Technical Specification 5.6.2

Palo Verde
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102-08269-MDD/MSC
May 6, 2021

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Sirs:

Subject: **Palo Verde Nuclear Generating Station - Units 1, 2, and 3**
Docket Nos. STN 50-528, 50-529, and 50-530
License Nos. NPF-41, NPF-51, and NPF-74
Annual Radiological Environmental Operating Report 2020

In accordance with Palo Verde Nuclear Generating Station (PVNGS) Technical Specification 5.6.2, enclosed please find the Annual Radiological Environmental Operating Report for 2020.

No new commitments are being made to the Nuclear Regulatory Commission (NRC) by this letter. Should you need further information regarding this submittal, please contact Matthew S. Cox, Licensing Section Leader, at (623) 393-5753.

Sincerely,

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Michael D. DiLorenzo
Department Leader, Regulatory Affairs

MDD/MSC/mg

Enclosure: Palo Verde Nuclear Generating Station Annual Radiological Environmental Operating Report 2020

cc:

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Enclosure

Palo Verde Nuclear Generating Station
Annual Radiological Environmental Operating Report 2020

PALO VERDE NUCLEAR GENERATING STATION ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT 2020

(Reference: RCTSAI 1643, Legacy Item No.036843.01)

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Manager, Radiation Protection

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ABSTRACT

The Radiological Environmental Monitoring Program (REMP) is an ongoing program conducted by Arizona Public Service Company (APS) for the Palo Verde Nuclear Generating Station (PVNGS). Various types of environmental samples are collected near PVNGS and analyzed for plant-related radionuclide concentrations.

During 2020, the following categories of samples were collected by APS:

- Broadleaf vegetation
- Groundwater
- Drinking water
- Surface water
- Airborne particulate and radioiodine
- Goat milk
- Sludge

Thermoluminescent dosimeters (TLDs) were used to measure environmental gamma radiation. The Environmental TLD program is also conducted by APS.

The Arizona Department of Health Services, Bureau of Radiation Control (BRC) performs radiochemistry analyses on various duplicate samples provided to them by APS. Samples analyzed by BRC include onsite samples from the Reservoirs, Evaporation Ponds, and two (2) Deep Wells. Offsite samples analyzed by BRC include two (2) local resident wells. BRC also performs air sampling at seven (7) offsite locations identical to APS and maintains approximately fifty (50) environmental TLD monitoring locations, eighteen (18) of which are duplicates of APS locations.

A comparison of pre-operational and operational data indicates no changes to environmental radiation levels.

(NOTE: Reference to APS throughout this report refers to PVNGS personnel)

1. Introduction

This report presents the results of the operational Radiological Environmental Monitoring Program conducted by Arizona Public Service Company (APS). The Radiological Environmental Monitoring Program (REMP) was established for the Palo Verde Nuclear Generating Station (PVNGS) by APS in 1979.

This report contains the measurements and findings for 2020. All references are specifically identified in Section 12.

1.1 Overview

The Radiological Environmental Monitoring Program (REMP) provides representative measurements of radiation and radioactive materials in exposure pathways. REMP measures radionuclides that lead to the highest potential radiation exposures to members of the public resulting from station operation. This monitoring program implements Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix I, Section IV.B.2., and thereby supplements the radiological effluent monitoring program by verifying that the measurable concentrations of radioactive materials and levels of radiation are not higher than expected on the basis of the effluent measurements and the modeling of the environmental exposure pathways. Guidance for this monitoring program is provided by the US Nuclear Regulatory Commission (USNRC) in their Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 (incorporated into NUREG 1301). Results from the REMP help to evaluate sources of elevated levels of radioactivity in the environment (i.e. atmospheric nuclear detonations or abnormal plant releases).

The Land Use Census ensures that changes in the use of areas at, and beyond the site boundary, are identified and that modifications to the REMP are made if required by the results of this census. This census satisfies the requirements of Section IV.B.3 of Appendix I to 10 CFR Part 50.

The Interlaboratory Comparison Program is provided to ensure that independent checks on the precision and accuracy of the measurements of radioactive material in environmental sample matrices are performed as part of the quality assurance program for environmental monitoring in order to demonstrate that the results are valid for the purposes of 10 CFR 50, Appendix I, Section IV.B.2.

Results of the PVNGS pre-operational environmental monitoring program are presented in Reference 1.

The initial criticality of Unit 1 occurred May 25, 1985. Initial criticality for Units 2 and 3 were April 18, 1986, and October 25, 1987, respectively. PVNGS operational findings (historical) are presented in Reference 2.

1.2 Radiation and Radioactivity

Atoms are the basic building blocks of matter. Unstable atoms emit radiation and material that spontaneously emits radiation is referred to as radioactive. Radioactive material is frequently categorized as either "Natural" or "Man-made"

Natural sources of radiation exist naturally in the environment and include radon, thoron, cosmic, terrestrial, and internal. The sun and stars are a source of cosmic radiation. Atmospheric conditions, the Earth's magnetic field, and differences in elevation can affect the amount, or dose, of cosmic radiation an individual receives. The Earth is a source of terrestrial radiation. Uranium, thorium, and radium exist naturally in rock and soil. All organic matter contains carbon and potassium, and water contains small amounts of dissolved uranium and thorium. The largest contributor of dose to Americans from natural sources is attributed to radon which is found in air. All people are a source of internal radiation. Potassium-40 and carbon-14 are radioactive nuclides and inside all people from birth, making people a source of exposure.

Man-made sources of radiation include consumer products, nuclear medicine, and medical procedures. There are a number of occupational areas which result in exposure to individuals of varying amounts of radiation such as: radiography, radiology, radiation oncology, power generation, and research laboratories. The Nuclear Regulatory Commission (NRC) requires licensees to monitor exposure to workers and limit occupational exposure to 5,000 millirem per year. Several consumer products contain radioactive material such as: some ceramics, thorium lantern mantles, luminous watches containing tritium, smoke detectors, and tobacco. Other consumer product sources of radiation can come from building and road construction materials, combustible fuels (i.e. gas, coal), and x-ray security systems. The most significant contributor to radiation exposure from man-made sources is medical procedures. Diagnostic x-rays and nuclear medicine procedures, such as those that use iodine-131 or cesium-137, are examples of man-made medical sources.

The average member of the public receives a total annual dose of approximately 620 millirem from ionizing radiation. Figure 1-1 illustrates the contribution of various sources of radiation to radiation exposure in the United States (NCRP Report No.160 (2009)).

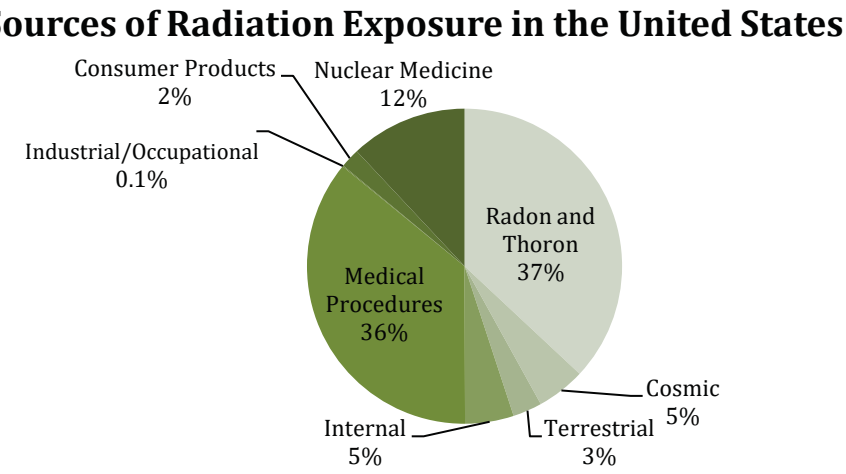


Figure 1-1 Sources of Radiation Exposure in the United States

2. Description of the Monitoring Program

APS and vendor organizations performed the pre-operational Radiological Environmental Monitoring Program between 1979 and 1985. APS and vendors continued the program into the operational phase.

2.1 Radiological Environmental Monitoring Program

The assessment program consists of routine measurements of environmental gamma radiation and of radionuclide concentrations in media such as air, groundwater, drinking water, surface water, vegetation, milk, sludge, and sediment.

Samples were collected by APS at the monitoring sites shown in Figures 2-1 and 2-2. The specific sample types, sampling locations, and sampling frequencies, as set forth in the PVNGS Offsite Dose Calculation Manual (ODCM), Reference 4, are presented in Tables 2-l, 2-2 and 9-1. Additional onsite sampling (outside the scope of the ODCM) is performed to supplement the REMP. All results are included in this report. Routine sample analyses were performed at the onsite Central Chemistry Laboratory and Operating Unit laboratories. Analyses for hard-to-detect radionuclides were performed by GEL Laboratories LLC.

Environmental gamma radiation measurements were performed by APS using TLDs at fifty (50) locations near PVNGS. The PVNGS Dosimetry Department is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) to process personnel ionizing radiation dosimeters.

In addition to monitoring environmental media, a Land Use Census is performed annually to identify the nearest milk animals, residents, and gardens. This information is used to evaluate the potential dose to members of the public for those exposure pathways that are indicated.

2.2 Radiological Environmental Monitoring Program Changes for 2020

No changes to the REMP occurred in 2020.

2.3 REMP Deviations/Abnormal Events Summary

During calendar year 2020, there were eighteen (18) deviations/abnormal events with regards to the monitoring program. Refer to Table 2-3 for more detail and corrective actions taken.

There were ten (10) events involving Air Sample data. Six (6) events involved reduced sampling period due to pump failure. Three (3) events were due to failure of the Elapsed Time Meter (ETM). One (1) event was due to a disconnected sample head. Three (3) of these ten (10) events resulted in sufficient data to obtain VALID results for the sampling period, while seven (7) events resulted in the determination that the sample was INVALID. Palo Verde Nuclear Generating Station has ten (10) Air Sample sites: one (1) control, four (4) ODCM required, and five (5) supplemental sites. Supplemental sampling locations were available and produced valid data for the sampling period involving an invalid sample from a required sample location.

One (1) event was due to the inability to obtain a Drinking Water Sample, due to an inoperable well pump at the donor location. The event impacted the ability to meet the required Lower Limit of Detection for La-140.

Three (3) events were due to power interruptions to the Multi-Channel Analyzer (MCA). One (1) of these events impacted the ability to meet the required Lower Limit of Detection for I-131.

One (1) event was documented due to a procedural exceedance for the Cs-137 action level (30 pCi/L) from a lined Evaporation Pond sample. The exceedance occurred for the primary sample (35 pCi/L); however, the secondary sample (29 pCi/L) did not exceed the procedural action level. Neither level exceed the ODCM, Table 6-2, action/reporting level of 50 pCi/L. This sample was taken from a lined pond that is at reduced inventory and there is no indication of leak to the environment; there is no pathway to drinking water from this source.

There were two (2) events involving environmental dosimetry; dosimetry at Site 44 was identified as missing during the 2nd and 4th Quarter TLD change-out. Data for this location was unavailable for those sampling periods.

One (1) event was documented due to a failure to run a monthly blank on a detector that was used to analyze two (2) water samples.

2.4 Groundwater Protection

PVNGS has implemented a groundwater protection initiative developed by the Nuclear Energy Institute (NEI). The implementing guidance of this initiative, NEI 07-07 (Industry Ground Water Protection Initiative – Final Guidance Document, August 2007), and later revised in March of 2019, provides added assurance that groundwater will not be adversely affected by PVNGS operations.

Several monitoring wells have been installed to monitor the subsurface water and shallow aquifer at Units 1, 2, and 3. Many of these wells were previously monitored in accordance with the State of Arizona Aquifer Protection Permit (Area-Wide) No. P-100388 (APP), which provided agreed upon monitoring parameters and reporting thresholds. The APP was revised in 2018, which included the removal of several of the wells from mandated sampling. These wells are now referred to as Legacy Wells and continue to be sampled for data continuity and in support of the Groundwater Protection Initiative. The frequency of sampling of the wells varies and may be done monthly, quarterly, and or annually for chemical and radiological parameters. Sample results for the shallow aquifer wells are reported in the PVNGS Annual Radioactive Effluent Release Report (ARERR).

Three subsurface samples were obtained, one each from Units 2 and 3 tritium monitoring wells, and one from the shallow aquifer outside of the Unit 1 Radiologically Controlled Area (RCA). These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) as verification that there are no underground leaks from plant systems that may affect groundwater. All results were <MDA. Refer to Table 8-12 for sample results.

Table 2-1 Sample Collection Locations

SAMPLE SITE #	*SAMPLE TYPE*	*LOCATION* (a)	*LOCATION DESCRIPTION*
4	Air	E16	APS Office
6A*	Air	SSE13	Old US 80
7A	Air	ESE3	Arlington School
14A	Air	NNE2	371st Ave. and Buckeye-Salome Rd.
15	Air	NE2	NE Site Boundary
17A	Air	E3	351st Ave.
21	Air	S3	S Site Boundary
29	Air	W1	W Site Boundary
35	Air	NNW8	Tonopah
40	Air	N2	Transmission Rd
46	Drinking Water	NNW8	Local resident
47	Vegetation	N3	Local resident
48	Drinking Water	SW1	Local resident
49	Drinking Water	N2	Local resident
51	Milk	NNE3	Local resident-goats
	Vegetation	NNE3	Local resident
53*	Milk	NE30	Local resident- goats
54	Milk	NNE4	Local resident- goats
55	Drinking Water (Supplemental)	SW3	Local resident
57	Groundwater	ONSITE	Well 27ddc
58	Groundwater	ONSITE	Well 34abb
58A	Groundwater	ONSITE	Well 27dcb
59	Surface Water	ONSITE	Evaporation Pond 1
60	Surface Water	ONSITE	85 Acre Reservoir
61	Surface Water	ONSITE	45 Acre Reservoir
62*	Vegetation	ENE26	Commercial Farm
63	Surface Water	ONSITE	Evaporation Pond 2
64	Surface Water	ONSITE	Evaporation Pond 3
65	Groundwater	ONSITE	Well 34aab

NOTES:

***Designates a control site

(a) Distances and direction are from the centerline of Unit 2 containment and rounded to the nearest mile

Air sample sites designated with the letter 'A' are sites that have the same site number as a TLD location, but are not in the same location (e.g. site #**6** TLD location is different from site #**6A** air sample location; site #**4** TLD location is the same as site #**4** air sample location)

Table 2-2 Sample Collection Schedule

SAMPLE SITE #	*AIRBORNE PARTICULATE*	*MILK*	*AIRBORNE RADIOIODINE*	*VEGETATION*	*GROUND WATER*	*DRINKING WATER*	*SURFACE WATER*
4	W		W				
6A	W		W				
7A	W		W				
14A	W		W				
15	W		W				
17A	W		W				
21	W		W				
29	W		W				
35	W		W				
40	W		W				
46						W	
47				M/AA			
48						W	
49						W	
51			M/AA	M/AA			
53			M/AA				
54			M/AA				
55						W	
57					Q		
58					Q		
59							Q
60							Q
61							Q
62				M/AA			
63							Q
64							Q

W = WEEKLY M/AA = MONTHLY AS AVAILABLE Q = QUARTERLY

Table 2-3 Summaries of the REMP Deviations/Abnormal Events

Deviation/Abnormal Event	*Actions Taken*
1. Air Sample Site 15 INVALID due to pump failure for sample period 2/4/2020-2/10/2020 and 2/10/2020- 2/18/2020.	Pump found inoperable at time of sample change out. Pump replaced. Sample volume unknown and conservative values used for analysis; sample is INVALID, and data is for INFO ONLY for Week 6. Pump volume for Sample Week 7 slightly shorter due to pump replacement. Event documented through CR 20-01823 (Table 8-1 and Table 8-4, Note 1).
2. Air Sample site 21 INVALID due to pump failure for sample period 2/25/2020-3/3/2020	Pump found inoperable at time of sample change out. ETM still running, but bump had stopped. Volume unknown and conservative value used for analysis; sample is INVALID, and data is for INFO ONLY. Event documented through CR 20-02874 (Table 8-1 and Table 8-4, Note 2).
3. Air Sample site 4 INVALID due to pump failure for sample period 3/10/2020-3/17/2020.	Pump found inoperable at time of sample change out. Sample is INVALID and data is for INFO ONLY. Event documented through CR 20-03756 (Table 8-1 and Table 8-4, Note 3).
4. Air Sample Site 4 experienced ETM failure. Sample is VALID, volume calculated due to ETM failure for sample period 3/31/2020-4/7/2020.	Elapsed Time Meter (ETM) failed. Sample pump continued operating normally and filter appeared to have expected dust loading. Volume calculated using documented runtime and start/stop flow measurement. Sample VALID. Event documented through CR 20-04663 (Table 8-1 and Table 8-4, Note 4).
5. Air Sample Site 7 INVALID due to pump failure for sample period 4/14/2020-4/21/2020	Sample pump failed with indications of broken pump vanes at some time during the sample period. ETM continued running; sample volume could not be determined, sample counted with default volume. Sample is INVALID, data is for INFO ONLY. Event documented through CR 20-05496 (Table 8-1 and Table 8-4, Note 5).
6. Air Sample Site 40 INVALID due to sample disconnected from pump for sample period 6/23/2020-6/29/2020.	Sample found on ground mid-sampling period. Sample replaced. Sample INVALID; data for info only. Event documented through CR 20-08450 (Table 8-1 and Table 8-4, Note 6).
7. Air Sample Site 21 experienced ETM failure. Sample is VALID, sample volume was calculated for sample period 9/1/2020-9/8/2020 and 9/8/2020-9/15/2020.	Elapsed Time Meter (ETM) failed during sample period. Volume was manually calculated. Sample is VALID. Event documented through CR 20-11100 (Table 8-2 and Table 8-5, Note 7).
8. Air Sample Site 21 INVALID due to failed pump and inability to estimate volume of sample for sample period 9/15/2020-9/22/2020.	Pump found inoperable at time of sample change out. ETM still running. Not possible to determine sample volume. Data reported for INFO ONLY. Sample is INVALID. Event documented through CR 20-11937 (Table 8-2 and Table 8-5, Note 8).
9. Air Sample Site 29 INVALID due to pump regulator failure resulting in insufficient flow for sample period 9/22/2020-9/29/2020	Note 8: Sample flow found at 18 LPM, vs normal flow of 43 LPM. Regulator screw found to be out of position and was corrected. Sample INVALID due to flow rate <25 LPM. Event documented through CR 20-12260 (Table 8-2 and Table 8-5, Note 9).

10. Air Sample Site 15 experienced ETM failure. Sample is VALID, volume calculated for sample period 12/15/2020-12/21-2020	Elapsed Time Meter (ETM) failed. Volume was manually calculated using the flow rate and sample start/stop time. Sample is VALID. Event documented through CR 20-16673 (Table 8-2 and Table 8-5, Note 10).
11. Drinking Water Sample Site 55 did not achieve LLD for La-140 for September	Donor's pump failed to operate. As a result, no sample could be obtained from Site 55 for the final week of September sampling period, resulting in inability to achieve LLD for La-140.Event documented through CR 20-12459 (Table 8-8, Note 1).
12. Milk Sample Sites 51, 53, 54 had higher than typical MDA values August Milk Samples.	Multi-Channel Analyzer MCA power interruption resulted in higher than typical MDA. ODCM reports LLD to single significant digit; results comply with ODCM LLD., which results do comply with. Event documented through CR 20-11097 (Table 8-7, Note 3).
13. Milk Sample Sites 51 had higher than typical MDA values for October Milk Samples.	Multi-Channel Analyzer MCA power interruption resulted in higher than typical MDA. ODCM reports LLD to single significant digit; results comply with ODCM LLD., which results do comply with. Event documented through CR 20-14077 (Table 8-7, Note 4).
14. Milk Sample Sites 53 I-131 LLD not met for October Milk Sample.	MCA power interruption resulted in miss LLD for I-131. Event documented through CR 20-14425 (Table 8-7, Note 5).
15. Evap Pond 3A (Site 64) sample exceeded procedural action level.	The 1st Quarter sample had primary, but not secondary sample, results which exceeded the Cs-137 74RM-0EN09, Appendix B action/reporting level of 30 pCi/liter (primary of 35 pCi/L Cs-137, secondary sample concentration of 29 pCi/L Cs-137). This does NOT exceed the ODCM Table 6-2 Cs-137 reporting level of 50 pCi/liter. This is a lined pond there is no indication of leak to the environment and there is no pathway to drinking water. Event documented through CR 20-15331 (Table 8-10, Note 1).
16. Direct Radiation TLD Site 44 data unavailable for 2nd Quarter.	During the 2nd Quarter TLD change-out, TLD Site 44 was identified as missing. Data for this location was unavailable; however, dosimetry was replaced for 3rd Quarter data collection. Event documented through CR 20-08627 (Table 9-2, Note 1).
17. Direct Radiation TLD Site 44 data unavailable for 4th Quarter.	During the 4th Quarter TLD change-out, TLD Site 44 was identified as missing from their holder. Data for this location was unavailable; however, dosimetry was replaced for 1st Quarter, 2021, data collection. Event documented through CR 21-00216 (Table 9-2, Note 2).
18. Monthly Blank not analyzed on Detector 3 for Month of April	The monthly 1-L blank was not run on Detector 3. Sample Log lists a sample (C20-1619), but no data exists in the analytical system. 1-L blank validates the background for drinking water samples that were run on the detector. Site 46 and Site 55 were analyzed with Detector 3 in April. No issues found with validating blanks were analyzed prior or following these samples. Samples are VALID. Event documented through CR 20-12727.

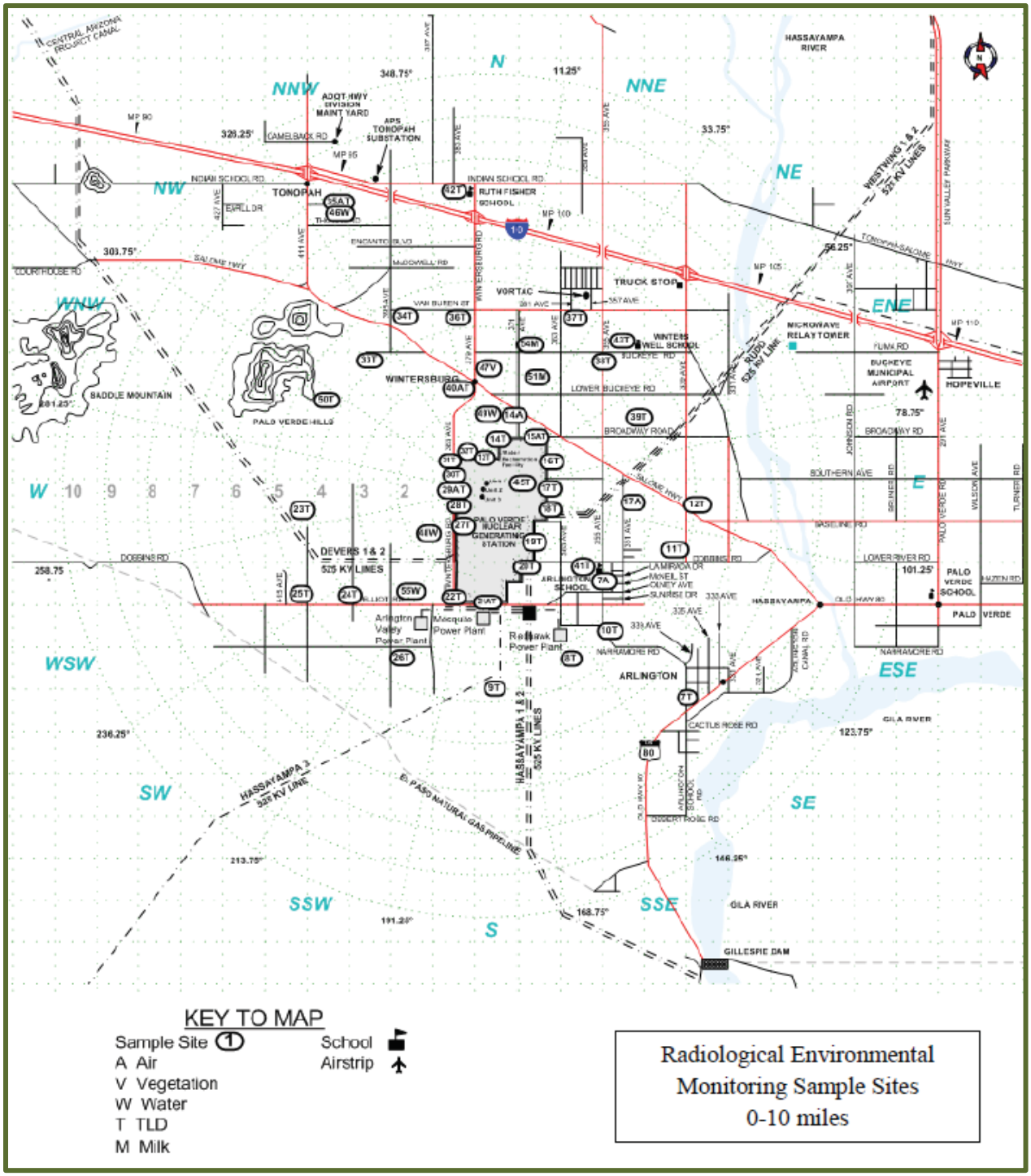


Figure 2-1 REMP Sample Sites- Map (0-10 miles)

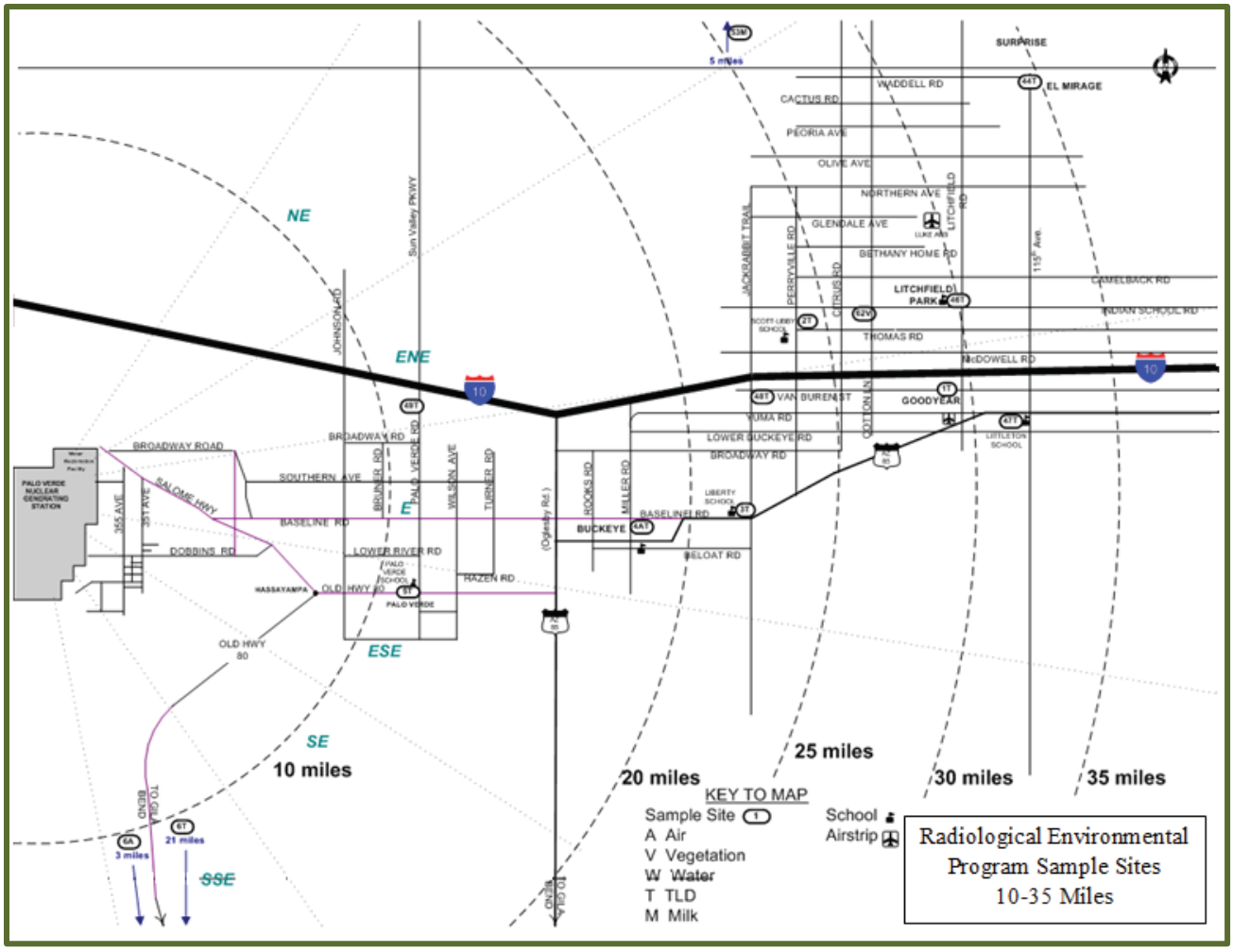


Figure 2-2 REMP Sample Sites- Map (10-35 Miles)

3. Sample Collection Program

APS Personnel, using PVNGS procedures, collected all samples.

3.1 Water

Weekly samples were collected from four (4) residence wells for monthly and quarterly composites. Samples were collected in one-gallon containers (plastic cubitainers) and 500 mL glass bottles. The samples were analyzed for gross beta, gamma-emitting radionuclides, and tritium.

Quarterly grab samples were collected from the 45-acre and 85-acre Reservoirs, active Evaporation Ponds 1A/B/C, 2A/B, and 3A/B, and onsite wells 27ddc, 34aab, and 27dcb. Samples were collected in one-gallon containers (plastic cubitainers) and 500 mL glass bottles. Samples were analyzed for gamma-emitting radionuclides and tritium.

Treated sewage effluent from the City of Phoenix was sampled as a weekly composite at the onsite Water Resources (WR) and analyzed for gamma-emitting radionuclides. A monthly composite was analyzed for tritium.

3.2 Vegetation

Vegetation samples were collected monthly, as available, and were analyzed for gamma-emitting radionuclides.

3.3 Milk

Goat milk samples were collected monthly, as available, and were analyzed for gamma-emitting radionuclides, including low level I-131.

3.4 Air

Air particulate filters and charcoal cartridges were collected at ten (10) sites on a weekly basis. Particulate filters were analyzed for gross beta. Charcoal cartridges were analyzed for Iodine-131. Particulate filters were composited quarterly, by location, and analyzed for gamma-emitting radionuclides.

3.5 Soil, Sludge, and Sediment

Sludge samples were obtained weekly from the WR waste centrifuge (during operational periods) and analyzed for gamma-emitting radionuclides. Cooling tower sludge was analyzed for gamma-emitting radionuclides prior to disposal in the WR sludge landfill.

4. Analytical Procedures

The procedures described in this report are those used by APS to routinely analyze samples

4.1 Air Particulate

4.1.1 Gross Beta

A glass fiber filter sample is placed in a stainless steel planchet and counted for gross beta activity utilizing a low background gas flow proportional counter.

4.1.2 Gamma Spectroscopy

The glass fiber filters are counted on a multichannel analyzer equipped with a High-purity Germanium (HPGe) detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.2 Airborne Radioiodine

4.2.1 Gamma Spectroscopy

The charcoal cartridge is counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for Iodine-131.

4.3 Milk

4.3.1 Gamma Spectroscopy

The sample is placed in a plastic marinelli beaker and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.3.2 Radiochemical I-131 Separation

Iodine in milk sample is reduced with sodium bisulfite and iodine is absorbed by the anion exchange resin. The iodine is eluted with NaOCl. Iodine is extracted from the sample with carbon tetrachloride. The iodine is back extracted from the organic phase with water containing sodium bisulfate and then precipitated as CuI. The precipitate is mounted in a planchet and counted for gross beta.

4.4 Vegetation

4.4.1 Gamma Spectroscopy

The sample is pureed in a food processor, placed in a one-liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.5 Sludge/Sediment

4.5.1 Gamma Spectroscopy

The wet/dry sample is placed in a one-liter plastic marinelli beaker, weighed, and counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.6 Water

4.6.1 Gamma Spectroscopy

The sample is placed in a one-liter plastic marinelli beaker and counted on a multichannel analyzer equipped with a HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

4.6.2 Tritium

The sample is evaluated to determine the appropriate method of preparation prior to counting. If the sample contains suspended solids or is turbid, it may be filtered, distilled, and/or de-ionized, as appropriate. Eight (8) milliliters of sample are mixed with fifteen (15) milliliters of liquid scintillation cocktail. The mixture is dark adapted and counted for tritium activity using a liquid scintillation counting system.

4.6.3 Gross Beta

A 200-250 milliliter sample is placed in a beaker. Five (5) milliliters of concentrated nitric (HNO_3) acid is added and the sample is evaporated down to about twenty (20) milliliters. The remaining sample is transferred to a stainless steel planchet. The sample is heated to dryness and counted for gross beta in a gas flow proportional counter.

4.7 Soil

4.7.1 Gamma Spectroscopy

The samples are sieved, placed in a one-liter plastic marinelli beaker, and weighed. The samples are then counted on a multichannel analyzer equipped with an HPGe detector. The resulting spectrum is analyzed by a computer for specific radionuclides and verified by trained technicians.

5. Nuclear Instrumentation

5.1 Gamma Spectrometer

The Canberra Gamma Spectrometer consists of a Canberra System equipped with HPGe detectors, having resolutions of 1.73 keV and 1.88 keV (as determined by full width half max with an energy of 0.5 keV per channel) and respective efficiencies of 21.5% and 38.4% (as determined by the manufacturer with Co-60). The Canberra System is used for all gamma counting. The system uses Canberra developed software to search, identify, and quantify the peaks of interest.

5.2 Liquid Scintillation Spectrometer

A Beckman LS-6500 Liquid Scintillation Counter is used for tritium determinations. The system background averages approximately 12-16 cpm with a counting efficiency of approximately 40% using a quenched standard.

5.3 Gas Flow Proportional Counter

The Tennelec S5E is a low background gas flow proportional counter for gross beta analysis. The system contains an automatic sample changer capable of counting 50 samples in succession. Average beta background count rate is about 1-2 cpm with a beta efficiency of approximately 30% for Cs-137.

6. Isotopic Detection Limits and Reporting Criteria

6.1 Lower Limits of Detection

The lower limits of detection (LLD) and the method for calculation are specified in the PVNGS ODCM, Reference 4. The ODCM required *a priori* LLDs are presented in Table 6-1.

6.2 Data Reporting Criteria

All results that are greater than the Minimum Detectable Activity (MDA) (*a posteriori* LLD) are reported as positive activity with its associated 2σ counting error. All results that are less than the MDA are reported as less than values at the associated MDA. For example, if the MDA is 12 pCi/liter, the value is reported as <12.

Typical MDA values are presented in Table 6-3.

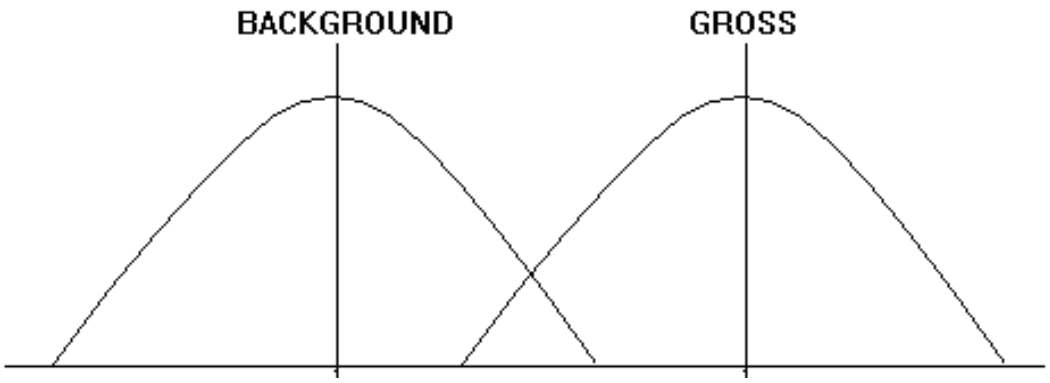
Occasionally, the PVNGS ODCM *a priori* LLDs may not be achieved as a result of:

- Background fluctuations
- Unavoidably small sample sizes
- The presence of interfering radionuclides
- Self-absorption corrections
- Decay corrections for short half-life radionuclides
- Other uncontrollable circumstances

In these instances, the contributing factors will be noted in the table where the data are presented. A summary of deviations/abnormal events is presented in Table 2-3 Summaries of the REMP Deviations/Abnormal Events and includes a description of any sample results that did not meet *a priori* LLD requirements.

6.3 LLD and Reporting Criteria Overview

Making a reasonable estimate of the limits of detection for a counting procedure or a radiochemical method is usually complicated by the presence of significant background. It must be considered that the background or blank is not a fixed value but that a series of replicates would be normally distributed. The desired net activity is the difference between the gross and background activity distributions. The interpretation of this difference becomes a problem if the two distributions intersect as indicated in the diagram.



If a sufficient number of replicate analyses are run, it is expected that the results would fall in a normal Gaussian distribution. Standard statistics allow an estimate of the probability of any particular deviation from the mean value. It is common practice to report the mean ± one or two standard deviations as the result. In routine analysis, such replication is not carried out, and it is not possible to report a Gaussian standard deviation. With counting procedures, however, it is possible to estimate a Poisson standard deviation directly from the count. Data are commonly reported as the measured value ± one or two Poisson standard deviations. The reported values are then considered to give some indication of the range in which the true value might be expected to occur.

LLD is the smallest amount of sample activity that will yield a net count for which there is confidence at a predetermined level that activity is present. LLDs are calculated values for individual radionuclides based on a number of different factors including sample size, counting efficiency and background count rate of the instrument, the background and sample counting time, the decay time, and the chemical recovery of the analytical procedures. A minimum detectable activity value (MDA) is the smallest amount of activity that can be detected in an actual sample and uses the values obtained from the instrument and outcome of the analytical process. Therefore, the MDA values may differ from the calculated LLD values if the sample size and chemical recovery, decay values, or the instrument efficiency, background, or count time differed from those used in the LLD calculation.

The factors governing the calculation of the LLD and MDA values are discussed below:

1. **Sample Size:** The number of observations included in a statistical analysis. Sample size dictates the amount of information available about a studied subject to make accurate inferences.

2. **Counting Efficiency**: The fundamental quantity in the measurement of a radioactive substance is the number of disintegrations per unit time. As with most physical measurements in analytical chemistry, an absolute measurement of the disintegration rate is seldom possible, rather it is necessary to compare the sample with one or more standards. The standards determine the counter efficiency that may then be used to convert sample counts per minute (cpm) to disintegrations per minute (dpm).

3. **Background Count Rate**: Any counter will show a certain counting rate without a sample in position. This background counting rate comes from several sources: 1) natural environmental radiation from the surrounding materials, 2) cosmic radiation, and 3) the natural radioactivity in the counter material itself. The background counting rate will depend on the amounts of these types of radiation and the sensitivity of the counter to the radiation.

4. **Background and Sample Counting Time**: The amount of time devoted to the counting of the background depends on the level of activity being measured. In general, with low level samples, this time should be about equal to that devoted to counting a sample.

5. **Time Interval between Sample Collection and Counting**: Decay measurements are useful in identifying certain short-lived nuclides. The disintegration constant is one of the basic characteristics of a specific radionuclide and is readily determined, if the half-life is sufficiently short. To ensure the required LLDs are achieved, appropriate decay correction values are used to account for radioactive decay during transit time and sample processing.

Table 6-1 ODCM Required Lower Limits of Detection (a priori)

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fresh Milk (pCi/l)	Food Products (pCi/kg, wet)
Gross Beta	4	0.01		
H-3	2000*			
Mn-54	15			
Fe-59	30			
Co-58, -60	15			
Zn-65	30			
Zr-95	30			
Nb-95	15			
I-131	1**	0.07	1	60
Cs-134	15	0.05	15	60
Cs-137	18	0.06	18	80
Ba-140	60		60	
La-140	15		15	

* If no drinking water pathway exists, a value of 3000 pCi/liter may be used
** If no drinking water pathway exists, a value of 15 pCi/liter may be used

NOTES:
This list does not mean that only these nuclides are to be detected and reported. Other peaks that are measurable and identifiable, together with the above nuclides, shall also be identified and reported.

Table 6-2 ODCM Required Reporting Levels

Analysis	Water (pCi/l)	Airborne Particulate or Gas (pCi/m^3)	Fresh Milk (pCi/l)	Food Products (pCi/kg, wet)
H-3	20,000 *			
Mn-54	1,000			
Fe-59	400			
Co-58	1,000			
Co-60	300			
Zn-65	300			
Zr-Nb-95	400			
I-131	2 **	0.9	3	100
Cs-134	30	10	60	1,000
Cs-137	50	20	70	2,000
Ba-La-140	200		300	

* For drinking water samples. This is a 40 CFR 141 value. If no drinking water pathway exists, a value of 30,000 pCi/L may be used.

** If no drinking water pathway exists, a reporting level of 20 pCi/L may be used.

Table 6-3 Typical MDA Values

Analysis/Nuclide	Water (pCi/liter)	Milk (pCi/liter)	Airborne Particulate or Gas (pCi/m^3)	Vegetation (pCi/kg, wet)
Gross Beta	2.08		0.004	
H-3	326			
Mn-54	10			
Fe-59	20			
Co-58	9			
Co-60	11			
Zn-65	22			
Zr-95	16			
Nb-95	10			
I-131	10[a]	1	0.04[b]	49
Cs-134	9	1	0.003[b]	47
Cs-137	10	1	0.003[b]	61
Ba-140	33	3		
La-140	13	1		

NOTES:

a - low level I-131 is not required since there is no drinking water pathway
b - Based on 433 m^3, the normal weekly sample volume

7. Interlaboratory Comparison Program

7.1 Quality Control Program

APS maintains an extensive QA/QC Program to provide assurance that samples are collected, handled, tracked, and analyzed to specified requirements. This program includes appropriate elements of USNRC Regulatory Guide 4.15, Quality Assurance for Radiological Monitoring Programs (Normal Operations) - Effluent Streams and the Environment, Revision 1. The program includes procedures for sample collection preparation and tracking, sample analysis, equipment calibration and checks, and ongoing participation in an interlaboratory comparison program. Duplicate/replicate samples are analyzed to verify analytical precision and sample methodology. Comprehensive data reviews are performed including trending of data where appropriate.

During 2020, APS analyzed the following sample types under the interlaboratory comparison program:

- Beta/Gamma/ in Air Filter
- I-131 in Air
- Beta in Water
- Gamma in Water
- Tritium in Water
- Gamma in Milk

7.2 Intercomparison Results

APS participates in a crosscheck program using vendor supplied blind radionuclide samples. Results for the interlaboratory comparison program are presented in Table 7-1.

Table 7-1 Interlaboratory Comparison Results

Sample Type	Analysis Type	Nuclide	PVNGS Value	1 sigma Error	Known Value	Resolution*	Ratio	NRC Range	Results
E13263 DET2	Gamma Water	Ce-141	9.95E+01	8.13E+00	9.86E+01	12	1.01	0.60 - 1.66	**Acceptable**
		Co-58	1.26E+02	1.48E+01	1.18E+02	9	1.07	0.60 - 1.66	**Acceptable**
		Co-60	2.54E+02	1.46E+01	2.49E+02	17	1.02	0.75 - 1.33	**Acceptable**
		Cr-51	2.39E+02	2.71E+01	2.44E+02	9	0.98	0.60 - 1.66	**Acceptable**
		Cs-134	1.03E+02	6.62E+00	1.32E+02	16	0.78	0.75 - 1.33	**Acceptable**
		Cs-137	1.83E+02	2.71E+01	1.64E+02	7	1.12	0.50 - 2.00	**Acceptable**
		Fe-59	1.58E+02	1.11E+01	1.32E+02	14	1.20	0.60 - 1.66	**Acceptable**
		Mn-54	1.36E+02	1.49E+01	1.18E+02	9	1.15	0.60 - 1.66	**Acceptable**
		Zn-65	2.05E+02	1.78E+01	1.77E+02	12	1.16	0.60 - 1.66	**Acceptable**
E13263 DET3	Gamma Filter	Ce-141	1.04E+02	7.67E+00	9.86E+01	14	1.05	0.60 - 1.66	**Acceptable**
		Co-58	1.22E+02	1.44E+01	1.18E+02	8	1.03	0.60 - 1.66	**Acceptable**
		Co-60	2.62E+02	1.55E+01	2.49E+02	17	1.05	0.75 - 1.33	**Acceptable**
		Cr-51	2.52E+02	2.55E+01	2.44E+02	10	1.03	0.60 - 1.66	**Acceptable**
		Cs-134	1.00E+02	5.74E+00	1.32E+02	17	0.76	0.75 - 1.33	**Acceptable**
		Cs-137	1.72E+02	2.14E+01	1.64E+02	8	1.05	0.60 - 1.66	**Acceptable**
		Fe-59	1.57E+02	1.16E+01	1.32E+02	14	1.19	0.60 - 1.66	**Acceptable**
		Mn-54	1.34E+02	1.55E+01	1.18E+02	9	1.14	0.60 - 1.66	**Acceptable**
		Zn-65	2.05E+02	1.93E+01	1.77E+02	11	1.16	0.60 - 1.66	**Acceptable**
E13266 DET2	I-131 Cartridge	I-131	7.62E+01	7.03E+00	7.65E+01	11	1.00	0.60 - 1.66	**Acceptable**
E13266 DET3	I-131 Cartridge	I-131	8.04E+01	6.67E+00	7.65E+01	12	1.05	0.60 - 1.66	**Acceptable**
E13264	Gross Beta Air	g beta	1.64E+04	2.86E+01	1.61E+02	573	101.86	0.85 - 1.18	**Acceptable**
E13194 DET 2	Gamma Milk	I-131	4.81E+01	2.50E+00	4.73E+01	19	1.02	0.75 - 1.33	**Acceptable**
		Ce-141	1.92E+01	2.00E+00	1.83E+01	10	1.05	0.60 - 1.66	**Acceptable**
		Co-58	2.82E+01	1.60E+00	2.85E+01	18	0.99	0.75 - 1.33	**Acceptable**
		Co-60	5.03E+01	1.70E+00	4.81E+01	30	1.05	0.75 - 1.33	**Acceptable**
		Cr-51	3.75E+01	9.00E+00	3.29E+01	4	1.14	0.50 - 2.00	**Acceptable**
		Cs-134	3.01E+01	9.20E+00	3.08E+01	3	0.98	0.40 - 2.50	**Acceptable**
		Cs-137	4.08E+01	2.10E+00	3.82E+01	19	1.07	0.75 - 1.33	**Acceptable**
		Fe-59	2.32E+01	1.60E+00	2.00E+01	15	1.16	0.60 - 1.66	**Acceptable**
		Mn-54	4.35E+01	2.40E+00	4.13E+01	18	1.05	0.75 - 1.33	**Acceptable**
		Zn-65	5.13E+01	3.60E+00	4.86E+01	14	1.06	0.60 - 1.66	**Acceptable**
E13194 DET 3	Gamma Milk	I-131	4.98E+01	2.60E+00	4.73E+01	19	1.05	0.75 - 1.33	**Acceptable**
		Ce-141	2.16E+01	1.80E+00	1.83E+01	12	1.18	0.60 - 1.66	**Acceptable**
		Co-58	3.04E+01	1.90E+00	2.85E+01	16	1.07	0.75 - 1.33	**Acceptable**
		Co-60	5.14E+01	1.90E+00	4.81E+01	27	1.07	0.75 - 1.33	**Acceptable**
		Cr-51	3.25E+01	7.80E+00	3.29E+01	4	0.99	0.50 - 2.00	**Acceptable**
		Cs-134	2.99E+01	1.00E+00	3.08E+01	30	0.97	0.75 - 1.33	**Acceptable**
		Cs-137	4.06E+01	2.20E+00	3.82E+01	18	1.06	0.75 - 1.33	**Acceptable**
		Fe-59	2.49E+01	1.70E+00	2.00E+01	15	1.25	0.60 - 1.66	**Acceptable**
		Mn-54	4.50E+01	2.60E+00	4.13E+01	17	1.09	0.75 - 1.33	**Acceptable**
		Zn-65	5.43E+01	3.00E+00	4.86E+01	18	1.12	0.75 - 1.33	**Acceptable**
E13265	Gross Beta Water	g beta	2.70E+02	3.82E+00	2.50E+02	71	1.08	0.80 - 1.25	**Acceptable**
E13267	H-3 Water	H-3	1.06E+04	3.41E+02	1.20E+04	31	0.88	0.75 - 1.33	**Acceptable**

* calculated from PVNGS value/1 sigma error value

NRC Acceptance Criteria [1]

Resolution	Ratio
<4	0.4-2.5
4-7	0.5-2.0
8-15	0.6-1.66
16-50	0.75-1.33
51-200	0.80-1.25
>200	0.85-1.18

[1] From CY-NISP-201, Rev1, Attachment E

Table 7-1 Interlaboratory Comparison Results (Continued)

Sample Type	Analysis Type	ERA PT Study	Nuclide	Units	PVGS Value	Assigned Value [1]	Acceptance Limit [2]	Results
Water	Tritium	RAD-121	H-3	pCi/L	13,272	23,700	17900-28800	Acceptable
Water	Gross Beta	MRAD-32	Gross Beta	pCi/L	68.8	63.9	44.2-70.5	Acceptable
Water	Gamma	RAD-123	Ba-133	pCi/L	39	37	29.8 - 41.6	Acceptable
Water	Gamma	RAD-123	Cs-134	pCi/L	52.2	52.7	42.5 - 58.0	Acceptable
Water	Gamma	RAD-123	Cs-137	pCi/L	131	131	118 - 146	Acceptable
Water	Gamma	RAD-123	Co-60	pCi/L	60.6	60.5	54.4 - 69.1	Acceptable
Water	Gamma	RAD-123	Zn-65	pCi/L	165	162	146 - 191	Acceptable

[1] The ERA assigned values are established per the guidelines contained in the National Environmental Laboratory Accreditation Conference (NELAC) program criteria as applicable.

[2] "Acceptance Limits" have been calculated per ERA's Standard Operating Procedure for the Generation of Performance Acceptance Limits.

8. Data Interpretation and Conclusions

Associated with the analytical process are potential random and systematic errors. Systematic errors can be caused by instrument malfunctions, incomplete precipitation, back scattering, and self-absorption.

Efforts are made to minimize both systematic and random errors in the data reported. Systematic errors are minimized by performing reviews throughout the analysis. For example, instruments are checked routinely with radioactive sources, and recovery and self-absorption factors based on individual sample analyses are incorporated into the calculation equations where necessary. Random errors are reduced by comparing all data to historical data for the same site and performing comparisons between analytical results when available. In addition, when data appears to not match historical results, analyses may be rerun on a separate aliquot of the sample to verify the presence of the activity. The acceptance of data is dependent upon the results of quality control samples and is part of the data review process for all analytical results.

The "plus or minus value" reported with each analytical result represents the counting error associated with the result and gives the 95% confidence (2σ) interval around the data.

Most samples contain radioactivity associated with natural background/cosmic radioactivity (e.g. K-40, Th-234, Be-7). Gross beta results for drinking water and air are due to natural background. Gamma-emitting radionuclides, which can be attributed to natural background sources, are not indicated in this report.

Results and interpretation of the data for samples analyzed during 2020 are presented in the following sections.

8.1 Air Particulates

Weekly gross beta results, in quarterly format, are presented in Table 8-1 and Table 8-2. Gross beta activity at indicator locations ranged from 0.009 to 0.063 pCi/m^3. Mean quarterly activity is normally calculated using weekly activity over a thirteen (13) week period. Also presented in the tables are the weekly mean values of all the sites as well as the percent relative standard deviation (RSD %) for the data.

Table 8-3 displays the results of gamma spectroscopy on the quarterly composites of the weekly samples. No plant-related activity was identified

8.2 Airborne Radioiodine

Table 8-4 and Table 8-5 present the quarterly radioiodine results. Radioiodine was not observed in any samples.

8.3 Vegetation

Table 8-6 presents gamma isotopic data for the vegetation samples. No gamma-emitting radionuclides were observed in any of the samples.

8.4 Milk

Table 8-7 presents gamma isotopic data for the goat milk samples. No gamma-emitting radionuclides were observed in any of the samples.

8.5 Drinking Water

Samples were analyzed for gross beta, tritium, and gamma-emitting radionuclides. Results of these analyses are presented in Table 8-8. No tritium or gamma-emitting radionuclides were detected in any samples. Gross beta activity ranged from less than detectable to a high of 5.34 pCi/liter. The gross beta activity is attributable to natural (background) radioactive materials.

8.6 Groundwater

Groundwater samples were analyzed from three onsite wells (regional aquifer) for tritium and gamma-emitting radionuclides. Results obtained from the analysis of the samples are presented in Table 8-9.

No tritium or gamma-emitting radionuclides were observed in any of the samples.

8.7 Surface Water

Surface water samples from the Reservoirs and Evaporation Ponds were analyzed for tritium and gamma-emitting radionuclides. The two Reservoirs contain processed sewage water from the City of Phoenix and are approximately 45 and 85 acres in size. The three Evaporation Ponds receive mostly circulating water from main turbine condenser cooling and are about 200-250 acres each.

Sample results are presented in Table 8-10. I-131 is sometimes observed in reservoirs and Evaporation Ponds, which is the result of radiopharmaceutical I-131 in the Phoenix sewage effluent and is not attributable to plant effluents. However, I-131 was not observed in these surface water samples during 2020.

Tritium was routinely observed in the Evaporation Ponds. The highest concentration was 977 pCi/liter. Tritium was not detected in the Reservoirs. The tritium identified in the Evaporation Ponds has been attributed to permitted plant gaseous effluent releases and secondary plant liquid discharges (e.g. condensate overboard discharge, secondary side steam generator drains, secondary plant sumps, demineralizer regeneration waste). The tritium concentrations were compared to historical values and are considered typical for the Evaporation Ponds.

Low levels of Cs-137 have been detected in Evaporation Pond 3A. Evaporation Pond 3A is in the process of being drained for liner repairs. The water inventory is very low, such that the sampling tool comes into contact with the bottom and sides of the pond, resulting in a small amount of salt and sediment intrusion into the water sample. Evaporation Pond 3A has not received any influent from the plant since 2016, and the low levels of Cs-137 were not detectable until the water inventory in the pond was low, such that sampling tools also came into contact with the salt and/or sediment during sampling. The low levels of Cs-137 are consistent with background levels seen in preoperational sediment analysis and are attributed sediment intrusion from the surrounding area. No ODCM action levels have been exceeded.

8.8 Sludge and Sediment

8.8.1 Water Resources Centrifuge Waste Sludge

Sludge samples were obtained from the Water Resources (WR) centrifuge and analyzed by gamma spectroscopy. I-131 activity in the sludge is consistent with historical values and, as previously discussed, is due to radiopharmaceuticals in the WR Influent. The concentration of I-131 ranged from "no detectable" to 771 pCi/kg.

Results for WR centrifuge waste sludge can be found in Table 8-11.

8.8.2 Cooling Tower Sludge

Sludge/sediment originating from the Unit 1 and Unit 2 Cooling Towers and Circulating Water canals was disposed of in the WR sludge landfill during 2020. Sample results can be found in Table 8-11.

8.9 Data Trends

Figure 8-1 through Figure 8-8 present data in graphical format. Historical data are displayed for comparison where practical.

8.10 Hard-To-Detect Radionuclide Results

Table 8-12 shows the results of the three subsurface samples obtained from 3 tritium monitoring points. These samples were analyzed for hard-to-detect radionuclides (e.g. C-14, Fe-55, Ni-63, Sr-90) and all results were <MDA. These results indicate that no leaks from plant systems have affected groundwater.

Table 8-1 Particulate Gross Beta in Air 1st-2nd Quarter

PARTICULATE GROSS BETA IN AIR 1st QUARTER

ODCM required samples denoted by *

units are pCi/m^3

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
1	31-Dec-19	7-Jan-20	0.029	0.028	0.026	0.024	0.026	0.026	0.024	0.024	0.024	0.023	0.025	7.1	
2	7-Jan-20	14-Jan-20	0.030	0.033	0.032	0.034	0.031	0.030	0.029	0.034	0.029	0.031	0.031	5.8	
3	14-Jan-20	21-Jan-20	0.036	0.036	0.035	0.037	0.035	0.036	0.035	0.032	0.034	0.032	0.035	4.9	
4	21-Jan-20	28-Jan-20	0.032	0.035	0.036	0.039	0.040	0.037	0.037	0.039	0.034	0.038	0.037	6.7	
5	28-Jan-20	4-Feb-20	0.021	0.021	0.020	0.019	0.018	0.019	0.020	0.020	0.016	0.016	0.019	10.5	
6	4-Feb-20	10-Feb-20	0.026	0.023	0.025	0.025	0.019	0.022	0.025	0.023	0.021	0.023	0.024	7.4	1
7	10-Feb-20	18-Feb-20	0.031	0.033	0.030	0.028	0.033	0.032	0.029	0.032	0.030	0.030	0.031	5.8	
8	18-Feb-20	25-Feb-20	0.034	0.032	0.035	0.032	0.034	0.031	0.031	0.034	0.030	0.035	0.033	5.3	
9	25-Feb-20	3-Mar-20	0.024	0.027	0.025	0.023	0.024	0.024	0.005	0.025	0.024	0.025	0.025	4.6	2
10	3-Mar-20	10-Mar-20	0.030	0.028	0.025	0.023	0.024	0.024	0.027	0.027	0.024	0.025	0.025	8.5	
11	10-Mar-20	17-Mar-20	0.004	0.012	0.010	0.009	0.009	0.009	0.009	0.010	0.011	0.009	0.010	10.3	3
12	17-Mar-20	24-Mar-20	0.015	0.012	0.013	0.013	0.013	0.013	0.012	0.015	0.013	0.013	0.013	7.7	
13	24-Mar-20	31-Mar-20	0.018	0.019	0.017	0.017	0.018	0.017	0.019	0.018	0.018	0.017	0.018	4.9	
	Mean		0.027	0.026	0.025	0.025	0.025	0.025	0.025	0.026	0.024	0.024	0.025	3.8	

Note 1: Site 15 pump found inoperable at time of sample change out. Pump replaced. Sample volume unknown and conservative values used for analysis; sample is INVALID and data is for INFO ONLY for Week 6. Pump volume for Sample Week 7 slightly shorter due to pump replacement. CR 20-01823

Note 2: Site 21 pump found inoperable at time of sample change out. ETM still running, but bump had stopped. Volume unknown and conservative value used for analysis; sample is INVALID and data is for INFO ONLY. CR 20-02874

Note 3: Site 4 pump found inoperable at time of sample change out. Sample is INVALID and data is for INFO ONLY. CR 20-03756

PARTICULATE GROSS BETA IN AIR 2nd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

Week #	START DATE	STOP DATE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
14	31-Mar-20	7-Apr-20	0.029	0.027	0.026	0.031	0.023	0.027	0.028	0.028	0.029	0.027	0.027	8.0	4
15	7-Apr-20	14-Apr-20	0.014	0.015	0.014	0.016	0.015	0.014	0.015	0.014	0.015	0.011	0.014	9.0	
16	14-Apr-20	21-Apr-20	0.023	0.031	0.006	0.025	0.024	0.029	0.028	0.026	0.027	0.028	0.027	9.3	5
17	21-Apr-20	28-Apr-20	0.026	0.033	0.032	0.029	0.026	0.032	0.027	0.027	0.028	0.025	0.029	10.1	
18	28-Apr-20	5-May-20	0.034	0.033	0.033	0.033	0.032	0.033	0.032	0.035	0.032	0.033	0.033	3.4	
19	5-May-20	12-May-20	0.038	0.035	0.036	0.038	0.037	0.036	0.035	0.040	0.039	0.035	0.037	4.8	
20	12-May-20	19-May-20	0.027	0.025	0.025	0.025	0.026	0.026	0.024	0.026	0.024	0.025	0.025	3.8	
21	19-May-20	26-May-20	0.023	0.019	0.022	0.019	0.021	0.023	0.019	0.021	0.022	0.019	0.021	8.4	
22	26-May-20	2-Jun-20	0.035	0.035	0.033	0.033	0.033	0.034	0.034	0.032	0.032	0.034	0.034	3.6	
23	2-Jun-20	9-Jun-20	0.025	0.024	0.025	0.022	0.024	0.026	0.025	0.028	0.026	0.024	0.025	6.5	
24	9-Jun-20	16-Jun-20	0.022	0.023	0.022	0.022	0.020	0.022	0.021	0.023	0.020	0.021	0.022	5.1	
25	16-Jun-20	23-Jun-20	0.025	0.022	0.020	0.021	0.022	0.023	0.022	0.024	0.026	0.022	0.023	7.9	
26	23-Jun-20	29-Jun-20	0.029	0.029	0.025	0.028	0.024	0.028	0.025	0.027	0.029	0.028	0.027	7.3	6
	Mean		0.027	0.027	0.026	0.026	0.025	0.027	0.026	0.027	0.027	0.025	0.026	2.8	

Note 4: Site 4 Elapsed Time Meter (ETM) failed. Sample pump continued operating normally and filter appeared to have expected dust loading. Volume calculated using documented runtime and start/stop flow measurement. Sample VALID. CR 20-04663

Note 5: Site 7 sample pump failed with indications of broken pump vanes at some time during the sample period. ETM continued running; sample volume could not be determined, sample counted with default volume. Sample is INVALID, data is for INFO ONLY. CR 20-05496

Note 6: Site 40 Sample found on ground mid-sampling period. Sample replaced. Sample INVALID; data for info only. CR 20-08450

Table 8-2 Particulate Gross Beta in Air 3rd-4th Quarter

PARTICULATE GROSS BETA IN AIR 3rd QUARTER

ODCM required samples denoted by *

units are pCi/m^3

3rd Quarter

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
27	29-Jun-20	7-Jul-20	0.023	0.021	0.022	0.022	0.019	0.021	0.020	0.021	0.022	0.019	0.021	7.0	
28	7-Jul-20	14-Jul-20	0.025	0.027	0.025	0.028	0.029	0.024	0.020	0.026	0.024	0.027	0.026	9.9	
29	14-Jul-20	21-Jul-20	0.024	0.023	0.021	0.023	0.022	0.023	0.020	0.021	0.023	0.022	0.022	5.5	
30	21-Jul-20	28-Jul-20	0.031	0.024	0.033	0.026	0.025	0.027	0.025	0.027	0.023	0.024	0.026	11.8	
31	28-Jul-20	4-Aug-20	0.029	0.032	0.030	0.027	0.029	0.030	0.029	0.030	0.030	0.030	0.030	4.3	
32	4-Aug-20	11-Aug-20	0.032	0.032	0.032	0.032	0.027	0.033	0.029	0.029	0.030	0.032	0.031	6.1	
33	11-Aug-20	18-Aug-20	0.034	0.036	0.033	0.035	0.034	0.037	0.033	0.035	0.036	0.033	0.035	4.1	
34	18-Aug-20	25-Aug-20	0.035	0.033	0.034	0.035	0.033	0.033	0.034	0.033	0.035	0.032	0.034	3.3	
35	25-Aug-20	1-Sep-20	0.038	0.037	0.037	0.038	0.036	0.041	0.037	0.036	0.039	0.037	0.037	4.3	7
36	1-Sep-20	8-Sep-20	0.035	0.036	0.033	0.034	0.028	0.035	⊥0.034	0.031	0.035	0.035	0.034	7.1	7
37	8-Sep-20	15-Sep-20	0.039	0.039	0.035	0.030	0.040	0.036	0.036	⊥0.035	0.037	0.034	0.036	8.4	
38	15-Sep-20	22-Sep-20	0.050	0.051	0.051	0.063	0.051	0.050	0.0492	0.048	0.054	0.051	0.052	8.3	8
39	22-Sep-20	29-Sep-20	0.035	0.035	0.034	0.030	0.036	0.034	0.033	0.018	0.031	0.034	0.033	5.3	9
	Mean		0.033	0.033	0.032	0.033	0.031	0.033	0.029	0.031	0.032	0.031	0.032	4.4	

Note 7: ETM failed for site 21. Volume calculated. Samples are VALID. CR 20-11100

Note 8: Site 21 found to have a failed air sample pump. ETM still running. Not possible to determine sample volume. Data reported for INFO ONLY. Sample is INVALID. CR 20-11937

Note 9: Site 29 sample flow found at 18 LPM, vs normal flow of 43 LPM. Regulator screw found to be out of position and was corrected. Sample INVALID due to flow rate <25 LPM. CR 20-12260

PARTICULATE GROSS BETA IN AIR 4th QUARTER

ODCM required samples denoted by *

units are pCi/m^3

Week #	START DATE	STOP DATE	Site 4	Site 6A* (control)	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Mean	RSD (%)	Note
40	29-Sep-20	6-Oct-20	0.049	0.052	0.045	0.045	0.042	0.042	0.046	0.047	0.046	0.044	0.046	6.4	
41	6-Oct-20	13-Oct-20	0.049	0.052	0.045	0.039	0.048	0.048	0.048	0.046	0.045	0.040	0.046	8.7	
42	13-Oct-20	20-Oct-20	0.042	0.049	0.038	0.037	0.038	0.040	0.038	0.039	0.035	0.032	0.039	11.9	
43	20-Oct-20	27-Oct-20	0.045	0.047	0.043	0.040	0.044	0.043	0.042	0.042	0.040	0.041	0.043	5.5	
44	27-Oct-20	3-Nov-20	0.045	0.050	0.043	0.047	0.049	0.047	0.048	0.047	0.046	0.042	0.046	5.5	
45	3-Nov-20	9-Nov-20	0.042	0.046	0.042	0.044	0.046	0.044	0.042	0.048	0.042	0.039	0.043	5.9	
46	9-Nov-20	17-Nov-20	0.034	0.035	0.031	0.031	0.033	0.034	0.033	0.033	0.031	0.030	0.033	4.4	
47	17-Nov-20	23-Nov-20	0.042	0.042	0.037	0.021	0.038	0.038	0.039	0.038	0.036	0.030	0.036	17.7	
48	23-Nov-20	1-Dec-20	0.043	0.040	0.039	0.024	0.038	0.039	0.038	0.040	0.039	0.035	0.037	14.0	
49	1-Dec-20	8-Dec-20	0.046	0.035	0.046	0.039	0.044	0.041	0.041	0.043	0.039	0.034	0.041	10.2	
50	8-Dec-20	15-Dec-20	0.040	0.044	0.041	0.041	0.040	0.042	0.039	0.039	0.042	0.035	0.040	6.1	
51	15-Dec-20	21-Dec-20	0.039	0.036	0.032	0.030	0.034	0.032	0.030	0.033	0.027	0.025	0.032	13.1	10
52	21-Dec-20	28-Dec-20	0.037	0.042	0.040	0.036	0.036	0.033	0.035	0.036	0.032	0.034	0.036	8.5	
	Mean		0.042	0.044	0.040	0.036	0.041	0.040	0.040	0.041	0.038	0.035	0.040	6.4	
	Annual Average		***0.03248***	***0.03234***	***0.03098***	***0.02993***	***0.03075***	***0.03114***	***0.02999***	***0.03105***	***0.03024***	***0.02918***	***0.0308***	***7.3080***	

Note 10: ETM for site 15 failed during sample period. Volume was manually calculated using the flow rate and sample start/stop time. Sample is VALID. CR 20-16673

Table 8-3 Gamma in Air Filter Composites

GAMMA IN AIR FILTER COMPOSITES

ODCM required samples denoted by *

units are pCi/m^3

QUARTER ENDPOINT	NUCLIDE	Site 4	(control) Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
31-Mar-20	Cs-134	<0.001	<0.002	<0.003	<0.002	<0.002	<0.002	<0.001	<0.002	<0.003	<0.002	
	Cs-137	<0.002	<0.002	<0.002	<0.001	<0.004	<0.003	<0.003	<0.002	<0.003	<0.002	
29-Jun-20	Cs-134	<0.001	<0.003	<0.001	<0.003	<0.001	<0.003	<0.003	<0.002	<0.002	<0.002	
	Cs-137	<0.001	<0.002	<0.003	<0.004	<0.002	<0.002	<0.003	<0.003	<0.003	<0.003	
29-Sep-20	Cs-134	<0.002	<0.001	<0.002	<0.002	<0.002	<0.004	<0.003	<0.002	<0.002	<0.002	
	Cs-137	<0.003	<0.001	<0.002	<0.003	<0.003	<0.002	<0.004	<0.001	<0.003	<0.001	
28-Dec-20	Cs-134	<0.001	<0.003	<0.002	<0.003	<0.002	<0.003	<0.001	<0.002	<0.002	<0.002	
	Cs-137	<0.001	<0.004	<0.003	<0.004	<0.003	<0.003	<0.002	<0.002	<0.002	<0.003	

Table 8-4 Radioiodine in Air 1st-2nd Quarter

RADIOIODINE IN AIR 1st QUARTER
ODCM required samples denoted by *
units are pCi/m^3

				(control)		required LLD <0.070							
Week #	START DATE	STOP DATE	Site 4	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	⊥Note
1	31-Dec-19	7-Jan-20	<0.024	<0.023	<0.039	<0.020	<0.012	<0.027	<0.047	<0.036	<0.016	<0.061	
2	7-Jan-20	14-Jan-20	<0.017	<0.030	<0.025	<0.017	<0.035	<0.021	<0.037	<0.024	<0.036	<0.024	
3	14-Jan-20	21-Jan-20	<0.054	<0.042	<0.026	<0.045	<0.022	<0.034	<0.032	<0.028	<0.050	<0.032	
4	21-Jan-20	28-Jan-20	<0.023	<0.006	<0.062	<0.022	<0.052	<0.033	<0.043	<0.027	<0.026	<0.043	
5	28-Jan-20	4-Feb-20	<0.034	<0.034	<0.034	<0.044	<0.023	<0.050	<0.027	<0.029	<0.044	<0.037	
6	4-Feb-20	10-Feb-20	<0.043	<0.030	<0.038	<0.025	<0.069	<0.030	<0.038	<0.030	<0.040	<0.030	1
7	10-Feb-20	18-Feb-20	<0.023	<0.019	<0.011	<0.023	<0.059	<0.024	<0.054	<0.026	<0.020	<0.031	1
8	18-Feb-20	25-Feb-20	<0.006	<0.031	<0.035	<0.031	<0.028	<0.025	<0.031	<0.017	<0.033	<0.028	
9	25-Feb-20	3-Mar-20	<0.027	<0.030	<0.013	<0.029	<0.036	<0.036	<0.047	<0.044	<0.027	<0.031	2
10	3-Mar-20	10-Mar-20	<0.031	<0.024	<0.040	<0.024	<0.047	<0.028	<0.047	<0.018	<0.021	<0.042	
11	10-Mar-20	17-Mar-20	<0.033	<0.028	<0.064	<0.021	<0.015	<0.026	<0.040	<0.034	<0.021	<0.021	3
12	17-Mar-20	24-Mar-20	<0.022	<0.029	<0.017	<0.028	<0.016	<0.030	<0.017	<0.031	<0.017	<0.028	
13	24-Mar-20	31-Mar-20	<0.027	<0.036	<0.007	<0.031	<0.022	<0.032	<0.023	<0.019	<0.023	<0.038	

Note 1: Site 15 pump found inoperable at time of sample change out. Pump replaced. Sample volume unknown and conservative values used for analysis; sample is INVALID and data is for INFO ONLY for Week 6. Pump volume for Sample Week 7 slightly shorter due to pump replacement. CR 20-01823

Note 2: Site 21 pump found inoperable at time of sample change out. ETM still running, but bump had stopped. Volume unknown and conservative value used for analysis; sample is INVALID and data is for INFO ONLY. CR 20-02874

Note 3: Site 4 pump found inoperable at time of sample change out. Sample is INVALID and data is for INFO ONLY. CR 20-03756

RADIOIODINE IN AIR 2nd QUARTER
ODCM required samples denoted by *
units are pCi/m^3

				(control)		required LLD <0.070							
Week #	DATE	DATE	4	6A*	7A	14A*	15*	17A	21	29*	35	40*	⊥Note
14	21-Mar-20	7-Apr-20	<0.027	<0.027	<0.038	<0.034	<0.031	<0.024	<0.024	<0.024	<0.028	<0.042	4
15	7-Apr-20	14-Apr-20	<0.018	<0.033	<0.040	<0.029	<0.037	<0.023	<0.029	<0.07	<0.033	<0.007	
16	14-Apr-20	21-Apr-20	<0.007	<0.029	<0.026	<0.023	<0.018	<0.007	<0.023	<0.027	<0.007	<0.018	5
17	21-Apr-20	28-Apr-20	<0.029	<0.039	<0.036	<0.030	<0.030	<0.019	<0.036	<0.024	<0.037	<0.040	
18	28-Apr-20	5-May-20	<0.031	<0.032	<0.025	<0.025	<0.039	<0.006	<0.030	<0.030	<0.041	<0.028	
19	5-May-20	12-May-20	<0.032	<0.017	<0.035	<0.006	<0.030	<0.021	<0.031	<0.028	<0.029	<0.027	
20	12-May-20	19-May-20	<0.030	<0.025	<0.031	<0.031	<0.027	<0.035	<0.031	<0.034	<0.036	<0.017	
21	19-May-20	26-May-20	<0.023	<0.027	<0.024	<0.019	<0.031	<0.023	<0.028	<0.027	<0.019	<0.027	
22	16-May-20	2-Jun-20	<0.030	<0.034	<0.039	<0.024	<0.024	<0.023	<0.032	<0.032	<0.037	<0.034	
23	2-Jun-20	9-Jun-20	<0.025	<0.026	<0.007	<0.035	<0.007	<0.035	<0.037	<0.025	<0.030	<0.026	
24	9-Jun-20	16-Jun-20	<0.032	<0.0331	<0.025	<0.025	<0.041	<0.028	<0.022	<0.017	<0.032	<0.006	
25	16-Jun-20	23-Jun-20	<0.031	<0.038	<0.031	<0.022	<0.021	<0.022	<0.021	<0.033	<0.028	<0.027	
26	23-Jun-20	29-Jun-20	<0.031	<0.040	<0.031	<0.008	<0.052	<0.035	<0.042	<0.034	<0.027	<0.056	6

Note 4: Site 4 Elapsed Time Meter (ETM) failed. Sample pump continued operating normally and filter appeared to have expected dust loading. Volume calculated using documented runtime and start/stop flow measurement. Sample VALID. CR 20-04663

Note 5: Site 7 sample pump failed with indications of broken pump vanes at some time during the sample period. ETM continued running; sample volume could not be determined, sample counted with default volume. Sample is INVALID, data is for INFO ONLY. CR 20-05496

Note 6: Site 40 Sample found on ground mid-sampling period. Sample replaced. Sample INVALID; data for info only. CR 20-08450

Table 8-5 Radioiodine in Air 3rd-4th Quarter

RADIOIODINE IN AIR 3rd QUARTER
ODCM required samples denoted by *

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
						required LLD <0.070							
27	29-Jun-20	7-Jul-20	<0.006	<0.005	<0.027	<0.019	<0.019	<0.024	<0.019	<0.019	<0.015	<0.022	
28	7-Jul-20	14-Jul-20	<0.026	<0.035	<0.007	<0.026	<0.035	<0.025	<0.026	<0.026	<0.035	<0.029	
29	14-Jul-20	21-Jul-20	<0.006	<0.017	<0.033	<0.006	<0.035	<0.022	<0.032	<0.022	<0.018	<0.017	
30	21-Jul-20	28-Jul-20	<0.033	<0.032	<0.054	<0.023	<0.036	<0.067	<0.027	<0.019	<0.048	<0.033	
31	28-Jul-20	4-Aug-20	<0.028	<0.017	<0.028	<0.017	<0.036	<0.021	<0.043	<0.037	<0.017	<0.043	
32	4-Aug-20	11-Aug-20	<0.034	<0.026	<0.046	<0.007	<0.037	<0.023	<0.047	<0.033	<0.007	<0.038	
33	11-Aug-20	18-Aug-20	<0.037	<0.026	<0.036	<0.029	<0.045	<0.042	<0.035	<0.031	<0.038	<0.022	
34	18-Aug-20	25-Aug-20	<0.035	<0.018	<0.048	<0.040	<0.038	<0.041	<0.014	<0.039	<0.031	<0.048	
35	25-Aug-20	1-Sep-20	<0.030	<0.028	<0.031	<0.023	<0.023	<0.032	<0.027	<0.007	<0.019	<0.027	7
36	1-Sep-20	8-Sep-20	<0.023	<0.031	<0.030	<0.026	<0.027	<0.018	┴<0.039	<0.023	<0.031	<0.024	7
37	8-Sep-20	15-Sep-20	<0.033	<0.035	<0.026	<0.025	<0.026	<0.023	<0.034	┴<0.025	<0.033	<0.031	
38	15-Sep-20	22-Sep-20	<0.023	<0.030	<0.028	<0.033	<0.023	<0.022	<0.031	<0.023	<0.018	<0.027	8
39	22-Sep-20	29-Sep-20	<0.035	<0.007	<0.039	<0.037	<0.032	<0.035	<0.031	<0.026	<0.024	<0.007	9

Note 7: ETM for site 21 failed during sample period. Volume was manually calculated using the flow rate and sample start/stop time. Sample is VALID. CR 20-11100

Note 8: Site 21 found to have a failed air sample pump. ETM still running. Not possible to determine sample volume. Data reported for INFO ONLY. Sample is INVALID. CR 20-11937

Note 9: Site 29 sample flow found at 18 LPM, vs normal flow of 43 LPM. Regulator screw found to be out of position and was corrected. Sample INVALID due to flow rate <25 LPM. CR 20-12260

RADIOIODINE IN AIR 4th QUARTER
ODCM required samples denoted by *
units are pCi/m^3

Week #	START DATE	STOP DATE	Site 4 (control)	Site 6A*	Site 7A	Site 14A*	Site 15*	Site 17A	Site 21	Site 29*	Site 35	Site 40*	Note
						required LLD <0.070							
40	29-Sep-20	6-Oct-20	<0.031	<0.029	<0.013	<0.026	<0.045	<0.030	<0.045	<0.023	<0.018	<0.054	
41	6-Oct-20	13-Oct-20	<0.007	<0.020	<0.032	<0.025	<0.027	<0.026	<0.034	<0.018	<0.018	<0.032	
42	13-Oct-20	20-Oct-20	<0.027	<0.023	<0.052	<0.023	<0.038	<0.045	<0.053	<0.038	<0.023	<0.029	
43	20-Oct-20	27-Oct-20	<0.032	<0.029	<0.007	<0.037	<0.027	<0.039	<0.024	<0.019	<0.023	<0.040	
44	27-Oct-20	3-Nov-20	<0.034	<0.006	<0.035	<0.026	<0.014	<0.023	<0.045	<0.029	<0.018	<0.037	
45	3-Nov-20	9-Nov-20	<0.034	<0.026	<0.042	<0.034	<0.069	<0.031	<0.043	<0.041	<0.026	<0.063	
46	9-Nov-20	17-Nov-20	<0.022	<0.052	<0.051	<0.016	<0.040	<0.030	<0.011	<0.025	<0.019	<0.029	
47	17-Nov-20	23-Nov-20	<0.008	<0.063	<0.038	<0.016	<0.065	<0.044	<0.036	<0.034	<0.016	<0.028	
48	23-Nov-20	1-Dec-20	<0.022	<0.031	<0.045	<0.019	<0.051	<0.019	<0.030	<0.030	<0.036	<0.024	
49	1-Dec-20	8-Dec-20	<0.026	<0.044	<0.035	<0.018	<0.065	<0.032	<0.017	<0.065	<0.022	<0.017	
50	8-Dec-20	15-Dec-20	<0.031	<0.021	<0.052	<0.031	<0.062	<0.025	<0.058	<0.021	<0.035	<0.025	
51	15-Dec-20	21-Dec-20	<0.025	<0.066	<0.038	<0.059	<0.050	<0.029	<0.050	<0.038	<0.058	<0.025	10
52	21-Dec-20	28-Dec-20	<0.007	<0.037	<0.055	<0.023	<0.038	<0.042	<0.014	<0.024	<0.023	<0.036	

Note 10: ETM for site 15 failed during sample period. Volume was manually calculated using the flow rate and sample start/stop time. Sample is VALID. CR 20-16673

Table 8-6 Vegetation

VEGETATION
ODCM required samples denoted by *
units are pCi/kg, wet

LOCATION	TYPE	DATE COLLECTED	I-131	Cs-134	Cs-137	Note
LOCAL RESIDENCE (Site #47)*	Lettuce	16-Jan-20	<45	<41	<40	
	Lettuce	20-Feb-20	<43	<13	<42	
	Romain	19-Mar-20	<59	<15	<49	
	Lettuce	16-Apr-20	<56	<49	<50	
	Lettuce	21-May-20	<47	<59	<64	
		June- No Sample Available				
		July- No Sample Available				
		August- No Sample Available				
		September- No Sample Available				
		October- No Sample Available				
		November- No Sample Available				
		December- No Sample Available				
COMMERCIAL FARM (Site #62)*	Lettuce	16-Jan-20	<37	<24	<48	
	Spinach	16-Jan-20	<42	<36	<58	
	Spring Mix	20-Feb-20	<45	<37	<62	
	Arugula	20-Feb-20	<36	<38	<11	
	Romaine	20-Feb-20	<50	<37	<59	
	Mizuna	26-Mar-20	<40	<31	<45	
	Red Romaine	26-Mar-20	<43	<30	<38	
	Spinach	26-Mar-20	<40	<10	<41	
	Mizuna	16-Apr-20	<40	<41	<61	
	Spinach	16-Apr-20	<31	<30	<37	
		May- No Sample Available				
		June-No Sample Available				
		July- No Sample Available				
		August- No Sample Available				
		September- No Sample Available				
		October- No Sample Available				
	Lettuce	20-Nov-20	<45	<34	<55	
	Spinach	18-Dec-20	<42	<22	<39	
	Baby Butter	18-Dec-20	<57	<48	<69	
LOCAL RESIDENCE (Site #51)		**January- No Sample Available**				
		February- No Sample Available				
	Chard	19-Mar-20	<59	<51	<70	
	Lettuce	17-Apr-20	<56	<43	<67	
	Swiss Chard	22-May-20	<54	<47	<66	
	Kale	22-May-20	<54	<54	<58	
	Lettuce	18-Jun-20	<60	<55	<72	
	Chard	16-Jul-20	<54	<46	<45	
	Chard	21-Aug-20	<59	<50	<62	
		September- No Sample Available				
		October- No Sample Available				
		November- No Sample Available				
		December- No Sample Available				

Table 8-7 Milk

MILK

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	I-131	Cs-134	Cs-137	Ba-140	La-140	⊥Note
	January Sample Unavailable- Baby Goats						
Local Resident Goats	**February Sample Unavailable- Baby Goats**						
	March Sample Unavailable- Baby Goats						
(Site #51)*	17-Apr-20	<1	<1	<1	<3	<1	
	22-May-20	<1	<1	<1	<3	<1	
	18-Jun-20	<1	<1	<1	<3	<1	
	16-Jul-20	<1	<1	<1	<3	<1	
	28-Aug-20	≤1	<1	<1	<4	<2	3
	18-Sep-20	<1	<1	<1	<3	<1	
	22-Oct-20	≤1	<1	<1	<3	<1	4
	19-Nov-20	<1	<1	<1	<3	<1	
	10-Dec-20	<1	<1	<1	<3	<1	
	23-Jan-20	<1	<1	<1	<3	<1	
	27-Feb-20	<1	<1	<1	<3	<1	
	26-Mar-20	<1	<1	<1	<3	<1	1
Local Resident Goats	24-Apr-20	<1	<1	<1	<3	<1	
	28-May-20	<1	<1	<1	<3	<1	
(Site #53)*	01-Jul-20	<1	<1	<1	<3	<1	2
	23-Jul-20	<1	<1	<1	<3	<1	
	26-Aug-20	≤1	<1	<1	<3	<2	3
	Sep	<1	<1	<1	<3	<1	
	29-Oct-20	<2	<2	<2	<9	<3	5
	20-Nov-20	<1	<1	<1	<3	<1	
	17-Dec-20	<1	<1	<1	<3	<1	
	09-Jan-20	<1	<1	<1	<3	<1	
Local Resident Goats	20-Feb-20	<1	<1	<1	<3	<1	
	13-Mar-20	<1	<1	<1	<4	<1	
(Site #54)*	09-Apr-20	<1	<1	<1	<3	<1	
	14-May-20	<1	<1	<1	<3	<1	
	11-Jun-20	<1	<1	<1	<3	<1	
	16-Jul-20	<1	<1	<1	<3	<1	
	14-Aug-20	<1	<1	<1	<3	<1	3
	11-Sep-20	<1	<1	<1	<3	<1	
	16-Oct-20	<1	<1	<1	<3	<2	
	12-Nov-20	<1	<1	<1	<3	<1	
	04-Dec-20	<1	<1	<1	<3	<1	

Note1: Initial sample analysis reported detectable levels of Zn-65. Confirmatory analysis showed no detectable Zn-65. CR 20-04338.

Note 2: Original sample had LLD @ 1..09 pCi/L. Sample recollected 7/1/2020to achieve LLD <1 pCi/L. Recount is documented in this table. All other LLDs were achieved on both samples.

Note 3: MCA power interruption resulted in higher than typical MDA. ODCM reports LLD to single significant digit, which results do comply with. CR 20-11097

Note 4: MCA power interruption resulted in higher than typical MDA. ODCM reports LLD to single significant digit, which results do comply with. CR 20-14077

Note 5: MCA power interruption resulted in missed LLD for I-131. CR 20-14425

Table 8-8 Drinking Water

DRINKING WATER

**ODCM required samples denoted by *
units are pCi/liter**

SAMPLE LOCATION	MONTH ENDPOINT	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Qtrly Tritium	Gross Beta	Note
LOCAL RESIDENCE (Site #48) *	28-Jan-20	<10	<10	<14	<10	<19	<12	<18	<9	<9	<10	<29	<14		<2.85	
	25-Feb-20	<12	<11	<24	<10	<24	<13	<16	<12	<8	<11	<37	<12		5.04±1.83	
	31-Mar-20	<10	<8	<19	<9	<21	<9	<16	<9	<6	<8	<32	<14	<325	<2.84	
	28-Apr-20	<9	<12	<23	<9	<17	<11	<19	<9	<8	<11	<31	<13		<2.90	
	26-May-20	<11	<12	<21	<9	<22	<11	<20	<11	<11	<12	<35	<10		3.36±1.73	
	29-Jun-20	<11	<10	<19	<7	<23	<10	<15	<9	<8	<11	<30	<9	<330	<2.73	
	28-Jul-20	<11	<11	<24	<7	<25	<12	<19	<10	<9	<14	<36	<14		<2.81	
	25-Aug-20	<9	<13	<28	<10	<17	<13	<23	<11	<9	<16	<36	<14		<3.11	
	29-Sep-20	<9	<9	<21	<12	<19	<12	<18	<10	<9	<10	<33	<10	<324	<3.16	
	27-Oct-20	<4	<4	<7	<4	<8	<4	<7	<5	<3	<4	<14	<14		3.31±1.72	
	23-Nov-20	<14	<11	<24	<8	<29	<10	<24	<11	<8	<14	<40	<15		3.27±1.84	
	28-Dec-20	<13	<14	<23	<11	<24	<13	<23	<12	<11	<12	<39	<15	<325	3.04±1.83	
LOCAL RESIDENCE (Site #55)	28-Jan-20	<11	<11	<20	<11	<20	<11	<21	<9	<7	<13	<30	<13		3.14±1.69	
	25-Feb-20	<4	<4	<8	<5	<9	<5	<8	<4	<4	<4	<16	<12		3.97±1.63	
	31-Mar-20	<9	<9	<16	<8	<14	<8	<15	<9	<7	<8	<29	<15	<325	4.15±1.74	
	28-Apr-20	<11	<9	<22	<11	<19	<11	<15	<8	<8	<10	<35	<14		3.30±1.76	
	26-May-20	<9	<10	<20	<8	<12	<10	<17	<7	<7	<7	<31	<8		4.19±1.67	
	29-Jun-20	<12	<9	<11	<11	<20	<10	<19	<7	<9	<8	<31	<10	<332	<2.65	
	30-Jul-20	<10	<10	<19	<11	<20	<10	<19	<10	<9	<9	<28	<9		5.34±1.76	
	25-Aug-20	<9	<9	<17	<9	<23	<9	<19	<10	<9	<9	<34	<12		<2.91	
	22-Sep-20	<3	<3	<6	<3	<6	<3	<5	<5	<2	<3	<13	<72	<323	<2.96	1
	27-Oct-20	<5	<6	<12	<5	<13	<6	<10	<6	<5	<7	<20	<15		4.82±1.68	
	23-Nov-20	<10	<9	<16	<10	<20	<10	<17	<10	<10	<11	<32	<10		4.72±1.82	
	28-Dec-20	<10	<12	<20	<12	<21	<12	<16	<9	<10	<11	<37	<15	<324	4.33±1.78	

Note 1: LLD for LA-140 not achieved due to an inability to get final sample for the monthly composite. Well was out of service for final week in sampling period. CR 20-12459

Table 8-8 Drinking Water (Continued)

DRINKING WATER

**ODCM required samples denoted by *
units are pCi/liter**

SAMPLE LOCATION	MONTH ENDPOINT	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Qtrly Tritium	Gross Beta	Note
LOCAL RESIDENCE (Site #46) *	28-Jan-20	<14	<12	<20	<8	<23	<11	<22	<11	<11	<11	<37	<13		<2.62	
	25-Feb-20	<5	<5	<11	<4	<11	<5	<9	<5	<4	<5	<18	<14		5.32±1.65	
	31-Mar-20	<5	<5	<10	<5	<10	<5	<10	<6	<4	<6	<19	<12	<324	<2.62	
	28-Apr-20	<10	<6	<11	<8	<19	<8	<17	<8	<8	<7	<33	<10		<2.70	
	26-May-20	<7	<6	<13	<7	<16	<7	<12	<7	<6	<8	<21	<12		3.40±1.62	
	29-Jun-20	<10	<11	<21	<10	<22	<11	<15	<8	<8	<9	<33	<11	<330	<2.66	
	28-Jul-20	<10	<9	<19	<11	<17	<10	<17	<9	<8	<11	<32	<10		2.99±1.66	
	25-Aug-20	<10	<11	<17	<11	<25	<8	<18	<9	<8	<9	<31	<12		<2.91	
	29-Sep-20	<10	<9	<19	<11	<19	<8	<17	<10	<7	<10	<31	<12	<322	<2.99	
	27-Oct-20	<6	<5	<12	<5	<12	<6	<10	<6	<5	<6	<20	<11		4.15±1.67	
	23-Nov-20	<12	<12	<25	<12	<23	<12	<18	<11	<10	<14	<30	<12		<2.82	
	28-Dec-20	<10	<9	<19	<11	<20	<10	<18	<10	<9	<11	<36	<11	<320	3.00±1.72	
LOCAL RESIDENCE (Site #49) *	28-Jan-20	<11	<10	<20	<11	<27	<11	<17	<10	<8	<11	<39	<13		<2.84	
	25-Feb-20	<7	<6	<12	<6	<15	<7	<11	<6	<6	<7	<22	<15		<2.41	
	31-Mar-20	<6	<6	<14	<6	<12	<7	<10	<6	<5	<5	<23	<15	<325	<2.58	
	28-Apr-20	<12	<8	<18	<9	<21	<10	<16	<8	<8	<11	<35	<8		<2.65	
	26-May-20	<8	<7	<12	<7	<13	<7	<12	<6	<6	<7	<24	<14		<2.46	
	29-Jun-20	<11	<8	<19	<9	<23	<8	<17	<8	<7	<7	<30	<10	<324	<2.61	
	28-Jul-20	<10	<9	<20	<8	<20	<12	<16	<9	<7	<9	<32	<14		<2.54	
	25-Aug-20	<8	<8	<15	<8	<22	<8	<17	<8	<8	<8	<26	<13		<2.80	
	29-Sep-20	<9	<10	<17	<9	<21	<9	<18	<9	<9	<11	<30	<9	<325	<2.84	
	27-Oct-20	<4	<4	<7	<4	<7	<4	<6	<4	<3	<4	<14	<12		<2.46	
	23-Nov-20	<10	<10	<23	<12	<24	<13	<20	<9	<10	<8	<30	<12		<2.71	
	28-Dec-20	<9	<8	<17	<9	<17	<10	<14	<7	<8	<9	<19	<12	<328	<2.64	

Table 8-9 Groundwater

GROUNDWATER

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium	Notes
WELL 27ddc (Site #57)*	28-Jan-20	<10	<10	<23	<10	<28	<13	<20	<10	<9	<10	<34	<13	<325	
	27-Apr-20	<12	<12	<19	<13	<27	<13	<16	<10	<10	<10	<38	<14	<334	
	28-Jul-20	<9	<10	<20	<10	<21	<9	<18	<9	<9	<12	<31	<14	<329	
	27-Oct-20	<12	<12	<19	<11	<22	<13	<17	<12	<9	<10	<35	<12	<322	
Well 34aab (Site #65)*	28-Jan-20	<12	<8	<19	<10	<20	<12	<18	<9	<7	<11	<34	<7	<319	
	27-Apr-20	<11	<10	<20	<11	<16	<11	<19	<11	<10	<12	<37	<13	<336	
	28-Jul-20	<10	<9	<17	<10	<20	<9	<17	<8	<8	<8	<32	<12	<329	
	27-Oct-20	<7	<7	<12	<7	<17	<9	<12	<7	<6	<8	<23	<14	<320	
Well 27dcb (Site #58A)	28-Jan-20	<11	<13	<30	<12	<28	<12	<21	<12	<11	<13	<41	<13	<320	
	27-Apr-20	<11	<9	<17	<10	<19	<9	<18	<10	<11	<12	<37	<13	<319	
	28-Jul-20	<9	<7	<14	<8	<17	<7	<14	<7	<6	<8	<24	<12	<327	
	27-Oct-20	<13	<11	<21	<10	<20	<12	<17	<11	<9	<12	<37	<11	<320	
WELL 34abb (Site #58)*	NO SAMPLE- WELL OUT OF SERVICE														

Table 8-10 Surface Water

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium	Notes
45 ACRE RESERVOIR (Site #61) *	27-Mar-20	<10	<9	<15	<11	<17	<10	<17	<10	<7	<12	<32	<10	<319	
	27-Apr-20	<11	<11	<20	<8	<22	<12	<17	<10	<8	<10	<35	<13	<335	
	28-Jul-20	<9	<10	<18	<11	<21	<9	<19	<11	<9	<11	<32	<12	<329	
	27-Oct-20	<9	<9	<21	<11	<24	<10	<16	<8	<8	<10	<33	<12	<323	
85 ACRE RESERVOIR (Site #60) *	28-Jan-20	<13	<11	<25	<10	<29	<9	<21	<13	<9	<13	<38	<12	<335	
	27-Apr-20	<9	<9	<23	<10	<23	<10	<14	<9	<7	<11	<31	<11	<326	
	28-Jul-20	<11	<11	<16	<10	<23	<9	<19	<10	<9	<7	<30	<12	<329	
	27-Oct-20	<11	<12	<24	<10	<30	<14	<19	<12	<11	<15	<36	<14	<326	
EVAP POND 1 (Site #59) *CELL 1A	1st Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	28-Apr-20	<10	<8	<20	<11	<25	<12	<17	<11	<10	<9	<25	<13	787±209	
	28-Jul-20	<11	<11	<26	<13	<25	<14	<23	<11	<11	<17	<41	<15	894±207	2
	4th Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
CELL 1B	1st Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	28-Jul-20	<10	<13	<20	<11	<23	<11	<19	<11	<9	<12	<32	<10	382±199	
	27-Oct-20	<12	<11	<21	<14	<21	<10	<18	<7	<8	<12	<27	<13	579±201	
CELL 1C	1st Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	28-Jul-20	<11	<12	<26	<15	<23	<10	<14	<10	<9	<9	<35	<7	619±203	
	4th Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
EVAP POND 2 (Site #63) *CELL 2A	28-Jan-20	<11	<11	<19	<10	<20	<12	<20	<11	<8	<12	<26	<13	557±197	
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	3rd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	27-Oct-20	<12	<10	<21	<10	<28	<11	<17	<11	<8	<10	<29	<13	566±201	
CELL 2B	1st Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	3rd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	27-Oct-20	<10	<11	<19	<13	<25	<12	<19	<9	<9	<11	<28	<10	977±212	
EVAP POND 3 (Site #64) *CELL 3A	26-Feb-20	<9	<8	<22	<10	<26	<8	<14	<6	<6	32±10	<23	<4	408±196	1
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	3rd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	4th Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
CELL 3B	1st Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	2nd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	3rd Quarter	**No Influent Since Last Sample Period- NO SAMPLE REQUIRED**													
	27-Oct-20	<10	<10	<26	<12	<29	<11	<18	<8	<9	<12	<28	<10	537±201	

Note 1: This cell has reduced inventory, leading to sediment that is unavoidably collected with the sample. There is not pathway to drinking water and the Cs-137 level shown here is below the Reporting Level for Cs-137 in drinking water (50 pCi/L). Data reported is average of the 2 samples.

Note 2: Duplicate samples taken for tritium. Tritium results averaged for reporting

Table 8-10 Surface Water (Continued)

ODCM required samples denoted by *

units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<3000 Tritium	Notes
	7-Jan-20	<13	<12	<25	<12	<28	<11	<21	<13	<12	<11	<45	<13		
	14-Jan-20	<10	<10	<15	<5	<15	<11	<18	21±7	<8	<8	<32	<14		
	21-Jan-20	<10	<9	<14	<7	<19	<11	<17	7±8	<8	<10	<31	<11		
	28-Jan-20	<10	<10	<14	<8	<21	<10	<16	11±9	<8	<12	<32	<8	<350	
	4-Feb-20	<10	<9	<18	<9	<21	<11	<17	<11	<8	<13	<29	<10		
	10-Feb-20	<9	<1	<19	<10	<21	<10	<14	14±8	<8	<9	<26	<12		
	18-Feb-20	<12	<10	<18	<11	<23	<10	<19	36±10	<9	<15	<32	<14		
	25-Feb-20	<8	<8	<17	<8	<21	<9	<16	28±17	<6	<8	<26	<11	<326	
	3-Mar-20	<9	<10	<21	<10	<24	<9	<16	24±10	<8	<12	<32	<10		
	10-Mar-20	<10	<9	<13	<7	<22	<10	<19	<12	<9	<13	<30	<8		
	17-Mar-20	<9	<9	<16	<5	<20	<8	<14	<10	<7	<9	<25	<12		
	24-Mar-20	<12	<11	<21	<9	<17	<11	<20	<11	<9	<11	<39	<12		
	31-Mar-20	<10	<9	<20	<9	<19	<10	<19	7±8	<10	<11	<36	<9	<368	
WR	7-Apr-20						**NO SAMPLE-WRF OUTAGE**								
INFLUENT	14-Apr-20						**NO SAMPLE-WRF OUTAGE**								
	21-Apr-20	<11	<10	<15	<12	<17	<10	<19	<11	<9	<10	<23	<15		
	28-Apr-20	<9	<9	<15	<7	<24	<11	<17	<11	<8	<7	<32	<3	<331	
	5-May-20	<10	<10	<19	<9	<21	<9	<16	<10	<8	<8	<34	<14		
	12-May-20	<10	<9	<21	<7	<20	<10	<19	<11	<8	<10	<32	<11		
	19-May-20	<10	<6	<18	<7	<14	<8	<14	<11	<9	<8	<35	<11		
	26-May-20	<8	<6	<15	<7	<15	<7	<14	<9	<5	<7	<25	<14	<341	
	2-Jun-20	<10	<8	<20	<10	<18	<10	<19	<11	<9	<11	<34	<10		
	9-Jun-20	<10	<8	<23	<11	<25	<9	<17	14±9	<10	<12	<33	<8		
	16-Jun-20	<9	<10	<11	<8	<21	<8	<17	9±8	<7	<7	<32	<8		
	23-Jun-20	<11	<10	<22	<8	<24	<10	<17	<9	<9	<10	<36	<12		
	29-Jun-20	<8	<10	<19	<11	<20	<11	<16	<10	<9	<9	<29	<12	<342	
	7-Jul-20	<8	<9	<17	<10	<20	<10	<13	<12	<8	<9	<33	<15		
	14-Jul-20	<<10	<8	<15	<7	<24	<8	<20	<11	<7	<11	<31	<9		
	21-Jul-20	<11	<9	<17	<9	<23	<11	<16	<11	<8	<9	<35	<13		

Table 8-10 Surface Water (Continued)

SURFACE WATER
ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	<15 Mn-54	<15 Co-58	<30 Fe-59	<15 Co-60	<30 Zn-65	<15 Nb-95	<30 Zr-95	<15 I-131	<15 Cs-134	<18 Cs-137	<60 Ba-140	<15 La-140	<3000 Tritium	Note
	28-Jul-20	<12	<10	<14	<10	<28	<10	<17	<11	<8	<12	<28	<15	<343	
	4-Aug-20	<10	<9	<19	<10	<23	<10	<15	<8	<8	<13	<30	<13		
	11-Aug-20	<9	<8	<19	<10	<19	<10	<17	<10	<8	<8	<31	<11		
	18-Aug-20	<12	<11	<14	<9	<21	<10	<16	<11	<9	<7	<30	<9		
	25-Aug-20	<10	<10	<18	<9	<20	<9	<19	<12	<9	<11	<30	<15	<335	
	1-Sep-20	<8	<8	<14	<7	<14	<7	<12	16±9	<6	<8	<21	<6		
	8-Sep-20	<8	<8	<18	<8	<23	<9	<14	<10	<8	<9	<29	<15		
	15-Sep-20	<12	<8	<13	<8	<17	<12	<15	<10	<8	<10	<31	<8		
	22-Sep-20	<11	<10	<18	<10	<20	<11	<19	15±8	<8	<13	<33	<11		
	29-Sep-20	<9	<10	<23	<9	<19	<11	<19	11±9	<7	<7	<26	<15	<331	
	6-Oct-20	<9	<9	<18	<9	<17	<10	<16	<11	<10	<9	<34	<8		
	13-Oct-20	<7	<9	<19	<10	<19	<10	<18	<12	<8	<9	<24	<3	<331	
WR	20-Oct-20	WRF Outage- So Sample Available													
INFLUENT	27-Oct-20	WRF Outage- So Sample Available													
	3-Nov-20	<12	<10	<17	<10	<17	<13	<16	<10	<8	<8	<33	<12		
	9-Nov-20	<10	<8	<20	<10	<20	<10	<17	8±9	<8	<9	<31	<12		
	17-Nov-20	<9	<7	<18	<10	<24	<13	<17	<9	<9	<10	<29	<11		
	23-Nov-20	<11	<10	<19	<10	<20	<10	<17	<10	<10	<8	<24	<3	<343	
	1-Dec-20	<11	<8	<19	<9	<24	<10	<18	<11	<6	<9	<32	<9		
	8-Dec-20	<10	<7	<18	<7	<22	<10	<18	8±8	<8	<9	<24	<12		
	15-Dec-20	<10	<7	<19	<9	<23	<10	<17	<10	<8	<11	<25	<7		
	21-Dec-20	<8	<8	<18	<8	<19	<10	<14	33±10	<8	<8	<27	<7		
	28-Dec-20	<9	<10	<20	<11	<20	<11	<18	25±10	<9	<11	<30	<10	<337	

Table 8-10 Surface Water (Continued)

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium	Note
SEDIMENTATION BASIN #2	7-Jan-20							**EMPTY**							
	14-Jan-20							**EMPTY**							
	21-Jan-20							**EMPTY**							
	28-Jan-20							**EMPTY**							
	4-Feb-20							**EMPTY**							
	10-Feb-20							**EMPTY**							
	18-Feb-20							**EMPTY**							
	25-Feb-20	<12	<11	<24	<11	<24	<11	<21	<10	<10	<13	<38	<15	<355	
	3-Mar-20							**EMPTY**							
	10-Mar-20							**EMPTY**							
	17-Mar-20	<11	<9	<17	<8	<19	<12	<18	<9	<9	<12	<30	<10	<400	
	24-Mar-20	<13	<11	<16	<7	<26	<11	<19	<9	<8	<10	<27	<15	<368	
	31-Mar-20	<9	<9	<19	<6	<21	<10	<16	<9	<8	<9	<22	<10	<378	
	7-Apr-20	<11	<10	<21	<10	<20	<10	<20	<9	<9	<12	<26	<11	<355	
	15-Apr-20	<12	<9	<21	<11	<25	<11	<20	<10	<8	<11	<28	<7	<364	
	21-Apr-20							**EMPTY**							
	28-Apr-20							**EMPTY**							
	5-May-20							**EMPTY**							
	12-May-20							**EMPTY**							
	19-May-20							**EMPTY**							
	26-May-20							**EMPTY**							
	2-Jun-20							**EMPTY**							
	9-Jun-20							**EMPTY**							
	16-Jun-20							**EMPTY**							
	23-Jun-20							**EMPTY**							
	29-Jun-20							**EMPTY**							

Table 8-10 Surface Water (Continued)

ODCM required samples denoted by *
units are pCi/liter

SAMPLE LOCATION	DATE COLLECTED	Mn-54	Co-58	Fe-59	Co-60	Zn-65	Nb-95	Zr-95	I-131	Cs-134	Cs-137	Ba-140	La-140	Tritium	Note
SEDIMENTATION BASIN #2	7-Jul-20							**EMPTY**							
	14-Jul-20							**EMPTY**							
	21-Jul-20							**EMPTY**							
	28-Jul-20							**EMPTY**							
	4-Aug-20							**EMPTY**							
	11-Aug-20							**EMPTY**							
	18-Aug-20							**EMPTY**							
	25-Aug-20							**EMPTY**							
	1-Sep-20							**EMPTY**							
	8-Sep-20							**EMPTY**							
	15-Sep-20							**EMPTY**							
	22-Sep-20							**EMPTY**							
	29-Sep-20							**EMPTY**							
	6-Oct-20							**EMPTY**							
	13-Oct-20							**EMPTY**							
	20-Oct-20							**EMPTY**							
	27-Oct-20							**EMPTY**							
	3-Nov-20							**EMPTY**							
	9-Nov-20							**EMPTY**							
	17-Nov-20							**EMPTY**							
	23-Nov-20							**EMPTY**							
	1-Dec-20							**EMPTY**							
	8-Dec-20							**EMPTY**							
	15-Dec-20							**EMPTY**							
	21-Dec-20							**EMPTY**							
	28-Dec-20							**EMPTY**							

Table 8-11 Sludge/Sediment

ODCM required samples denoted by *
units are pCi/kg, wet

SAMPLE LOCATION	DATE COLLECTED	I-131	<150 Cs-134	<180 Cs-137	In-111	Notes
WR CENTRIFUGE WASTE SLUDGE	7-Jan-20	242±142	<112	<107		
	14-Jan-20	381±130	<94	<140		
	21-Jan-20	326±119	<119	<164		
	28-Jan-20	264±127	<41	<120		
	4-Feb-20	211±141	<133	<142		
	10-Feb-20		<103	<109		
	18-Feb-20	347±142	<92	<114		
	25-Feb-20	518±172	<114	<106		
	3-Mar-20	300±157	<100	<123		
	10-Mar-20	437±142	<25	<85		
	17-Mar-20	331±112	<36	<83		
	24-Mar-20	603±197	<120	<180		
	31-Mar-20	607±145	<70	<127		
	7-Apr-20	447±137	<27	<116		
	14-Apr-20	**No Sample Available- WRF Outage**				
	21-Apr-20	341±123	<100	<28		
	28-Apr-20		<76	<175		
	5-May-20		<57	<102		
	12-May-20	249±117	<133	<148		
	19-May-20	621±178	<79	<157		
	26-May-20	414±154	<102	<136		
	2-Jun-20	294±102	<80	<29		
	9-Jun-20		<102	<100		
	16-Jun-20	720±206	<106	<135		
	23-Jun-20	331±139	<101	<139		
	29-Jun-20		<101	<85		

No required LLD for I-131 in Sludge/Sediment. Only values for detectable I-131 are reported in this table.

Table 8-11 Sludge/Sediment (Continued)

ODCM required samples denoted by *
units are pCi/kg, wet

SAMPLE LOCATION	DATE COLLECTED	I-131	Cs-134	Cs-137	In-111	Notes
WR CENTRIFUGE WASTE SLUDGE	7-Jul-20	739±187	<89	<128		
	14-Jul-20	619±185	<138	<172		
	21-Jul-20	357±169	<142	<159		
	28-Jul-20		<61	<142		
	4-Aug-20		<89	<98		
	11-Aug-20		<119	<54		
	18-Aug-20		<66	<132		
	25-Aug-20	191±109	<34	<115		
	1-Sep-20	343±128	<90	<160		
	8-Sep-20	466±139	<99	<169		
	15-Sep-20	332±114	<85	<71		
	22-Sep-20	120±74	<34	<99		
	29-Sep-20	269±112	<106	<174		
	6-Oct-20	279±128	<72	<113		
	13-Oct-20	337±126	<99	<122		
	20-Oct-20	WRF Outage- No Sample Available				
	27-Oct-20	WRF Outage- No Sample Available				
	3-Nov-20	WRF Outage- No Sample Available				
	9-Nov-20	510±161	<80	<179		
	17-Nov-20	379±150	<130	<149		
	23-Nov-20		<119	<30		
	1-Dec-20		<114	<175		
	8-Dec-20	191±143	<95	<178		
	15-Dec-20	131±64	<72	<133		
	21-Dec-20		<87	<140		
	28-Dec-20	771±191	<122	<107		

No required LLD for I-131 in Sludge/Sediment. Only values for detectable I-131 are reported in this table.

Table 8-11 Sludge/Sediment (Continued)
Cooling Tower Sludge

Unit Cycle	Approximate Volume (yd^3)	Isotope	Activity Range (pCi/g)	Sample Type
U3R21	615	All principal gamma-emitters	<MDA	Towers/Canal Sludge
U2R22	481	All principal gamma-emitters	<MDA	Towers/Canal Sludge

Table 8-12 Hard -To-Detect Radionuclide Results

Hard-To-Detect Radionuclide (pCi/Liter)						
Sample Location	**Well number**	**Sample Date**	**C-14**	**Fe-55**	**Ni-63**	**Sr-90**
Unit 1 (outside RCA)	APP-12	11/18/2020	<72.0	<161	<2.65	<1.25
Unit 2 (inside RCA)	H0A	11/12/2020	<73.1	<178	<3.70	<1.76
Unit 3 (inside RCA)	H11	11/8/2020	<73.1	<155	<3.51	<1.89

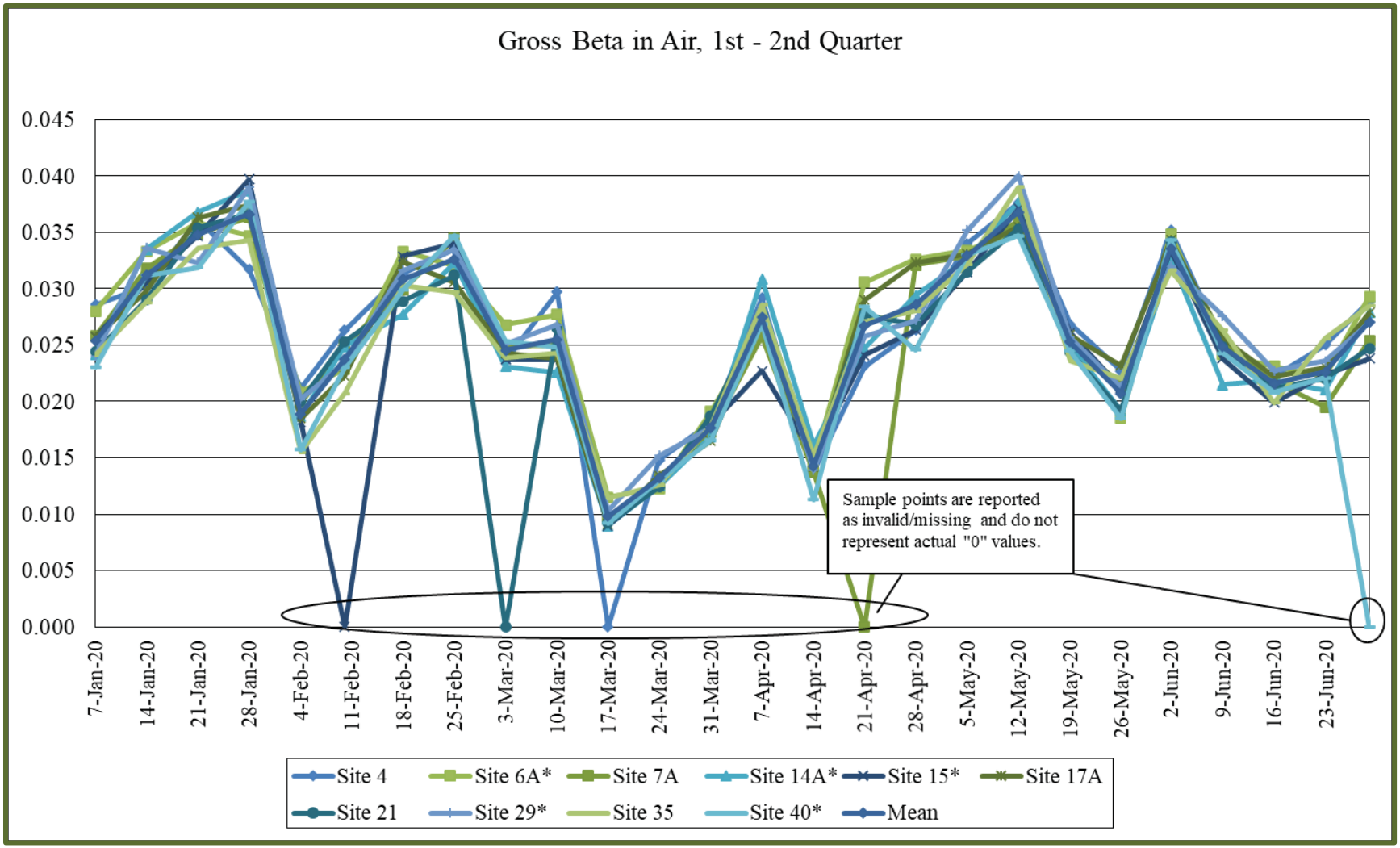


Figure 8-1 Gross Beta in Air, 1st-2nd Quarter

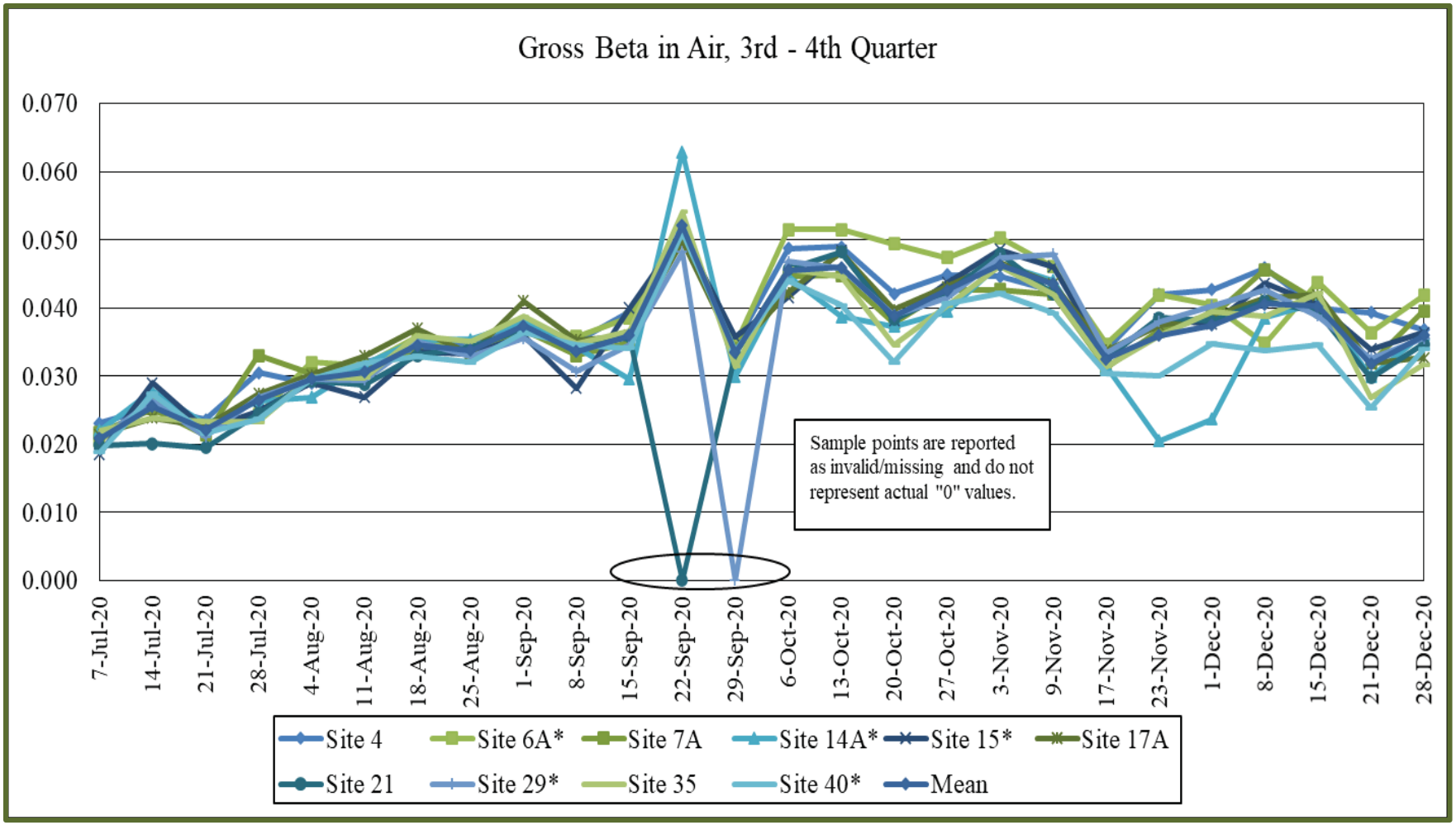


Figure 8-2 Gross Beta in Air, 3rd-4th Quarter

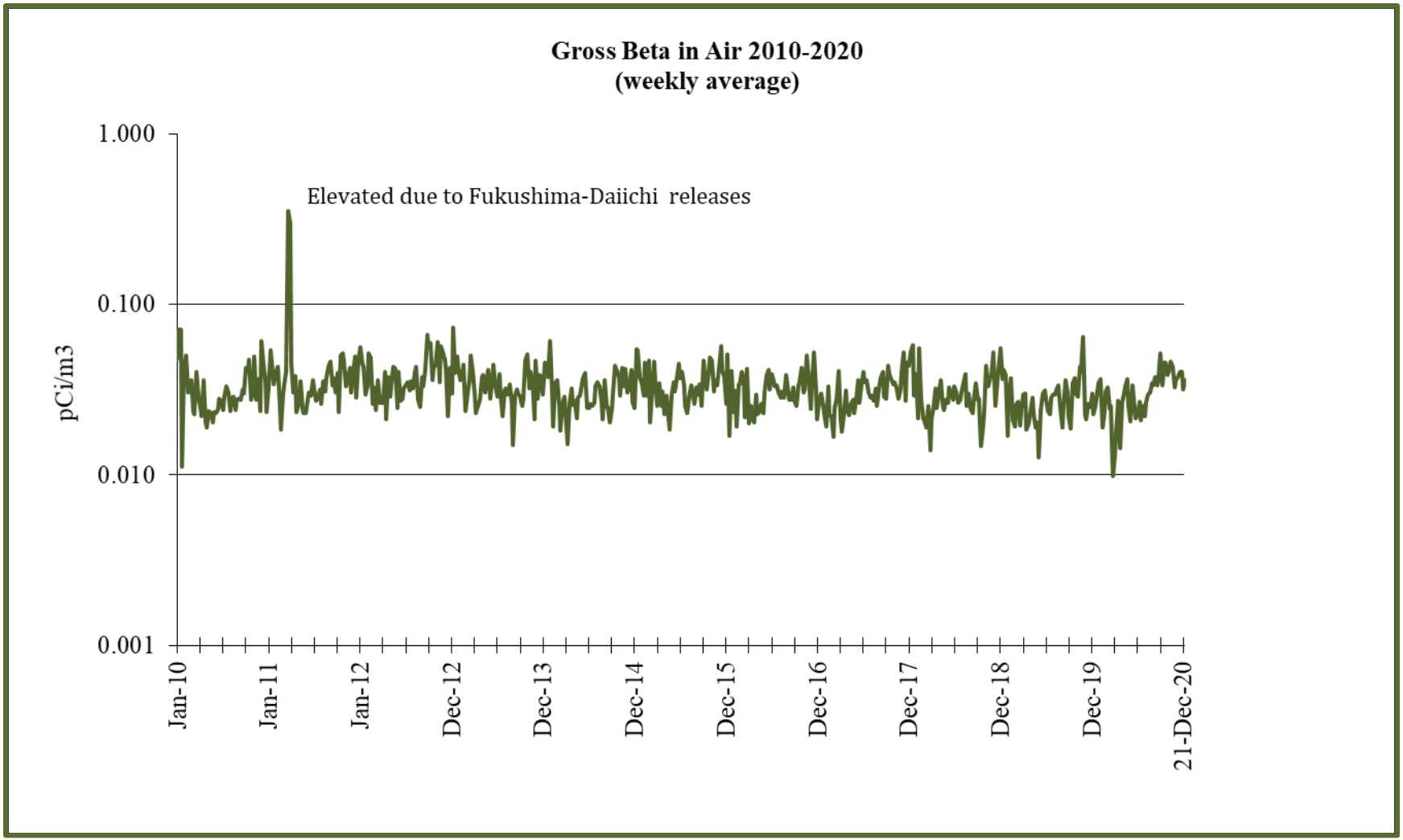


Figure 8-3 Historical Gross Beta in Air (Weekly System Average)

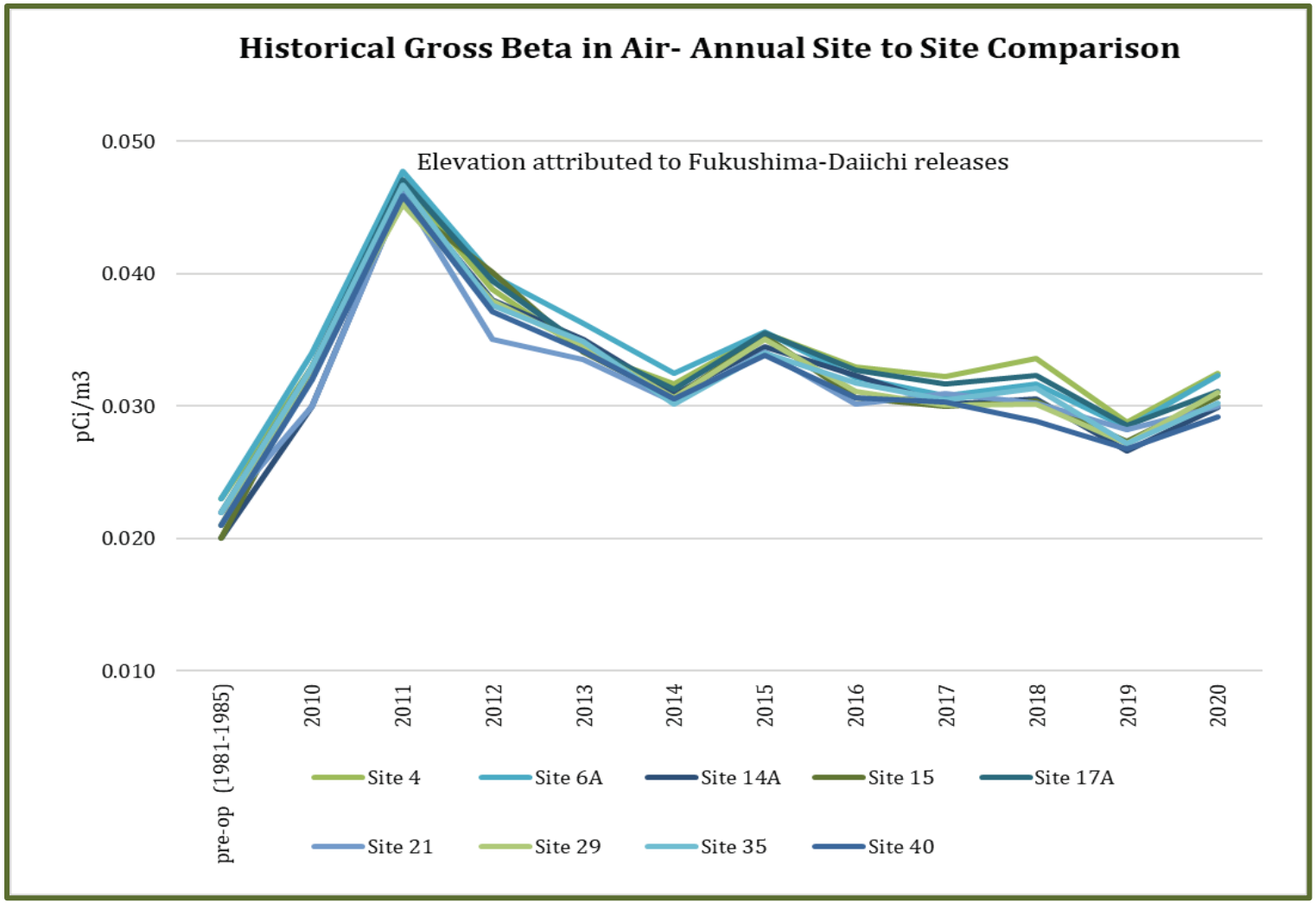


Figure 8-4 Historical Gross Beta in Air (Annual Site to Site Comparisons) Compared to Pre-Op

Note: 7A is not included due to the location change since pre-operational period. The elevated 2011 annual average values are attributed to the Fukushima-Daiichi release.

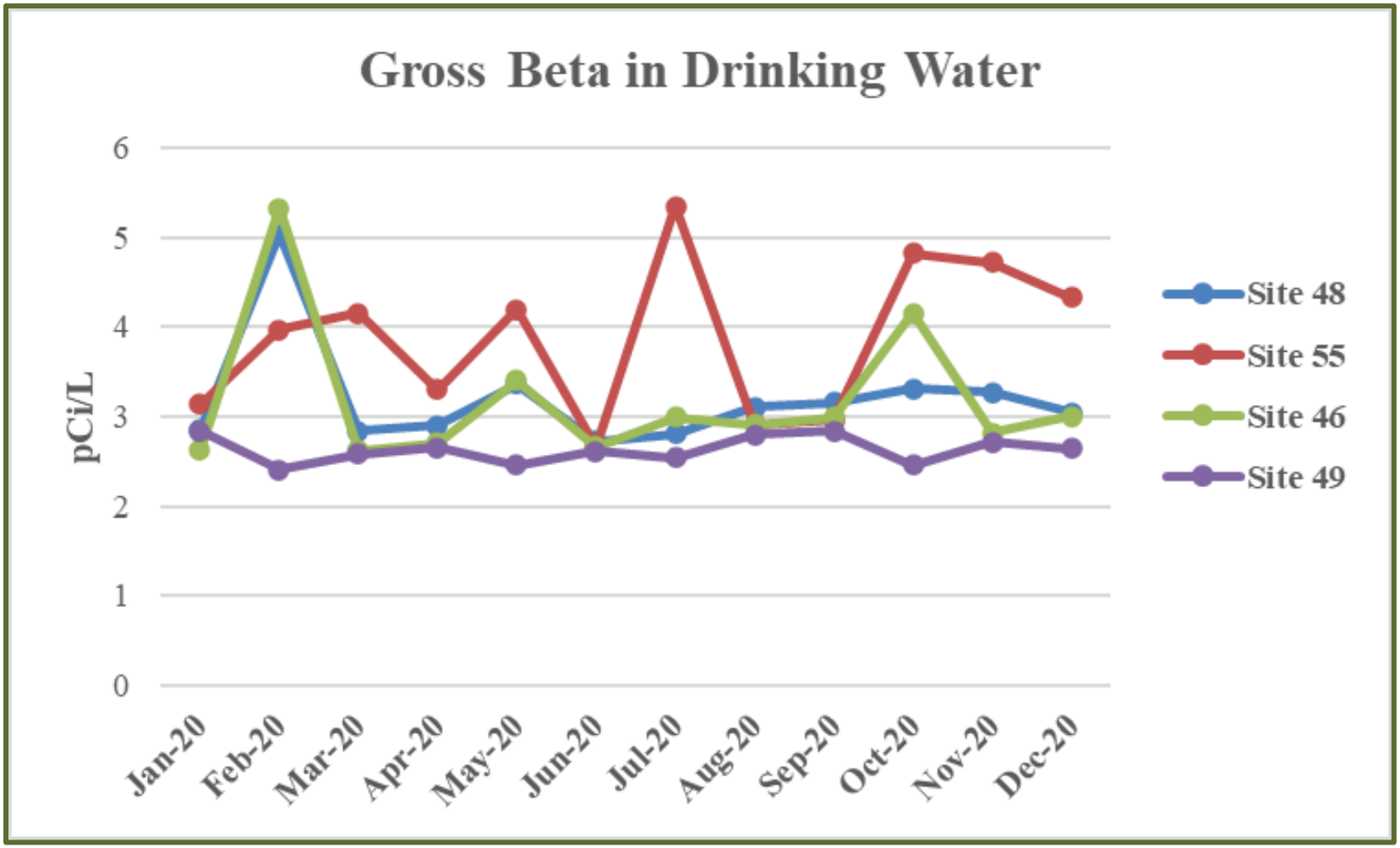


Figure 8-5 Gross Beta in Drinking Water

Notes: MDA values are plotted as activity (i.e. <2.3 is plotted as 2.3)
The action level is 30 pCi/liter

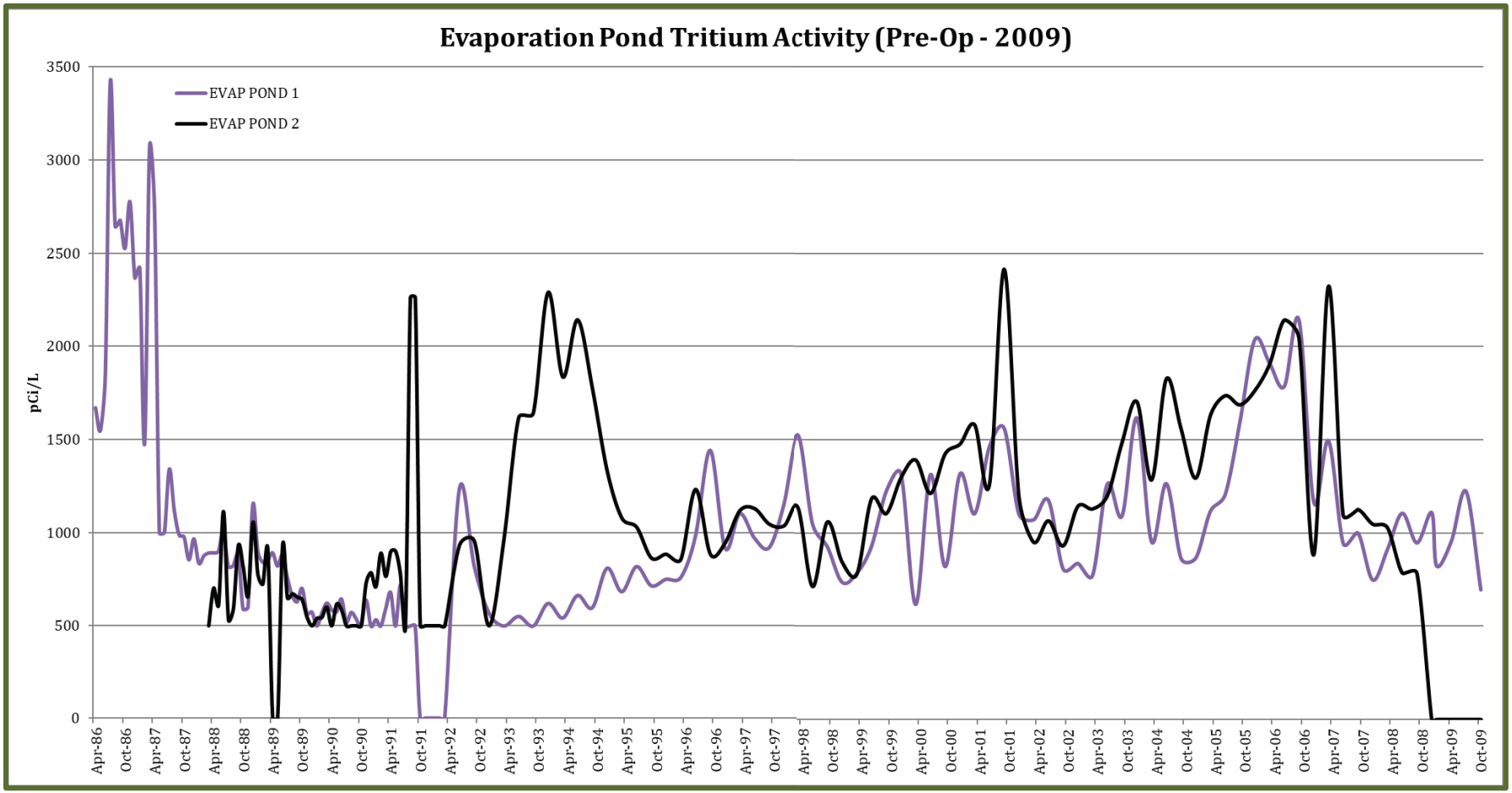


Figure 8-6 Evaporation Pond Tritium Activity (Pre-Op- 2009)

Note: Zero values represent no sample taken for sampling period, per procedural guidance or lack of sample material.

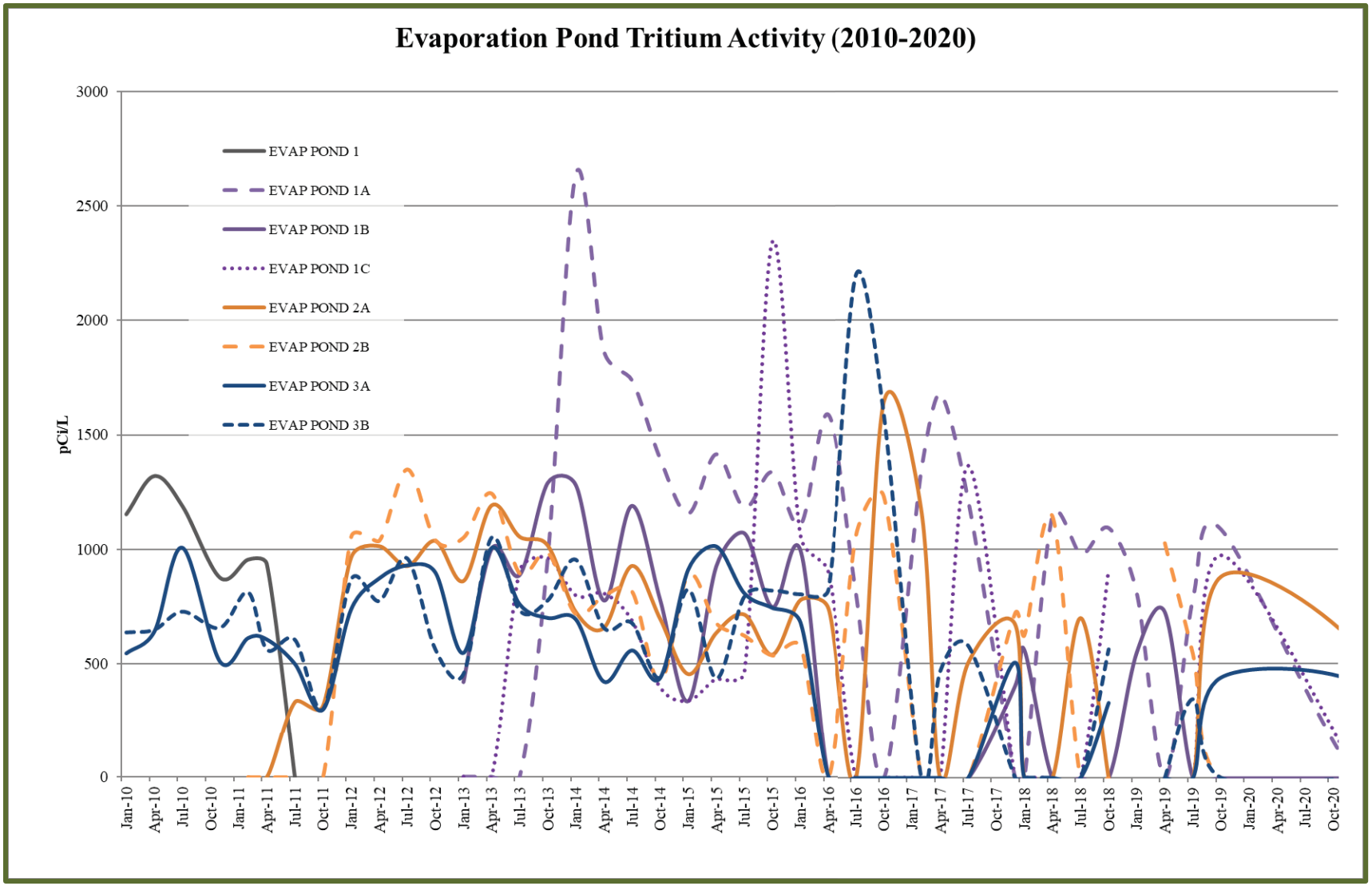


Figure 8-7 Evaporation Pond Tritium Activity (2010-2020)

Note: Zero values represent no sample taken for sampling period, per procedural guidance or lack of sample material.

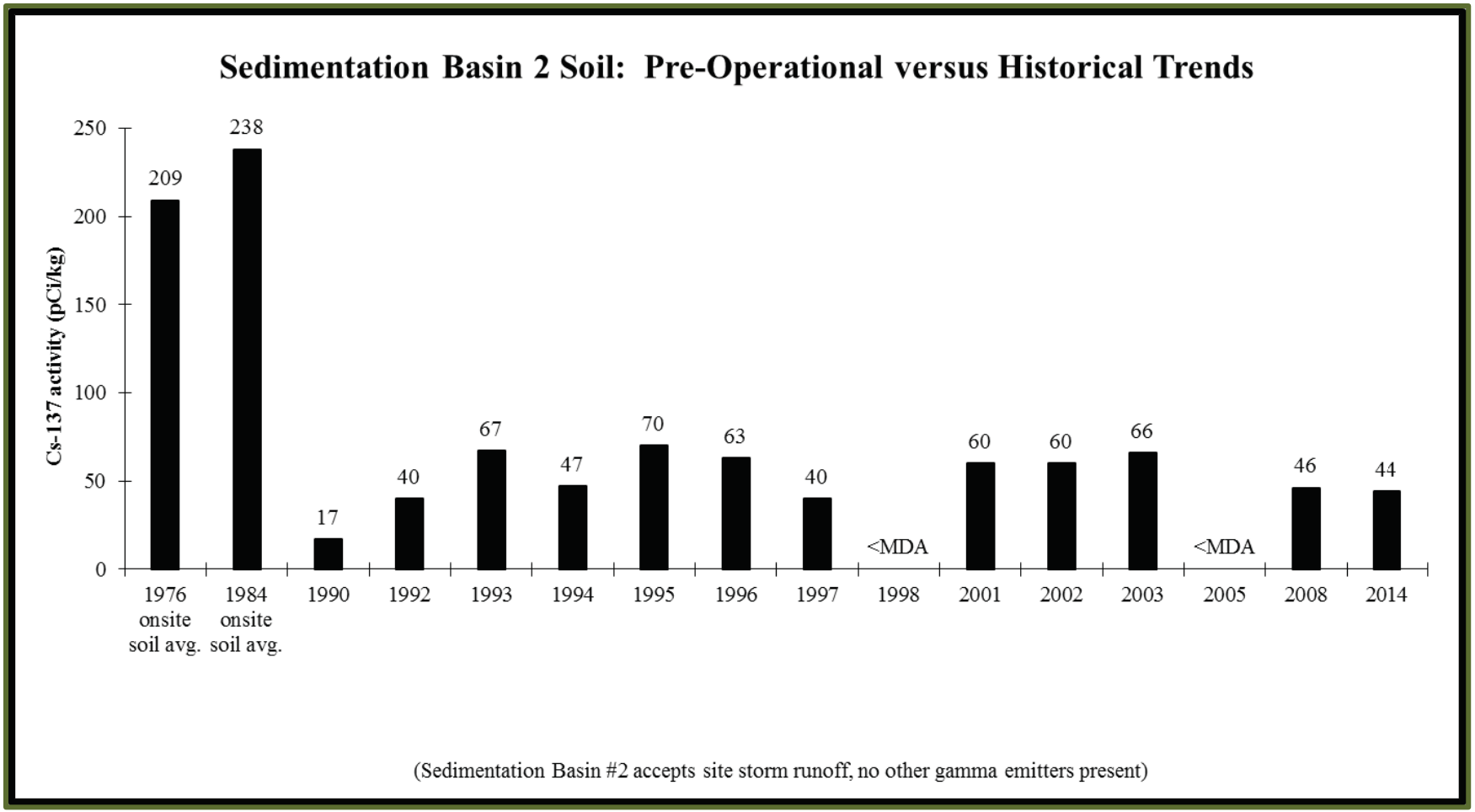


Figure 8-8 Sedimentation Basin 2 Cs-137

9. Thermoluminescent Dosimeter (TLD) Results and Data

The environmental TLD used at PVNGS is the Panasonic Model 812 Dosimeter. The Model 812 is a multi-element dosimeter combining two elements of lithium borate and two elements of calcium sulfate under various filters.

TLDs were placed in fifty locations from one to thirty-five miles from the PVNGS. TLD locations are shown in Figure 2-1 and Figure 2-2 and are described in Table 9-1. TLD results for 2020 are presented in Table 9-2. Definitions for Table 9-2 are as follows:

MDD_Q: Minimum differential dose, quarterly, 3 times 90^{th} percentile sQ determined from analysis (mRem).

MDD_A: Minimum differential dose, annual, 3 times 90^{th} percentile sA determined from analysis (mRem).

B_Q: Quarterly baseline (mRem) (average of previous 5 years)

M_Q: Locations 91-day standard quarter normalized dose (mRem per standard quarter)

L_Q: Quarterly investigation level dose (mRem)

B_A: Baseline background dose (mRem) (annual)

M_A: Annual monitoring data – MA determined by normalizing available quarterly data to 4 full quarters

L_A: Annual investigation level dose (mRem)

ND: Non-Detectable

The baseline is calculated as the average of the previous 5-year measurements. The minimum differential dose (MDD) is calculated as 3 times the 90^{th} percentile standard deviation of the data from the previous 5 years; quarterly MDD is calculated using the quarterly data and annual MDD is calculated using the annual summation of the quarterly data. Investigation level is calculated by the difference of the data measurement and the baseline; results less than, or equal to the MDD are Non-Detectable (ND) and any result exceeding the MDD meets the threshold for the investigation level. Locations exceeding the investigation level will be evaluated for cause and impact to the public and environment.

Historical environmental gamma radiation results for 1985 through 2020 are presented in graphical form on Figure 9-1 (excluding transit control TLD #45). Figure 9-2 depicts the environmental TLD results from 2020 as compared to the pre-operational TLD results (excluding sites #41 and #43, as they were deleted and later assigned to a new location, and #46-50, as they had no pre-op TLD at the location for comparison). The site to site comparisons indicate a direct correlation with respect to pre-operational results. It is indicated that the offsite dose, as measured by TLDs, has not changed since Palo Verde became operational.

Table 9-1 TLD Site Locations

(Distance and direction are relative to Unit 2 in miles)

TLD #	Location	Distance from Unit 2	TLD #	Location	Distance from Unit 2	TLD #	Location	Distance from Unit 2
1	E30	29.13	18	ESE2	1.48	35	NNW8	7.86
2	ENE24	24.18	19	SE2	1.35	36	N5	4.32
3	E21	21.87	20	SSE2	2.04	37	NNE5	4.69
4	E16	16.05	21	S3	2.68	38	NE5	4.21
5	ESE11	11.14	22	SSW3	2.74	39	ENE5	4.71
6	SSE31	31.47	23	W5	4.17	40	N2	2.37
7	SE7	6.87	24	SW4	3.75	41	ESE3	3.39
8	SSE4	4.33	25	WSW5	4.88	42	N8	7.24
9	S5	4.63	26	SSW4	4.13	43	NE5	4.60
10	SE5	3.91	27	SW1	0.93	44	ENE35	35.00
11	ESE5	5.14	28	WSW1	0.66	45	Onsite	0.18
12	E5	4.85	29	W1	0.64	46	ENE30	7.23
13	N1	0.85	30	WNW1	0.74	47	E35	32.35
14	NNE2	155	31	NW1	1.03	48	E24	22.76
15	NE2	1.63	32	NNW1	0.90	49	ENE11	11.32
16	ENE2	1.59	33	NW4	4.05	50	WNW5	4.24
17	E2	1.39	34	NNW5	4.84			

*Site #6 and site #44 are the control locations.

**Site #45 is the transit control TLD (stored in lead pig).

Table 9-2 Environmental TLD Results

Palo Verde 2020 MDD_Q: 5 mrem Palo Verde 2020 MDD_A: 10 mrem

Location	Quarterly (mrem)									Annual (mrem)			Note
	B_Q	M_QQ1	M_QQ2	M_QQ3	M_QQ4	L_QQ1	L_QQ2	L_QQ3	L_QQ4	B_A	M_A	L_A	
1	24.9	24.8	24.7	24.1	23.3	ND	ND	ND	ND	99.6	96.9	ND	
2	22.1	21.4	22.7	21.4	20.8	ND	ND	ND	ND	88.3	86.4	ND	
3	24.2	23.2	23.3	23.1	20.9	ND	ND	ND	ND	96.6	90.4	ND	
4	24.7	25.1	24.4	24.6	21.6	ND	ND	ND	ND	98.8	95.7	ND	
5	20.8	19.6	20.2	19.6	18.2	ND	ND	ND	ND	83.1	77.5	ND	
6	26.8	27.3	25.1	23.6	25.3	ND	ND	ND	ND	107.1	101.4	ND	
7	26.0	23.7	26.5	25.3	24.7	ND	ND	ND	ND	103.9	100.2	ND	
8	24.4	22.0	25.0	24.4	22.7	ND	ND	ND	ND	97.7	94.2	ND	
9	28.3	27.6	28.1	28.0	27.9	ND	ND	ND	ND	113.2	111.5	ND	
10	24.3	23.6	25.5	23.6	21.5	ND	ND	ND	ND	97.2	94.3	ND	
11	25.2	24.2	25.6	24.3	24.6	ND	ND	ND	ND	100.8	98.7	ND	
12	24.0	24.4	24.9	22.7	21.3	ND	ND	ND	ND	95.9	93.3	ND	
13	25.8	25.5	26.3	25.8	23.5	ND	ND	ND	ND	103.4	101.1	ND	
14	25.3	24.3	25.8	24.6	23.3	ND	ND	ND	ND	101.4	97.9	ND	
15	23.9	23.1	24.8	23.6	21.9	ND	ND	ND	ND	95.5	93.5	ND	
16	23.5	22.3	23.4	22.8	22.5	ND	ND	ND	ND	93.9	91.0	ND	
17	25.0	24.6	25.3	25.1	23.2	ND	ND	ND	ND	100.0	98.2	ND	
18	23.8	22.1	23.6	23.4	20.4	ND	ND	ND	ND	95.1	89.4	ND	
19	25.4	24.7	25.5	24.6	22.7	ND	ND	ND	ND	101.8	97.5	ND	
20	24.7	23.0	24.5	24.2	23.6	ND	ND	ND	ND	99.0	95.2	ND	
21	26.2	23.6	27.0	25.7	24.7	ND	ND	ND	ND	104.6	101.0	ND	
22	26.3	24.3	27.0	25.8	25.2	ND	ND	ND	ND	105.0	102.3	ND	
23	23.5	22.2	22.2	22.5	22.6	ND	ND	ND	ND	93.8	89.5	ND	
24	22.9	21.5	22.1	21.7	21.2	ND	ND	ND	ND	91.7	86.5	ND	
25	23.9	22.2	22.8	23.8	23.2	ND	ND	ND	ND	95.8	92.1	ND	
26	28.0	28.0	27.5	27.2	27.4	ND	ND	ND	ND	112.1	110.1	ND	
27	27.4	25.3	27.0	26.9	24.4	ND	ND	ND	ND	109.5	103.6	ND	
28	26.0	24.6	25.7	25.6	23.7	ND	ND	ND	ND	104.1	99.5	ND	
29	24.4	23.3	24.6	23.2	22.9	ND	ND	ND	ND	97.6	93.9	ND	
30	26.2	25.2	26.0	25.4	23.4	ND	ND	ND	ND	105.0	99.9	ND	
31	23.7	21.9	23.3	22.1	21.2	ND	ND	ND	ND	94.8	88.5	ND	
32	25.6	25.7	25.4	24.6	25.3	ND	ND	ND	ND	102.2	101.0	ND	
33	26.4	26.2	26.1	25.4	24.4	ND	ND	ND	ND	105.4	102.0	ND	
34	28.7	28.7	27.4	28.2	25.7	ND	ND	ND	ND	114.8	110.0	ND	
35	31.7	33.6	30.8	31.1	29.2	ND	ND	ND	ND	126.8	124.6	ND	
36	25.9	26.3	26.1	25.2	25.5	ND	ND	ND	ND	103.8	103.1	ND	
37	24.4	22.8	25.1	24.2	22.3	ND	ND	ND	ND	97.4	94.4	ND	
38	28.0	28.0	28.0	26.9	26.7	ND	ND	ND	ND	111.9	109.7	ND	
39	24.4	24.2	25.4	23.3	23.5	ND	ND	ND	ND	97.4	96.4	ND	
40	25.6	24.0	24.9	23.4	23.9	ND	ND	ND	ND	102.3	96.2	ND	
41	26.9	26.9	25.5	26.0	25.1	ND	ND	ND	ND	107.6	103.5	ND	
42	27.2	26.6	26.2	25.5	25.4	ND	ND	ND	ND	108.6	103.7	ND	
43	27.8	28.8	27.4	26.7	24.8	ND	ND	ND	ND	111.3	107.8	ND	
44	23.9	22.3	0.0	24.2	0.0	ND	*	ND	*	47.7	46.5	ND	1
45	5.5	4.3	4.7	6.0	3.6	ND	ND	ND	ND	21.9	18.6	ND	
46	24.1	23.8	24.4	23.3	21.5	ND	ND	ND	ND	96.4	93.0	ND	
47	24.1	22.3	22.7	24.0	22.3	ND	ND	ND	ND	96.2	91.3	ND	
48	24.4	23.6	23.5	23.2	21.4	ND	ND	ND	ND	97.6	91.8	ND	
49	22.9	22.7	22.5	21.4	19.7	ND	ND	ND	ND	91.7	86.4	ND	
50	19.7	18.5	19.2	18.4	18.1	ND	ND	ND	ND	78.9	74.1	ND	

Note 1: The 2 TLDs used for monitoring Site 44 were missing at time of changeout for the Second and 4th Quarters, 2020. The MA and LA were calculated using the First and Third Quarter Data. BA was calculated using BQ*2. Documented with CR 20-08627 and 21-00216.

Figure 9-1 Network Environmental TLD Exposure Rates

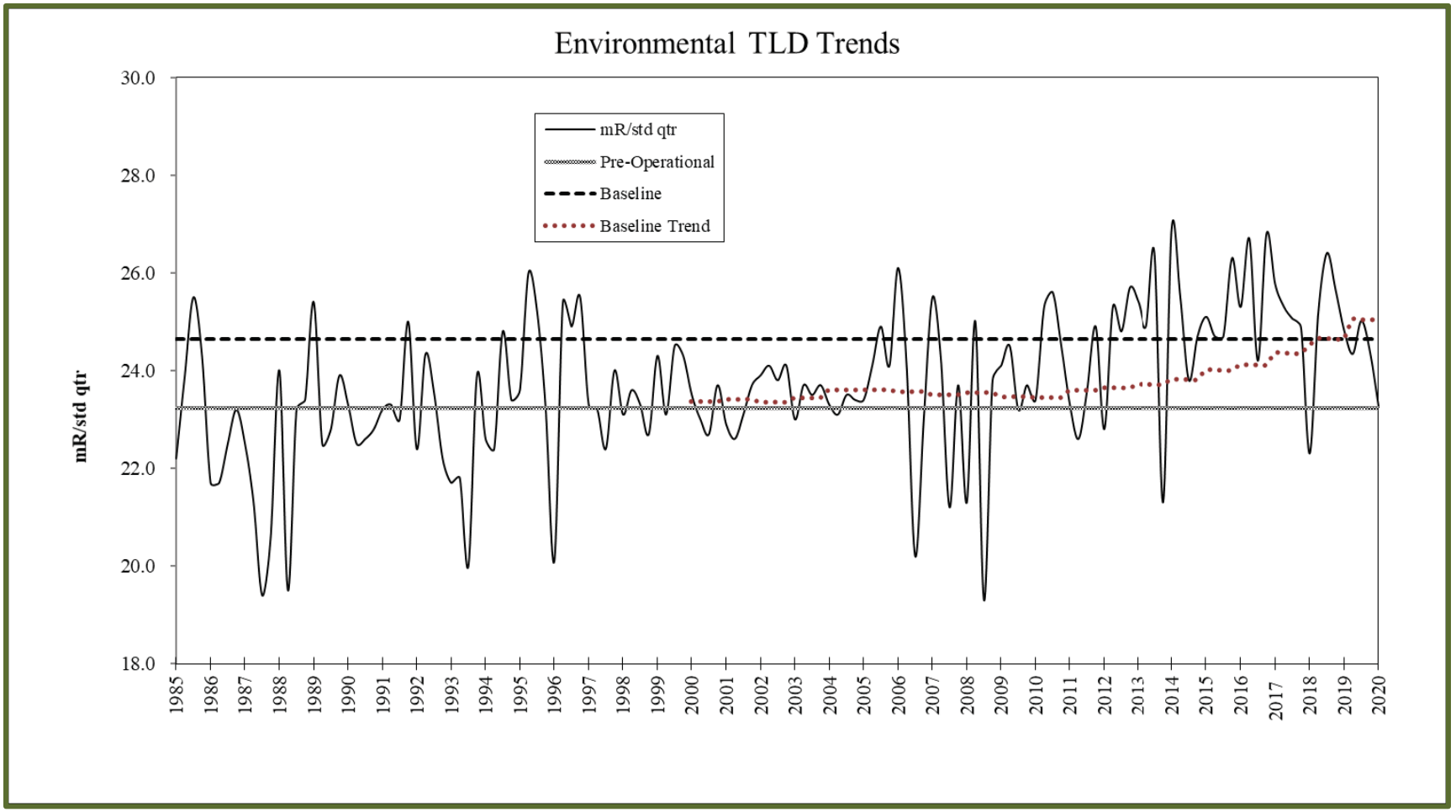
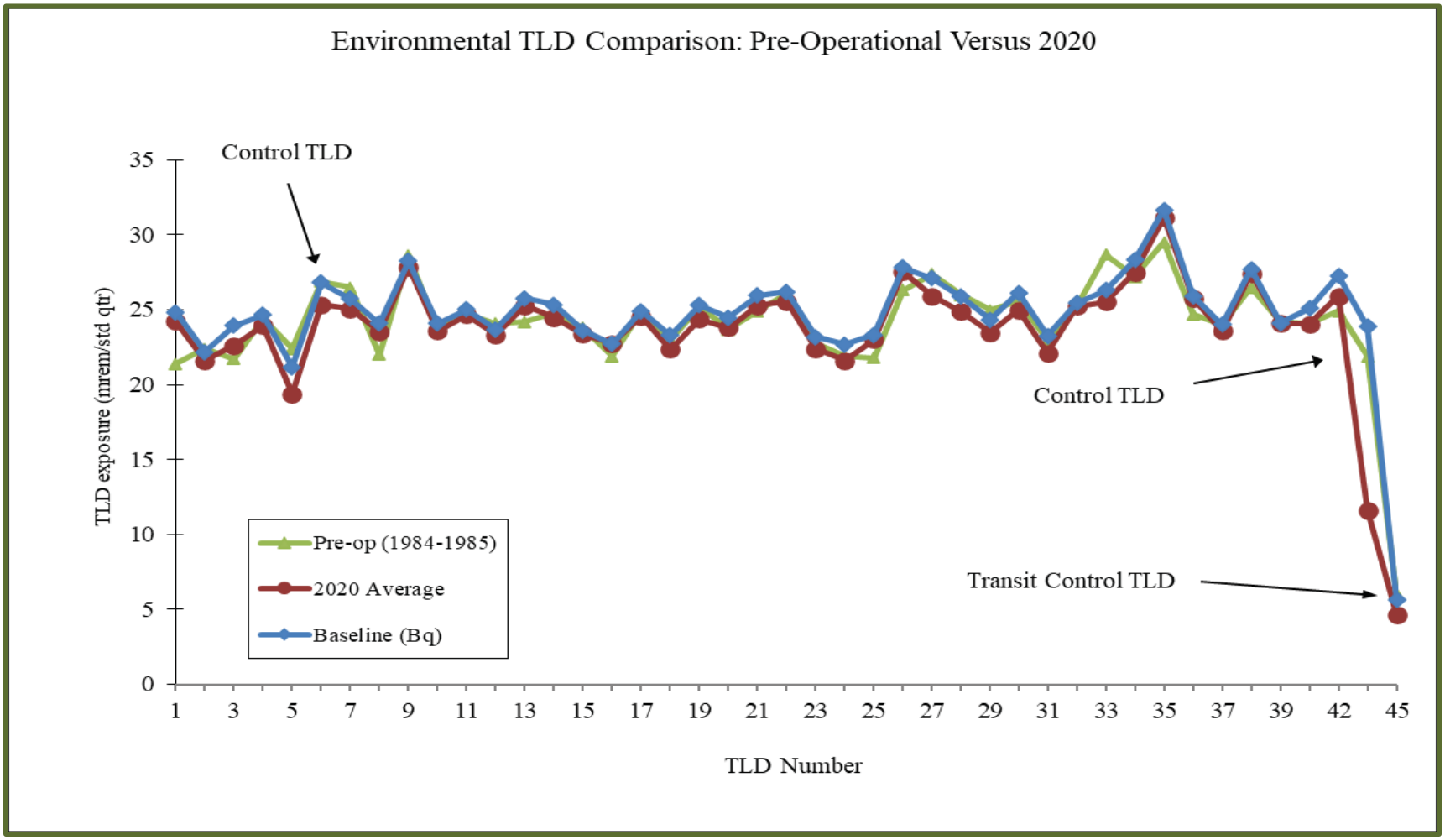


Figure 9-2 Environmental TLD Comparison: Pre-Operational versus 2020



The following TLDs are not included on this graph:
TLD #41 monitoring location was deleted in June, 2000 due to school closing (this TLD was replaced at a new school in 2004)
TLD #43 monitoring location was deleted in 1994 due to school closing (this TLD was placed at a new school in 2007)
TLDs #46-50 are not included since they were not included in the pre-op monitoring program.

10. Land Use Census

10.1 Introduction

In accordance with the PVNGS ODCM, Section 6.2, the field portion of the annual Land Use Census was performed by June 2020.

Observations were made in each of the 16 meteorological sectors to determine the nearest milking animals, residences, and gardens of greater than 500 square feet. This census was completed by driving the roads and speaking with residents.

The results of the Land Use Census are presented in Table 10-1 and discussed below. The directions and distances listed are in sectors and miles from the Unit 2 containment.

10.2 Census Results

The 2020 Land Use Census results identified new potential Radiological Effluent Release Report dose receptor locations. Each location was evaluated. The changes identified, and the evaluation results, are described below.

Nearest Resident

There was three (3) changes in nearest resident status from the previous year. Dose calculations indicated the highest dose to be 0.486 mrem.

Milk Animal

There were nine (9) changes in milk animal status from the previous year. There were four (4) of the locations that were identified in the census which had the potential for having a dose greater than 20% that of our current sampling location with the lowest dose potential. The locations were visited by the REMP manager to evaluate program participation potential. As of November 2020, none of the locations had milk animals. Dose calculations indicated the highest dose to be 0.486 mrem.

Vegetable Gardens

There were four (4) changes in the nearest gardens identified in the previous year. There were four (4) of the locations that were identified in the census which had the potential for having a dose greater than 20% that of our current sampling location with the lowest dose potential. The locations were visited by the REMP manager to evaluate program participation potential. As of November 2020, none of the gardens were suitable for a donor location. Three (3) locations lacked adequate size and two (2) were covered with shading material. One (1) location was confirmed by owner to not be used for food products. Dose calculations indicated the highest dose to be 0.257 mrem.

See Table 10-1 for a summary of the specific results and Table 2-1 for current sample locations. Figure 10-1 through Figure 10-3 provide graphs depicting historical calculated doses for nearest residents, nearest milk receptor, and nearest garden receptor locations in each sector.

Differences in calculated doses are the result of many variables, including:

- Changes in receptor locations from year to year (proximity to the power plant)
- Changes in local meteorology (wind direction, wind speed, precipitation, and temperature)
- Concurrent meteorology at the time of effluent releases
- Exposure pathways

Table 10-1 Land Use Census

(Distance and direction are relative to Unit 2 in miles)

Sector	Nearest Resident	Nearest Garden	Nearest Milk Animal (Cow/Goat)	Calculated Dose (mrem)		Change from 2019
N	1.55	1.71	3.25	Resident Garden Milk	2.72E-2 1.43E-1 6.80E-2	Garden
NNE	1.52	NONE	2.75	Resident Milk	6.22E-2 1.08E-1	Milk
NE	2.16	NONE	2.16	Resident Milk	2.44E-1 2.44E-1	Milk
ENE	1.91	4.84	1.91	Resident Garden Milk	4.86E-1 1.66E-1 4.86E-1	Resident Milk
E	2.81	4.39	3.49	Resident Garden Milk	5.90E-2 1.28E-1 1.23E-1	Garden Milk
ESE	2.44	3.59	2.44	Resident Garden Milk	3.06E-1 2.57E-1 3.06E-1	Resident Garden Milk
SE	3.39	NONE	4.22	Resident Milk	8.99E-2 3.84E-1	Milk
SSE	NONE	NONE	NONE	NA		
S	NONE	NONE	NONE	NA		
SSW	NONE	NONE	NONE	NA		
SW	1.48	NONE	NONE	Resident	7.79E-2	Resident
WSW	0.83	NONE	1.08	Resident Milk	4.18E-2 2.50E-1	Milk
W	0.76	1.87	NONE	Resident Garden	3.43E-2 8.71E-2	Garden
WNW	NONE	NONE	NONE	NA		
NW	0.92	NONE	3.74	Resident Milk	2.53E-2 5.54E-2	Milk
NNW	1.31	4.34	3.87	Resident Garden Milk	2.45E-2 3.66E-2 5.17E-2	Milk

Comments: Dose calculations were performed using GASPAR code and 2019 meteorological data and source term. Dose reported for each location is the total for all three PVNGS Units and is the highest individual critical organ dose identified.

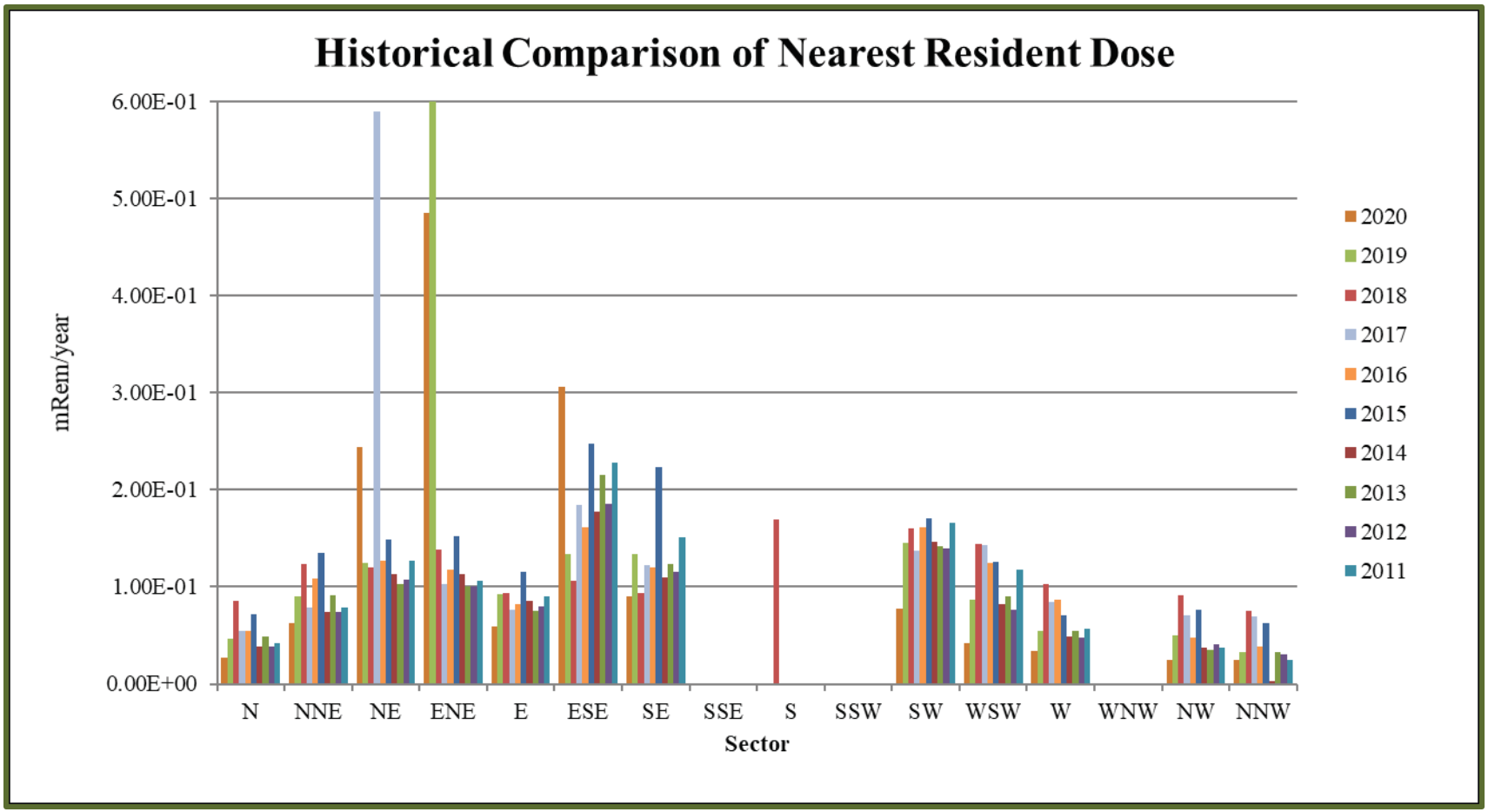


Figure 10-1 Historical Comparison of Nearest Resident Dose

Historical annual average most prevalent wind direction is from the SW; the next highest is from the N. This contributes to the higher doses assigned to residents in the S sector. The 2017 Land Use Census identified potential garden pathway for the nearest resident in the NE Sector and the 2020 Land Use Census identified a potential garden pathway for the nearest resident in the ENE sector; dose is reflective of the assumption of direct radiation and ingestion pathway.

Historical annual average least prevalent wind direction is from the SE; the second least prevalent is from the ESE. This contributes to the lower doses assigned to the residents in the WNW, NW, and NNW sectors.

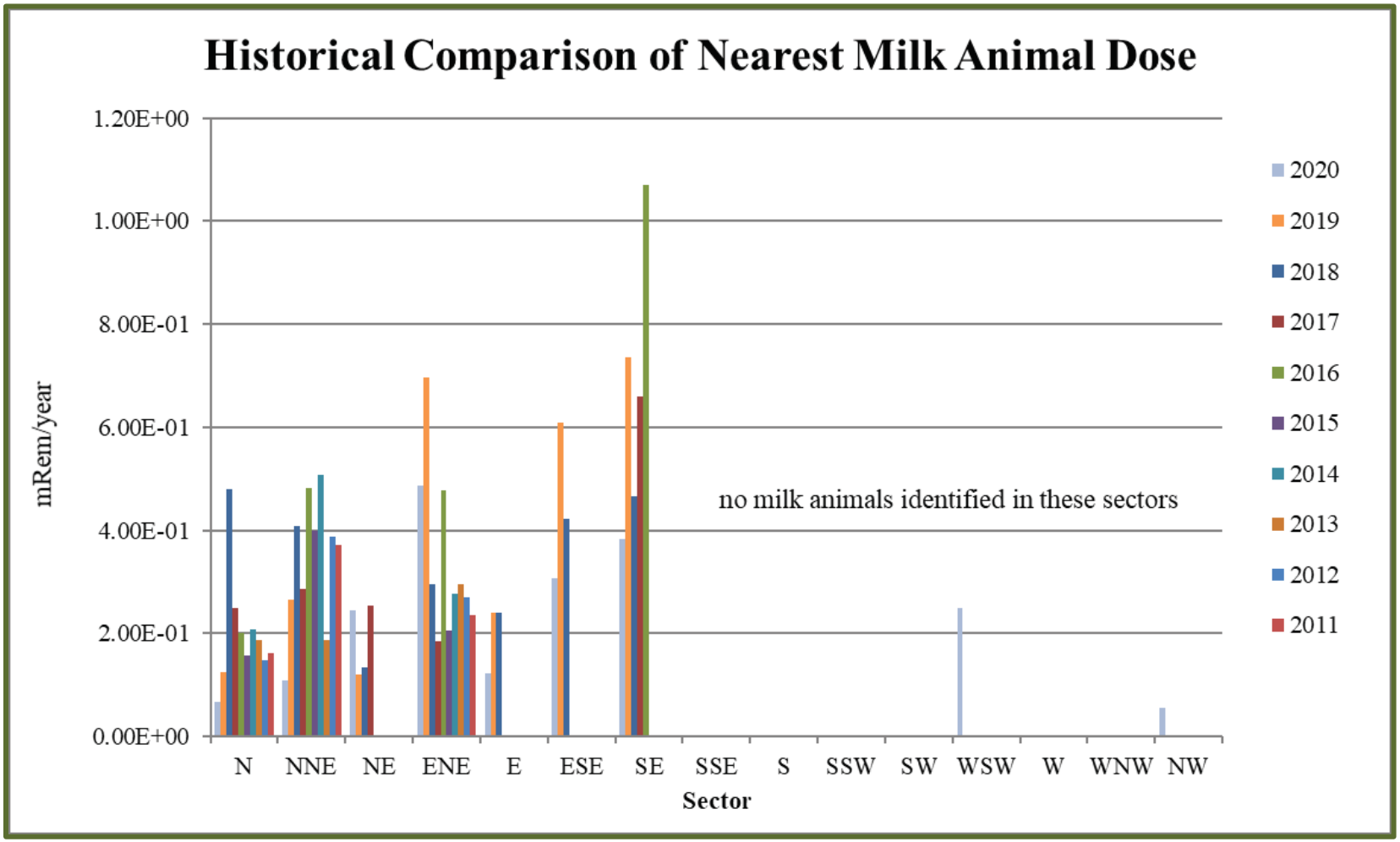


Figure 10-2 Historical Comparison of Nearest Milk Animal Dose

Milk animals include goats and/or cows. No milk samples have indicated any plant-related radionuclides. Additionally, milk animals in the desert environment are normally fed stored feed and are not on pasture. The calculated doses are conservative due to the inclusion of pastured feed as part of the calculation.

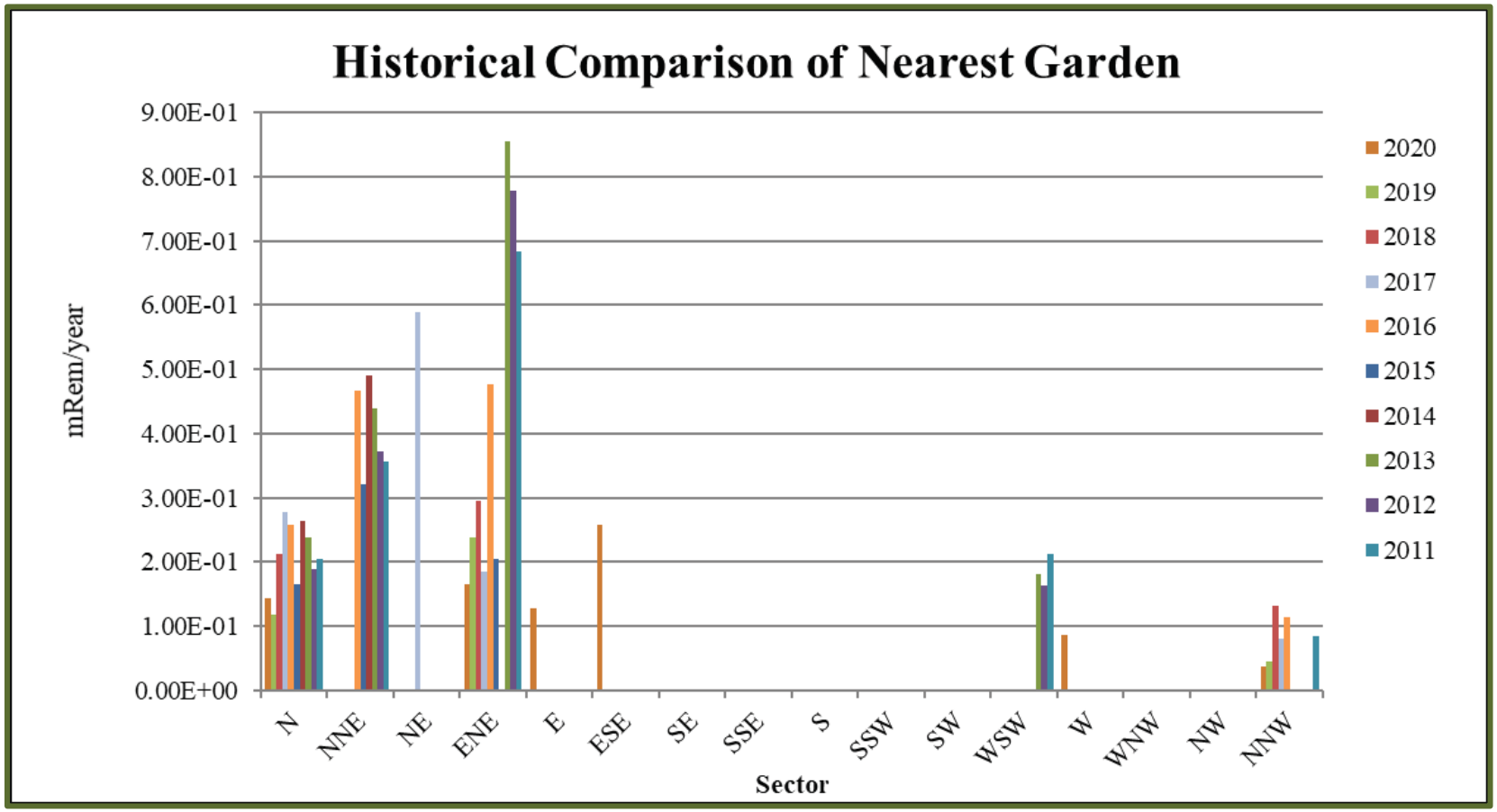


Figure 10-3 Historical Comparison of Nearest Garden Dose

Gardens have been sporadically identified from year to year. Gardening is not prevalent in the desert environment.

11. Summary and Conclusions

Summary

The conclusions are based on a review of the radioassay results and environmental gamma radiation measurements for the 2020 calendar year. Where possible, the data were compared to pre-operational sample data.

All sample results for 2020 are presented in Table 8-1 through Table 8-12 and do not include observations of naturally occurring radionuclides, with the exception of gross beta in air and gross beta in drinking water. Table 11-1 summarizes the ODCM required samples and is in the format required by the NRC BTP on Environmental Monitoring.

I-131 identified in the evaporation ponds, Water Resources influent, Water Resources centrifuge sludge, and reservoirs is the result of offsite sources and appears in the effluent sewage from Phoenix. The levels of I-131 detected in these locations are consistent with levels identified in previous years.

Cs-137 was detected in the primary and secondary samples of the Evaporation Pond 3A sample. The averaged sample result was 32 pCi/L +/- 10 pCi/L. The required lower limit of detection for Cs-137 in water is 18 pCi/L; the ODCM action level for Cs-137 in water is 50 pCi/L. Evaporation Pond 3A has not received any influent during 2020 and is being drained to another evaporation pond to make repairs to the top liner. The water inventory in Evaporation Pond 3A is low, such that sediment that has collected in the pond was unavoidably collected in the sample. Cs-137 is known to bind to sediment, and the levels detected in the water sample is consistent with what was found in the preoperational soils in the surrounding area as a result of atmospheric bomb testing.

Tritium concentrations identified in surface water onsite have been attributed to PVNGS permitted gaseous effluent releases and secondary plant releases. These concentrations are consistent with historical values.

Environmental radiation levels are consistent with measurements reported in previous Pre-operational and Operational Radiological Environmental annual reports, References 1 and 2.

Conclusion

There was no measurable radiological impact on the environment in 2020 resulting from the operation of PVNGS.

Table 11-1 Environmental Radiological Monitoring Program Annual Summary

TABLE 11.1 ENVIRONMENTAL RADIOLOGICAL MONITORING PROGRAM ANNUAL SUMMARY

Palo Verde Nuclear Generating Station — Docket Nos. STN 50-528/529/530
Maricopa County, Arizona — Calendar Year 2020

Medium or Pathway Sampled (Unit of Measurement)	Type and Total Number of Analyses Performed	Lower Limit of Detection (LLD) (from Table 6.1)	All Indicator Locations Mean (f)[a] Range	Location with Highest Annual Mean Name / Distance and Direction	Mean (f)[a] / Range	Control Locations Mean (f)[a] Range	Number of Nonroutine Reported Measurements
Direct Radiation (mrem/std. qtr.)	TLD - 198	NA	24.0 (186/188) 18.1 – 33.6	Site #35 8 miles 330°	31.2 (8/8) 29.2 – 33.6	23.2 (4/4) 22.3 – 24.2	0
Air Particulates (pCi/m^3)	Gross Beta - 520	0.01	0.031 (468/468) 0.009 - 0.063	Site # 14A 2 miles 22.5º	0.030 (52/52) 0.009 - 0.063	0.032 (52/52) 0.012 - 0.052	0
	Gamma Spec Composite - 40						
	Cs-134 (quarterly)	0.05	<LLD <LLD	NA NA	<LLD <LLD	<LLD <LLD	0
	Cs-137 (quarterly)	0.06	<LLD <LLD	NA NA	<LLD <LLD	<LLD <LLD	0
Air Radioiodine (pCi/m^3)	Gamma Spec. - 520 I-131	0.07	<LLD	NA	<LLD	<LLD	0
Broadleaf Vegetation (pCi/Kg-wet)	Gamma Spec. - 25						
	I-131	60	<LLD	NA	<LLD	<LLD	0
	Cs-134	60	<LLD	NA	<LLD	<LLD	0
	Cs-137	80	<LLD	NA	<LLD	<LLD	0

Groundwater (pCi/liter)	H-3 – 12	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. - 12						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	Gross Beta – 48	4	3.22 (48/48) 2.41 – 5.34	Site #55 3 miles 214°	3.87 (12/12) 2.65 -5.34	NA	0
	H-3 – 16	2000	<LLD	NA	<LLD	NA	0
	Gamma Spec. – 48						
Drinking Water (pCi/liter)	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	<LLD	NA	<LLD	NA	0
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0

Milk (pCi/liter)	Gamma Spec. – 33						
	I-131	1	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-134	15	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Cs-137	18	<LLD	NA	<LLD	<LLD	0
			<LLD	NA	<LLD	<LLD	
	Ba-140	60	<LLD	NA	<LLD	<LLD	0
	La-140	15	<LLD	NA	<LLD	<LLD	0
Surface Water (pCi/liter)	Gamma Spec. - 18						
	Mn-54	15	<LLD	NA	<LLD	NA	0
	Fe-59	30	<LLD	NA	<LLD	NA	0
	Co-58	15	<LLD	NA	<LLD	NA	0
	Co-60	15	<LLD	NA	<LLD	NA	0
	Zn-65	30	<LLD	NA	<LLD	NA	0
	Zr-95	30	<LLD	NA	<LLD	NA	0
	Nb-95	15	<LLD	NA	<LLD	NA	0
	I-131	15	<LLD	NA	<LLD	NA	0
	Cs-134	15	<LLD	NA	<LLD	NA	0
	Cs-137	18	32(1/18) 41-41	Site #64 Onsite 190º	32 (2/2) 29-35	NA	1
	Ba-140	60	<LLD	NA	<LLD	NA	0
	La-140	15	<LLD	NA	<LLD	NA	0
	H-3 - 25	3000	631 (10/18) 382-977	Site #63 Onsite 180°	977 (1/1) 977-977	NA	0

(a) Mean and range based upon detectable measurements only. Fraction of detectable measurements at specified locations is indicated in parentheses. (f)

NOTE: Miscellaneous samples that are not listed on Tables 2.1 and 9.1 (not ODCM required) are not included on this table.

12. References

1. Pre-Operational Radiological Monitoring Program, Summary Report 1979-1985

2. 1985-2019 Annual Radiological Environmental Operating Reports, Palo Verde Nuclear Generating Station

3. Palo Verde Nuclear Generating Station Technical Specifications and Technical Reference Manual

4. Offsite Dose Calculation Manual, Revision 28, PVNGS Units 1, 2, and 3

5. Regulatory Guide 4.1, Programs for Monitoring Radioactivity in the Environs of Nuclear Power Plants

6. Regulatory Guide 4.8, Environmental Technical Specifications for Nuclear Power Plants

7. NRC Radiological Assessment Branch Technical Position on Environmental Monitoring, Revision 1, November 1979 (Incorporated into NUREG-1301)

8. "Sources of Radiation." *NRC: Sources of Radiation*. Nuclear Regulatory Commission, 2 Oct. 2017. Web. 31 Jan. 2020.

9. "NCRP Report No. 160: Ionizing Radiation Exposure of the Population of the United States." *Journal of Radiological Protection J. Radiol. Prot.* 29.3 (2009): 465. Web.

10. NEI 07-07, Nuclear Energy Institute, Industry Groundwater Protection Initiative – Final Guidance Document, Rev. 1, March 2019

11. Offsite Dose Calculation Manual, Revision 29, PVNGS Units 1, 2, and 3
    - Editorial changes made in March 2020 to correct corrupted equations in Revision 28. No Technical changes were made.