ADP CR3, LLC

Crystal River Nuclear Plant
2760 South Falkenburg Rd
Riverview, FL 33578
Docket 50-302
Docket 72-1035
Operating License No. DPR-72

ODCM

April 18, 2023
3F0423-03

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

Subject: Crystal River Unit 3 – 2022 Annual Radiological Environmental Operating Report

Dear Sir or Madam:

ADP CR3, LLC hereby provides the 2022 Annual Radiological Environmental Operating Report for Crystal River Unit 3 in accordance with the Offsite Dose Calculation Manual (ODCM). The data provided in the attached report is consistent with the objectives outlined in the ODCM and includes all radiological environmental samples taken during the report period from January 1, 2022 through December 31, 2022.

This letter contains no new regulatory commitments.

If you have any questions regarding this submittal, please contact Ms. Holly Van Sicklen, Licensing Manager, at (352) 634-1028.

Sincerely,

Phyllis A. Dixon
ISFSI Manager

PAD/hvs

Attachment 1: 2022 Annual Radiological Environmental Operating Report

cc: NMSS Project Manager
Regional Administrator, Region I

ADP CR3, LLC

DOCKET NUMBER 50-302 / 72-1035
LICENSE NUMBER DPR-72

ATTACHMENT 1

2022 ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

ANNUAL RADIOLOGICAL ENVIRONMENTAL OPERATING REPORT

2022

ADP CR3, LLC

CRYSTAL RIVER UNIT 3

TABLE OF CONTENTS

INTRODUCTION

This report is submitted as required by procedure CP-500: Special Actions and Reporting Requirements, Section 4.2.1.a, and the Offsite Dose Calculation Manual (ODCM).

The following information is required to be included in this report:

- Data Summaries
- Interpretations
- Unachievable LLDs
- An analysis of trends
- An assessment of any observed impact of plant operation on the environment

  NOTE: If harmful effects or evidence of irreversible damage are detected by the monitoring, the report shall provide an analysis of the problem and a planned course of action to correct it.

- Summarized and tabulated results of all radiological environmental samples taken during the report period, in the format of Radiological Assessment Branch Technical Position, Revision 1, November 1979.

  NOTE: If some results are not available for inclusion, the report shall note and explain the reason for the missing results. The missing results shall be submitted as soon as possible in a supplementary report.

- A summary description of the Radiological Environmental Monitoring Program.
- A map of all sampling locations keyed to a table giving distances and directions from the reactor.
- Land-use census results.
- Inter-laboratory Comparison Program results.
- A discussion of airborne sample station availability.
- Results of any unplanned release or spill of radioactive material that could have the potential to contaminate the groundwater as reported to maintain compliance with the groundwater protection initiative (NEI 07-07).

Additional Information

On February 5, 2013, Duke Energy decided to permanently retire Crystal River Unit 3. The decision was made due to the risk associated with repairing the containment building's delaminated concrete wall. The company placed the facility in a SAFSTOR status until Sept 30th, 2020. Beginning on October 1st, 2020, the site radiological license was transferred from Duke Energy to ADP CR3, LLC and active decommissioning commenced. Also in 2020, CR3 received approval from the NRC to reduce the licensed area of the site to 884 acres as part of the Partial Site Release project. This had no effect on any REMP sample location or REMP sample frequency. Additionally, all spent nuclear fuel was transferred from the spent fuel pool to the onsite Independent Spent Fuel Storage Installation (ISFSI) for dry storage in January 2018 and most plant systems have been abandoned.

I. SUMMARY DESCRIPTION OF THE RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM

The analytical results of the Crystal River Unit 3 (CR-3) operational Radiological Environmental Monitoring Program (REMP) for 2022 are contained in this report. The operational program began on January 1, 1977, just prior to initial criticality, which was achieved on January 14, 1977.

Sampling of the facility environs is performed by the State of Florida Department of Health, Bureau of Radiation Control. The State also performs the required analyses, participates in the Interlaboratory Comparison Program, and performs the annual land-use census. Prior to 1990, the program was split between the Department of Health and the University of Florida.

Sample station locations are given in Table I-1 and Figures I-2, I-3 and I-4. Sample frequency and analysis type is shown on Table I-2. Figure I-1 illustrates the relevant exposure pathways. Regarding waterborne pathways, the groundwater area of the Crystal River site is too saline to be used as a source of drinking water, hence there is no credible drinking water intake pathway. Additionally, the Florida aquifer groundwater flows in a west-southwest direction across the site toward the Gulf of Mexico, and since the location of the site is along the coast, there is no downstream public impact regarding groundwater.

Except for air sample gross beta results and direct radiation measurements, most of the analytical results are below the lower limit of detection (LLD) of the sample. Sample LLDs are generally much lower than the required "a priori" LLD listed in the ODCM. When measurable results are reported, the values are also usually less than the required "a priori" LLD.

Trace levels of Cs-137 are still occasionally seen in vegetation samples due to past global fallout. The vegetation control sample station located in Orlando Florida is also experiencing similar Cs-137 deposition on the broad leaf sample media. Traces of Cs-137 can also be detected occasionally in soil/sediment for the same reason.

The results of the 2022 REMP samples have been compared to previous years' results. This comparison, in part illustrated by the trend graphs of Section IV, shows no evidence of consistent long-term increasing trends in any of the sample media. However, CR3 plant related radioactive material is occasionally quantified in sediment samples which are taken in the discharge canal near the liquid release discharge point. In general, these results verify the effectiveness of in-plant measures for controlling radioactive releases.

Trend graphs illustrate the mean measured concentration of a particular radionuclide for the year. When measurable results are not obtained, the highest sample LLD is plotted. LLD and measured values are plotted on the same line to best illustrate any trend.

Statistical summary pages are provided for each medium or pathway. Measured values are reported in terms of a mean and range. In addition, the number of measured values versus samples obtained is reported. For example, in the following entry.

15 (249/256)
(4 - 35)

the "All Indicator Locations" column would be interpreted as indicating a mean measured value of 15, with measured values ranging from 4 to 35. (249/256) means that out of 256 samples, 249 were measured values above LLD.

TABLE I-1

ADP CR3, LLC- 2022

SAMPLE STATION LOCATIONS

SAMPLE MEDIA	STATION ID	DIRECTION	APPROX. DISTANCE (Miles)
TLD – on-site	C60	N	0.88
	C61	NNE	0.92
	C62	NE	1.17
	C63	ENE	0.87
	C64	E	0.80
	C65	ESE	0.33
	C66	SE	0.36
	C67	SSE	0.33
	C68	S	0.27
	C69	SSW	0.31
	C41	SW	0.43
	C70	WSW	0.74
	C71	WNW	0.58
	C72	NW	0.30
	C73	NNW	0.74
	C27	W	0.41
TLD – off-site	C18	N	5.3
	C03	NNE	4.89
	C04	NE	5.95
	C74	ENE	5.13
	C75	E	3.99
	C76	ESE	5.61
	C08	SE	5.66
	C77	SSE	3.39
	C09	S	3.23
	C14G	W	2.0
	C01	NW	4.8
	C79	NNW	4.97
	C47-Control	ESE	78
	C07*	ESE	7.67
	C40*	E	3.48
	C46*	N	0.37

*TLDs not required by ODCM. Deployed at air sample locations.

TABLE I-1 (CONT'D)

ADP CR3, LLC- 2022

SAMPLE STATION LOCATIONS

SAMPLE MEDIA	STATION ID	DIRECTION	DISTANCE (Miles)
AIR	C07	ESE	7.7
	C18	N	5.3
	C40	E	3.5
	C41	SW	0.4
	C46	N	0.4
	C47-Control	ESE	78
SEAWATER	C14H	NW	0.1
	C14G	W	2.0
	C13-Control	WSW	3.4
GROUND WATER	C40-Control	E	3.7
SITE GROUND WATER	CR3-1	E	0.1
	CR3-2	E	0.1
	CR3-3S and 3D	SSE	0.1
	CR3-4	SSE	0.1
	CR3-5	SSW	0.05
	CR3-6S	W	0.04
	CR3-6D	W	0.04
	CR3-7	WNW	0.06
	CR3-8	WNW	0.07
	CR3-9	NW	0.1
	CR3-10	NNE	0.1
DRINKING WATER	C07-Control	ESE	7.4
	C10-Control	ESE	6.0
	C18-Control	N	5.3
SHORELINE SEDIMENT	C09-Control	S	3.2
	C14H	NW	0.1
	C14M	W	1.2
	C14G	W	2.0
FISH & OYSTERS	C29	W	2.5
	C30-Control	WSW	3.4
BROAD LEAF VEGETATION	C48A	N	0.4
	C48B	ENE	0.9
	C47-Control	ESE	78
WATERMELON	C04	NE	6.0
CITRUS	C19	ENE	9.6

TABLE I-2

ADP CR3, LLC- 2022

SAMPLING AND ANALYSIS PROGRAM

SAMPLE MEDIA	# OF STATIONS	FREQUENCY	ANALYSIS		LLD[1]
TLD	32*	Quarterly	γ Dose		---
Air Particulate	6	Weekly	Gross ß		0.01 pCi/m^3
		Quarterly	γ Spec :	Cs-134	0.05[b]
				Cs-137	0.06[b]
Seawater	3	Monthly	Tritium		2000[a] pCi/L
		Monthly	γ Spec :	Co-60	15
				Cs-134	15
				Cs-137	18
Ground Water	1	Semiannual	Tritium		2000[a] pCi/L
		Semiannual	γ Spec :	[2]	[2]
Site Ground Water[3]	10	Quarterly	Tritium		2000[a] pCi/L
		Quarterly	γ Spec :	[2]	[2]
Drinking Water	3	Quarterly	Tritium		2000[a] pCi/L
		Quarterly	γ Spec :	[2]	[2]
Shoreline Sediment	4	Semiannual	γ Spec :	Cs-134	150 pCi/kg
				Cs-137	180

* Includes 3 stations which are not required by the ODCM
[1] The maximum "a priori" LLD listed in the ODCM
[2] Same as Seawater γ Spec
[3] Additional 2 stations reported that are not required by the ODCM
[a] LLD for drinking water. If no drinking water pathway exists, a value of 3000 pCi/L may be used
[b] LLDs apply only to quarterly composite gamma spectral analysis, not to analyses of single particulate filters

TABLE I-2 (Cont'd)

ADP CR3, LLC- 2022

SAMPLING AND ANALYSIS PROGRAM

SAMPLE MEDIA	# OF STATIONS	FREQUENCY	ANALYSIS		LLD[1]
Carnivorous Fish and Oysters	2	Quarterly	γ Spec :	Co-60	130 pCi/kg
				Cs-134	130
				Cs-137	150
Broad Leaf Vegetation	3	Monthly[3]	γ Spec :		
				Cs-134	60
				Cs-137	80
Watermelon	1	Annual[4]	γ Spec :	[5]	[5]
Citrus	1	Annual[4]	γ Spec :	[5]	[5]

[1] The maximum "a priori" LLD
[2] ---Not Used ---
[3] When available
[4] During harvest
[5] Same as broad leaf vegetation

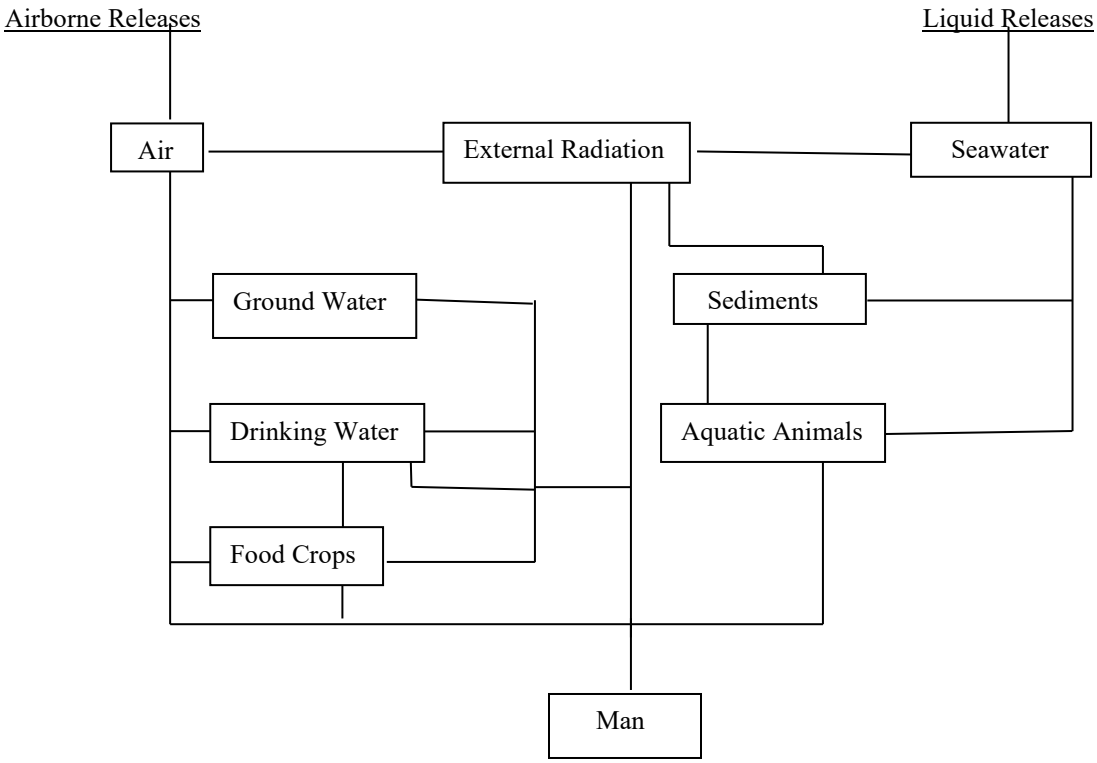


FIGURE I-1: Environmental Media and Exposure Pathways

FIGURE I-2: Environmental Monitoring Sample Stations (non-TLDs) Outlying Areas

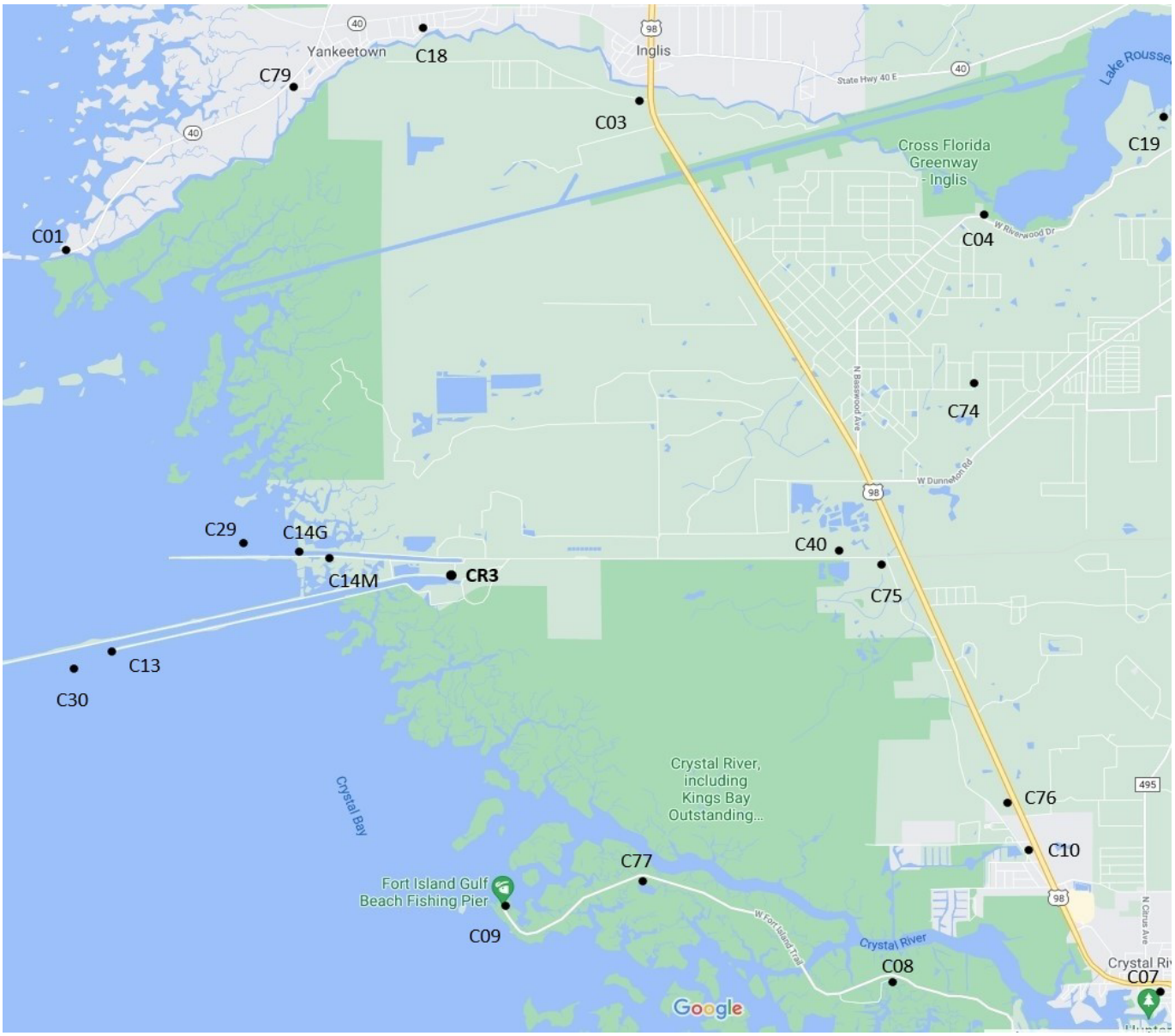


Figure I-3

Environmental Monitoring Locations Site and Adjacent Areas

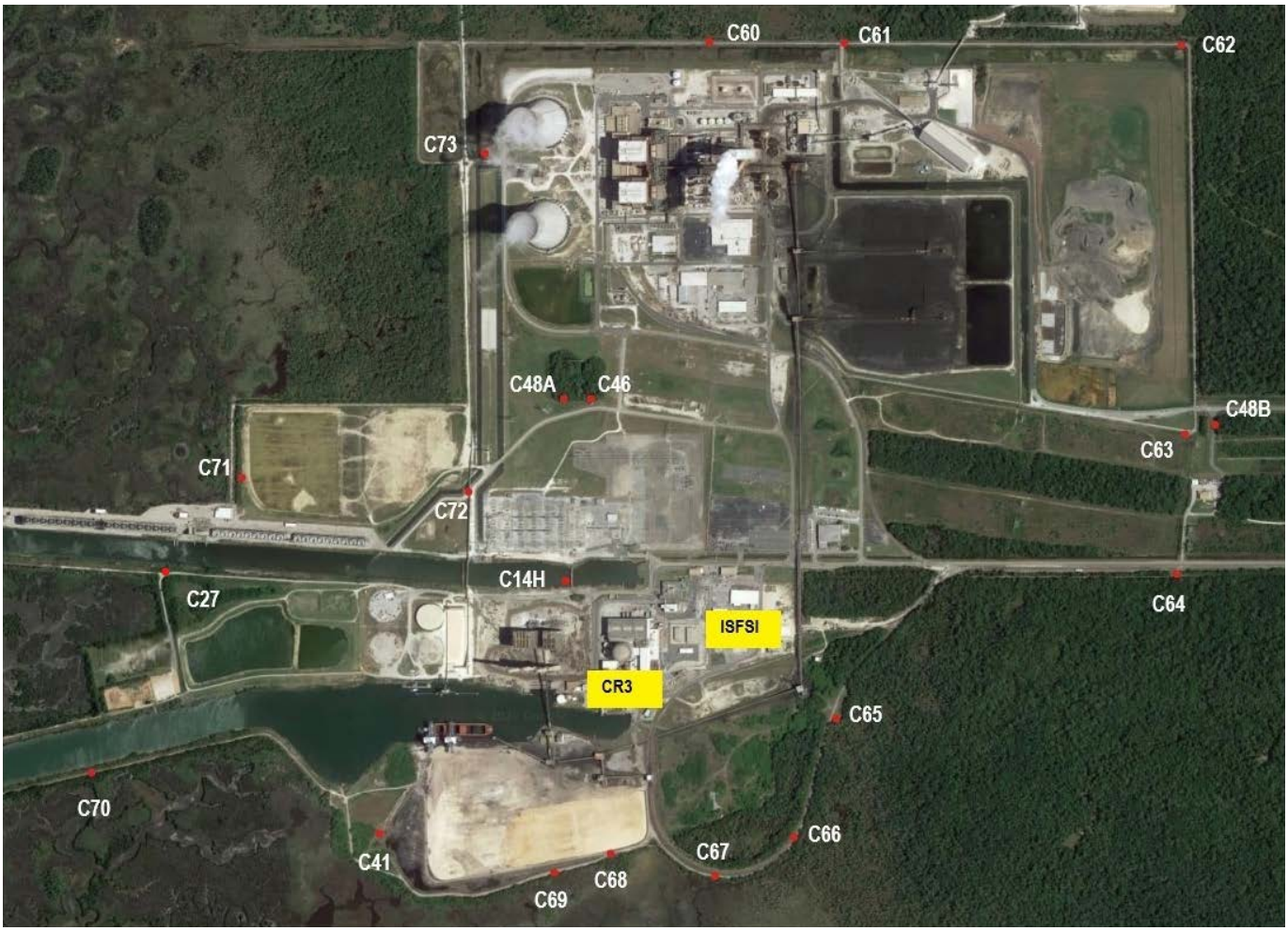
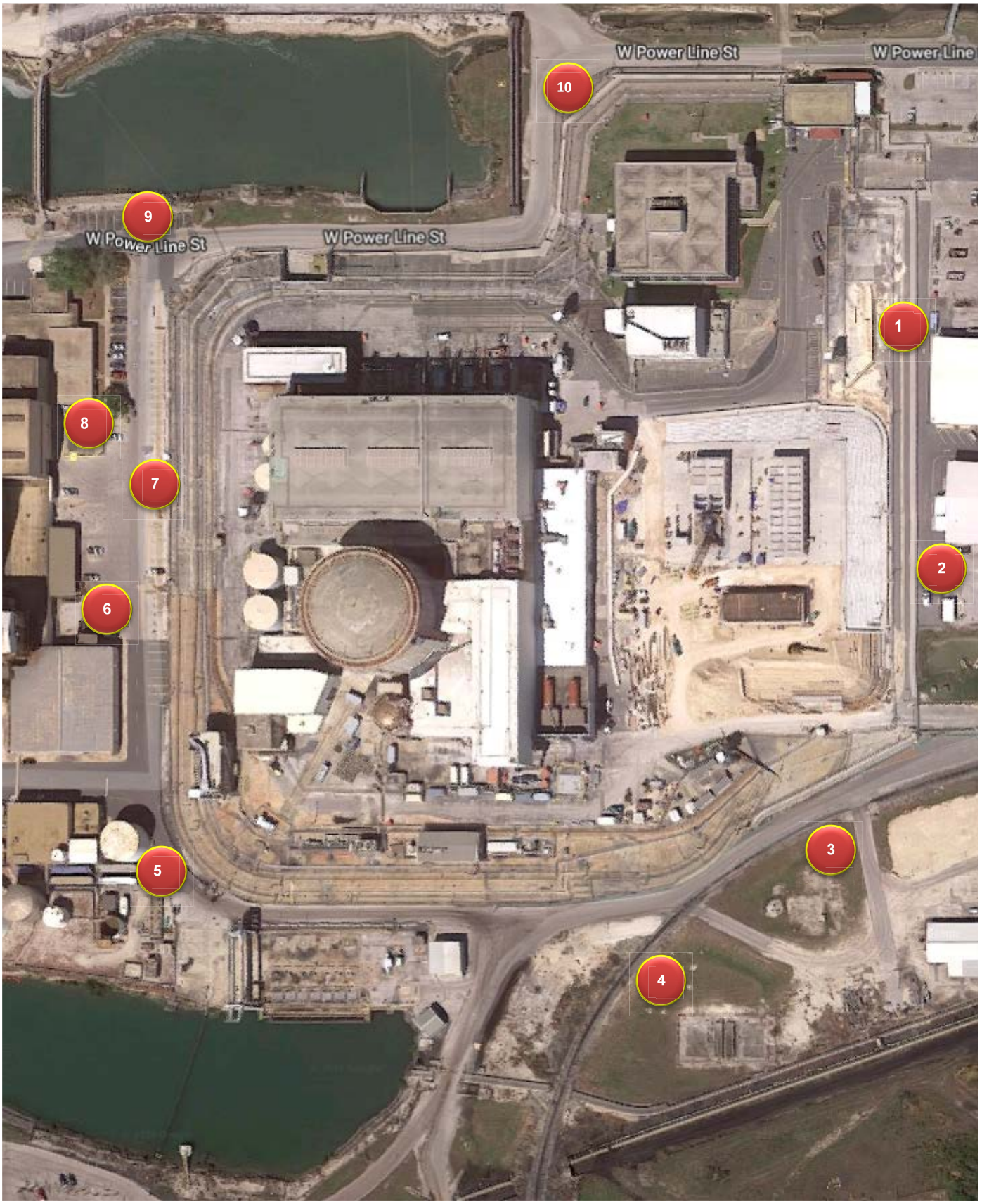


Figure I-4: CR3 Groundwater Monitoring Well Locations
Deep Wells Are Also Installed at #'s 1, 3, 6



II. LAND-USE CENSUS

A 2022 land-use census was conducted in June. The purpose of the census is to identify the nearest residences, vegetable gardens, and potential milk-producing animals within a five-mile radius of the nuclear plant. The distance in miles and bearing in degrees for each receptor type in each of the sixteen sectors is summarized below. No milk-producing animals were found within a 5-mile radius of the plant, same as 2021. One new garden area was found ENE at 4.4 miles of CR3 in 2022 but nothing was planted at the time of the survey.

SECTOR	NEAREST RESIDENCE	NEAREST GARDEN (A)	NEAREST MILK ANIMAL
N	4.5 @ 2º	*	*
NNE	4.6 @ 15º	*	*
NE	3.8 @ 54º	*	*
ENE	4.4 @ 76º	4.4	*
**E	2.4 @ 92º	*	*
ESE	4.2 @ 102º	*	*
SE	4.8 @ 133º	*	*
SSE	3.5 @ 149º	*	*
S	*	*	*
SSW	*	*	*
SW	*	*	*
WSW	*	*	*
W	*	*	*
WNW	*	*	*
NW	4.8 @ 321°	*	*
NNW	4.6 @ 339º	*	*

(A) - Only gardens with an estimated total area of 500 square feet, or more, and producing green leafy vegetables are considered.

* No suitable sites were located within 5 miles.
** Not a permanent resident but occupied intermittently by various DEP personal

III. FLORIDA DEPARTMENT OF HEALTH - INTERLABORATORY COMPARISON PROGRAM DATA

The EPA crosscheck program ceased operation at the end of 1998. To meet the requirements for a crosscheck program, the Florida Department of Health participates in the Department of Energy's Mixed-Analyte Performance Evaluation Program (MAPEP). For 2022, all results were within the indicated Acceptance Ranges, as shown below.

The following units are used for each of the four media:

Air Filters: Bq/sample
Soil: Bq/Kg
Vegetation: Bq/sample
Water: Bq/L

Analytical performance is based on historical analytical capabilities for individual analyte/matrix pairs.
Acceptable performance is designated by an "A".
Acceptable with warning is designated by a "W".
Performance which is not acceptable is designated by an "N".

MAPEP Results for August 2022:

Media	Nuclide	Result	% Bias	Acceptance Range	Flag
Air Filter	Cs-134	0.045	-	False Positive Test	A
Air Filter	Cs-137	1.593	4.1	1.07-1.99	A
Air Filter	Zn-65	1.872	18.5	1.11-2.05	A
Air Filter	Co-60	1.954	-1.8	1.39-2.59	A
Air Filter	Mn-54	2.029	7.9	1.32-2.44	A
Soil	Cs-134	641.82	2.4	439-815	A
Soil	Cs-137	1.14	-	False Positive Test	A
Soil	Co-57	687.01	-12.6	550-1022	A
Soil	Co-60	0.15	-	False Positive Test	A
Soil	Mn-54	828.11	-1.5	589-1093	A
Soil	Zn-65	1156.63	1.5	798-1482	A
Vegetation	Cs-134	-0.005	-	False Positive Test	A
Vegetation	Cs-137	1.189	9.8	0.758-1.408	A
Vegetation	Co-57	0.002	-	False Positive Test	A
Vegetation	Co-60	4.776	3.4	3.23-6.01	A
Vegetation	Mn-54	2.613	7.5	1.70-3.16	A
Vegetation	Zn-65	8.217	9.7	5.24-9.74	A
Water	Cs-134	16.178	-5.4	12.0-22.2	A
Water	Cs-137	16.71	-0.5	11.8-21.8	A
Water	Co-60	16.462	-3.2	11.9-22.1	A
Water	Mn-54	0.198	-	False Positive Test	A
Water	Zn-65	11.824	4.6	7.9-14.7	A
Water	H-3	567.7	1.4	488.3-614.1	A

IV-A. AIRBORNE PATHWAY

Air samples are taken at five locations near the plant. The control location (station C-47) is 78 miles ESE of the plant, at the Department of Health, State Bureau of Radiation Control, in Orlando.

Table IV-A.1 provides a statistical summary of the analytical results for 308 gross beta samples.

Tables IV-A.2 and IV-A.3 provide the results for each weekly air sample.

In 2022, 308 particulate samples were analyzed for gross beta activity, and all 308 had measurable activity above LLD. The average indicator concentration for collected samples was 18 pCi/1000 m^3 with a range of 3 to 39 pCi/1000 m^3. In 2021 the average value was 18 pCi/1000 m^3 and in 2020 it was 16 pCi/1000 m^3. The average indicator concentration since 1996 has been in the range of 14 to 24 pCi/1000 m^3. The control location concentration for 2022 averaged 16 pCi/1000 m^3, with a range of 5 to 25 pCi/1000 m^3. The control location in 2021 averaged 16 pCi/1000 m^3. In 2022, location C18 had the highest yearly indicator concentration at 19 pCi/1000 m^3. C18 was also the highest location in 2021, with an average of 20 pCi/1000 m^3. Air sample locations C40, C41 and C46 were relocated about 100 meters or less to new sample hutches in August to enable hook up to new onsite power sources. These moves were necessitated by changing site conditions due to the decommissioning of CR3 and coal units 1 and 2.

Quarterly composite data are summarized in Table IV-A.3. In 2022, measurable quantities of cesium were not identified in any particulate filter sample. The highest cesium-137 LLD was 1.0 pCi/1000 m^3, versus 1.7 pCi/1000 m^3 in 2021.

The 2022 airborne sample data is comparable with previous year's sample data with exception of samples collected in 2011 during the March and April time frame where airborne particulate and iodine samples were affected by the Fukushima earthquake and tsunami event that occurred on March 11, 2011. Those sample data were thoroughly discussed in the 2011 Annual Radiological Environmental Operating Report submitted for Crystal River Unit 3.

There were threeinstances of weekly air samples that were not collected. They were identified during the routine weekly sample change-outs and documented in Certrec Condition Report 2022000004: REMP Program Tracking for 2022.

1. C41: 4-Jan - Power outage at site.
2. C46: 16-Aug: Filter not present.
3. C40: 23-Aug – Pump Malfunction.

The yearly percentages of missed or partial air samples (3) was 1.2 % of the total indicator samples (260).

TABLE IV-A.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
AIRBORNE PARTICULATES (pCi/1000m^3 for Gross ß, pCi/1000m^3 for γ Spec)	Gross ß 309	10	18 (257/257) (3–39)	C18 5.3 miles North	19 (52/52) (6–36)	16 (52/52) (5–25)	0
	γ Spec 24						
	Cs-134	50	<LLD	--	--	<LLD	0
	Cs-137	60	<LLD	--	--	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

.

TABLE IV-A.2

ADP CR3, LLC - 2022

pCi/1000 m^3 GROSS BETA IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
04-Jan-22	14	16	15	*	16	15
11-Jan-22	18	20	18	16	19	18
18-Jan-22	23	23	22	27	17	22
25-Jan-22	24	29	26	24	22	22
01-Feb-22	26	31	24	27	22	21
08-Feb-22	17	17	13	14	15	10
15-Feb-22	25	25	28	26	27	20
22-Feb-22	19	21	16	21	15	18
01-Mar-22	13	17	19	14	16	12
08-Mar-22	26	21	25	25	25	18
14-Mar-22	9	6	12	11	12	12
21-Mar-22	18	14	12	14	16	13
30-Mar-22	20	20	20	19	17	17
Average:	**19**	**20**	**19**	**20**	**18**	**17**

* No power at site during this period

TABLE IV-A.2 (Cont'd)

ADP CR3, LLC - 2022

pCi/1000 m^3 GROSS BETA IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
06-Apr-22	17	17	18	20	19	17
12-Apr-22	20	14	18	20	16	14
19-Apr-22	12	10	10	10	12	12
25-Apr-22	24	25	21	23	23	20
03-May-22	22	20	22	20	20	21
10-May-22	16	17	14	13	14	15
18-May-22	16	24	19	21	19	15
24-May-22	22	24	20	24	19	13
31-May-22	21	25	17	20	17	25
06-Jun-22	10	9	11	13	14	10
15-Jun-22	14	15	15	15	11	13
21-Jun-22	21	24	24	23	28	17
29-Jun-22	18	19	15	11	16	17
Average	**18**	**19**	**17**	**18**	**18**	**16**

TABLE IV-A.2 (Cont'd)

ADP CR3, LLC - 2022

pCi/1000 m^3 GROSS BETA IN AIR

	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
05-Jul-22	6	12	11	6	5	6
13-Jul-22	9	12	11	10	11	7
19-Jul-22	14	16	10	17	10	10
26-Jul-22	17	12	16	13	15	11
02-Aug-22	16	22	18	13	15	18
08-Aug-22	14	15	11	10	14	12
16-Aug-22	25	15	11	10	**	14
23-Aug-22	26	25	*	26	12	19
31-Aug-22	6	6	7	5	6	5
06-Sep-22	9	8	9	9	6	9
13-Sep-22	3	6	5	10	7	10
20-Sep-22	10	12	12	8	10	9
27-Sep-22	27	25	24	25	20	19
Average	**14**	**14**	**12**	**12**	**11**	**11**

* Not Collected – pump malfunction
** Not collected as filter not present

TABLE IV-A.2 (Cont'd)

ADP CR3, LLC - 2022

pCi/1000 m^3 GROSS BETA IN AIR

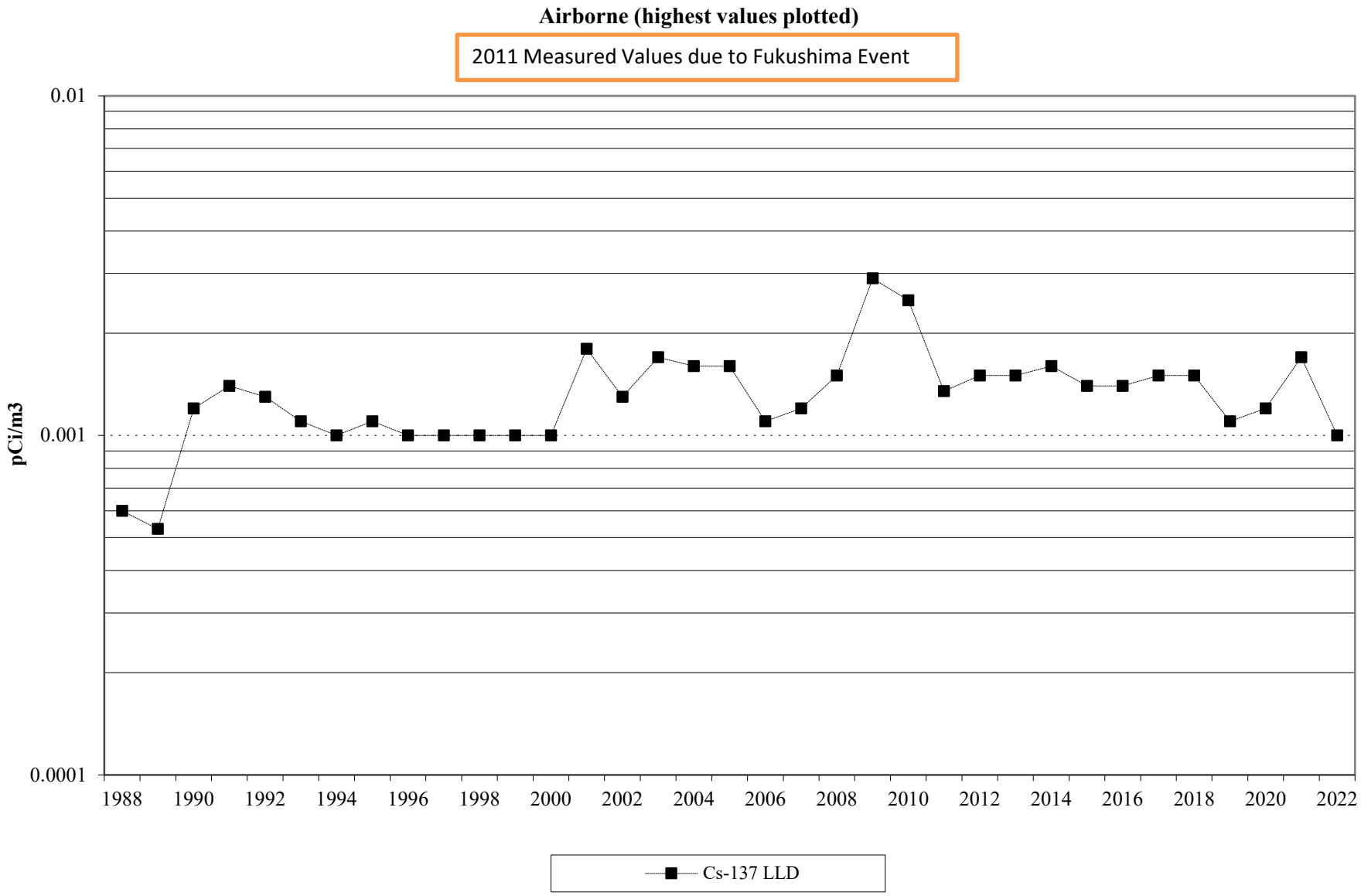
	SAMPLE SITE					
Collection Date	C07	C18	C40	C41	C46	C47
04-Oct-22	17	23	18	21	20	12
11-Oct-22	33	36	36	33	39	25
18-Oct-22	23	23	24	24	30	25
24-Oct-22	23	26	24	20	25	25
31-Oct-22	16	19	19	18	21	15
08-Nov-22	16	18	21	21	20	15
16-Nov-22	18	18	26	28	19	17
22-Nov-22	25	18	26	28	26	17
29-Nov-22	19	21	25	23	23	19
05-Dec-22	20	22	22	23	22	19
13-Dec-22	20	19	22	23	22	19
21-Dec-22	26	28	24	28	23	19
27-Dec-22	24	25	18	18	22	23
Average	**22**	**23**	**23**	**24**	**24**	**19**

TABLE IV-A.3

ADP CR3, LLC - 2022

pCi/1000 m^3 GAMMA EMITTERS IN QUARTERLY COMPOSITES OF AIR PARTICULATES

STATION	NUCLIDE	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
C07	Be-7	87	133	152	120
	K-40	<9	<14	<13	<13
	Cs-134	<1.1	<1.3	<1.3	<1.1
	Cs-137	<0.7	<0.9	<0.9	<0.6
C18	Be-7	146	126	85	158
	K-40	<15	<22	<16	<16
	Cs-134	<0.7	<0.9	<0.8	<1.1
	Cs-137	<0.7	<0.9	<0.8	<0.9
C40	Be-7	93	152	116	178
	K-40	<11	<14	<18	<16
	Cs-134	<1.2	<1.2	<0.9	<1.1
	Cs-137	<0.9	<0.9	<0.7	<0.9
C41	Be-7	137	141	123	107
	K-40	<17	<18	<12	<18
	Cs-134	<1.2	<1	<0.8	<1.1
	Cs-137	<0.8	<0.8	<0.8	<0.9
C46	Be-7	66	141	123	114
	K-40	<17	<14	<13	<16
	Cs-134	<0.8	<1.1	<1	<1
	Cs-137	<0.6	<0.6	<0.8	<0.8
C47	Be-7	148	72	140	155
	K-40	<14	<15	<19	<14
	Cs-134	<1	<1	<1.1	<1.2
	Cs-137	<1	<0.8	<1	<1


Airborne (highest values plotted)
2011 Measured Values due to Fukushima Event
0.01
0.001
0.0001
pCi/m3
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Cs-137 LLD

IV-B. DIRECT RADIATION

Direct radiation measurements (using TLDs) were taken at 31 locations surrounding the plant, and at one control location 78 miles from the site (C47). Of the 124 non-control quarterly TLD's, 120 were collected. Locations C14G and C70 could not be collected during the fourth quarter and location C79 could not be collected during the first and second quarters as they were missing.

Table IV-B provides a statistical summary of the analytical results for 120 non-control TLDs collected throughout the year.

Table IV-B.1 provides the results of the individual TLD measurements.

In 2022, the highest annual average on-site dose was 50.0 mrem at station C72 (NW of CR3 RB at 1600 feet). In 2021, the highest annual average on-site dose was 61 mrem at station C71 (WNW at 3600 feet). Location C71 was also the highest in 2020 at 55 mrem and in 2019 at 56 mrem. Station C72 is near the old helper cooling towers which are being demolished. The area around locations C71 and C72 is undergoing construction work associated with the Unit 1 & 2 coal plant demolition and other Duke Energy site improvement initiatives.

The highest annual average off-site dose was 40.2 mrem at station C40 (E at 3.5 miles). The highest annual average off-site dose in 2021 was 40 mrem at station C77 (SSE at 3.4 miles). C40 at 40 mrem was the highest offsite location in 2020. The control station (C47) average annual dose was 36.9 mrem in 2022 versus 36 mrem in 2021. The average for all stations (except control) was 37 mrem for 2022 versus 40 mrem for 2021. Direct radiation results in 2022 are like previous results and do not show any indication of a trend.

The Independent Spent Fuel Storage Installation (ISFSI) was loaded with spent fuel beginning June 2017 and completed January 2018. Calculations performed prior to fuel movement into dry storage, derived a conservative dose rate at ~ 400 meters from the ISFSI pad of ~ 2.0 E-4 mrem/h gamma plus neutron (Ref. N16-0003, Table 11-27). The gamma component contributes most of the dose. Greater than class C waste, stored at the ISFSI in May 2018, has a much lower gamma dose rate (Ref. N18-0002). The combined dose at 400 meters is ~ 0.4 mrem for 90 days of exposure. 90 days is the approximate exposure period for REMP TLDs, and 400 meters is the approximate nearest distance from the ISFIS pad (center) for any of the REMP TLDs (e.g. C65). A review of quarterly TLD results shows that normal quarter to quarter variation in dose is greater than the dose increment due to ISFSI. Likewise, four of the REMP TLDs (C65, C66, C67, and C68) most likely to be influenced by the ISFSI based on no discernable step change increases in annual dose over the period of 2018 through 2022 when compared to the period of 2014 through mid-2017.

TABLE IV-B

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DIRECT RADIATION (mrem/yr)	γ DOSE, 124	15	37 (120/120) (24 - 73)	C72 0.3 @NW	50 (4/4) (32 - 73)	34 (4/4) (30 – 43)	0

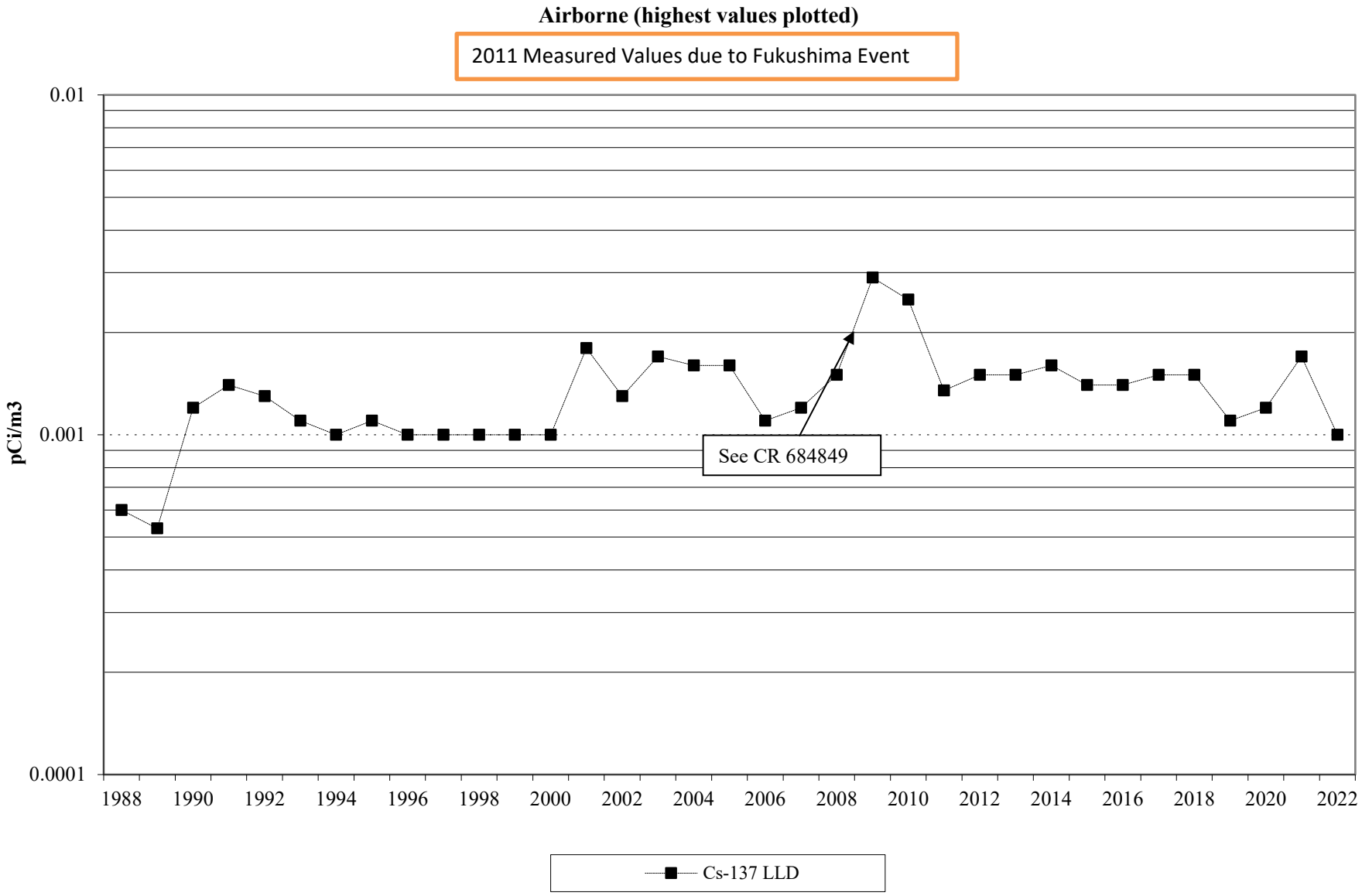
TABLE IV-B.1

ADP CR3, LLC- 2022

Annual Gamma (γ) Dose (mrem)

TLD STATION	Quarter	1	2	3	4
C01		38	26	28	26
C03		39	26	29	28
C04		39	27	29	28
C07*		38	29	28	28
C08		37	29	27	27
C09		40	26	**	27
C14G		46	32	34	**
C18		41	32	31	29
C27		53	39	39	38
C40*		51	40	38	32
C41		46	34	33	35
C46*		48	38	36	34
C47 (CONTROL)		43	31	31	30
C60		46	34	34	33
C61		51	39	36	35
C62		53	38	37	37
C63		50	37	35	26
C64		45	36	33	28
C65		55	45	41	28
C66		49	38	37	28
C67		53	39	38	26
C68		49	36	35	27
C69		52	39	38	**
C70		62	46	45	29
C71		51	37	51	39
C72		73	59	35	32
C73		46	35	33	34
C74		38	25	26	34
C75		45	33	32	31
C76		42	28	30	33
C77		36	25	24	35
C79		**	38	29	38

*TLD's not required by ODCM
**Missing


Airborne (highest values plotted)
2011 Measured Values due to Fukushima Event
0.01
0.001
0.0001
pCi/m3
See CR 684849
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Cs-137 LLD

IV-C. WATERBORNE PATHWAY

To evaluate the waterborne pathway, samples are taken of seawater, groundwater, drinking water, and shoreline sediment.

1. Monthly seawater grab samples are taken at two locations in the discharge canal (C14G and C14H) and at one control location (C13) near the mouth of the intake canal. In 2022, of twenty-four indicator samples, one had measurable tritium. The April 6th sample at location C14H at the head of the discharge canal showed tritium above LLD at 496 pCi/liter. A permitted liquid effluent discharge was made four days before the sample collection and was the source of the measured tritium.

   Gamma spectral analysis was performed on all thirty-six samples, (including the 12 control samples at C13) and none of them showed measurable amounts of the gamma emitters of licensed CR3 radionuclides.

   Table IV-C.1 provides a statistical summary of the seawater tritium and gamma spectroscopy results.

   Table IV-C.1.a provides the results of the monthly samples.

2. Semiannual ground water samples are taken at one location, station C40, located approximately 3.7 miles east of CR-3 at well station #12. It is taken as a reference background and is up gradient from CR3. Gamma spectral and tritium analyses are performed. In 2022, all results were less than the detection limits. Since plant startup, all results, except for the results of one 1985 tritium analysis, have been less than LLD. The ODCM required sensitivity for measuring tritium in groundwater is 2000 pCi/L. Analysis of groundwater in the vicinity of CR-3 is done at a sensitivity of approximately 170 pCi/L for tritium and less than 10 pCi/L for select gamma emitters. The C40 groundwater sample is taken from pump #12.

   Table IV-C.2 provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

   Table IV-C.2.a provides the results of the semi-annual samples.

3. Quarterly site groundwater samples are taken at thirteen locations surrounding the perimeter of the CR-3 protected area (See Figure 1-4). Historically five of these groundwater wells have shown indications of very low levels of tritium on the west-southwest side of the plant. It is believed that this tritium is the result of a leak in the Station Drain Tank (SDT-1) to the settling pond discharge line that occurred in 1998. This discharge line has recently been leak tested and it is leak free. There are no other known leaking plant components.

   In 2022, one groundwater well - CR3-5 - continued to show tritium at very low concentrations above LLD, same as in 2021. One of the two collected samples from CR3-5 showed a value of 171 pCi/liter. The other was less than LLD. It was inaccessible for two quarters due to demolition work. Well CR3-5 had an average tritium concentration of 183 pCi/L in 2021 based on all four quarterly samples. It showed an average of 227 pCi/l in 2020. No other groundwater wells showed greater than LLD tritium in 2022.

   Along with these wells, two other wells that are not presently part of the REMP program were sampled. They are on either side (north and south) of the plant settling ponds (percolation ponds) and are referred to as MWC-27 and MWC-IF2. Both wells did not show tritium concentrations above LLD levels in 2022, same as in 2021.

   Due to ongoing site demolition work, and flooding in the first quarter, several well samples could not be obtained in 2022. This is documented in Condition Report (CR) 2022000004. The following groundwater well samples could not be collected in 2022: First quarter: CR3-1S, CR3-1D, CR3-2 and CR3-9; Third quarter: CR3-2, CR3-5, CR3-6D and CR3-6S; Fourth Quarter: CR3-2, CR3-5 and CR3-8.

There have been no measurable amounts of gamma emitting radionuclides in any of these wells. There have also been no measurable amounts of hard-to-detect (HTD) radionuclides in any of these wells with exception of trace levels of gross alpha, which is expected, given the naturally occurring limestone strata that surrounds the Florida aquifer. As already noted, site ground water flows in a west-southwest direction toward the Gulf of Mexico. This flow was re-verified in 2022, after the ISFSI pad sub-surface construction was completed, with a new ground water flow study

It is noted that groundwater at the CR3 site is too saline for use as a potable water source, hence there is no drinking water intake pathway at the Crystal River site.

Table IV-C.3 provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

Table IV-C.3.a.1 provides the results of the quarterly samples.

4. Quarterly non-REMP required well samples at two locations were collected as discussed in item #3 above. These two wells are located on the north side and the south side of the site percolation ponds. The information is discussed above. Both wells showed no measurable amounts of any other gamma emitting radionuclides of concern. The tritium concentration in these wells, have decreased significantly due to a focused reduction in the number of discharges from the station drain tank (SDT-1) to the site settling ponds (percolation ponds) and are now less than the minimum detection limit. Note: The first and fourth quarter samples from well MIF2 were not available due to nearby construction work.

   Table IV-C.4 provides a statistical summary of the groundwater tritium and gamma spectroscopy results.

   Table IV-C.4.a provides the results of the supplemental non-REMP required samples.

5. Quarterly drinking water samples are drawn from three locations: the Crystal River City Hall (C07), the Days Inn Motel (C10), and the Yankeetown City Well (C18). All samples were collected and analyzed for gamma emitters and tritium. All samples are Control samples.

   In 2022, none of the samples yielded measurable activities of tritium or the required gamma emitters, same as in 2021. The measurement sensitivity for drinking water samples is the same as those for ground water samples.

   Since the beginning of sampling, the drinking water samples have not had any other positive-measured radionuclides of interest detected.

   Table IV-C.5 provides a statistical summary of the drinking water tritium and gamma spectroscopy results.

   Table IV-C.5.a provides the results of the quarterly samples.

6. Semiannual shoreline sediment samples are taken at three indicator locations in the discharge canal (C14H, C14M, C14G) and one control location (C09) at Fort Island Gulf Beach. The plant discharge canal is the primary liquid effluent release pathway from CR-3. In 2022, five of the six samples showed Cs-137 below LLD. The reported positive sample was at C14G at a concentration of 35 pCi/kg. Five of the six samples also showed Co-60 less than LLD, with the February 23rd sample from location C14H, at the head of the discharge canal, showing Co-60 at 143 pCi/kg. It is not unexpected to see licensed material in the discharge canal as CR3 still makes permitted liquid releases to the discharge canal. The 2022 results are similar to previous years' results.

   Table IV-C.6 provides a statistical summary of the shoreline sediment gamma spectroscopy results.

   Table IV-C.6.a provides the results of the semi-annual samples.

7. There were no unmonitored spills or releases of radioactive material in 2022 that had the potential to contaminate the ground water per the guidelines of the Nuclear Energy Institute Ground Water Protection Initiative – Final Guidance Document 07-07. As such, there were no communiqués issued to state, local, or regulatory agencies.

TABLE IV-C.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SEAWATER (pCi/L)	Tritium, 36	172	496[2]	C14H NW 0.1 mile	496[2]	<LLD	0
	γ Spec, 36						
	Co-60	4	<LLD	--	--	<LLD	0
	Cs-134	4	<LLD	--	--	<LLD	0
	Cs-137	4	<LLD	--	--	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.
[2] Only one sample showed greater than LLD tritium – April 6th sample at location C14H

TABLE IV-C.1.a
ADP CR3, LLC- 2022
pCi/L GAMMA EMITTERS AND TRITIUM IN SEAWATER

STATION	MONTH	H-3	K-40	Co-60	Cs-134	Cs-137
C13	JAN*	<133	197±20	<4	<3	<4
	FEB	<135	218±21	<4	<3	<4
	MAR	<133	150±17	<4	<3	<3
	APR	<134	289±35	<6	<5	<6
	MAY	<132	262±35	<5	<5	<6
	JUN	<198	252±25	<6	<5	<6
	JUL	<136	203±21	<3	<4	<3
	AUG	<136	277±34	<5	<5	<5
	SEP	<131	276±33	<5	<5	<4
	OCT	<128	268±23	<3	<3	<3
	NOV	<128	330±36	<6	<6	<4
	DEC**	<142	216±21	<3	<3	<3
C14G	JAN	<137	221±31	<4	<4	<4
	FEB	<133	204±20	<3	<3	<4
	MAR	<135	205±22	<3	<3	<4
	APR	<133	175±34	<6	<5	<5
	MAY	<134	139±18	<4	<3	<4
	JUN	<198	277±33	<6	<6	<6
	JUL	<132	224±21	<3	<3	<4
	AUG	<136	232±23	<3	<4	<3
	SEP	<133	280±28	<6	<5	<6
	OCT	<131	260±23	<3	<3	<4
	NOV	<129	306±35	<5	<5	<6
	DEC	<128	224±33	<5	<4	<6

TABLE IV-C.1a (CONT'D)

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN SEAWATER

STATION	MONTH	H-3	K-40	Co-60	Cs-134	Cs-137
C14H	JAN	<137	188±20	<3	<4	<4
	FEB	<133	235±22	<4	<3	<4
	MAR	<135	226±21	<3	<3	<4
	APR	496	<68	<3	<3	<4
	MAY	<134	179±19	<7	<3	<4
	JUN	<198	237±32	<7	<5	<6
	JUL	<132	316±35	<4	<5	<5
	AUG	<136	219±22	<3	<3	<3
	SEP	<136	225±22	<3	<3	<3
	OCT	<131	252±34	<5	<5	<5
	NOV	<134	324±29	<4	<4	<4
	DEC	<135	305±28	<4	<4	<4

* January sample collected 2/2/22
** December sample collected 1/4/23

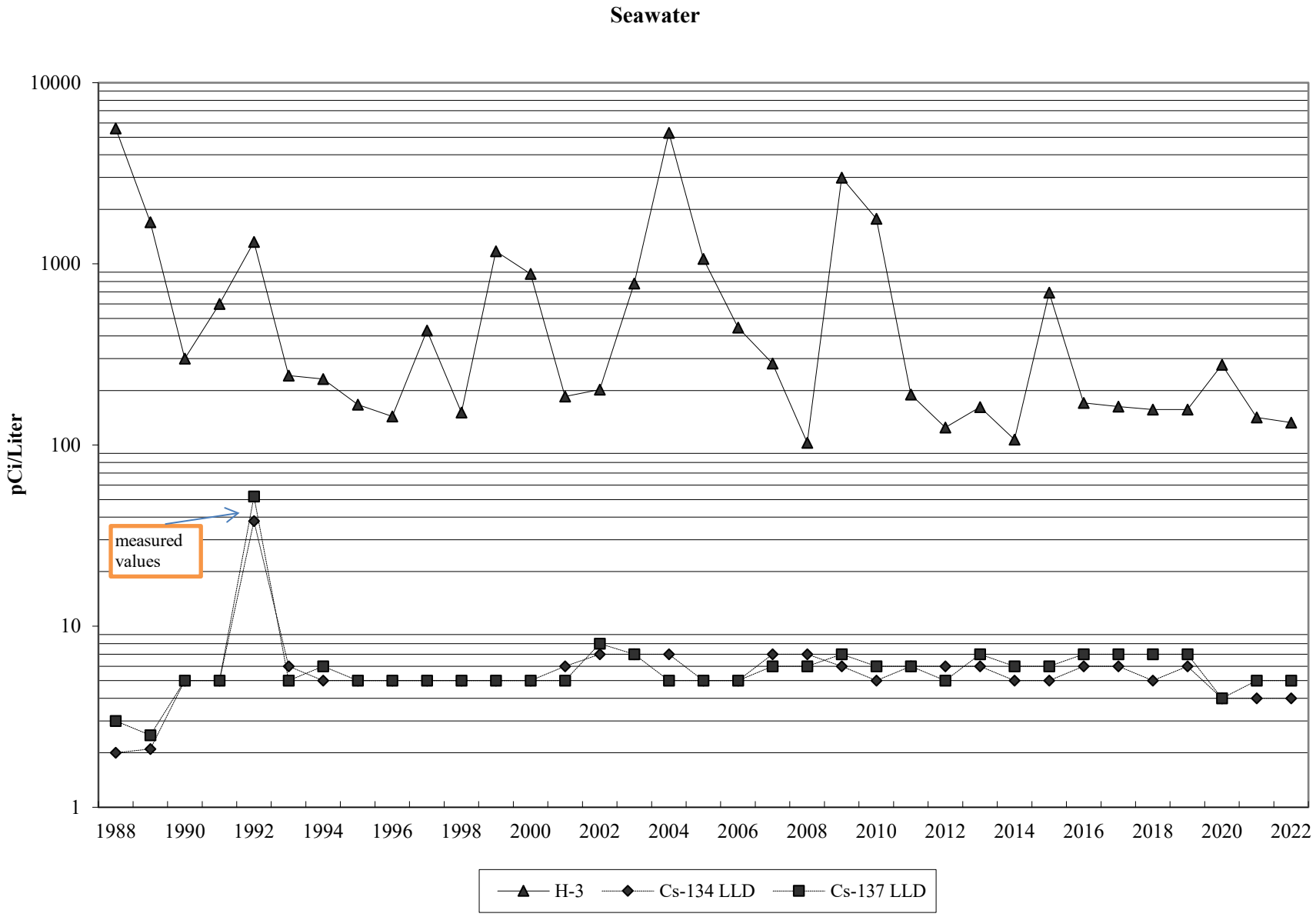

Seawater
10000
1000
100
10
1
pCi/Liter
measured values
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
H-3
Cs-134 LLD
Cs-137 LLD

TABLE IV-C.2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 DOCKET NO. 50-302

CITRUS COUNTY, FLORIDA JANUARY 1 TO DECEMBER 31, 2022

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
GROUND WATER[2] (pCi/L)	Tritium, 2	172	-	--	--	<LLD	0
	γ Spec, 2						
	Co-60	4	-	--	--	<LLD	0
	Cs-134	4	-	--	--	<LLD	0
	Cs-137	4	-	--	--	<LLD	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

[2] There is no drinking water uptake pathway at the Crystal River site.

TABLE IV-C.2.a

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN GROUND WATER

STATION	NUCLIDE	FIRST HALF	SECOND HALF
C40	H-3	<139	<137
	Co-60	<3	<3
	Cs-134	<3	<6
	Cs-137	<4	<4
	K-40	<40	<72

Semi-Annual Ground Water

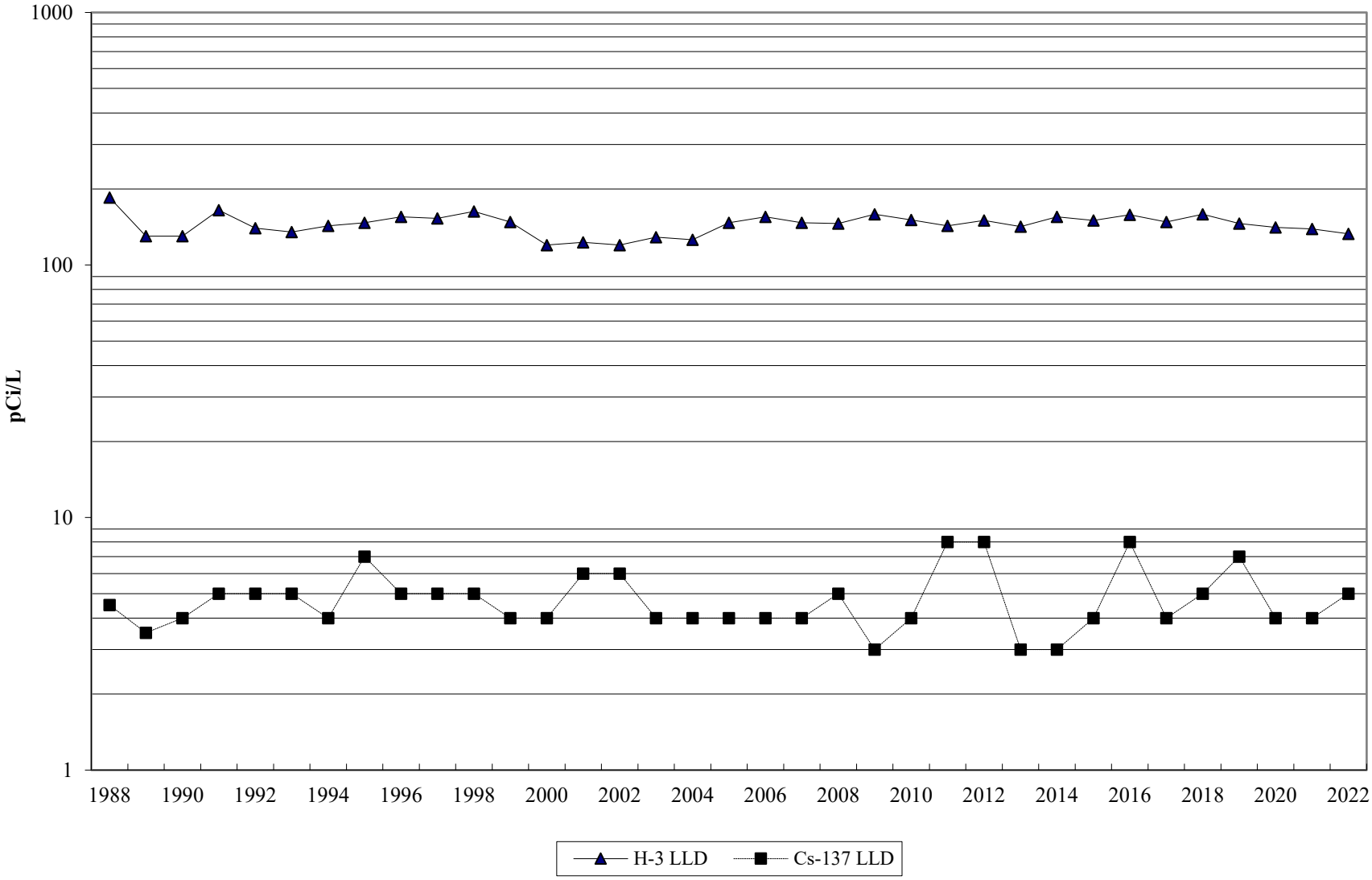


TABLE IV-C.3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 DOCKET NO. 50-302

CITRUS COUNTY, FLORIDA JANUARY 1 TO DECEMBER 31, 2022

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL (NUMBER)[2] OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
CR3 SITE GROUND WATER (pCi/L)	Tritium 41	172	171(1/46) (171)	CR3-5 0.051 mi WSW	171(1/2) (171)	[3] - -	0
	γ Spec 46						
	Co-60	4	<LLD	--	--	-	0
	Cs-134	4	<LLD	--	--	-	0
	Cs-137	4	<LLD	--	--	-	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

[2] Includes extra samples collected for data trending.

[3] REMP location C-40 is used as the background control reference

TABLE IV-C.3.a.1

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
CR3-1D	04-25	<137	<57	<4	<5	<5
	07-15	<132	<84	<6	<5	<5
	10-21	<129	<50	<4	<4	<3
CR3-1S	04-25	<137	<46	<4	<3	<4
	07-15	<132	<90	<6	<5	<5
	10-21	<129	<64	<5	<5	<5
CR3-2	04-25	<137	<48	<4	<3	<4

TABLE IV-C.3.a.1

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
CR3-3D	01-04	<132	<39	<3	<4	<3
	04-25	<140	54±12	<4	<4	<5
	07-15	<132	<82	<7	<6	<5
	10-21	<129	<53	<3	<3	<4
CR3-3S	01-04	<132	<36	<3	<3	<3
	04-25	<137	<47	<3	<3	<4
	07-15	<132	<61	<5	<4	<5
	10-21	<129	<86	<6	<5	<6
CR3-4	01-04	<132	<53	<4	<5	<5
	04-25	<133	<52	<4	<4	<5
	07-15	<132	<73	<5	<6	<6
	10-21	<129	<44	<3	<4	<3

TABLE IV-C.3.a.1

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
CR3-5	01-06	171	30±10	<5	<5	<5
	04-25	<137	68±19	<5	<5	<7
CR3-6S	01-06	<133	154±13	<3	<3	<3
	04-25	<140	<73	<6	<5	<5
	10-21	<129	<97	<6	<5	<6
CR3-6D	01-06	<133	174±19	<3	<4	<4
	04-25	<137	208±32	<5	<5	<5
	10-21	<129	<62	<6	<5	<6

TABLE IV-C.3.a.1 (cont'd)

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
CR3-7	01-06	<133	<51	<4	<4	<4
	04-25	<140	<90	<6	<4	<5
	07-15	<136	<64	<5	<5	<4
	10-21	<129	<85	<6	<5	<4
CR3-8	01-06	<133	<56	<5	<5	<5
	04-25	<140	<86	<6	<4	<6
	07-15	<132	<53	<4	<4	<4
CR3-9	04-25	<140	<84	<5	<5	<6
	07-15	<132	<70	<6	<5	<6
	10-21	<129	<53	<4	<3	<4

TABLE IV-C.3.a.1 (cont'd)

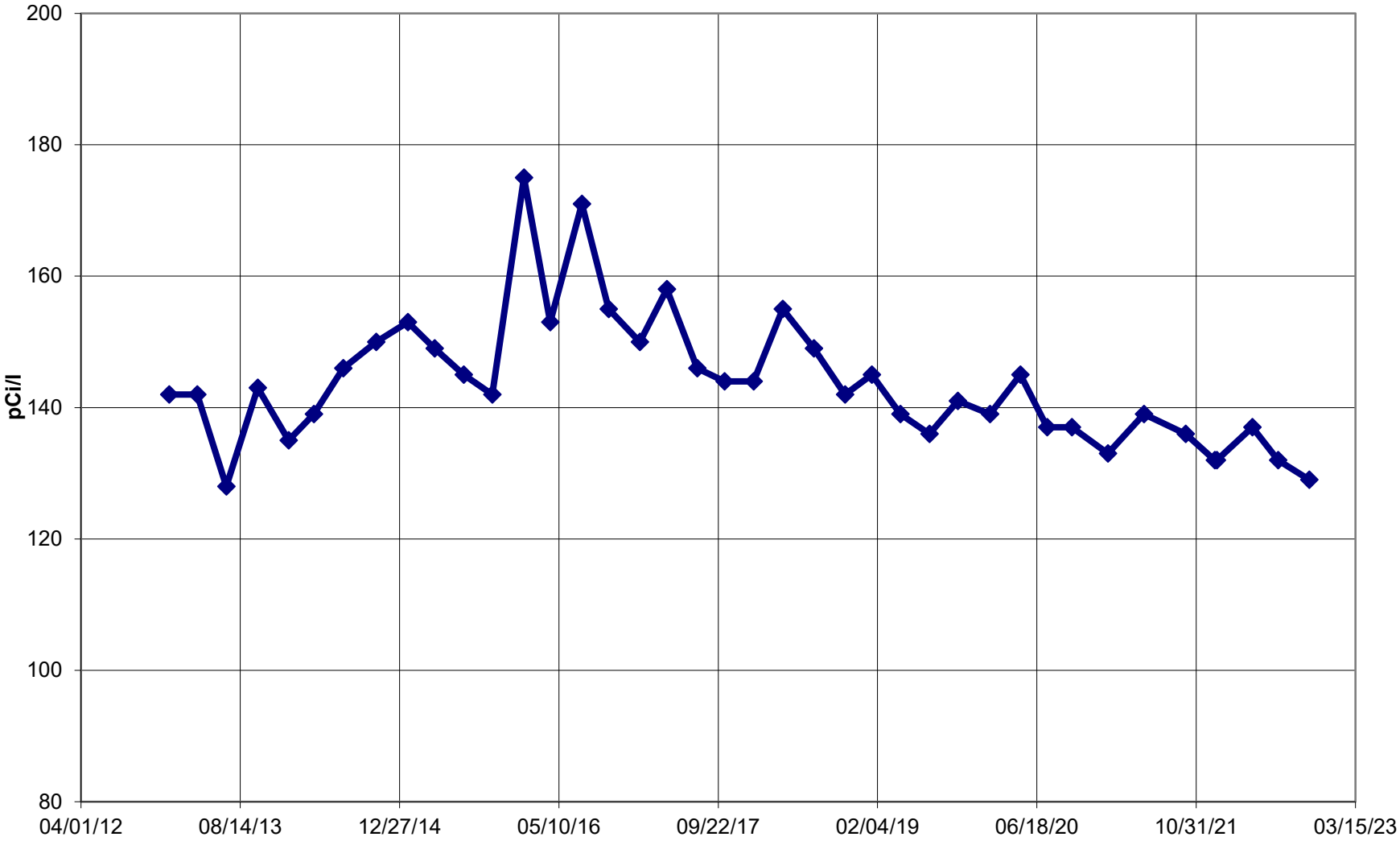
ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
CR3-10	01-04	<133	<52	<4	<4	<4
	04-25	<137	<46	<4	<5	<5
	07-15	<136	<24	<4	<4	<4
	10-21	<134	<72	<6	<5	<6

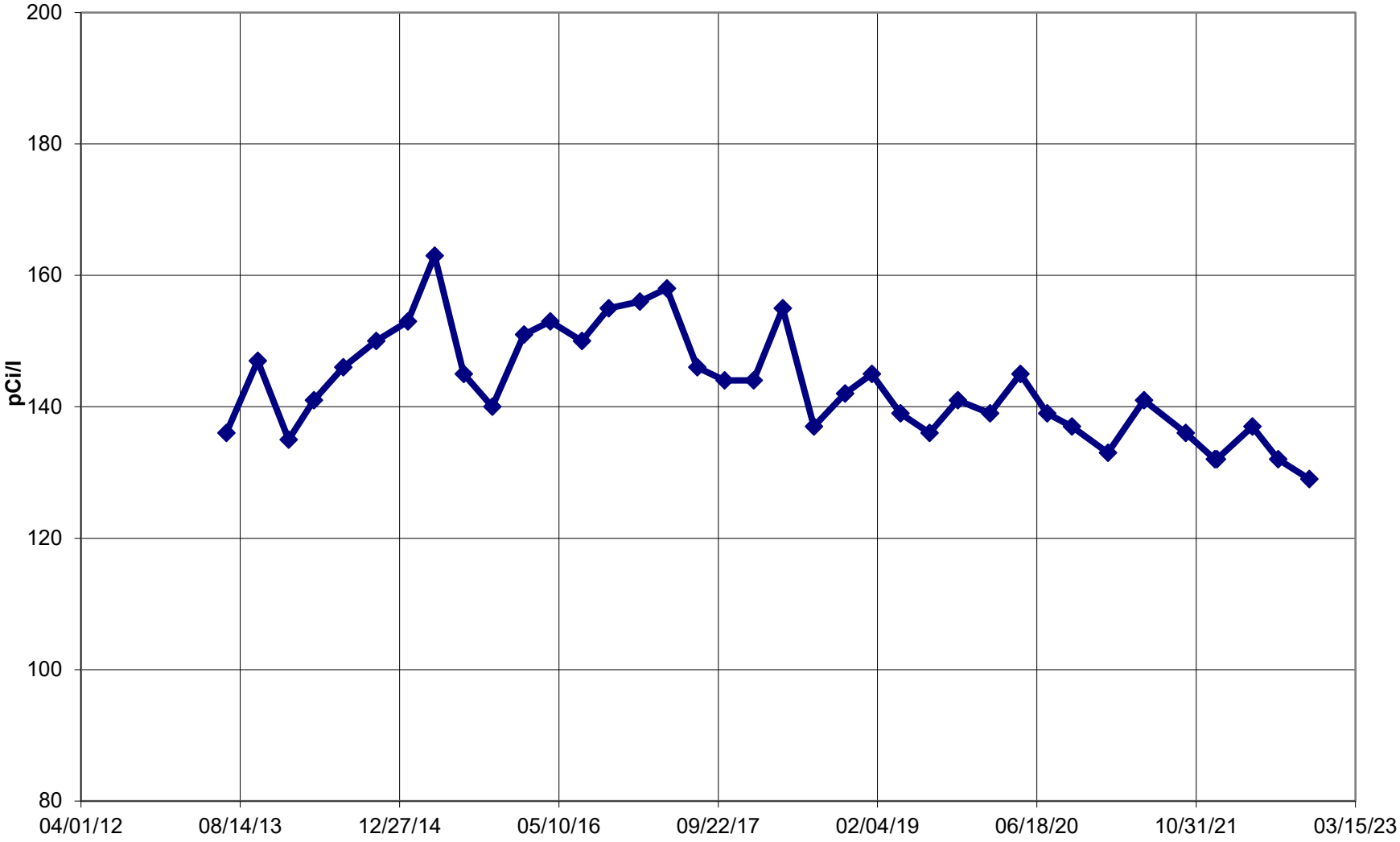
Tritium Measurement GW Well # CR3-1S

All results are < LLD since 2010



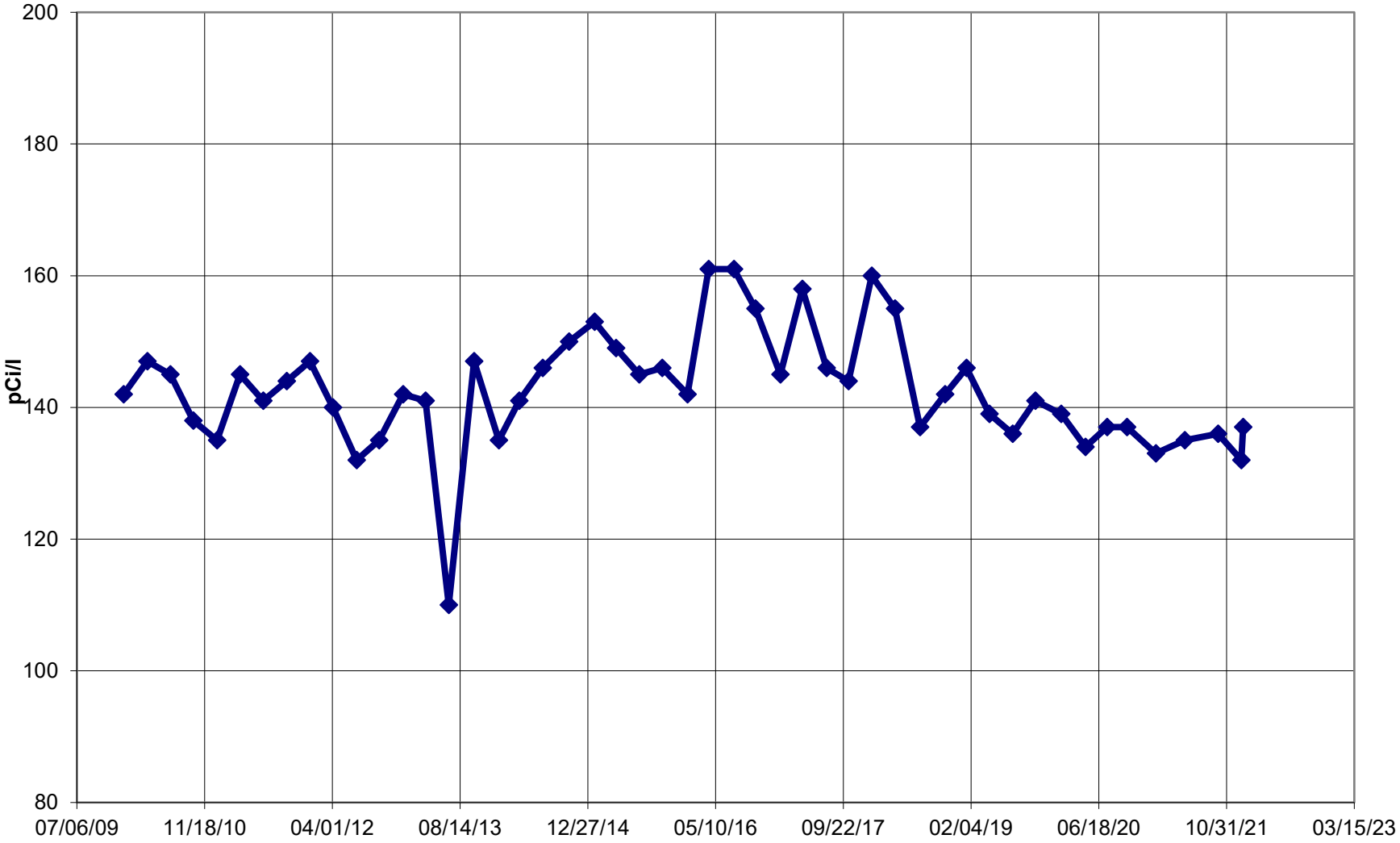
Tritium Measurement GW Well # CR3-1D

All results are < LLD



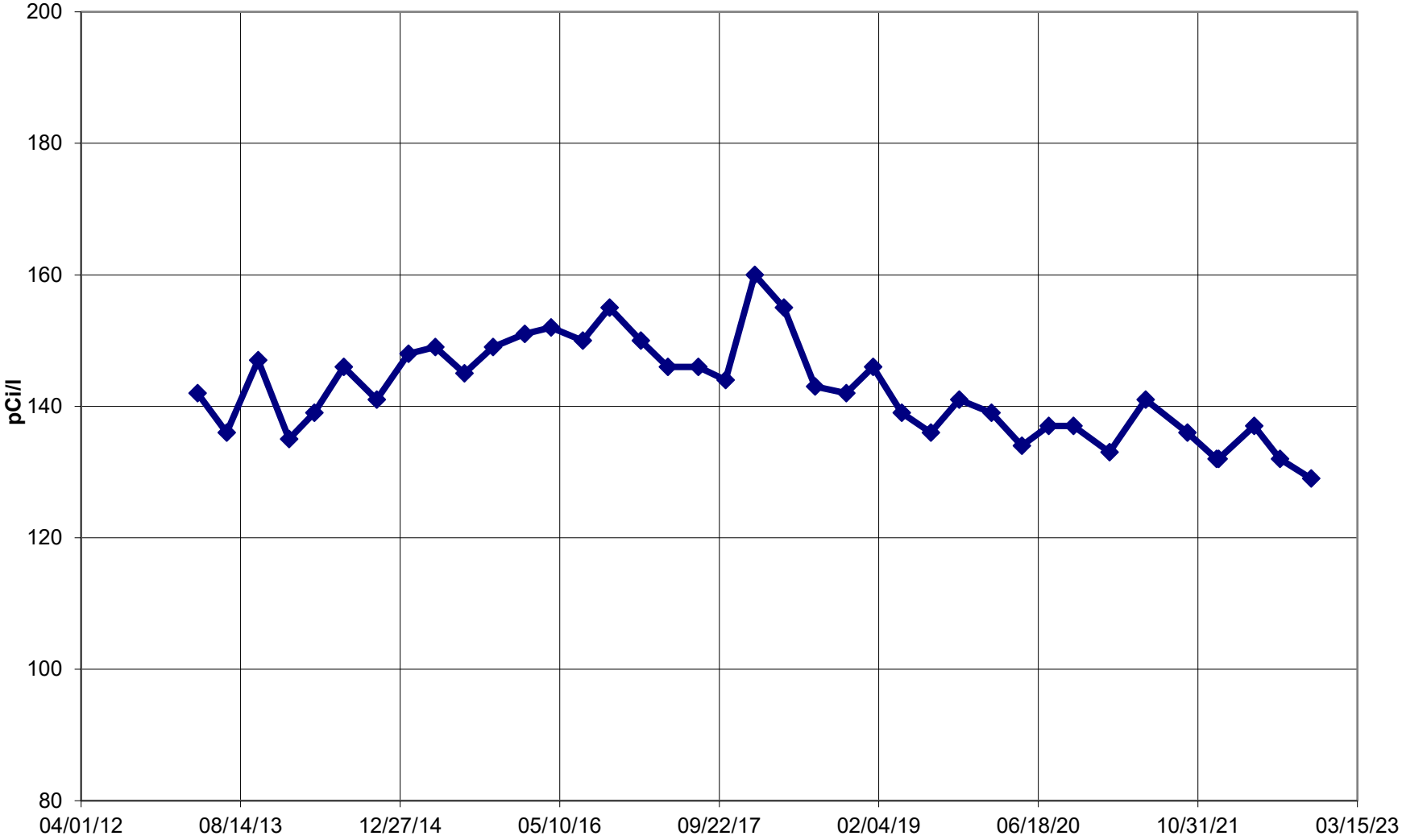
Tritium Measurement GW Well # CR3-2

All results are < LLD



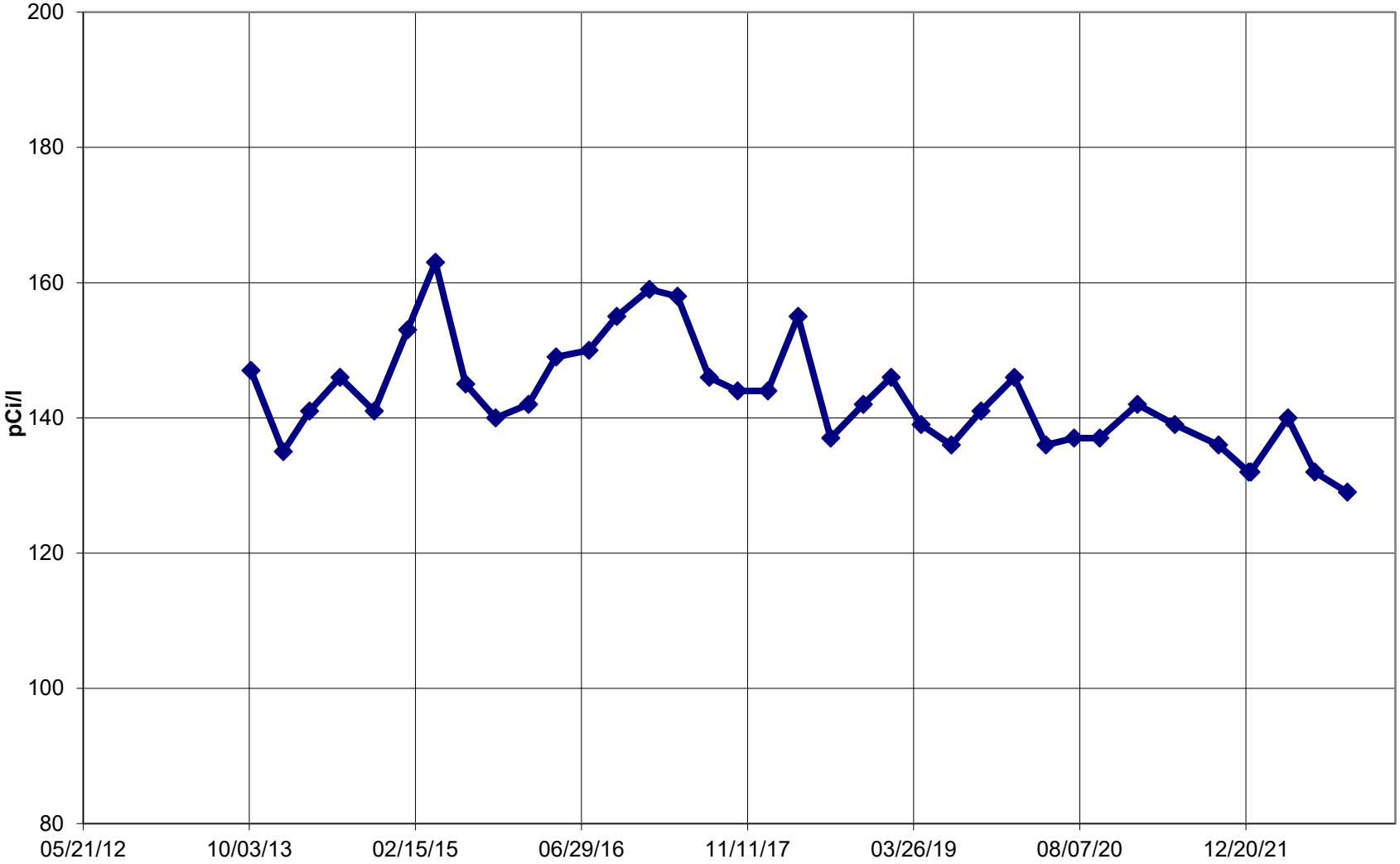
Tritium Measurement GW Well # CR3-3S

All results are < LLD unless noted



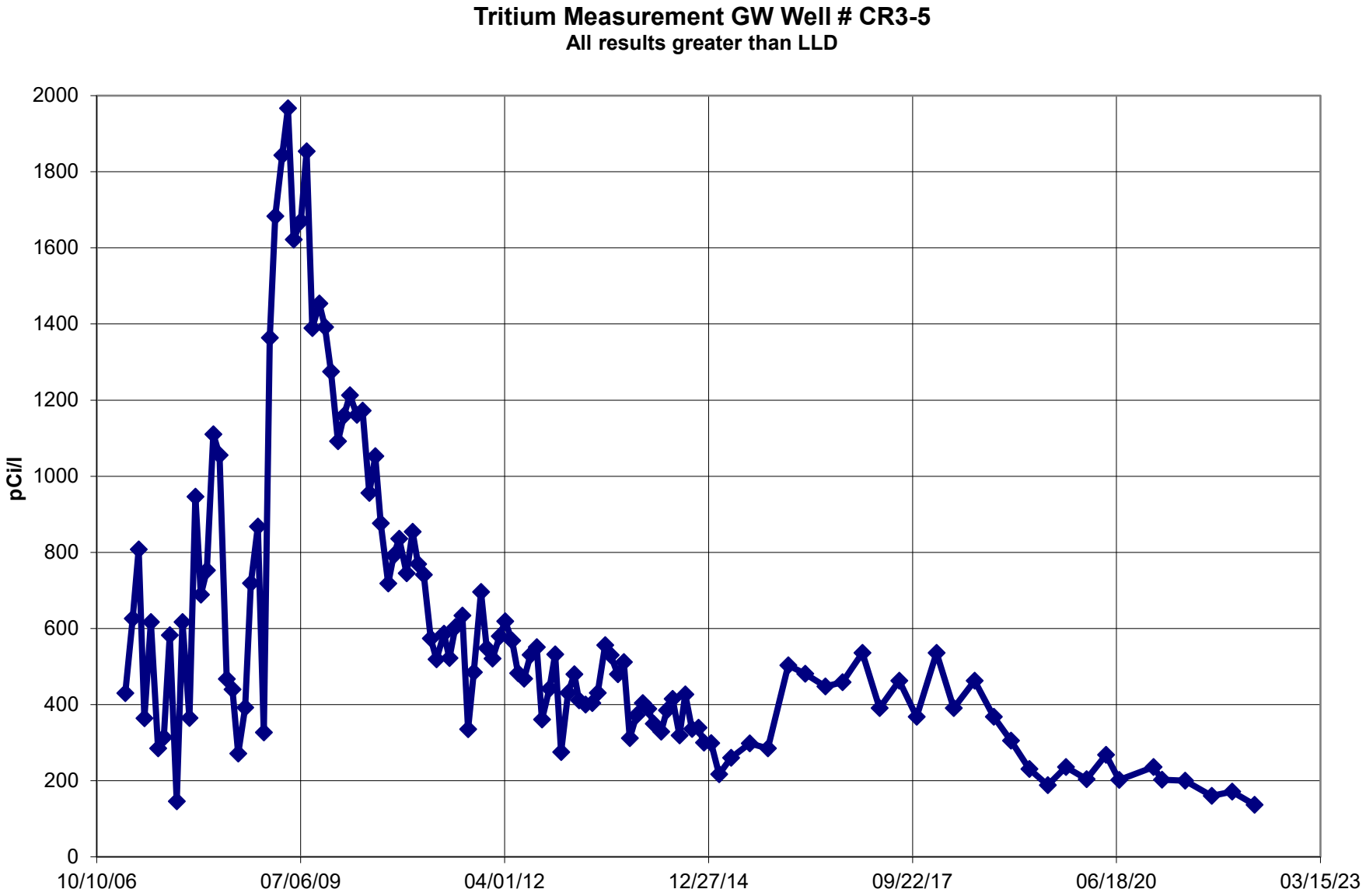
Tritium Measurement GW Well # CR3-3D

All results are < LLD



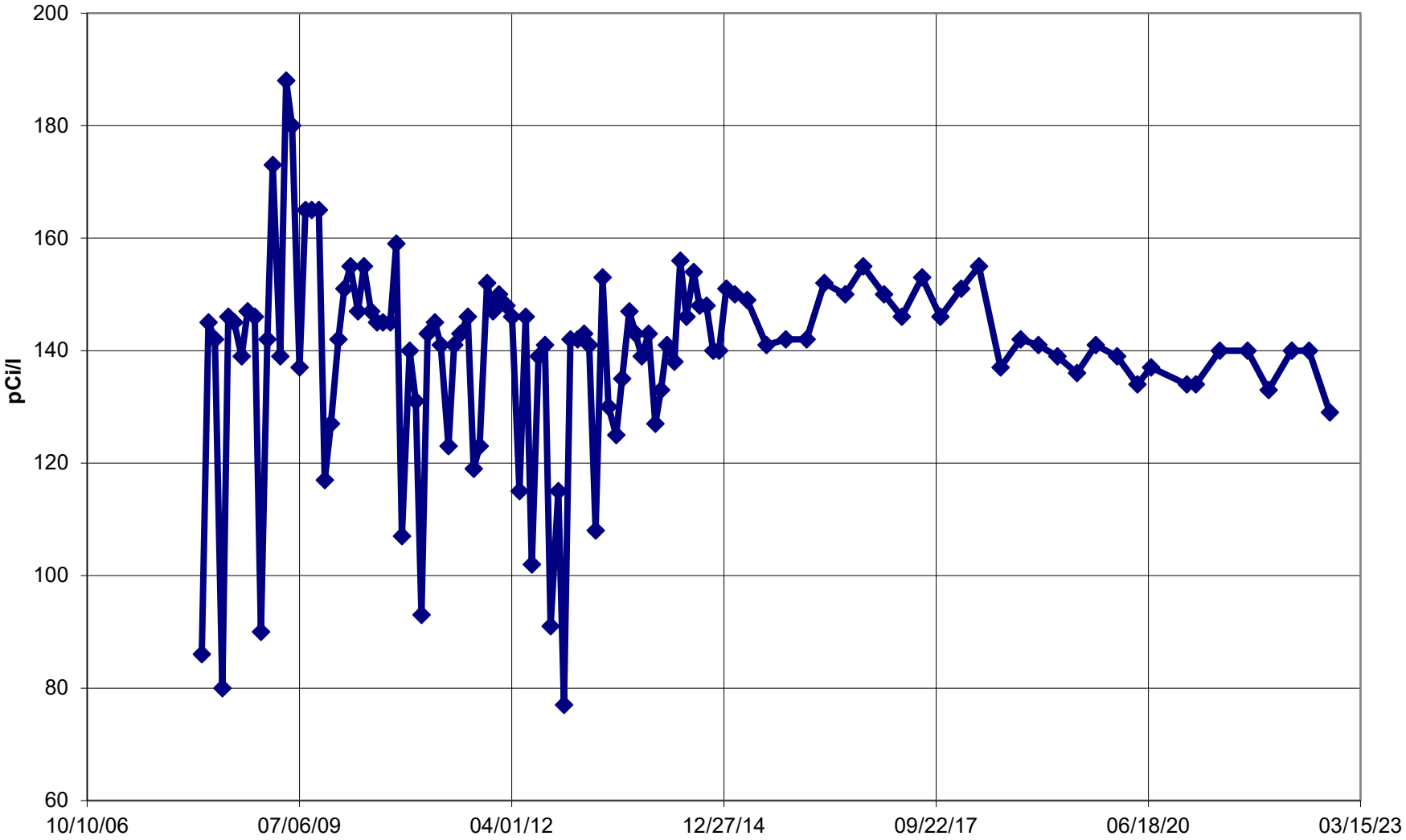
Tritium Measurement GW Well # CR3-4

All results are < LLD since 2013


Tritium Measurement GW Well # CR3-5
All results greater than LLD
pCi/l
2000
1800
1600
1400
1200
1000
800
600
400
200
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23

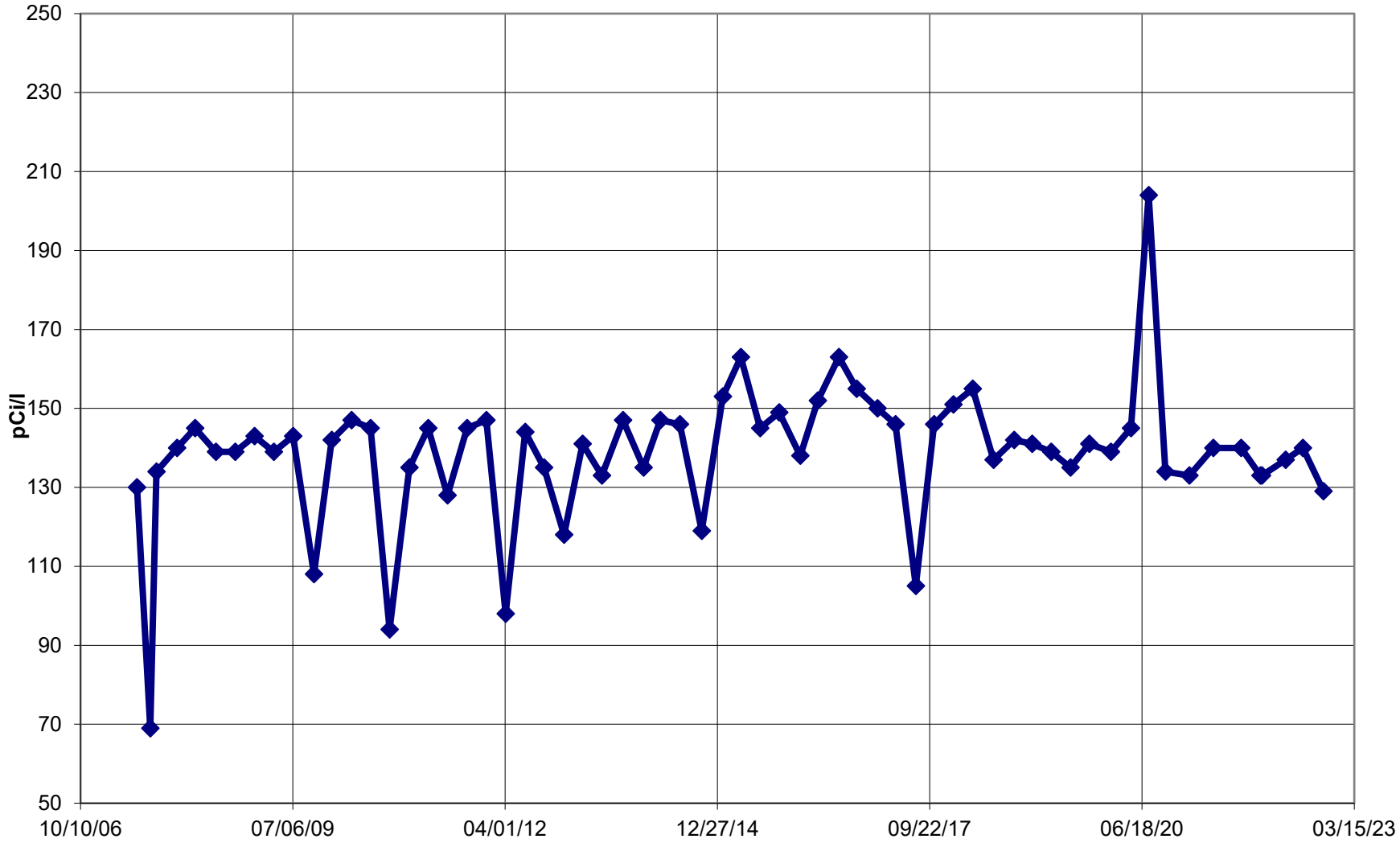
Tritium Measurement GW Well # CR3-6S

Results after 2014 are < LLD

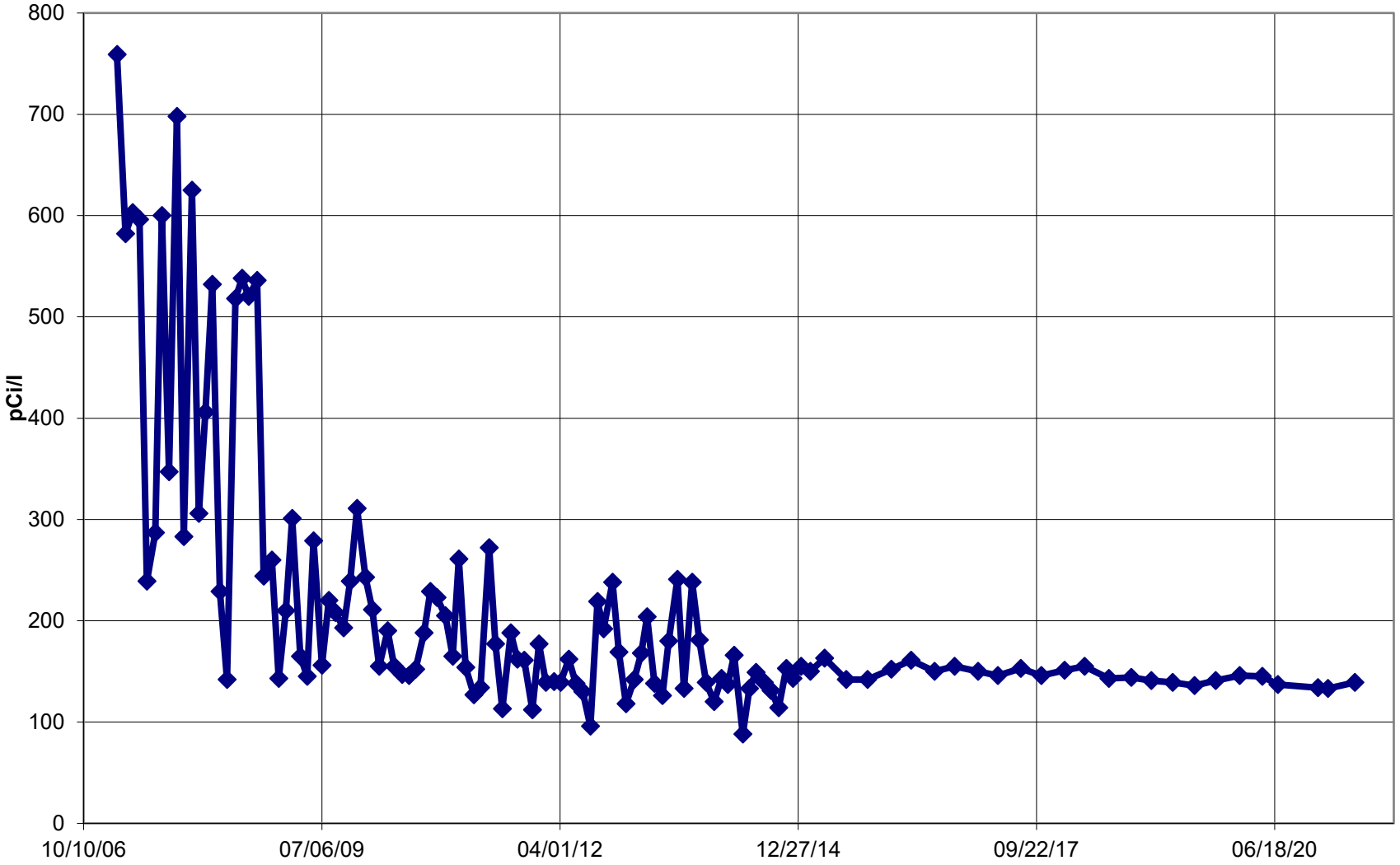


Tritium Measurements GW Well # CR3-6D

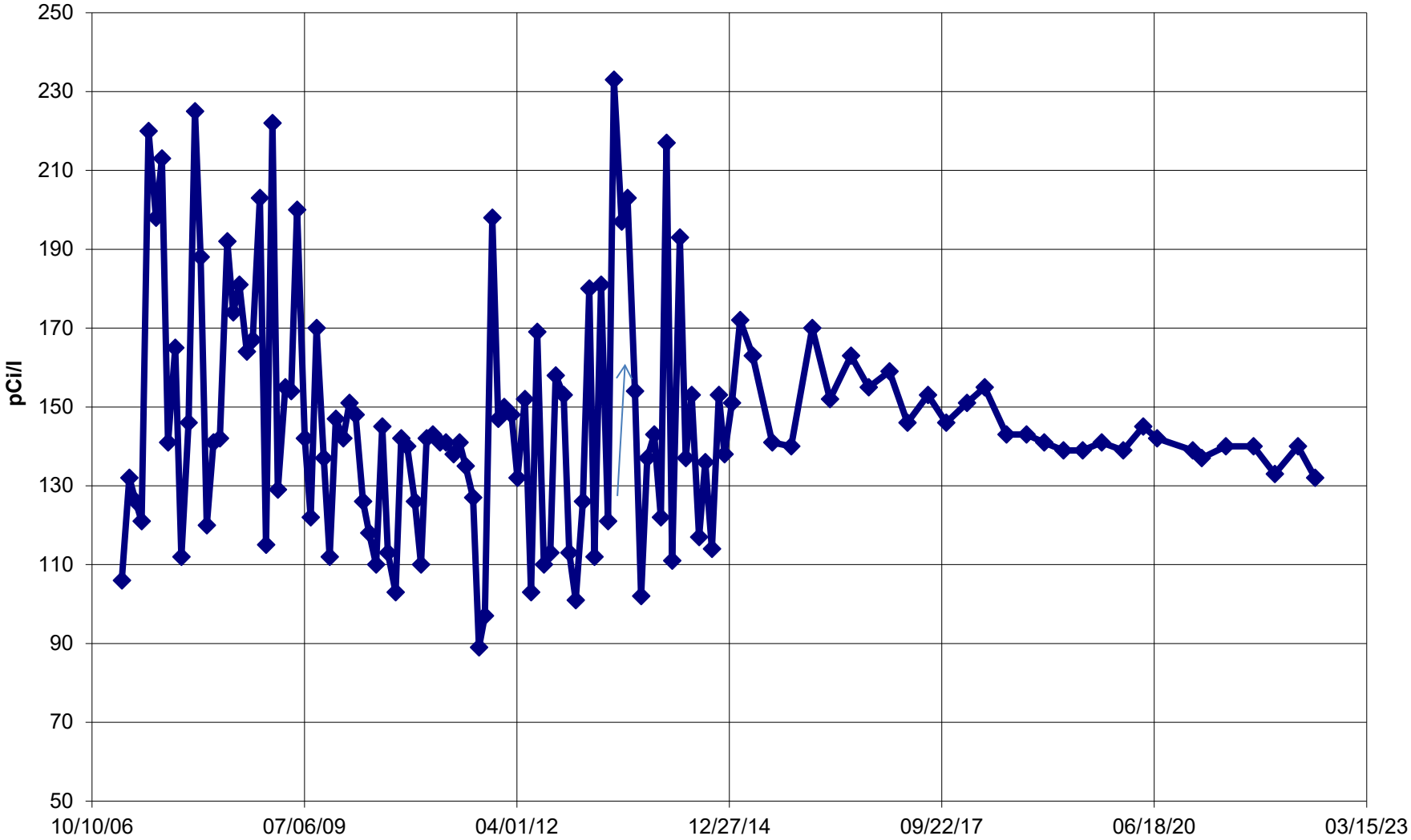
All results are < LLD after 2010



Tritium Measurements GW Well # CR3-7
All measurements LLD after 2015

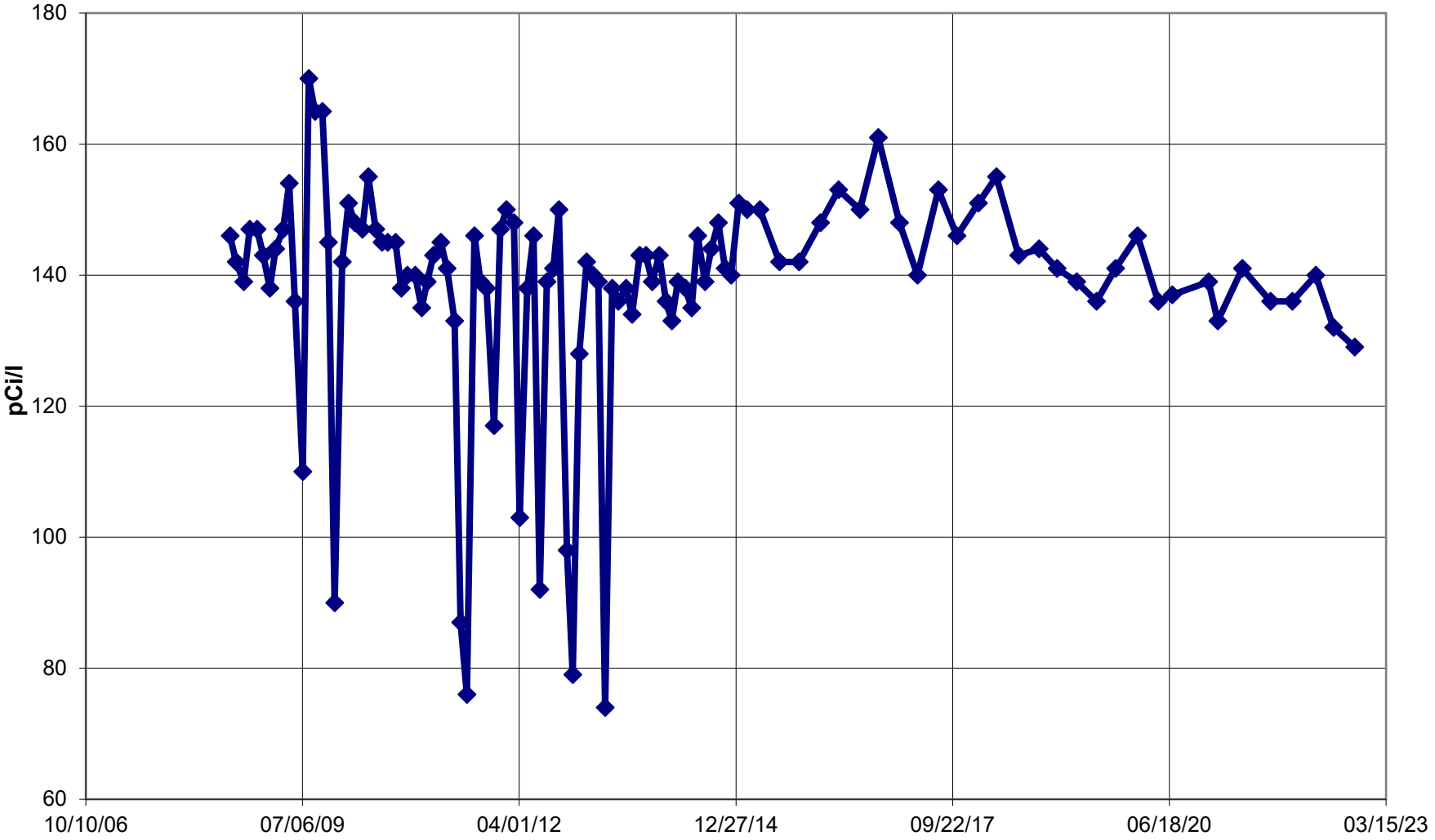


Tritium Measurements GW Well # CR3-8
All measurments LLD after 2016



Tritium Measurements GW Well # CR3-9

All measurements <LLD after 2013



Tritium Measurements GW Well # CR3-10

All measurements LLD after 2012

TABLE IV-C.4

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
*CR3 SITE GROUND WATER (pCi/L)	Tritium 6	172	<LLD	-	-	**	0
	γ Spec 6					-	
	Co-60	4	<LLD	-	-	-	0
	Cs-134	4	<LLD	-	-	-	0
	Cs-137	4	<LLD	-	-	-	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.
* Non-REMP required samples (MWC-IF2, MWC-27)
** REMP location C-40 is the site background. All C-40 results are <LLD

TABLE IV-C.4.a

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER (SUPPLEMENTAL DATA)

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
MWC-27*	01-04	<133	154±18	<4	<4	<4
	04-25	<140	141±17	<4	<3	<4
	07-15	<136	261±32	<6	<5	<5
	10-21	<134	335±36	<6	<5	<7

* These wells are not officially included in the REMP and are located on either side (north and south) of the site percolation ponds.

TABLE IV-C.4.a (cont'd)

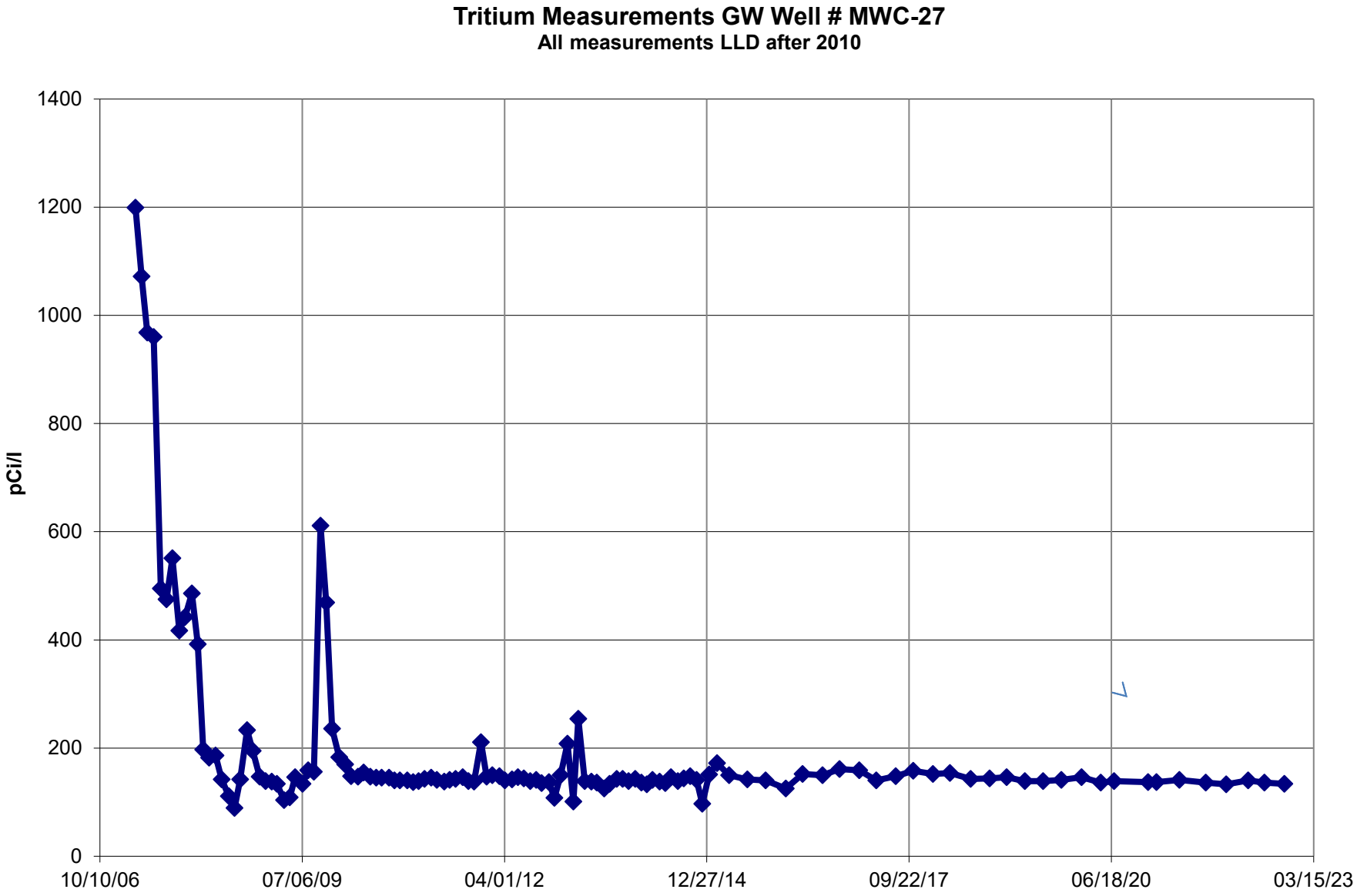
ADP CR3, LLC- 2022

pCi/L γ EMITTERS AND TRITIUM IN CR3 SITE GROUND WATER (SUPPLEMENTAL DATA)

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
MWC-IF2*	04-25	<140	<68	<6	<6	<6
	07-15	<132	<26	<4	<4	<4

* These wells are not officially included in the REMP and are located on either side (north and south) of the site percolation ponds.

Note: Samples for first and fourth quarters were not available due to nearby construction work.


Tritium Measurements GW Well # MWC-27
All measurements LLD after 2010
pCi/l
1400
1200
1000
800
600
400
200
0
10/10/06
07/06/09
04/01/12
12/27/14
09/22/17
06/18/20
03/15/23

Tritium Measurements GW Well # MWC-IF2

All measurements LLD after 2012

TABLE IV-C.5

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
DRINKING WATER (pCi/L)	Tritium 12	172		-	-	<LLD	0
	γ Spec 12						
	Co-60	4		-	-	<LLD	0
	Cs-134	4		-	-	<LLD	0
	Cs-137	4		-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

TABLE IV-C.5.a

ADP CR3, LLC- 2022

pCi/L GAMMA EMITTERS AND TRITIUM IN DRINKING WATER

STATION	DATE	H-3	K-40	Co-60	Cs-134	Cs-137
C07	04-25	<137	<42	<3	<3	<3
	07-07	<132	<40	<5	<3	<3
	10-21	<130	<68	<5	<5	<5
	01-04*	<142	<63	<4	<5	<6
C10	04-25	<137	<41	<3	<4	<4
	07-07	<132	<33	<3	<3	<3
	10-21	<130	<68	<6	<5	<5
	01-04*	<142	<65	<4	<3	<4
C18	04-25	<137	<35	<3	<3	<4
	07-07	<136	<56	<5	<4	<5
	10-21	<130	<56	<4	<4	<5
	01-04*	<142	<60	<4	<3	<4

* Taken January 2023

Quarterly Drinking Water

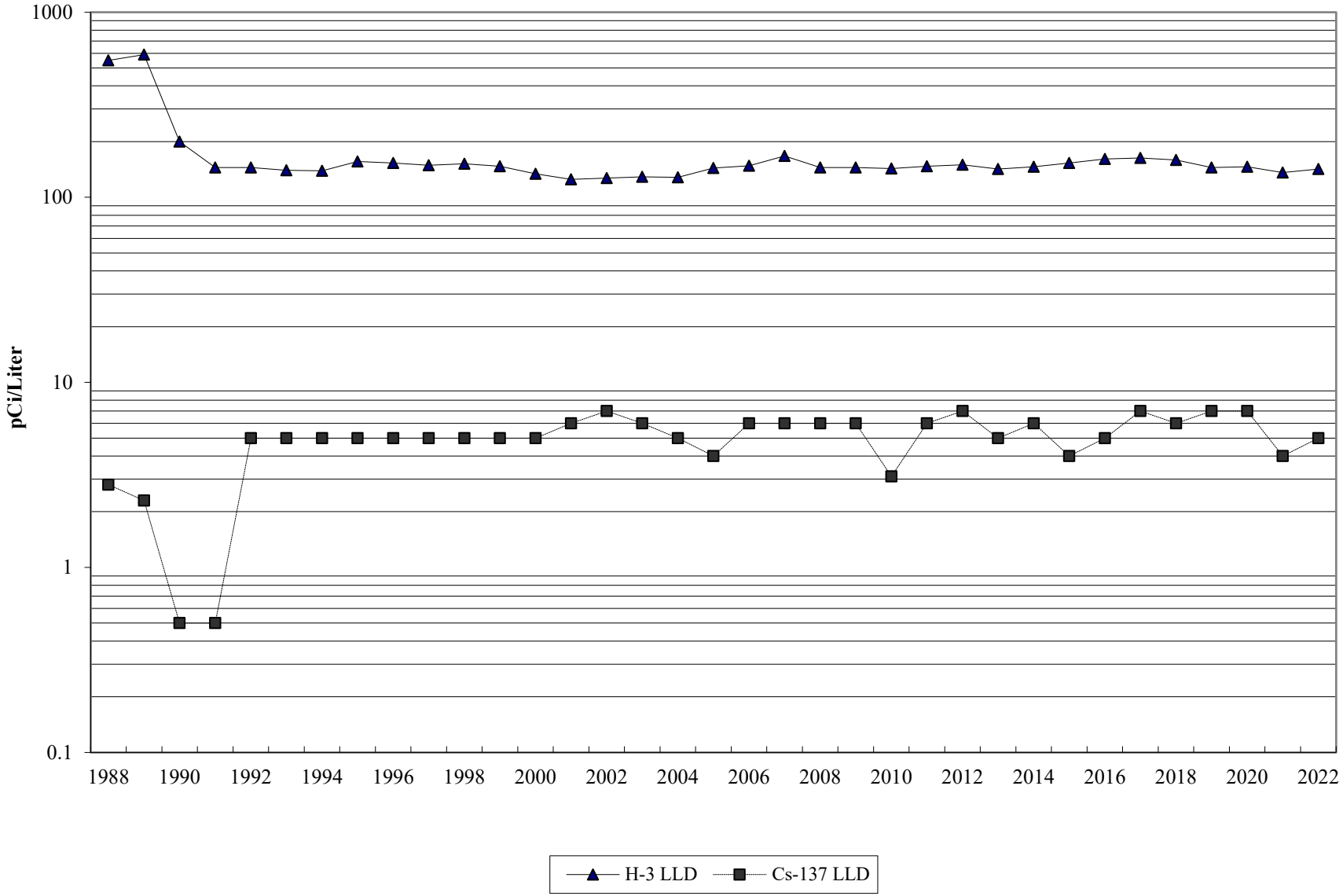


TABLE IV-C.6

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
SHORELINE SEDIMENT	γ Spec 8						
(pCi/kg)	Cs-134	7	<LLD	—	—	<LLD	0
	Cs-137	7	35 (1/2) 35	C14G 2.0 @W	35 (1/2)	<LLD	0
	Co-60	7	143 (1/2) 143	C14H 0.1 @NW	143 (1/2)	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.
* Only one sample with >LLD

TABLE IV-C.6.a

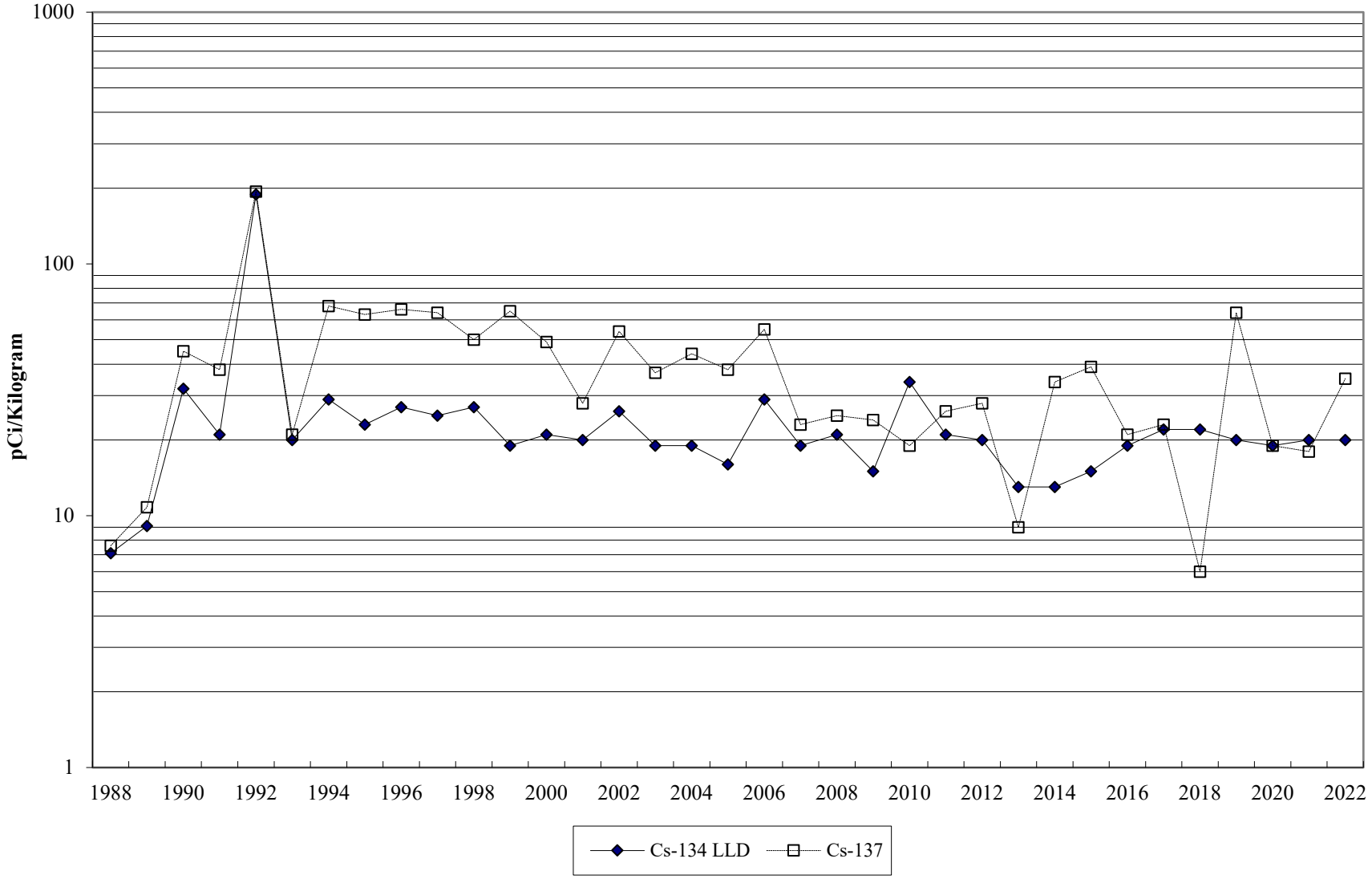
ADP CR3, LLC- 2022

pCi/kg GAMMA EMITTERS IN SHORELINE SEDIMENT

STATION	PERIOD	Co-60	Cs-134	Cs-137	K-40
C09	First Half	<8	<8	<9	383±58
	Second Half	<8	<8	<9	204±34
C14H	First Half	143±6	<12	<11	456±72
	Second Half	<436*	<14	<18	866±63
C14M	First Half	<24	<20	<22	1220±131
	Second Half	<9	<10	<12	<135
C14G	First Half	<18	<15	35±5	1640±94
	Second Half	<10	<11	<12	92±22

C09 is the control station at Ft. Island Beach. C14H, C14M, & C14G are discharge canal stations. * High MDA reported due to high background

Shoreline Sediment



IV-D. INGESTION PATHWAY

To evaluate the ingestion pathway, samples are taken of fish, oysters, broad leaf vegetation, citrus, milk and watermelon.

1. Quarterly carnivorous fish samples were taken at two locations: C29 at the end of the discharge canal, and C30, the control location, near the mouth of the intake canal.

   In 2022, none of the required radionuclides were found in measurable quantities. The highest Cs-137 LLD for stations C29 and C30 was 24 pCi/kg. Naturally occurring K-40 was quantified in all eight samples at an average concentration of 2,498 pCi/kg.

   In 2021, none of the required radionuclides were found in measurable quantities.

   In 2020, none of the required radionuclides were found in measurable quantities.

   In 2019, none of the required radionuclides were found in measurable quantities.

   In 2018, none of the required radionuclides were found in measurable quantities.

   In 2017, none of the required radionuclides were found in measurable quantities.

   In 2016, none of the required radionuclides were found in measurable quantities.

   In 2015, none of the required radionuclides were found in measurable quantities.

   Table IV-D.1 provides a statistical summary of the carnivorous fish gamma spectroscopy results.

   Table IV-D.1.a provides the results of the quarterly samples.

2. Quarterly oyster samples were taken at the same locations as fish samples, C29 and C30.

   In 2022, none of the required radionuclides were found in measurable quantities. Only two samples could be collected at location C30 and three sample at C29 due to lack of oysters.

   In 2021, none of the required radionuclides were found in measurable quantities.

   In 2020, none of the required radionuclides were found in measurable quantities.

   In 2019, none of the required radionuclides were found in measurable quantities.

   In 2018, none of the required radionuclides were found in measurable quantities.

   In 2017, none of the required radionuclides were found in measurable quantities.

   In 2016, none of the required radionuclides were found in measurable quantities.

   In 2015, none of the required radionuclides were found in measurable quantities.

   Table IV-D.2 provides a statistical summary of the oyster gamma spectroscopy results.

   Table IV-D.2.a provides the results of the quarterly samples.

3. Monthly broad leaf vegetation samples were taken at two indicator locations, C48A and C48B, and one control location, C47.

   In 2022, 11 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 82 pCi/kg and a range of 22 to 345 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 10 of 12 samples ranging from 21 to 80 pCi/kg. The results are similar to 2021 results.

In 2021, 11 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 83 pCi/kg and a range of 12 to 212 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 8 of 12 samples ranging from 10 to 96 pCi/kg. The results at location C48B are slightly greater than in 2020 mainly due to the July sample. The other samples at C48B were consistent with historical values. July was a very wet month and may have influenced the sample result. The K-40 result for July was also the highest of the year.

In 2020, 12 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 51 pCi/kg and a range of 10 to 116 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 10 of 12 samples ranging from 16 to 336 pCi/kg. These results are similar to those in 2019.

In 2019, 11 out of the 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 52 pCi/kg and a range of 6 to 329 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137 in 7 of 12 samples ranging from 13 to 154 pCi/kg. These results are similar to those in 2018.

In 2018, 13 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 27 pCi/kg and a range of 13 to 48 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 12 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 111 pCi/kg and a range of 38 to 184 pCi/kg. These results are similar to those in 2017.

In 2017, 12 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 30 pCi/kg and a range of 17 to 66 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 10 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 99 pCi/kg and a range of 19 to 186 pCi/kg. These results are similar to those in 2016.

In 2016, 13 out of 24 indicator locations (C48A and C48B) had measurable amounts of Cs-137 with an average concentration of 46 pCi/kg and a range of 11 to 179 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 10 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 73 pCi/kg and a range of 10 to 174 pCi/kg. These results are similar to those in 2015.

In 2015, 14 of 24 indicator samples had measurable amounts of cesium-137 with an average concentration of 50 pCi/kg and a range of 12 to 105 pCi/kg. The control station (C47) located in Orlando, Fl. also had measurable amounts of Cs-137. In 11 of 12 control station samples there were measurable amounts of Cs-137 with an average concentration of 67 pCi/kg and a range of 15 to 150 pCi/kg. The Cs-137 values are similar in concentration as compared to samples collected in 2014 which experienced radionuclide deposition as a result of the Fukushima earthquake event in 2011 and are not a result of the operation of CR3.

Table IV-D.3 provides a statistical summary of the vegetation gamma spectroscopy results.

4. In 2022 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also four milk samples collected in 2022, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM. This is no change from 2021.

   In 2021 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also four milk samples collected in 2021, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM.

In 2020 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also three milk samples collected in 2020, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM.

In 2019 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample. There were also three milk samples collected in 2019, all at location C28. Location C28 is about 20 miles SSE of the plant. All showed less than LLD for Cs-134 and Cs-137. Milk samples are not required per the ODCM.

In 2018 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample.

In 2017 the State was unable to locate a watermelon field at location C04 or anywhere in the vicinity of C04. This is documented in plant condition report 2192486. Also, only one citrus sample was collected versus the usual two samples. It showed above MDA levels of Cs-137 at 9 pCi/kg with an uncertainty of 2 pCi/kg. It was collected at location C19 which is 9.6 miles ENE of CR3. This reported value is less than the MDA of 11 pCi/kg reported in 2016 and is likely due to natural background.

In 2016 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (oranges and grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus sample.

In 2015 one watermelon sample was collected at station C04. None of the required radionuclides were found in measurable quantities. One citrus sample (grapefruit) was collected at station C19. None of the required radionuclides were found in measurable quantities in the citrus samples with exception of Cs-137 at a concentration of 9 pCi/kg. It is not unusual to periodically see Cs-137 in citrus samples due to widespread deposition of Cs-137 from fallout due to past weapons testing and more recent from the Fukushima earthquake and tsunami event that occurred in 2011.

Table IV-D.4 provides a statistical summary of the watermelon and citrus gamma spectroscopy results.
Table IV-D.4.a provides the results of the semi-annual samples.

.

TABLE IV-D.1

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 **DOCKET NO. 50-302**

CITRUS COUNTY, FLORIDA **JANUARY 1 TO DECEMBER 31, 2022**

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
CARNIVOROUS FISH (pCi/kg)	γ Spec 8						
	Co-60	16	<LLD	-	-	<LLD	0
	Cs-134	16	<LLD	-	-	<LLD	0
	Cs-137	18	<LLD	-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

TABLE IV-D.1.a

ADP CR3, LLC- 2022

pCi/kg GAMMA EMITTERS IN CARNIVOROUS FISH

STATION	QUARTER	Co-60	Cs-134	Cs-137	K-40
C29	1	<22	<20	<21	1930±170
	2	<24	<22	<24	2640±203
	3	<17	<15	<15	2260±146
	4	<22	<18	<20	2660±194
C30	1	<21	<20	<22	2590±195
	2	<23	<19	<21	2430±195
	3	<24	<17	<22	2920±213
	4	<24	<16	<18	2550±181

Carnivorous Fish

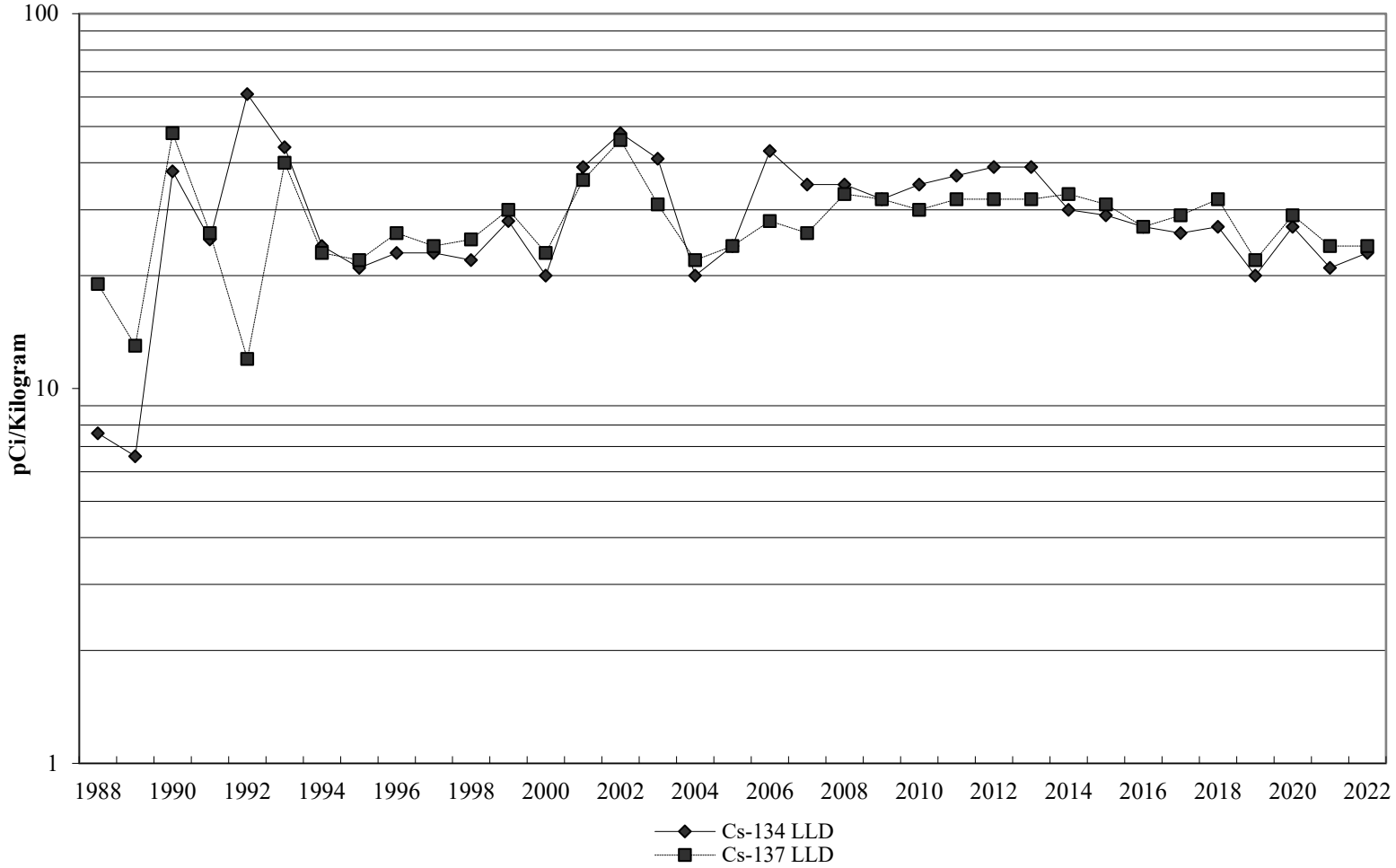


TABLE IV-D.2

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 DOCKET NO. 50-302

CITRUS COUNTY, FLORIDA JANUARY 1 TO DECEMBER 31, 2022

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
OYSTERS (pCi/kg)	γ Spec 5						
	Co-60	16	<LLD	-	-	<LLD	0
	Cs-134	16	<LLD	-	-	<LLD	0
	Cs-137	18	<LLD	-	-	<LLD	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

TABLE IV-D.2.a

ADP CR3, LLC- 2022

pCi/kg GAMMA EMITTERS IN OYSTERS

STATION	QUARTER	Co-60	Cs-134	Cs-137	K-40
C29	2	<22	<20	<22	1700±158
	3	<23	<20	<21	756±124
	4	<21	<20	<22	966±126
C30	2	<29	<23	<32	1800±208
	4	<25	<25	<25	1930±174

Oysters

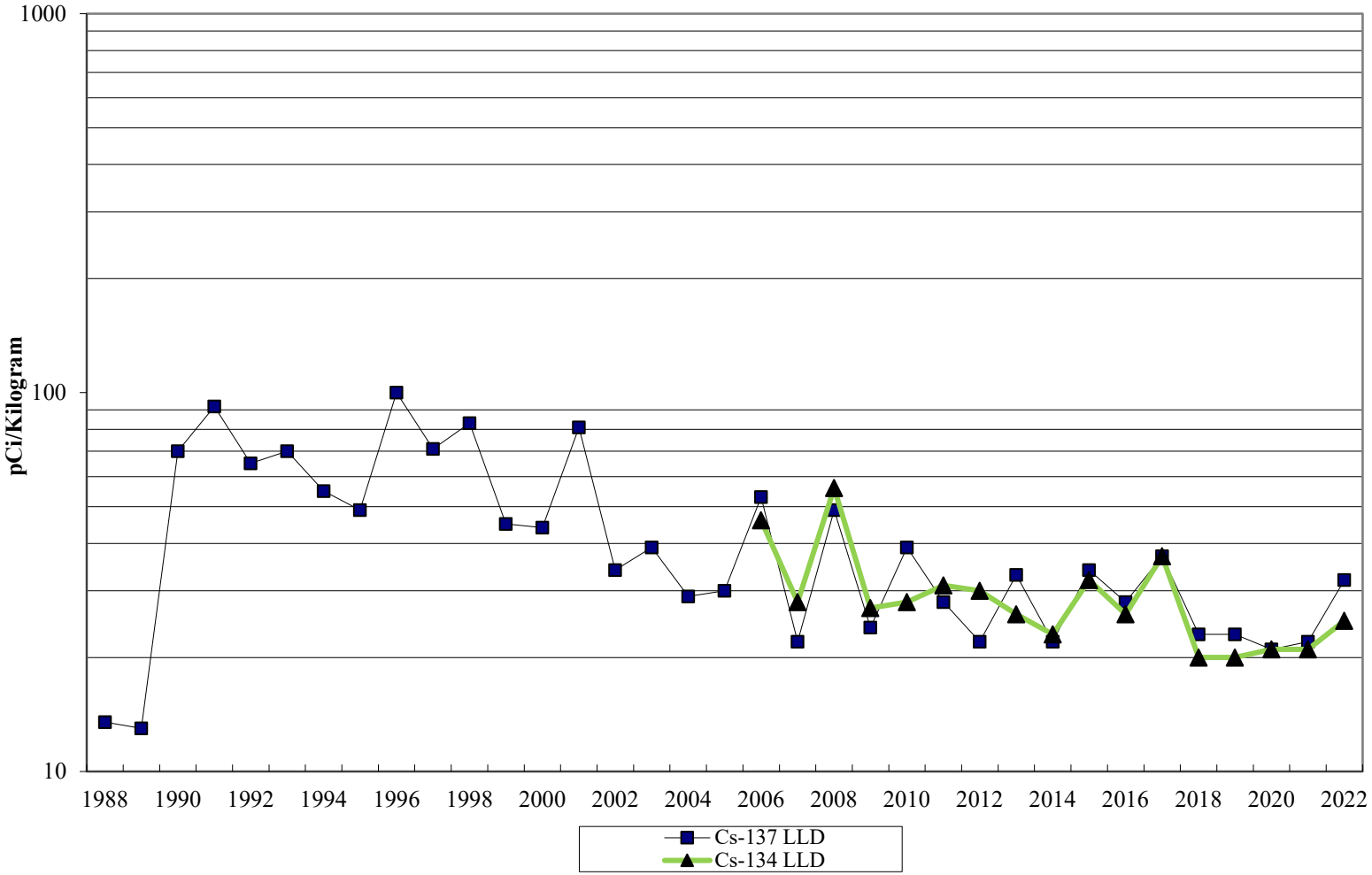

1000
100
10
pCi/Kilogram
1988
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
2014
2016
2018
2020
2022
Cs-137 LLD
Cs-134 LLD

TABLE IV-D.3

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 DOCKET NO. 50-302

CITRUS COUNTY, FLORIDA JANUARY 1 TO DECEMBER 31, 2022

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
BROAD LEAF VEGETATION (pCi/kg)	γ Spec 36						
	Cs-134	8	<LLD	_	_	<LLD	0
	Cs-137[2]	8	82 (11/24) (22-345)	C48B 0.9 @ 73º	88(10/12) (22-345)	40 (10/12) (21-80)	0

[1] The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

[2] The elevated Cs-137 values are not associated with the operation of CR3 and are a direct result of global fallout including the Fukushima earthquake and tsunami event that occurred in 2011.

TABLE IV-D.3.a

ADP CR3, LLC- 2022

pCi/kg OF GAMMA EMITTERS IN BROAD LEAF VEGETATION

STATION	MONTH	Cs-134	Cs-137	K-40
C47	JAN	<10	31±4	3790±162
	FEB	<12	46±5	2150±120
	MAR	<10	<15	2780±129
	APR	<7	38±3	2630±117
	MAY	<11	47±5	2810±142
	JUN	<10	46±5	2690±133
	JUL	<11	24±3	2150±112
	AUG	<16	40±8	4140±243
	SEP	<10	80±6	2470±124
	OCT	<10	31±4	1630±91
	NOV	<8	<12	3410±145
	DEC	<11	21±5	2970±158
C48A	JAN	<10	<12	1810±101
	FEB	<9	<11	1600±99
	MAR	<13	<16	3120±167
	APR	<12	<16	3930±204
	MAY	<13	<20	2610±170
	JUN	<12	<16	2510±156
	JUL	<13	<17	1830±134
	AUG	<14	24±6	1930±146
	SEP	<10	<14	2670±148
	OCT	<12	<16	2670±160
	NOV	<13	<12	5060±215
	DEC	<12	<15	6260±253

TABLE IV-D.3.a (CONT'D)

ADP CR3, LLC- 2022

pCi/kg OF GAMMA EMITTERS IN BROAD LEAF VEGETATION

STATION	MONTH	Cs-134	Cs-137	K-40
C48B	JAN	<11	64±5	1300±83
	FEB	<11	63±5	1360±87
	MAR	<10	71±6	1700±101
	APR	<9	22±3	2390±118
	MAY	<11	83±6	2370±122
	JUN	<12	36±6	1830±134
	JUL	<9	64±5	1510±87
	AUG	<11	<17	2410±153
	SEP	<8	69±5	1090±68
	OCT	<12	59±6	1520±118
	NOV	<17	345±18	1740±143
	DEC	<17	<25	1310±135

The elevated Cs-137 values are a direct result of the Fukushima earthquake and tsunami event that occurred in 2011 and legacy weapons testing fallout and are not associated with CR-3 operation.

Broad Leaf Vegetation
Cs-137

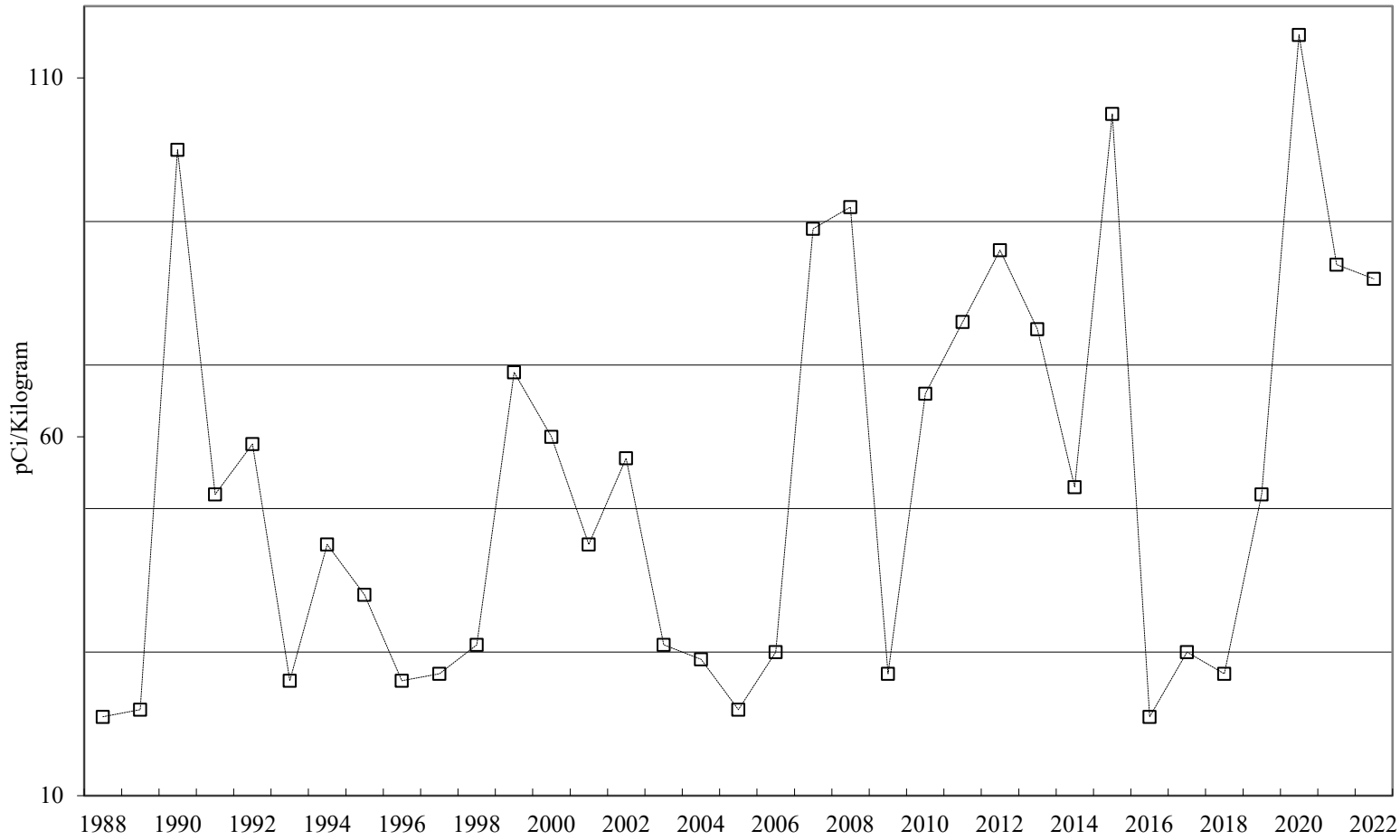


TABLE IV-D.4

RADIOLOGICAL ENVIRONMENTAL MONITORING PROGRAM SUMMARY

CRYSTAL RIVER UNIT 3 DOCKET NO. 50-302

CITRUS COUNTY, FLORIDA JANUARY 1 TO DECEMBER 31, 2022

MEDIUM OR PATHWAY SAMPLED (UNITS)	ANALYSIS AND TOTAL NUMBER OF ANALYSES PERFORMED	LOWER LIMIT OF DETECTION (LLD)[1]	ALL INDICATOR LOCATIONS MEAN RANGE	LOCATION WITH HIGHEST MEAN NAME DISTANCE & BEARING	LOCATION WITH HIGHEST MEAN MEAN RANGE	CONTROL LOCATION MEAN RANGE	NUMBER OF NONROUTINE REPORTED MEASUREMENTS
WATERMELON (pCi/kg)	γ Spec 1						
	Cs-134	8	<LLD			None	0
	Cs-137	8	<LLD	_		None	0
CITRUS (pCi/kg)	γ Spec 1						
	Cs-134	8	<LLD	_	_	None	0
	Cs-137	8	<LLD	_		None	0

[1]The "a priori" LLD which meets or exceeds the requirements of Table 2-5 of the CR-3 ODCM.

TABLE IV-D.4.a

ADP CR3, LLC- 2022

pCi/kg OF γ EMITTERS IN WATERMELON AND CITRUS

STATION	MONTH	Cs-134	Cs-137	K-40
C04 – Watermelon	June	<5	<6	1060±65
C19 – Citrus (Grapefruit)	January	<10	<11	2070±111