**	**Gross Alpha**	**Gross Beta**	**I-131**
		Peach Bottom Rising Sun Station			
12/29/2019	1/5/2020	277	<0.3	10±1	<13
1/5/2020	1/12/2020	292	0.7±0.1	9±1	<10
1/12/2020	1/19/2020	285	0.4±0.2	13±1	<11
1/19/2020	1/26/2020	283	0.7±0.2	13±1	<11
1/26/2020	2/2/2020	288	<0.3	9±1	<11
2/2/2020	2/9/2020	280	<0.3	8±1	<10
2/7/2020	2/16/2020	293	<0.3	13±1	<11
2/16/2020	2/23/2020	284	1.1±0.3	21±1	<11
2/23/2020	3/2/2020	329	<0.3	16±1	<9
3/2/2020	3/9/2020	30	0.8±0.2	14±1	<10
3/9/2020	3/16/2020	274	0.6±0.3	13±1	<9
3/16/2020	3/23/2020	295	3.4±0.3	15±0.3	NT
6/8/2020	6/15/2020	288	0.4±0.3	14±0.3	<12
6/15/2020	6/22/2020	287	0.5±0.2	8±1	<10
6/22/2020	6/29/2020	274	0.9±0.3	16±1	<0
6/29/2020	7/6/2020	295	1.2±0.2	15±1	<11
7/6/2020	7/13/2020	289	0.9±0.3	14±1	<10
7/13/2020	7/19/2020	236	0.6±0.2	13±1	<13
7/19/2020	7/27/2020	334	1.5±0.3	21±1	<8
7/27/2020	8/2/2020	229	0.5±0.3	14±1	<14
8/2/2020	8/9/2020	296	1±0.3	15±1	<7
8/9/2020	8/17/2020	329	1±0.3	25±1	<9
8/17/2020	8/24/2020	297	0.8±0.2	19±1	<11
8/24/2020	8/31/2020	278	1.4±0.2	15±1	<10
8/31/2020	9/8/2020	325	0.8±0.3	17±1	<8
9/8/2020	9/14/2020	244	0.5±0.2	12±1	<13
9/14/2020	9/21/2020	291	0.9±0.2	14±1	<10
9/21/2020	9/28/2020	283	1.2±0.3	26±1	<10
9/28/2020	10/5/2020	281	1.1±0.2	11±1	<11
10/5/2020	10/12/2020	287	1±0.3	17±1	<10
10/12/2020	10/19/2020	287	<0.3	14±1	<10
10/19/2020	10/26/2020	283	0.5±0.3	8±1	<10
10/28/2020	11/2/2020	291	0.6±0.2	11±1	<10
11/2/2020	11/9/2020	284	1.8±0.2	26±1	<6
11/9/2020	11/16/2020	284	1.1±0.2	17±1	<12
11/16/2020	11/23/2020	283	0.7±0.3	16±1	<11
11/23/2020	11/30/2020	287	1±0.2	19±1	<9
11/30/2020	12/7/2020	284	0.7±0.2	10±1	<7
12/7/2020	12/14/2020	280	0.9±0.2	26±1	<11
12/14/2020	12/21/2020	293	1.1±0.2	11±1	<11
12/21/2020	12/28/2020	269	1.1±0.2	14±1	<10
12/29/2020	1/3/2021	262	1.2±0.2	13±1	<14
	2020 Average		**0.8±1.2**	**15±10**	**--**

Table C-6. (Continued)					
Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
Peach Bottom Rising Sun Station (Continued)					
1/3/2021	1/10/2021	286	0.4±0.3	12±1	<12
1/10/2021	1/17/2021	283	1±0.2	24±1	<10
1/17/2021	1/24/2021	287	0.8±0.2	10±0.3	<12
1/24/2021	1/31/2021	287	0.8±0.2	10±1	<13
1/31/2021	2/7/2021	283	1±0.2	12±0.3	<11
2/7/2021	2/14/2021	286	1.4±0.2	22±1	<9
2/14/2021	2/22/2021	322	0.8±0.2	20±1	<10
2/22/2021	2/28/2021	247	0.9±0.1	10±1	<13
2/28/2021	3/8/2021	326	1.3±0.2	17±1	<11
3/8/2021	3/15/2021	284	1.4±0.2	19±1	<15
3/15/2021	3/23/2021	323	1.4±0.2	17±1	<8
3/23/2021	3/30/2021	275	0.9±0.2	9±1	<9
3/30/2021	4/6/2021	288	1.3±0.2	18±1	<10
4/6/2021	4/12/2021	247	0.6±0.2	8±1	<12
4/12/2021	4/19/2021	296	0.6±0.3	10±1	<10
4/19/2021	4/26/2021	284	0.9±0.2	19±1	<10
4/26/2021	5/4/2021	286	1.1±0.2	15±1	<9
5/3/2021	5/10/2021	286	1±0.1	7±1	<10
5/10/2021	5/17/2021	287	1.2±0.1	14±1	<8
5/17/2021	5/24/2021	277	0.9±0.2	17±1	<7
5/24/2021	6/1/2021	321	0.8±0.1	10±1	<9
6/1/2021	6/7/2021	251	1.1±0.1	13±1	<6
6/7/2021	6/14/2021	292	0.9±0.2	7±1	<10
6/14/2021	6/22/2021	280	1.1±0.2	16±1	<8
6/21/2021	6/28/2021	288	1±0.2	11±1	<7
6/28/2021	7/6/2021	323	0.8±0.2	13±1	<7
7/6/2021	7/12/2021	244	0.8±0.2	14±1	<8
7/12/2021	7/19/2021	285	1.2±0.2	15±1	<7
7/19/2021	7/26/2021	285	2.2±0.2	16±1	<8
7/26/2021	8/2/2021	286	1.1±0.2	17±1	<7
8/2/2021	8/9/2021	286	0.8±0.2	16±1	<10
8/9/2021	8/17/2021	326	1±0.3	19±1	<9
8/15/2021	8/23/2021	245	0.8±0.2	10±1	<7
8/23/2021	8/30/2021	302	0.4±0.3	15±1	<8
8/30/2021	9/7/2021	325	0.8±0.3	18±1	<9
9/7/2021	9/13/2021	243	1±0.4	25±1	<11
9/13/2021	9/20/2021	282	1.4±0.2	24±1	<7
9/20/2021	9/27/2021	286	0.9±0.3	16±1	<11
9/27/2021	10/4/2021	287	1.2±0.3	27±1	<10
10/4/2021	10/11/2021	285	0.8±0.4	13±1	<8
10/11/2021	10/18/2021	286	1.3±0.4	24±1	<8
10/18/2021	10/25/2021	287	1.6±0.3	33±1	<8
10/25/2021	11/1/2021	262	0.8±0.3	18±1	<11
11/1/2021	11/8/2021	286	0.8±0.3	22±1	<11
11/8/2021	11/15/2021	NA	2.4±0.1	30±1	<11

Table C-6. (Continued)					
Sample Date					
Start	End	Volume	Gross Alpha	Gross Beta	I-131
		Peach Bottom Rising Sun Station (Continued)			
11/15/2021	11/22/2021	281	1.7±0.3	22±0.5	<9
11/22/2021	11/28/2021	251	1.6±0.4	19±1	<12
11/28/2021	12/5/2021	283	1.9±0.3	25±1	<10
12/5/2021	12/12/2021	282	5.1±0.3	26±1	NT
12/12/2021	12/20/2021	335	4.3±0.3	19±1	NT
12/20/2021	12/27/2021	267	4.5±0.2	24±1	NT
	2021 Average		**1.3±1.9**	**17±12**	--
	Overall		**1.1±0.7**	**16±3**	--
		Peach Bottom Whiteford Station			
12/29/2019	1/5/2020	278	0.5±0.2	9±1	<13
1/5/2020	1/12/2020	291	<0.2	10±1	<10
1/12/2020	1/19/2020	285	0.9±0.2	15±1	<11
1/19/2020	1/26/2020	283	0.5±0.3	13±1	<11
1/26/2020	2/2/2020	288	0.4±0.3	10±1	<11
2/2/2020	2/9/2020	283	0.7±0.2	9±1	<10
2/7/2020	2/16/2020	293	<0.3	14±1	<11
2/16/2020	2/23/2020	284	0.4±0.3	19±1	<11
2/23/2020	3/2/2020	329	0.9±0.2	19±1	<9
3/2/2020	3/9/2020	30	1±0.1	12±1	<10
3/9/2020	3/16/2020	274	0.4±0.3	12±1	<9
3/16/2020	3/23/2020	295	3.9±0.2	13±1	NT
6/8/2020	6/15/2020	288	0.7±0.2	12±1	<12
6/15/2020	6/22/2020	287	0.4±0.2	9±1	<10
6/22/2020	6/29/2020	275	0.7±0.2	16±1	<0
6/29/2020	7/6/2020	294	0.8±0.2	15±1	<11
7/6/2020	7/13/2020	289	<0.3	12±1	<10
7/13/2020	7/19/2020	236	<0.3	11±1	<13
7/19/2020	7/27/2020	331	0.8±0.2	20±1	<8
7/27/2020	8/2/2020	232	0.4±0.3	15±1	<14
8/2/2020	8/9/2020	296	1±0.3	15±1	<7
8/9/2020	8/17/2020	325	1±0.3	24±1	<9
8/17/2020	8/24/2020	300	0.8±0.3	17±1	<11
8/25/2020	8/31/2020	275	1.1±0.1	15±1	<10
8/31/2020	9/8/2020	325	0.8±0.3	16±1	<8
9/8/2020	9/14/2020	244	0.5±0.2	10±1	<13
9/14/2020	9/21/2020	291	0.4±0.3	13±1	<10
9/21/2020	9/28/2020	283	0.5±0.4	23±1	<10
9/28/2020	10/5/2020	281	1±0.2	10±1	<11
10/5/2020	10/12/2020	287	0.5±0.3	17±1	<10
10/12/2020	10/19/2020	287	<0.3	10±1	<10
10/19/2020	10/26/2020	283	<0.3	8±1	<10
10/28/2020	11/2/2020	291	<0.3	10±1	<10
11/2/2020	11/9/2020	284	1.3±0.2	26±1	<12

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Peach Bottom Whiteford Station (Continued)					
11/9/2020	11/16/2020	284	0.7±0.2	14±1	<12
11/16/2020	11/23/2020	283	0.7±0.3	14±1	<11
11/23/2020	11/30/2020	287	0.9±0.2	18±1	<9
11/30/2020	12/7/2020	285	<0.3	9±1	<7
12/7/2020	12/14/2020	283	0.8±0.2	22±1	<11
12/14/2020	12/21/2020	290	0.4±0.3	9±1	<11
12/21/2020	12/28/2020	269	0.7±0.3	15±1	<10
12/29/2020	1/3/2021	262	0.9±0.2	13±1	<14
	2020 Average		**0.7±1.2**	**14±9**	**--**
1/3/2021	1/10/2021	286	<0.3	15±1	<12
1/10/2021	1/17/2021	282	1.6±0.2	26±1	<10
1/17/2021	1/24/2021	288	0.6±0.3	9±1	<12
1/24/2021	1/31/2021	287	0.5±0.3	10±1	<13
1/31/2021	2/7/2021	283	0.4±0.3	11±1	<11
2/7/2021	2/14/2021	286	1.7±0.2	23±1	<9
2/14/2021	2/22/2021	322	0.8±0.3	23±1	<10
2/22/2021	2/28/2021	247	0.4±0.3	11±1	<13
2/28/2021	3/8/2021	326	1.2±0.2	16±1	<11
3/8/2021	3/15/2021	284	1.2±0.2	22±1	<15
3/15/2021	3/23/2021	323	0.7±0.2	17±1	<8
3/23/2021	3/30/2021	275	<0.3	8±1	<9
3/30/2021	4/6/2021	288	0.9±0.2	15±1	<10
4/6/2021	4/12/2021	247	0.5±0.2	9±1	<12
4/12/2021	4/19/2021	296	0.4±0.3	10±1	<10
4/19/2021	4/26/2021	284	1.3±0.2	17±1	<10
4/26/2021	5/4/2021	286	0.7±0.2	17±1	<9
5/3/2021	5/10/2021	286	<0.3	6±1	<10
5/10/2021	5/17/2021	287	1±0.3	15±1	<8
5/17/2021	5/24/2021	276	0.7±0.2	16±1	<7
5/24/2021	6/1/2021	321	<0.3	11±1	<9
6/1/2021	6/7/2021	251	<0.3	13±1	<6
6/7/2021	6/14/2021	292	0.4±0.3	8±1	<10
6/14/2021	6/22/2021	280	0.7±0.2	15±1	<8
6/21/2021	6/28/2021	288	0.3±0.2	9±1	<7
6/28/2021	7/6/2021	325	0.5±0.3	12±1	<7
7/6/2021	7/12/2021	244	0.7±0.3	13±1	<8
7/12/2021	7/19/2021	285	0.9±0.3	13±1	<7
7/19/2021	7/26/2021	284	1.1±0.3	14±1	<8
7/26/2021	8/2/2021	285	1±0.2	15±1	<7
8/2/2021	8/9/2021	286	0.6±0.3	13±1	<10
8/9/2021	8/17/2021	325	0.4±0.3	13±1	<9
8/15/2021	8/23/2021	245	0.4±0.3	10±1	<7
8/23/2021	8/30/2021	302	1.1±0.3	22±1	<8
8/30/2021	9/7/2021	325	<0.3	19±1	<9
9/7/2021	9/13/2021	243	0.9±0.3	25±1	<11

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Beta	I-131
Peach Bottom Whiteford Station (Continued)					
9/13/2021	9/20/2021	278	1.5±0.2	22±1	<7
9/20/2021	9/27/2021	286	0.7±0.4	17±1	<11
9/27/2021	10/4/2021	287	2.2±0.3	31±1	<10
10/4/2021	10/11/2021	285	1.7±0.3	19±1	<8
10/11/2021	10/18/2021	286	2±0.3	27±1	<8
10/18/2021	10/25/2021	287	2.4±0.3	35±1	<8
10/25/2021	11/1/2021	262	1.8±0.3	19±1	<11
11/1/2021	11/8/2021	286	1.5±0.3	28±0.3	<11
11/8/2021	11/15/2021	NA	2.4±0.1	37±1	<11
11/15/2021	11/22/2021	281	2.6±0.3	27±1	<9
11/22/2021	11/28/2021	251	4.4±0.3	25±1	<12
11/28/2021	12/5/2021	283	3.2±0.3	26±1	<10
12/5/2021	12/12/2021	282	6.2±0.4	26±1	NT
12/12/2021	12/20/2021	335	4.4±0.3	19±1	NT
12/20/2021	12/27/2021	270	5.5±0.2	25±1	NT
	2021 Average		**1.3±2.7**	**18±15**	**--**
	Overall		**1±0.9**	**16±5**	**--**
Peach Bottom Dempsey Farm Station					
12/29/2019	1/5/2020	NA	0.4±0.2	10±1	<13
1/5/2020	1/12/2020	NA	0.4±0.2	10±1	<10
1/12/2020	1/19/2020	285	0.8±0.2	15±1	<11
1/19/2020	1/26/2020	283	1±0.2	15±1	<11
1/26/2020	2/2/2020	288	0.6±0.2	10±1	<11
2/2/2020	2/9/2020	280	0.7±0.2	9±1	<10
2/7/2020	2/16/2020	293	<0.2	13±1	<11
2/16/2020	2/23/2020	284	1.1±0.2	19±1	<11
2/23/2020	3/2/2020	329	0.5±0.2	13±1	<9
3/2/2020	3/9/2020	285	0.6±0.2	13±1	<10
3/9/2020	3/16/2020	274	0.5±0.3	11±1	<9
3/16/2020	3/23/2020	295	3.4±0.2	13±1	NT
6/8/2020	6/15/2020	288	0.6±0.3	11±1	<12
6/15/2020	6/22/2020	287	1.7±0.2	14±1	<10
6/22/2020	6/29/2020	274	1.7±0.2	21±1	<0
6/29/2020	7/6/2020	295	1.7±0.2	19±1	<11
7/6/2020	7/13/2020	289	1.8±0.3	17±1	<10
7/13/2020	7/19/2020	236	1.4±0.2	18±1	<13
7/19/2020	7/27/2020	333	1.7±0.3	25±1	<8
7/27/2020	8/2/2020	231	1.4±0.2	18±1	<14
8/2/2020	8/9/2020	296	1.2±0.2	18±1	<7
8/9/2020	8/17/2020	327	2.2±0.2	29±1	<9
8/17/2020	8/24/2020	298	1.4±0.2	21±1	<11
8/25/2020	8/31/2020	277	1.1±0.3	21±1	<10
8/31/2020	9/8/2020	325	1.2±0.3	21±1	<8
9/8/2020	9/14/2020	244	2±0.2	15±1	<13

Table C-6.	(Continued)				
	Sample Date				
Start	**End**	**Volume**	**Gross Alpha**	**Gross Beta**	**I-131**
	Peach Bottom Dempsey Farm Station (Continued)				
9/14/2020	9/21/2020	291	1.7±0.2	20±1	<10
9/21/2020	9/28/2020	283	2±0.3	29±1	<10
9/28/2020	10/5/2020	281	1.9±0.2	17±1	<11
10/5/2020	10/12/2020	287	1.6±0.2	22±1	<10
10/12/2020	10/19/2020	287	1.4±0.2	19±1	<10
10/19/2020	10/26/2020	283	1.6±0.3	13±1	<10
10/26/2020	11/2/2020	291	1.4±0.2	16±1	<10
11/2/2020	11/9/2020	284	2.1±0.3	34±1	<12
11/9/2020	11/16/2020	284	1.5±0.2	21±1	<12
11/16/2020	11/23/2020	283	1.3±0.3	21±1	<11
11/23/2020	11/30/2020	287	2.2±0.2	26±1	<9
11/30/2020	12/7/2020	284	1.4±0.2	17±1	<7
12/7/2020	12/14/2020	282	1.9±0.2	33±1	<11
12/14/2020	12/21/2020	292	1.2±0.2	16±1	<11
12/21/2020	12/28/2020	269	1.7±0.2	18±1	<10
12/29/2020	1/3/2021	NA	1.7±0.2	18±1	<14
	2020 Average		**1.4±1.3**	**18±12**	**--**
1/3/2021	1/10/2021	286	1.2±0.3	17±1	<12
1/10/2021	1/17/2021	283	1.9±0.2	27±1	<10
1/17/2021	1/24/2021	288	1.4±0.3	13±1	<12
1/24/2021	1/31/2021	287	1.4±0.3	13±1	<13
1/31/2021	2/7/2021	283	1.6±0.3	17±1	<11
2/7/2021	2/14/2021	286	2.7±0.2	27±1	<9
2/14/2021	2/22/2021	322	1.6±0.3	24±1	<10
2/22/2021	2/28/2021	247	1.7±0.3	15±1	<13
2/28/2021	3/8/2021	326	2.2±0.2	23±1	<11
3/8/2021	3/15/2021	284	2.2±0.3	26±1	<15
3/15/2021	3/23/2021	323	2.5±0.3	23±1	<8
3/23/2021	3/30/2021	275	1±0.2	14±1	<9
3/30/2021	4/6/2021	288	0.9±0.2	20±1	<10
4/6/2021	4/12/2021	247	<0.3	10±1	<12
4/12/2021	4/19/2021	296	<0.3	8±1	<10
4/19/2021	4/26/2021	284	1.1±0.2	20±1	<10
4/26/2021	5/4/2021	286	0.9±0.2	17±1	<9
5/3/2021	5/10/2021	286	0.9±0.2	7±1	<10
5/10/2021	5/17/2021	287	1.2±0.2	12±1	<8
5/17/2021	5/24/2021	276	1.1±0.3	18±1	<7
5/24/2021	6/1/2021	321	0.8±0.1	11±1	<9
6/1/2021	6/7/2021	251	0.6±0.1	13±1	<6
6/7/2021	6/14/2021	292	0.8±0.2	8±1	<10
6/14/2021	6/22/2021	280	0.6±0.2	15±1	<8
6/21/2021	6/28/2021	288	0.6±0.2	10±1	<7
6/28/2021	7/6/2021	323	0.8±0.2	12±1	<7
7/6/2021	7/12/2021	244	<0.3	14±1	<8

Table C-6. (Continued)

Sample Date Start	End	Volume	Gross Alpha	Gross Bata	I-131
Peach Bottom Dempsey Farm Station (Continued)					
7/12/2021	7/19/2021	286	1±0.2	14±1	<7
7/19/2021	7/26/2021	284	1.6±0.3	14±1	<8
7/26/2021	8/2/2021	285	1.2±0.3	15±1	<7
8/2/2021	8/9/2021	286	0.8±0.2	13±1	<10
8/9/2021	8/17/2021	326	1±0.2	15±1	<9
8/15/2021	8/23/2021	245	0.6±0.2	7±1	<7
8/23/2021	8/30/2021	302	0.9±0.2	18±1	<8
8/30/2021	9/7/2021	325	0.9±0.2	18±1	<9
9/7/2021	9/13/2021	243	0.9±0.3	22±1	<11
9/13/2021	9/20/2021	281	0.9±0.2	21±1	<7
9/20/2021	9/27/2021	285	<0.3	16±1	<11
9/27/2021	10/4/2021	287	1.6±0.3	24±1	<10
10/4/2021	10/11/2021	285	0.9±0.3	15±1	<8
10/11/2021	10/18/2021	286	1.1±0.3	23±1	<8
10/18/2021	10/25/2021	288	1.2±0.2	28±1	<8
10/25/2021	11/1/2021	NA	1±0	14±1	<11
11/1/2021	11/8/2021	286	1.3±0.1	22±0.4	<11
11/8/2021	11/15/2021	NA	1.1±0.3	29±1	<11
11/15/2021	11/22/2021	281	1.9±0.1	21±0.5	<9
11/22/2021	11/28/2021	251	1.7±0.4	16±1	<12
11/28/2021	12/5/2021	283	3.3±0.3	23±1	<10
12/5/2021	12/12/2021	282	8.2±0.4	35±1	NT
12/12/2021	12/20/2021	335	4.1±0.3	18±1	NT
12/20/2021	12/27/2021	268	4.6±0.2	24±1	NT
12/27/2021	1/5/2022	286	4.4±0.2	18±1	NT
	2021 Average		**1.5±2.7**	**18±12**	--
	Overall		**1.4±0.2**	**18±1**	--

Table C-7. Radionuclide Concentrations in Monthly Composite Air Particulate (fCi/m^3) ± 2 SD. Sample volume is in m^3. Note: a portion of March and June 2020 samples were analyzed and reported together, due to COVID-related closures. NA = Not Available.

Sample Date Start	End	Volume	Be-7	Cs-137
Calvert Cliffs Long Beach Station				
1/14/2020	2/10/2020	1101	69±12	<1
2/18/2020	3/17/2020	1139	91±14	<2
3/17/2020	6/30/2020	1140	68±11	<2
6/30/2020	7/27/2020	NA	69±11	<1
7/27/2020	8/25/2020	1214	74±10	<1
8/25/2020	9/22/2020	1069	60±11	<1
10/20/2020	11/17/2020	1146	64±11	<1
11/17/2020	12/16/2020	1179	90±12	<1
12/16/2020	1/12/2021	1097	66±12	<2
	2020 Average		**72±22**	--
1/12/2021	2/10/2021	1004	79±12	<2
2/10/2021	3/8/2021	1082	73±12	<2
3/8/2021	4/6/2021	1127	110±14	<2
4/5/2021	5/4/2021	1176	84±13	<1
5/4/2021	6/2/2021	1182	83±12	<1
6/2/2021	6/29/2021	1102	83±12	<1
6/29/2021	7/27/2021	1141	92±14	<2
7/27/2021	8/24/2021	1143	95±12	<1
8/24/2021	9/21/2021	1142	81±11	<2
9/21/2021	10/27/2021	1467	71±9	<1
10/27/2021	11/23/2021	1387	22±6	<1
11/30/2021	12/28/2021	1143	68±11	<1
	2021 Average		**78±42**	--
	Overall		**75±8**	--
Calvert Cliffs Lusby Station				
1/14/2020	2/10/2020	1102	67±11	<2
2/18/2020	3/17/2020	1138	77±12	<1
3/17/2020	6/30/2020	1139	7013	<2
6/30/2020	7/27/2020	NA	83±11	<1
7/27/2020	8/25/2020	1213	64±11	<2
8/25/2020	9/22/2020	1128	59±9	<1
10/20/2020	11/17/2020	1143	49±10	<2
11/17/2020	12/16/2020	1178	51±72	<10
12/16/2020	1/12/2021	1096	70±13	<2
	2020 Average		**65±22**	--

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
	Calvert Cliffs Lusby Station (Continued)			
1/12/2021	2/10/2021	1007	64±10	<1
2/10/2021	3/8/2021	1082	84±12	<2
3/8/2021	4/5/2021	1127	109±13	<2
4/5/2021	5/4/2021	1183	83±11	<1
5/4/2021	6/2/2021	1175	69±11	<2
6/2/2021	6/29/2021	1102	72±11	<2
6/29/2021	7/27/2021	1142	77±11	<2
7/27/2021	8/24/2021	1142	95±12	<2
8/24/2021	9/21/2021	1142	111±16	<2
9/21/2021	10/27/2021	1466	90±12	<2
10/27/2021	11/23/2021	1388	26±4	<1
11/30/2021	12/28/2021	856	52±12	<2
	2021 Average		**78±48**	--
	Overall		**72±17**	--
	Calvert Cliffs Cove Point Station			
1/14/2020	2/10/2020	1102	61±12	<2
2/18/2020	3/17/2020	1139	88±14	<2
3/17/2020	6/30/2020	1138	71±10	<1
6/30/2020	7/27/2020	NA	67±12	<2
7/27/2020	8/25/2020	1212	61±10	<1
8/25/2020	9/22/2020	1129	80±12	<1
10/20/2020	11/17/2020	1150	54±13	<2
11/17/2020	12/16/2020	1178	80±14	<2
12/16/2020	1/12/2021	1096	61±10	<2
	2020 Average		**69±22**	--
1/12/2021	2/10/2021	1012	63±12	<2
2/10/2021	3/8/2021	1082	66±13	<2
3/8/2021	4/5/2021	1127	105±10	<1
4/5/2021	5/4/2021	1183	75±8	<1
5/4/2021	6/2/2021	1176	91±9	<1
6/2/2021	6/29/2021	1102	88±8	<1
6/29/2021	7/27/2021	1126	98±10	<1
7/27/2021	8/24/2021	1158	49±6	<1
8/24/2021	9/21/2021	1142	99±10	<1
9/21/2021	10/27/2021	1466	95±8	<1
10/27/2021	11/23/2021	1390	32±4	<1
11/30/2021	12/28/2021	1140	65±7	<1
	2021 Average		**77±45**	--
	Overall		**73±11**	--

Table C-7. (Continued)

Sample Date				
Start	**End**	**Volume**	**Be-7**	**Cs-137**
		Calvert Cliffs Horn Point Station		
1/12/2020	2/9/2020	1136	73±10	<1
2/16/2020	3/16/2020	1173	89±12	<1
3/16/2020	6/29/2020	1170	7110	<1
6/29/2020	7/27/2020	NA	83±13	<2
7/26/2020	8/24/2020	1199	64±9	<2
8/25/2020	9/22/2020	1146	70±10	<1
10/19/2020	11/16/2020	1140	53±9	<2
11/16/2020	12/14/2020	1130	76±13	<2
12/14/2020	1/10/2021	1100	65±11	<2
	2020 Average		**72±21**	--
1/10/2021	2/7/2021	1426	63±12	<2
2/7/2021	3/8/2021	1181	83±12	<1
3/8/2021	4/6/2021	1171	127±17	<2
4/6/2021	5/3/2021	1114	81±14	<2
5/3/2021	6/1/2021	1170	75±11	<1
6/1/2021	6/28/2021	1105	83±14	<2
6/28/2021	7/26/2021	1132	78±11	<2
7/26/2021	8/23/2021	1142	65±10	<1
8/23/2021	9/20/2021	1161	76±11	<2
9/20/2021	10/25/2021	1431	78±12	<1
10/25/2021	11/22/2021	1389	28±7	<1
11/28/2021	12/27/2021	1159	53±12	<1
	2021 Average		**74±46**	--
	Overall		**73±4**	--
		Baltimore City Station		
1/14/2020	2/10/2020	1138	66±10	<2
2/18/2020	3/17/2020	1137	71±11	<1
6/16/2020	6/16/2020	568	12019	<3
6/30/2020	7/27/2020	NA	106±13	<2
7/27/2020	8/25/2020	1217	100±12	2±1
8/25/2020	9/22/2020	1141	85±11	<1
10/20/2020	11/17/2020	1150	72±11	<2
11/17/2020	12/16/2020	1171	72±10	<2
12/16/2020	1/12/2021	1109	76±11	<2
	2020 Average		**85±38**	**2±1**

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
	Baltimore City Station (Continued)			
1/12/2021	2/10/2021	1283	63±11	<2
2/10/2021	3/8/2021	1133	71±11	<2
3/10/2021	4/7/2021	1141	90±9	<1
4/7/2021	5/4/2021	1109	71±7	<1
5/4/2021	6/2/2021	1183	72±7	<1
6/2/2021	6/29/2021	1102	71±7	<1
6/29/2021	7/27/2021	1141	70±7	<1
7/27/2021	8/24/2021	1143	79±8	<1
8/24/2021	9/21/2021	1141	91±8	<1
9/21/2021	10/27/2021	1487	88±8	<1
10/27/2021	11/23/2021	1388	27±3	<1
11/30/2021	12/28/2021	1141	51±5	<1
	2021 Average		**70±36**	**--**
	Overall		**78±21**	**2±1**
	Peach Bottom Rising Sun Station			
1/12/2020	2/9/2020	1136	81±11	<1
2/16/2020	3/16/2020	1173	97±13	<1
3/16/2020	6/29/2020	1173	7713	<1
6/29/2020	7/27/2020	NA	90±12	<1
7/26/2020	8/24/2020	1203	93±12	<2
8/25/2020	9/22/2020	1139	75±11	<2
10/19/2020	11/16/2020	1140	58±11	<1
11/16/2020	12/14/2020	1138	71±11	<2
12/14/2020	1/10/2021	1109	69±11	<2
	2020 Average		**79±25**	**--**
1/10/2021	2/7/2021	1424	72±12	<2
2/7/2021	3/8/2021	1181	63±10	<2
3/8/2021	4/6/2021	1172	97±13	<2
4/6/2021	5/3/2021	1113	76±11	<2
5/3/2021	6/1/2021	1170	89±14	<2
6/1/2021	6/28/2021	1101	91±12	<2
6/28/2021	7/26/2021	1146	96±12	<2
7/26/2021	8/23/2021	1141	103±12	<2
8/23/2021	9/20/2021	1152	81±12	<2
9/20/2021	10/25/2021	1431	86±10	<1
10/25/2021	11/22/2021	1388	25±6	<1
11/28/2021	12/27/2021	1167	51±12	<1
	2021 Average		**77±45**	**--**
	Overall		**78±2**	**--**

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
	Peach Bottom Whiteford Station			
1/12/2020	2/9/2020	1136	78±13	<2
2/16/2020	3/16/2020	1173	90±14	<2
3/16/2020	6/29/2020	1172	7110	<1
6/29/2020	7/27/2020	NA	84±11	<1
7/26/2020	8/24/2020	1188	70±10	<1
8/25/2020	9/22/2020	1136	57±10	<1
10/19/2020	11/16/2020	1140	46±12	<2
11/16/2020	12/14/2020	1139	70±10	<2
12/14/2020	1/10/2021	1106	56±12	<2
	2020 Average		**69±29**	--
1/10/2021	2/7/2021	1424	63±10	<2
2/7/2021	3/8/2021	1181	89±12	<1
3/8/2021	4/6/2021	1172	105±13	<2
4/6/2021	5/3/2021	1113	80±11	<2
5/3/2021	6/1/2021	1170	91±14	<2
6/1/2021	6/28/2021	1101	80±14	<2
6/28/2021	7/26/2021	1146	87±14	<2
7/26/2021	8/23/2021	1144	87±14	<2
8/23/2021	9/20/2021	1149	100±15	<2
9/20/2021	10/25/2021	1431	80±12	<2
10/25/2021	11/22/2021	1388	30±5	<1
11/28/2021	12/27/2021	1170	57±9	<1
	2021 Average		**79±41**	--
	Overall		**74±14**	--
	Peach Bottom Dempsey Farm Station			
1/12/2020	2/9/2020	1121	74±11	<1
2/16/2020	3/16/2020	1176	90±13	<2
3/16/2020	6/29/2020	1173	71±10	<1
6/29/2020	7/27/2020	NA	81±11	<2
7/26/2020	8/24/2020	1204	68±10	<1
8/25/2020	9/22/2020	NA	61±11	<1
10/19/2020	11/16/2020	1140	61±10	<2
11/16/2020	12/14/2020	1139	70±11	<2
12/14/2020	1/10/2021	1108	62±10	<2
	2020 Average		**71±20**	--
1/10/2021	2/7/2021	1424	55±10	<2
2/7/2021	3/8/2021	1181	75±11	<2
3/8/2021	4/6/2021	1171	104±13	<2
4/6/2021	5/3/2021	1113	97±14	<2
5/3/2021	6/1/2021	1170	85±11	<2
6/1/2021	6/28/2021	1115	86±12	<2
6/28/2021	7/26/2021	1134	84±14	<2
7/26/2021	8/23/2021	1140	83±14	<2

Table C-7. (Continued)

Sample Date Start	End	Volume	Be-7	Cs-137
Peach Bottom Dempsey Farm Station (Continued)				
8/23/2021	9/20/2021	1140	83±12	<1
9/20/2021	10/25/2021	1430	95±10	<1
10/25/2021	11/22/2021	1388	26±7	<1
11/28/2021	12/27/2021	1168	61±10	<1
	2021 Average		**78±43**	**--**
	Overall		**74±10**	**--**

Table C-8. Radionuclide Concentrations in Potable Water; CCNPP stations and control

Sample Date	Concentrations in Potable Water (pCi/L ± 2 SD)		
	Gross Alpha	**Gross Beta**	**Tritium**
Baltimore City Station (control)			
9/29/2020	<2	<4	<100
11/2/2020	<2	<4	<100
11/3/2020	<2	<4	<100
2020 Average	--	--	--
1/4/2021	<2	<4	<100
2/3/2021	2±1	<4	<100
3/1/2021	<2	<4	<100
4/1/2021	<2	<4	<100
5/10/2021	<2	<4	<100
6/1/2021	<2	<4	<100
7/1/2021	<2	<4	<100
7/28/2021	<2	7±2	<100
9/1/2021	<2	<4	<100
10/1/2021	<2	6±2	<100
11/4/2021	<2	<4	<100
12/2/2021	3±1	<4	<100
2021 Average	**2.6±1**	**6±1**	--
Overall	**2.6±1**	**6±1**	--
Chesapeake Country Club Station			
12/22/2020	3±2	8±2	<100
2020 Average	**2.7±1.5**	**8±2**	--
3/16/2021	<2	6±2	<100
8/10/2021	<2	6±2	134±87
12/28/2021	<2	6±2	<100
2021 Average	--	**6±1**	**134±87**
Overall	**2.7±1.5**	**7±3**	**134±87**

Table C-8. (Continued)

Sample Date	Concentrations in Potable Water (pCi/L ± 2 SD) Gross Alpha	Gross Beta	Tritium
Calvert County Courthouse Station			
12/22/2020	<2	11±2	<100
2020 Average	**--**	**11±2**	**--**
3/16/2021	<2	13±2	<100
8/10/2021	<2	13±2	125±86
12/28/2021	<2	29±3	<100
2021 Average	**--**	**19±19**	**125±86**
Overall	**--**	**15±10**	**125±86**
Appeal Elementary School Station			
12/22/2020	<2	12±2	<100
2020 Average	**--**	**12±2**	**--**
3/16/2021	<2	11±2	<100
8/10/2021	<2	11±2	107±89
2021 Average	**--**	**11.2±0.1**	**107±89**
Overall	**--**	**11.4±0.4**	**107±89**
Calvert County Health Department Station			
12/22/2020	<2	<4	<100
2020 Average	**--**	**--**	**--**
3/16/2021	<2	<4	<100
8/10/2021	<2	11±2	141±87
12/28/2021	<2	7±2	<100
2021 Average	**--**	**9±7**	**141±87**
Overall	**--**	**9±7**	**141±87**

Table C-8. (Continued)

Sample Date	Concentrations in Potable Water (pCi/L ± 2 SD)		
	Gross Alpha	**Gross Beta**	**Tritium**
Southern Middle School Station			
12/22/2020	<2	9±2	<100
2020 Average		**9±2**	
3/16/2021	4±2	11±2	<100
8/10/2021	<2	9±2	145±87
2021 Average	**4±2**	**10±3**	**145±87**
Overall	**4±2**	**9±1**	**145±87**
Frying Pan Restaurant Station			
12/22/2020	<2	142	<100
2020 Average		**14±2**	
3/16/2021	<2	12±2	<100
8/10/2021	<2	11±2	<100
12/28/2021	<2	11±2	<100
2021 Average	**--**	**11±2**	**--**
Overall	**--**	**12±3**	**--**
Calvert Cliffs Volunteer Fire Department Station			
12/22/2020	<2	13±2	<100
2020 Average		**13±2**	
3/16/2021	<2	12±2	<100
8/10/2021	<2	11±2	<100
12/28/2021	<2	14±2	<100
2021 Average	**--**	**12±3**	**--**
Overall	**--**	**12±1**	**--**

Table C-9. Radionuclide Concentrations in Precipitation (pCi/L) ± 2 SD. Depth in inches.

Sample Date	Depth	Gross Alpha	Gross Beta	Tritium	Be-7
		Baltimore City Station			
1/8/2020	0.81	NT	NT	NT	18±13
1/30/2020	2.30	<2	<4	<100	25±13
2/11/2020	2.00	<2	<4	<100	35±16
2/25/2020	0.57	<2	<4	<100	12±12
3/3/2020	0.39	<2	<4	<100	<32
3/17/2020	0.54	<2	<4	NT	<29
5/23/2020	0.79	<2	<4	<100	18±16
7/28/2020	4.26	3.6±1.2	8.3±2	<100	56±0
8/4/2020	3.55	3.5±1.4	7.5±1.8	<100	<9
8/11/2020	1.32	4±1.3	8±2	<100	40±20
8/19/2020	3.88	<2	<4	<100	60±17
9/2/2020	0.72	<2	<4	<100	39±14
9/9/2020	0.63	0.9±0.3	1.4±0.4	127±98	<10
9/16/2020	0.71	NT	NT	NT	n/a
9/30/2020	2.17	<2	<4	<100	31±22
10/14/2020	1.66	<2	<4	<100	<35
12/1/2020	2.25	<2	<4	<100	48±17
12/8/2020	0.87	<2	<4	<100	<25
12/16/2020	1.07	<2	<4	<100	25<25
12/22/2020	1.59	<2	<4	<100	30±14
12/29/2020	0.94	<2	<4	<100	29±16
2020 average		**3±2.8**	**6.3±6.6**	**127**	**33±28**
1/5/2021	1.39	<2	<4	<100	32±17
2/3/2021	0.74	3.4±0.5	7.8±0.6	<100	35±18
2/10/2021	0.54	2±0.4	<4	<100	14±16
2/17/2021	1.21	<2	<4	<100	31±19
2/23/2021	0.98	<2	<4	<100	16±17
3/3/2021	1.55	<2	<4	<100	34±19
3/31/2021	2.40	<2	<4	<100	23±13
4/7/2021	0.88	<2	<4	<100	23±12
4/14/2021	0.90	2.3±0.4	<4	<100	<4
4/27/2021	0.56	4.1±0.6	<4	<100	<27
5/11/2021	0.90	3.7±0.6	2.8±0.5	<100	<24
6/8/2021	0.62	2.6±0.5	<4	<100	2±9
6/15/2021	6.00	<2	<4	<100	24±12
6/22/2021	0.70	<2	5.8±0.6	<100	68±15
7/7/2021	1.19	<2	<4	<100	<30
8/3/2021	1.63	3±0.5	4±0.5	151±87	33±18
8/10/2021	0.78	3.9±0.6	6.6±0.6	199±79	54±17
8/16/2021	2.18	<2	<4	<100	51±9
8/24/2021	2.43	<2	<4	<100	12±12
9/8/2021	3.60	<2	<4	<100	44±18
9/14/2021	0.78	1.2±0.3	3.6±0.5	141±92	34±16
9/29/2021	1.28	<2	<4	<100	37±14

Table C-9. (Continued)

Sample Date	Depth	Gross Alpha	Gross Beta	Tritium	Be-7
10/27/2021	2.06	2±0.4	<4	<100	27±13
11/3/2021	2.04	<2	<4	<100	14±10
11/17/2021	0.80	2.6±0.5	<4	<100	<30
2021 Average		**2.8±1.8**	**5.1±3.9**	**164±62**	**30±31**
Overall		**2.9±0.3**	**5.7±1.7**	**145.3±51.9**	**32±4**

Table C-10. Radionuclide Concentrations in Processed and Raw Milk (pCi/L) ± 2 SD

Sample Date	I-131	Ba-140	Cs-137	Sr-90	Sr-89
			Maryland Composite Processed Milk		
6/19/2020	<4	<3	<3	<0.6	<0.6
9/16/2020	<3	<11	<3.2	<0.5	1.9±0.6
2020 Average	--	--	--	--	**1.9±0.6**
2/8/2021	<4	<5	<4	1.2±0.8	<0.6
5/26/2021	<4	<11	<3.1	0.7±0.4	<0.6
8/18/2021	<5	<5	<4.2	<0.5	<0.4
11/4/2021	<4	<4	<4	0.7±0.6	<0.6
2021 Average	--	--	--	**0.9±0.6**	--
Overall	--	--	--	**0.9±0.6**	**1.9±0.6**
			Peach Bottom Kilby Farm Raw Milk		
1/13/2020	<3	<3	<3.3	<0.3	0.8±0.5
3/23/2020	<9	<3	<3.4	<0.4	1.3±0.5
6/16/2020	<3	<3	<3	<0.4	<0.6
9/15/2020	<3	<3	<3.3	<0.5	1.4±0.6
2020 Average	--	--	--	--	**1.2±0.6**
2/9/2021	<3	<3	<3	1.2±0.6	<0.6
5/24/2021	<3	<11	<3	0.5±0.2	<0.6
8/17/2021	<4	<5	<4.4	0.7±0.5	<0.4
11/2/2021	<4	<3	<3	<0.4	<0.6
2021 Average	--	--	--	**0.6±1**	--
Overall	--	--	--	**0.6±1**	**1.2±0.1**