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**The Administrative Record Staff**

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JUNE - 1989 EM-4180110-177

# ROCKY FLATS PLANT



000024329

## MONTHLY ENVIRONMENTAL MONITORING REPORT

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Rocky Flats Plant  
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A Prime Contractor to  
The United States Department of Energy

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Reviewed for Classification/UCNI/OUO  
By: Janet Nesheim, Derivative Classifier  
DOE, EMCBC  
Date: 11/17/08 KG  
Confirmed Unclassified, Not UCNI/Not OUO

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SW-A-003690

ADMIN RECORD

SW-A-003690

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R. J Erfurdt  
E R. Heintz  
F D Hobbs  
A M Long  
C M Marsh  
K B McKinley  
E R. Naimon  
G L Potter  
R. E Richardella  
R. Roberts  
D J Sanchini  
G H Setlock  
C L Sundblad  
C Trice  
W. F Weston  
J J Whicker  
EMF  
Rocky Flats Plant-Library

JUNE 1989 ENVIRONMENTAL MONITORING REPORT  
ROCKY FLATS PLANT

This report summarizes the effluent and environmental monitoring programs at the Rocky Flats Plant for the month of June 1989. The data presented herein are the best information available to the Rocky Flats Plant at this time. Should subsequent analyses indicate that any data presented herein are inaccurate or misleading appropriate revisions will be issued promptly.

Included in the report are monitoring results for radioactive and nonradioactive airborne effluents continuously sampled from Plant buildings, Tables I and II. Tables III through V summarize environmental monitoring data from the Rocky Flats Plant ambient air sampling network. This network is comprised of continuously operating air samplers located on plantsite, around the Plant boundary, and in neighboring communities.

Water sampling results for radioactive constituents are given in Tables VI through VIII. Results are summarized for Plant surface water control ponds, for nearby drinking water reservoirs, and for tap water for neighboring communities. Nitrate monitoring for Great Western Reservoir and Standley Lake, the two drinking water reservoirs which can receive surface water discharges from the Plant, are summarized in Table IX.

The Environmental Protection Agency (EPA) has issued to the Plant a National Pollutant Discharge Elimination System (NPDES) permit for control of surface water discharges. Water sampling results associated with the NPDES permit, as well as applicable discharge limitations imposed by that permit, are reported in Table X. Analytical results for nonradioactive parameters in water at the Walnut Creek at Indiana Street location are summarized in Table XI. Daily flow data for surface water from the two Plant drainage systems are given in Tables XI, XII, and XIII.

The data provided in this report are provided as a matter of comity and should not be construed as an application for a permit or license, or in support of such an application. Approval of the Department of Energy should be obtained prior to publication of any data contained within this report.

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Name/Org: Shayne Nauy 6/PRC Date 11/17/08  
Directed by: J.A. Nesheim DOE M471-3-1

4/39

Table I. 1989 Plutonium and Uranium Airborne Effluent Data

Month	Plutonium (05/22/89 - 06/19/89 - JUN)		Uranium (05/23/89 - 06/20/89 - JUN)	
	Release (uCi)	CMax (pCi/m3)	Release (uCi)	CMax (pCi/m3)
CY 1988	15.07	0.023 ± 0.0052	11.28	0.009 ± 0.0009
January	0.33	0.005 ± 0.0005	0.15	0.000 ± 0.0001
February	0.15	0.001 ± 0.0001	0.20	0.001 ± 0.0002
March	0.07	0.001 ± 0.0001	0.04	0.002 ± 0.0002
April	0.28	0.001 ± 0.0001	0.04	0.001 ± 0.0001
May	0.18*	0.001 ± 0.0001*	-0.03	0.001 ± 0.0001
June	0.06**	0.001 ± 0.0001**	0.08	0.001 ± 0.0002
July				
August				
September				
October				
November				
December				
Year to Date	1.04**	0.005 ± 0.0005**	0.40*	0.002 ± 0.0002*

\* Previously reported incomplete.

\*\* Three incomplete Analyses

NOTE: The plutonium, uranium, americium, and beryllium measured concentrations in this report include values that are less than the corresponding calculated minimum detectable concentrations (MDC's). In some cases, the values are less than zero. This method of reporting began in January 1981. These negative values result when the measured value for the laboratory reagent blank is subtracted from an analytical result which was measured as a smaller value than the reagent blank. This may happen when measuring concentrations which are very close to zero.

5/39

Table II. 1989 Tritium and Beryllium Airborne Effluent Data

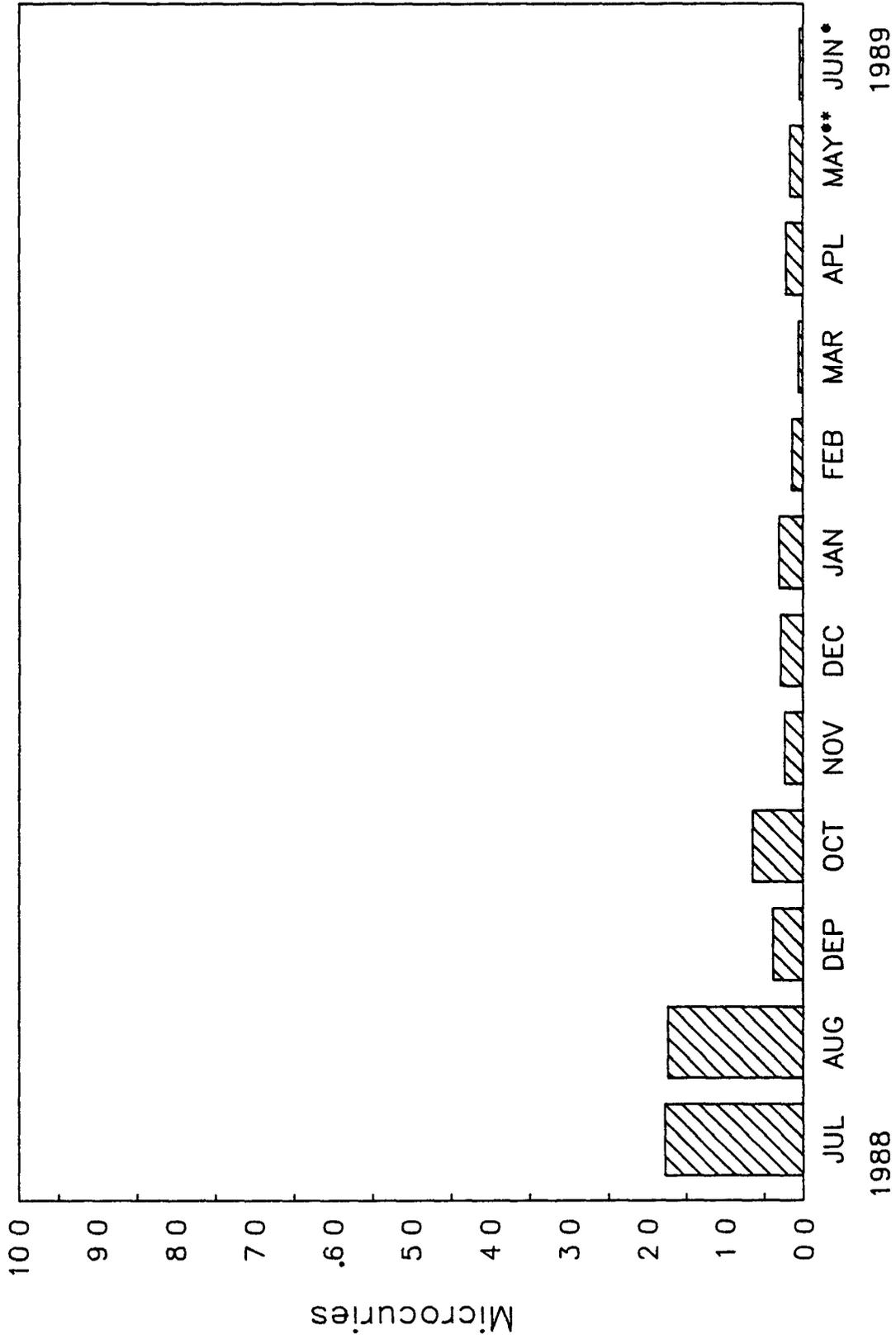
Month	Tritium		Beryllium	
	Release (Ci)	CMax (pCi/m3)	Release (grams)	CMax (ug/m3)
CY 1988	0.014	417 ± 250	0.1322	0.00041
January	0.001	97 ± 145	0.0285	0.00033
February	0.002	166 ± 120	-0.0392	-0.00005
March	0.007	389 ± 220	-0.0025	0.00000
April	0.152	14000 ± 320	-0.0031	0.00017
May	0.003	65 ± 35	0.0024	0.00004
June	0.001	99 ± 10	0.0525*	0.00025
July				
August				
September				
October				
November				
December				
Year to Date	0.166	14000 ± 320	-0.0139*	0.00033*

\* Not Blank Correct

NOTE: Beryllium measured at 36 other screening locations was below the screening level of 0.1 gram per month.

4/39

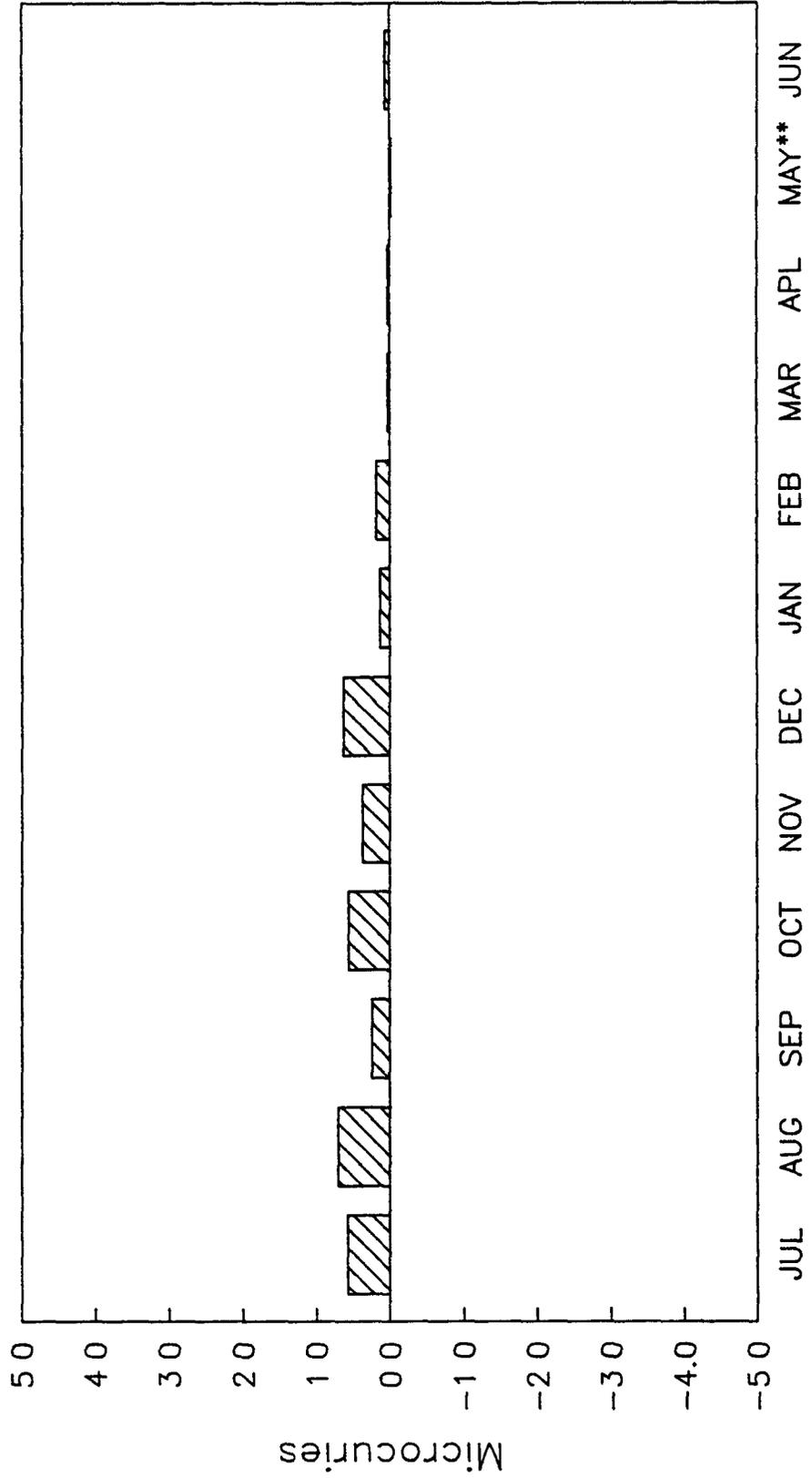
PLUTONIUM MEASURED IN EFFLUENT AIR



\* Incomplete Analysis  
 \*\* Previously Incomplete

7/39

URANIUM MEASURED IN EFFLUENT AIR



1988

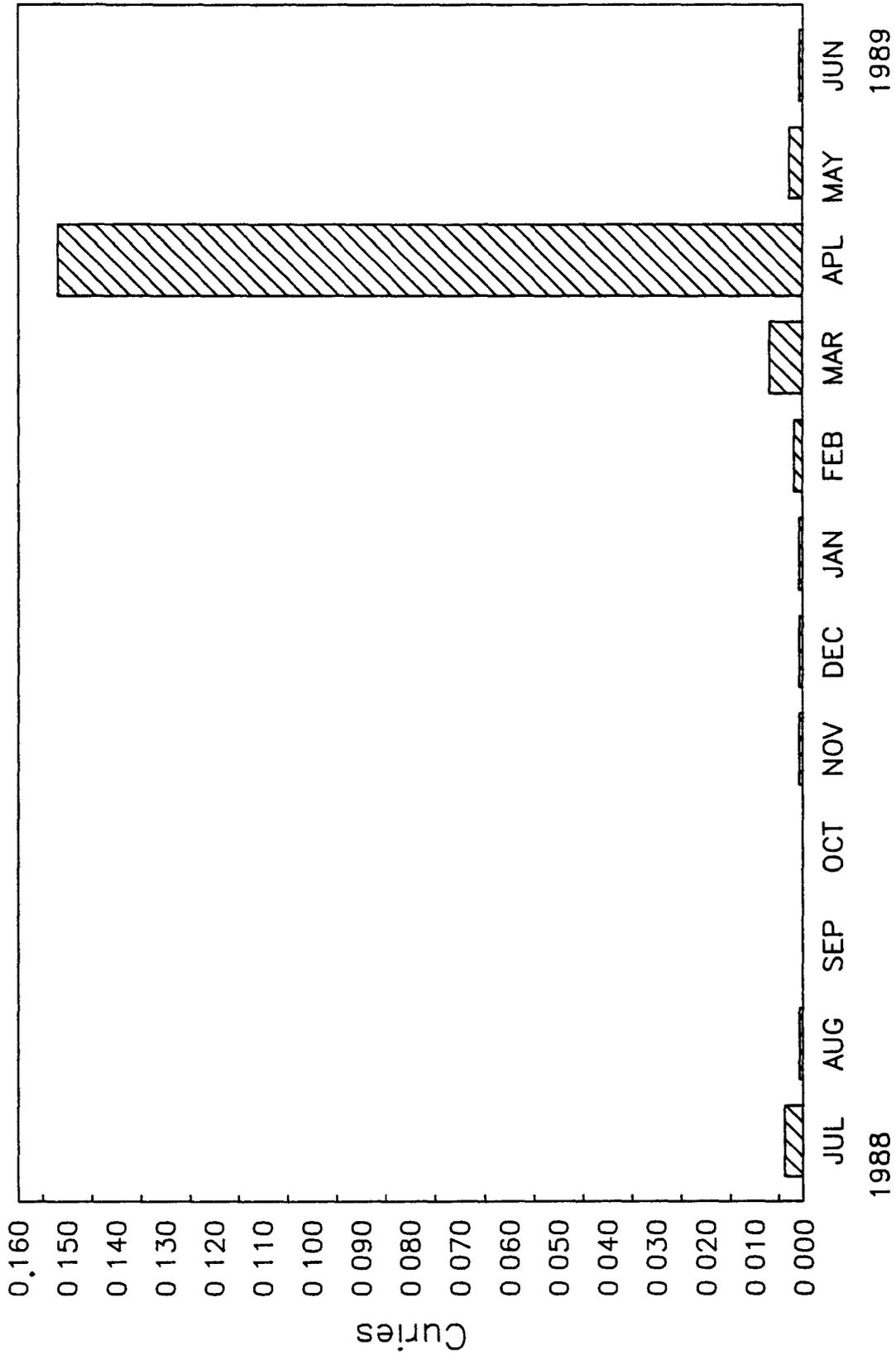
1989

\*\* Previously Incomplete

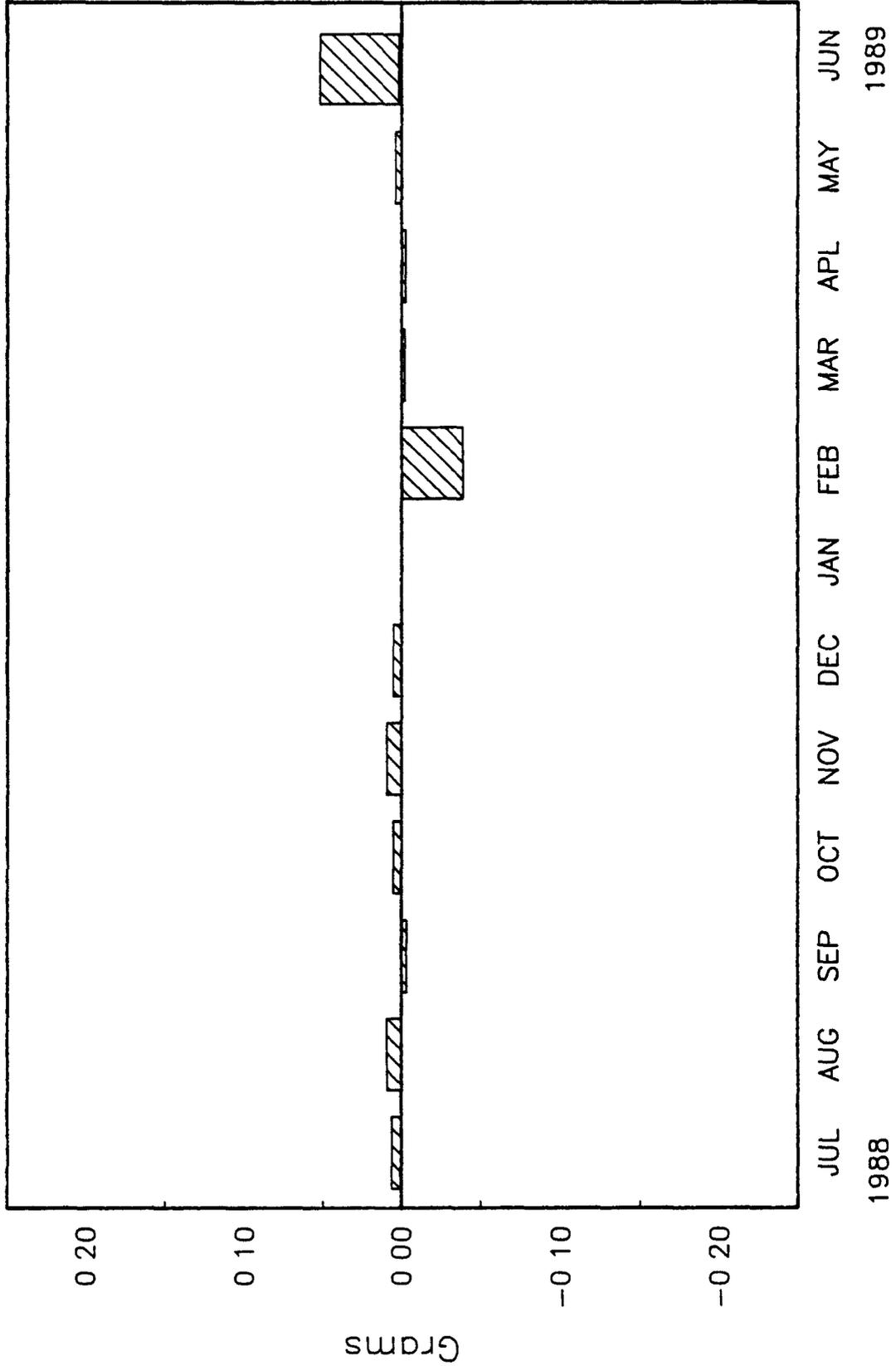
8/39

9/39

# TRITIUM MEASURED IN EFFLUENT AIR



BERYLLIUM MEASURED IN EFFLUENT AIR



10/39

JUNE 1989

Table III. Plutonium at Selected Onsite Ambient Air Locations  
(05/30/89 - 06/27/89)

<u>Location</u>	<u>n</u>	<u>Volume (m3)</u>	<u>Concentration (pCi/m3)</u>	
			<u>Point Estimate</u>	<u>± Error</u>
S-05	2	31000	0.000037	0.000011
S-06	2	33000	0.000090	0.000021
S-07	2	26000	0.000252	0.000066
S-08	2	34000	0.000283	0.000064
S-09	2	28000	0.000259	0.000055

NOTE: The total long-lived alpha activities of the remaining 18 onsite ambient air sampler locations were below 0.01 pCi/m<sup>3</sup>. Plutonium-specific analyses are performed and reported if any filter from these 18 air samplers exceeds the Rocky Flats Plant screening level of 0.01 pCi/m<sup>3</sup> total long-lived alpha activity. Plutonium concentration data is routinely reported only for the five locations (above) which have historically produced the largest total long-lived alpha activities of the 23 onsite ambient air sampler locations.

11/39

MAY 1989

Table III. Plutonium at Selected Onsite Ambient Air Locations  
(05/02/89 - 05/30/89)

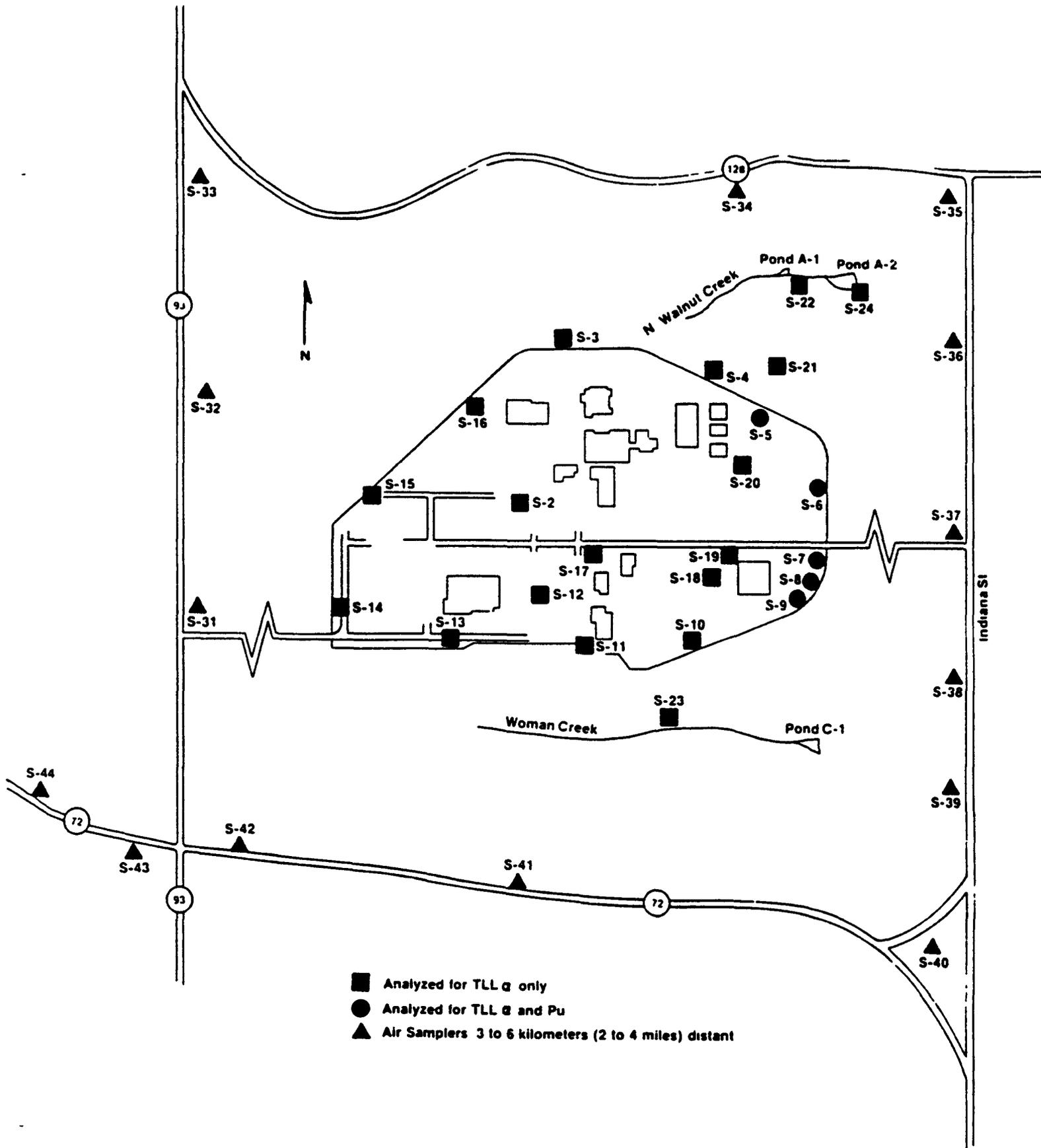
<u>Location</u>	<u>n</u>	<u>Volume (m3)</u>	<u>Concentration (pCi/m3)</u>	
			<u>Point Estimate</u>	<u>± Error</u>
S-05	2	31000	0.000037	0.000012
S-06	2	32000	0.000185	0.000041
S-07	2	28000	0.000153	0.000043
S-08	1*	17000**	0.000113**	0.000027**
S-09	2	31000	0.000216	0.000055

NOTE: Total long-lived alpha at the remaining 18 onsite ambient air samplers was below the screening level of 0.01 pCi/m<sup>3</sup>.

\* The S-08 plutonium analysis was performed on a single filter from the 05/02/89 to 05/16/89 sampling period. The S-08 air sampler was inoperational for the remainder of the month.

\*\* Correction of previously reported data.

12/39



Location of Onsite and Plant Perimeter Ambient Air Samplers  
(Portions of figure are not to scale)

13/39

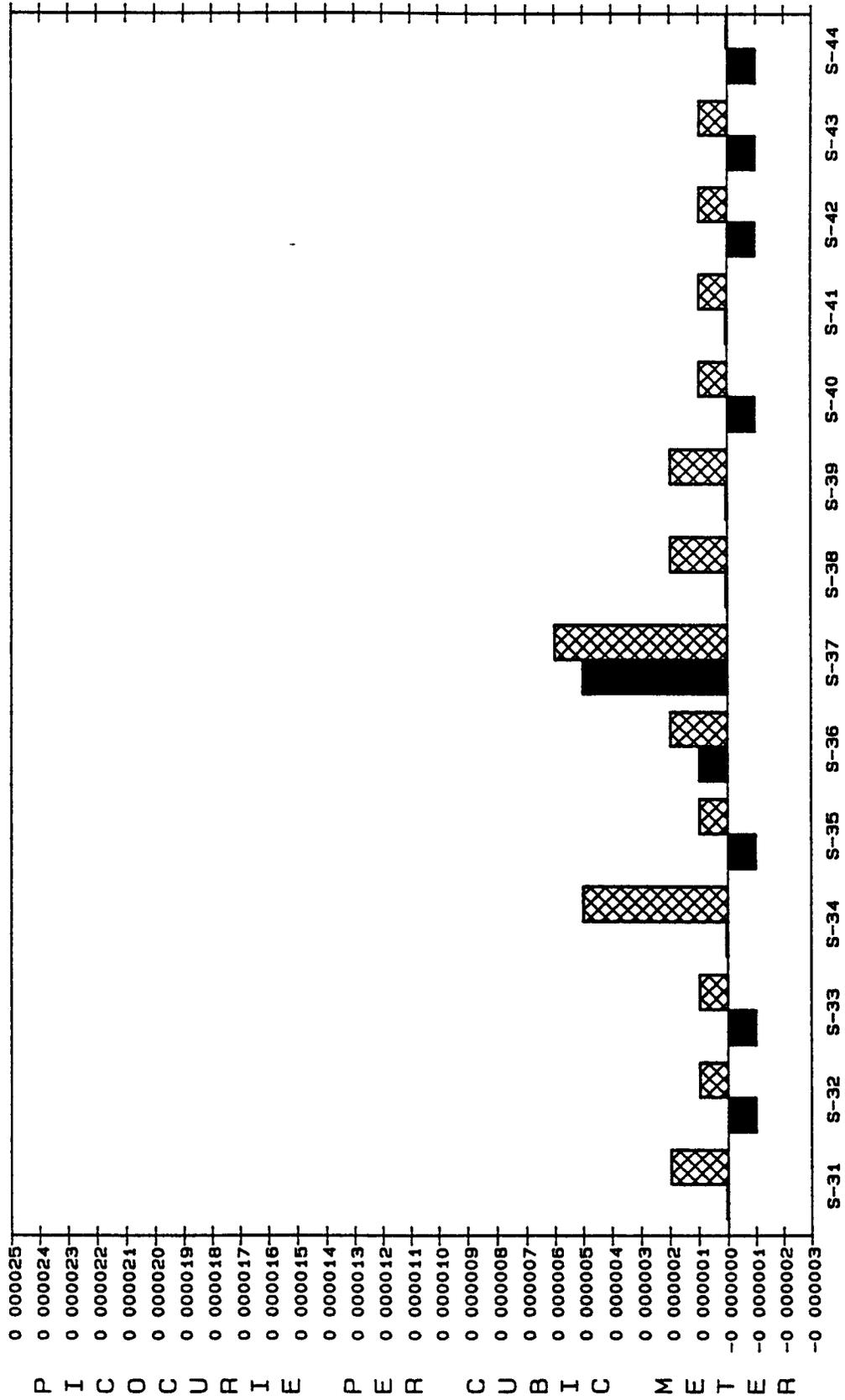
JUNE 1989

Table IV. Plutonium in Perimeter Ambient Air  
(05/23/89 to 06/20/89)

<u>Location</u>	<u>n</u>	<u>Volume (m3)</u>	<u>Concentration (pCi/m3)</u>	
			<u>Point Estimate</u>	<u>± Error</u>
S-31	1	29000	0.000000	0.000003
S-32	1	31000	-0.000001	0.000003
S-33	1	32000	-0.000001	0.000003
S-34	1	29000	0.000000	0.000003
S-35	1	33000	-0.000001	0.000003
S-36	1	30000	0.000001	0.000003
S-37	1	31000	0.000005	0.000003
S-38	1	30000	0.000000	0.000003
S-39	1	32000	0.000000	0.000003
S-40	1	29000	-0.000001	0.000003
S-41	1	33000	0.000000	0.000003
S-42	1	31000	-0.000001	0.000003
S-43	1	32000	-0.000001	0.000003
S-44	1	31000	-0.000001	0.000003

14/39

PLUTONIUM CONCENTRATIONS IN PERIMETER AMBIENT AIR



AIR SAMPLER LOCATION

■ JUNE 1989

▨ ANNUAL MEAN

P I C O C U R I E P E R C U B I C M E T E R

15/39

JUNE 1989

Table V. Plutonium in Community Ambient Air  
(5/24/89 - 06/21/89)

<u>Location</u>	<u>Community Name</u>	<u>n</u>	<u>Volume (m3)</u>	<u>Concentration (pCi/m3)</u>	
				<u>Point Estimate</u>	<u>± Error</u>
S-51	Marshall	1	29000	-0.000001	0.000003
S-52	Jeffco Airport	1	32000	0.000003	0.000003
S-53	Superior	**	0		
S-54	Boulder	*	31000		
S-55	Lafayette	1	33000	0.000003	0.000003
S-56	Broomfield	1	29000	-0.000001	0.000003
S-57	Walnut Creek	1	30000	-0.000001	0.000003
S-58	Wagner	1	32000	-0.000001	0.000003
S-59	Leyden	1	33000	0.000000	0.000003
S-60	Westminster	1	22000	-0.000001	0.000004
S-61	Denver	1	28000	-0.000001	0.000003
S-62	Golden	1	31000	0.000002	0.000003
S-68	Lakeview Pointe	1	30000	0.000000	0.000003
S-73	Cotton Creek	1	22000	-0.000001	0.000004

\* Incomplete Analysis

\*\* Air sampler was inoperational during this period.

16/39

MAY 1989

Table V. Plutonium in Community Ambient Air  
(4/26/89 - 5/24/89)

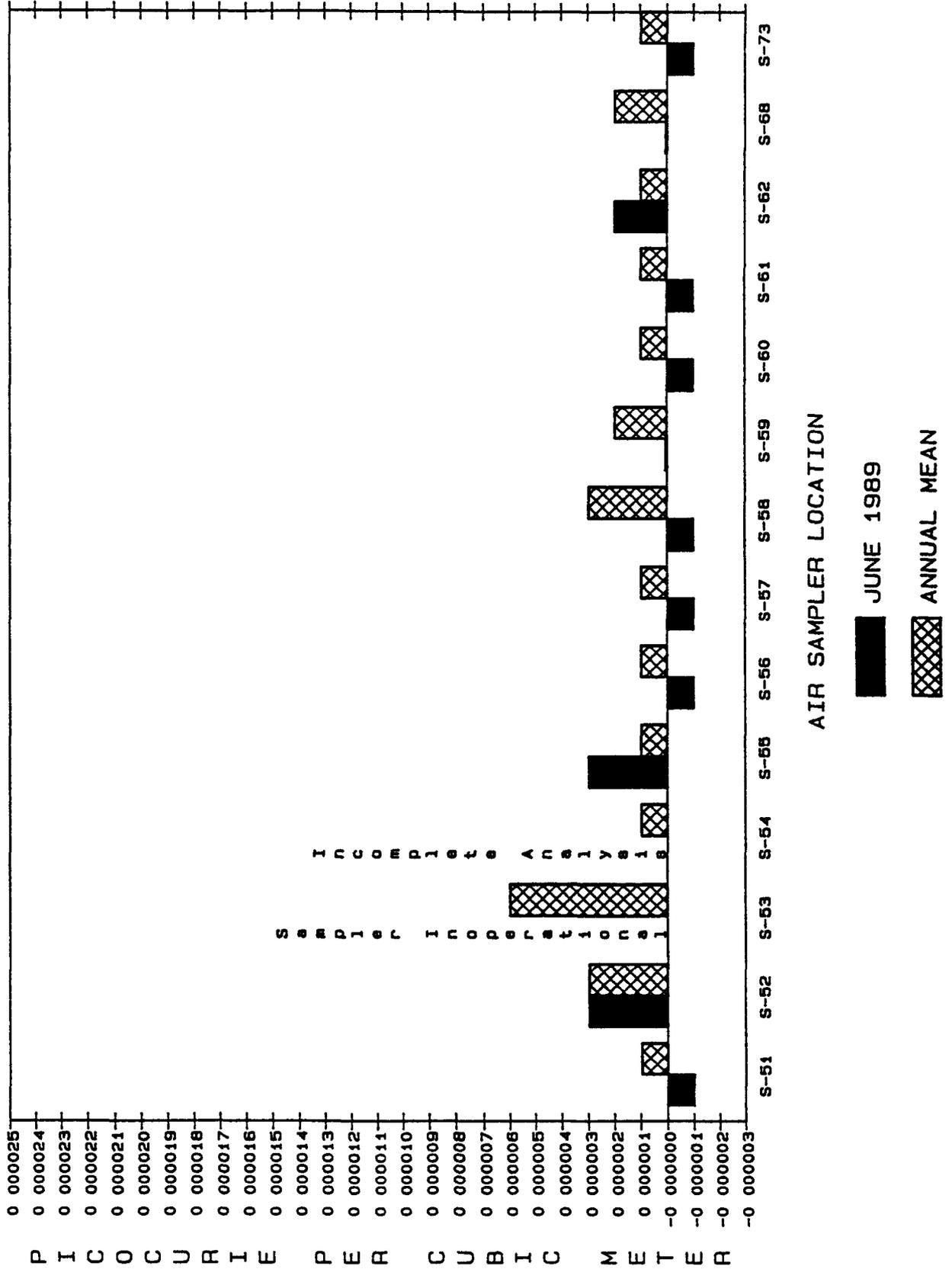
<u>Location</u>	<u>Community Name</u>	<u>n</u>	<u>Volume (m3)</u>	<u>Concentration (pCi/m3)</u>	
				<u>Point Estimate</u>	<u>± Error</u>
S-51	Marshall	1*	30000	0.000000	0.000003
S-52	Jeffco Airport	1	32000	-0.000001	0.000003
S-53	Superior	1*	29000	-0.000001	0.000003
S-54	Boulder	1	32000	-0.000001	0.000003
S-55	Lafayette	1*	33000	-0.000001	0.000003
S-56	Broomfield	1	29000	0.000000	0.000003
S-57	Walnut Creek	1	30000	-0.000001	0.000003
S-58	Wagner	**			
S-59	Leyden	1*	33000	-0.000001	0.000003
S-60	Westminster	1	21000	0.000002	0.000005
S-61	Denver	1	27000	-0.000001	0.000004
S-62	Golden	1	30000	0.000001	0.000003
S-68	Lakeview Pointe	1*	30000	-0.000001	0.000003
S-73	Cotton Creek	1	20000	-0.000003	0.000005

\* Previously unreported data

\*\* S-58 air sampler was inoperational during this period.

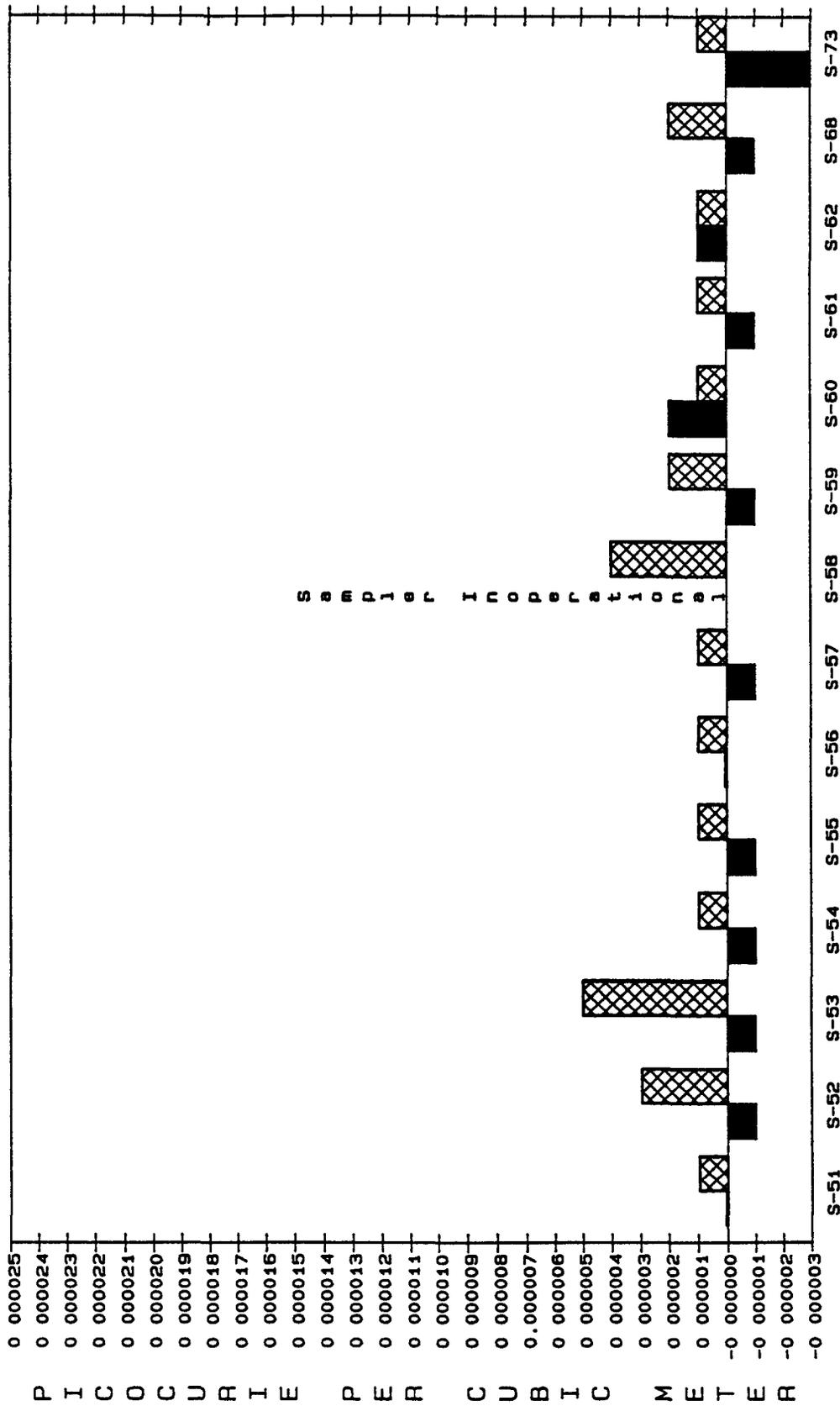
17/39

PLUTONIUM CONCENTRATIONS IN COMMUNITY AMBIENT AIR



18/39

PLUTONIUM CONCENTRATIONS IN COMMUNITY AMBIENT AIR



AIR SAMPLER LOCATION

■ MAY .1989

▨ ANNUAL MEAN

P I C O C U R I E P E R C U B I C M E T E R

19/39



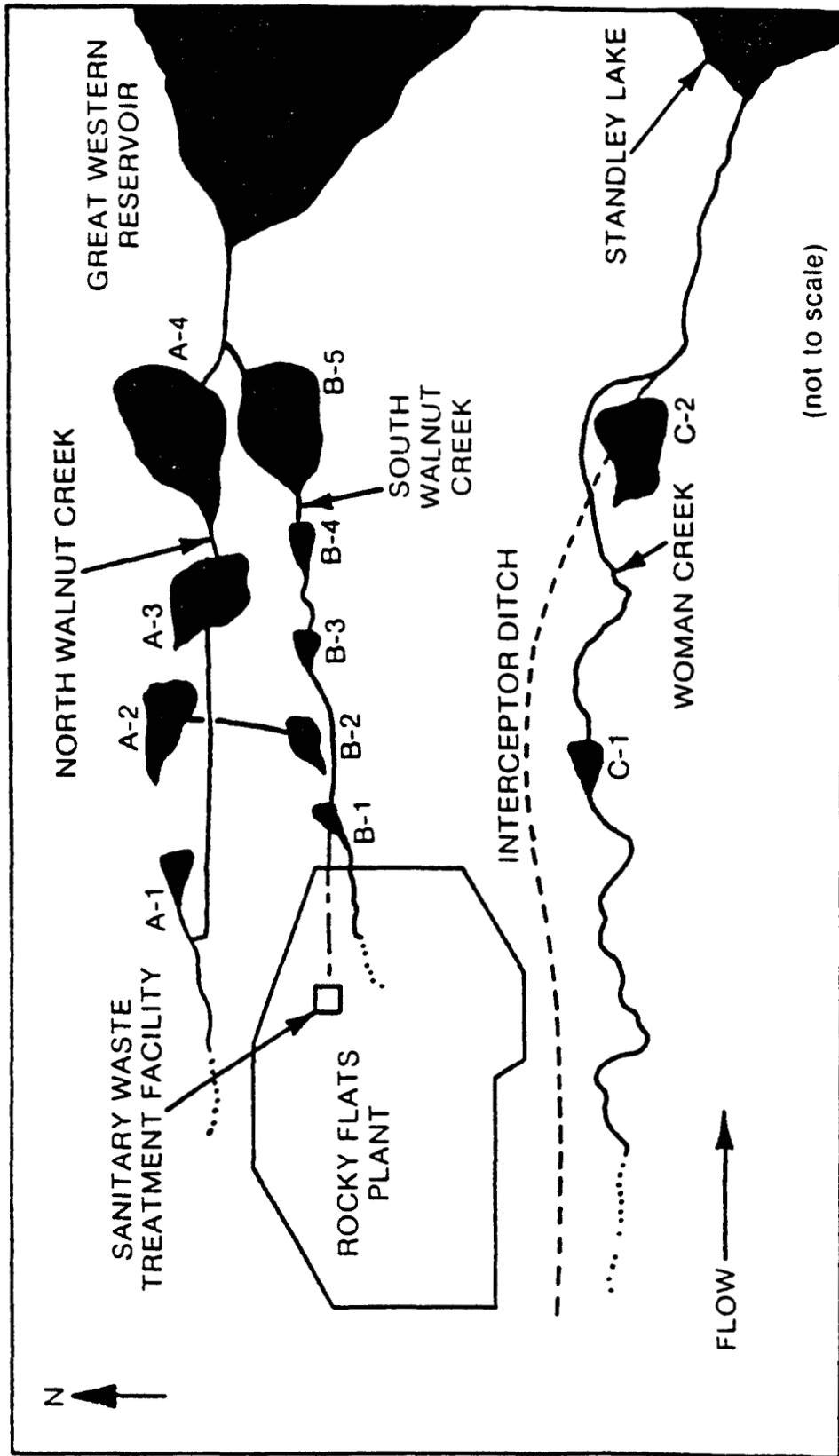
JUNE 1989

Table VI. Onsite Water Sample Results - Plutonium, Uranium, and Americium

Holding Pond Outfall (pCi/l)

<u>Location</u>	<u>Plutonium</u>	<u>Uranium</u>	<u>Americium</u>
<u>Pond A-4</u>			
No Discharge			
Average Concentration			
<u>Pond B-5</u>			
No Discharge			
Average Concentration			
<u>Pond C-1</u>			
06/05/89 to 06/09/89	0.014 ± 0.008	1.12 ± 0.19	0.075 ± 0.014
06/12/89 to 06/16/89	0.012 ± 0.007	0.82 ± 0.18	-0.001 ± 0.005
06/19/89 to 06/23/89	0.008 ± 0.006	5.00 ± 0.42	0.000 ± 0.005
06/26/89 to 06/30/89	*	2.22 ± 0.19	-0.002 ± 0.005
Average Concentration	*	2.29 ± 0.27	0.018 ± 0.008
<u>Pond C-2</u>			
No Discharge			
Average Concentration			
<u>Walnut Creek at Indiana</u>			
06/02/89	0.003 ± 0.029	4.36 ± 0.33	0.023 ± 0.025
06/05/89 to 06/07/89	0.004 ± 0.010	1.74 ± 0.21	0.009 ± 0.009
06/12/89 to 06/16/89	0.000 ± 0.006	2.90 ± 0.22	0.003 ± 0.005
06/19/89 to 06/20/89	0.021 ± 0.017	1.55 ± 0.16	0.019 ± 0.014
Average Concentration	0.007 ± 0.018	2.64 ± 0.24	0.014 ± 0.015
* Analysis Incomplete			

21/39

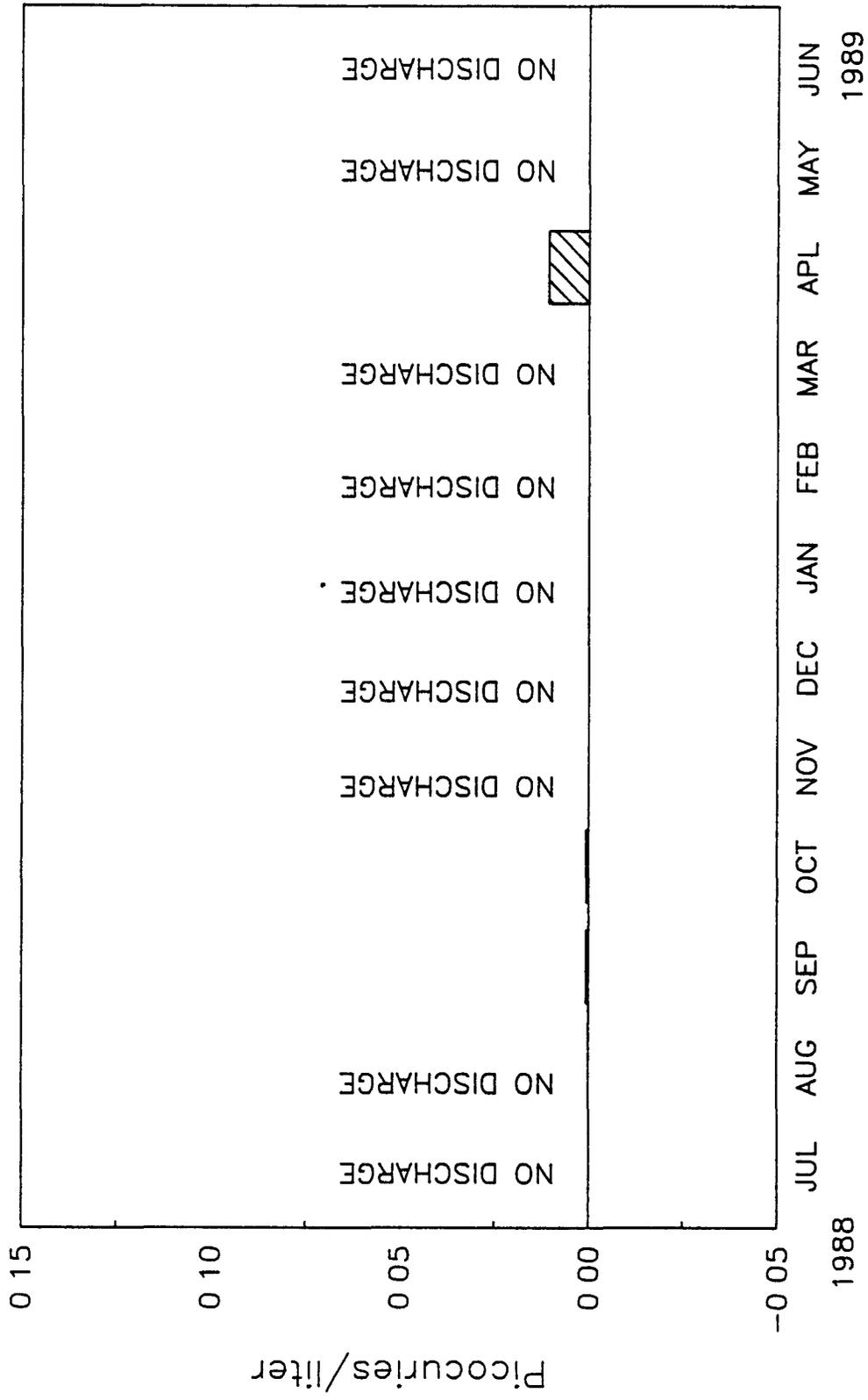


(not to scale)

Holding Ponds and Liquid Effluent Watercourses

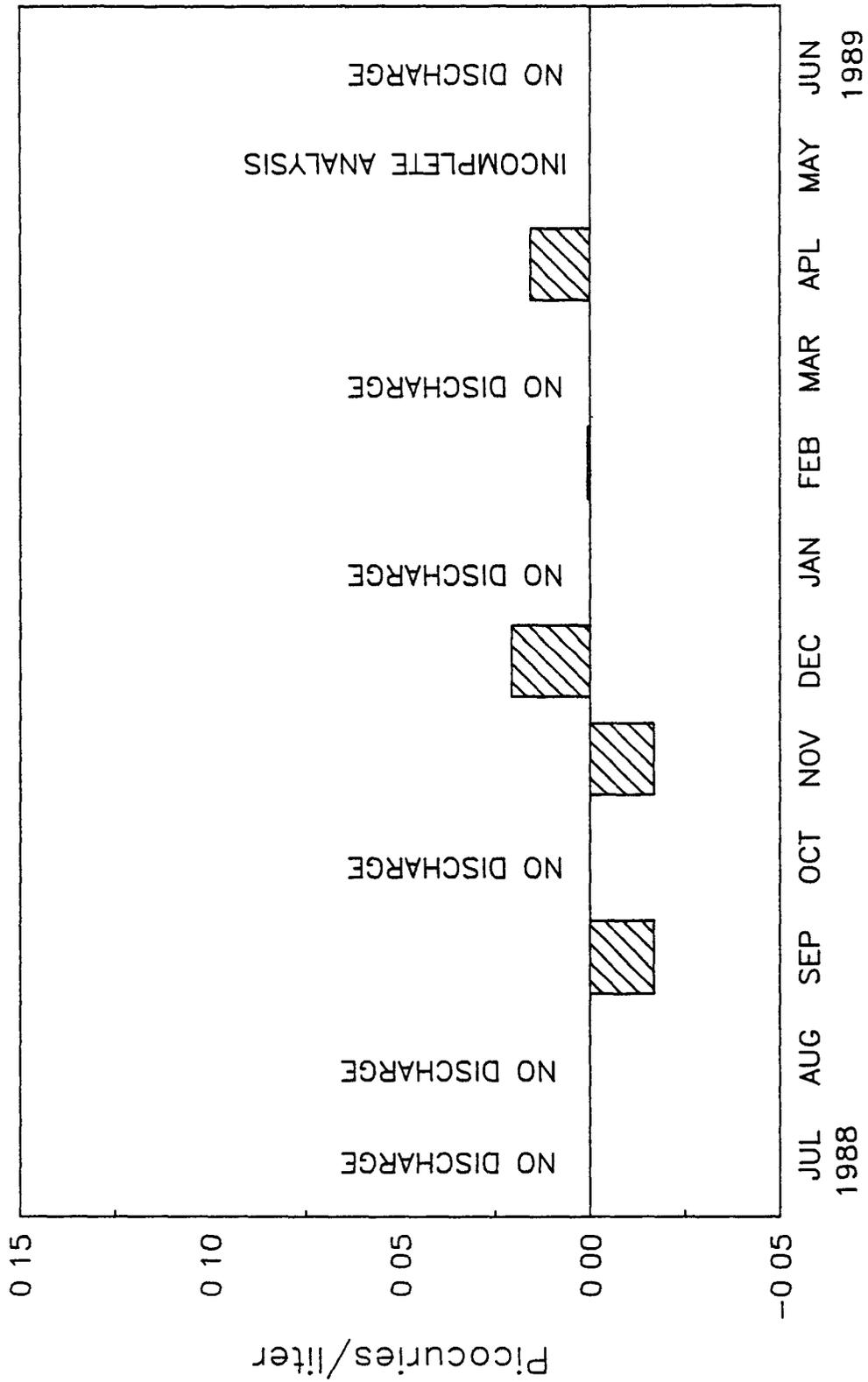
22/39

PLUTONIUM IN POND A--4 EFFLUENT WATER



23/39

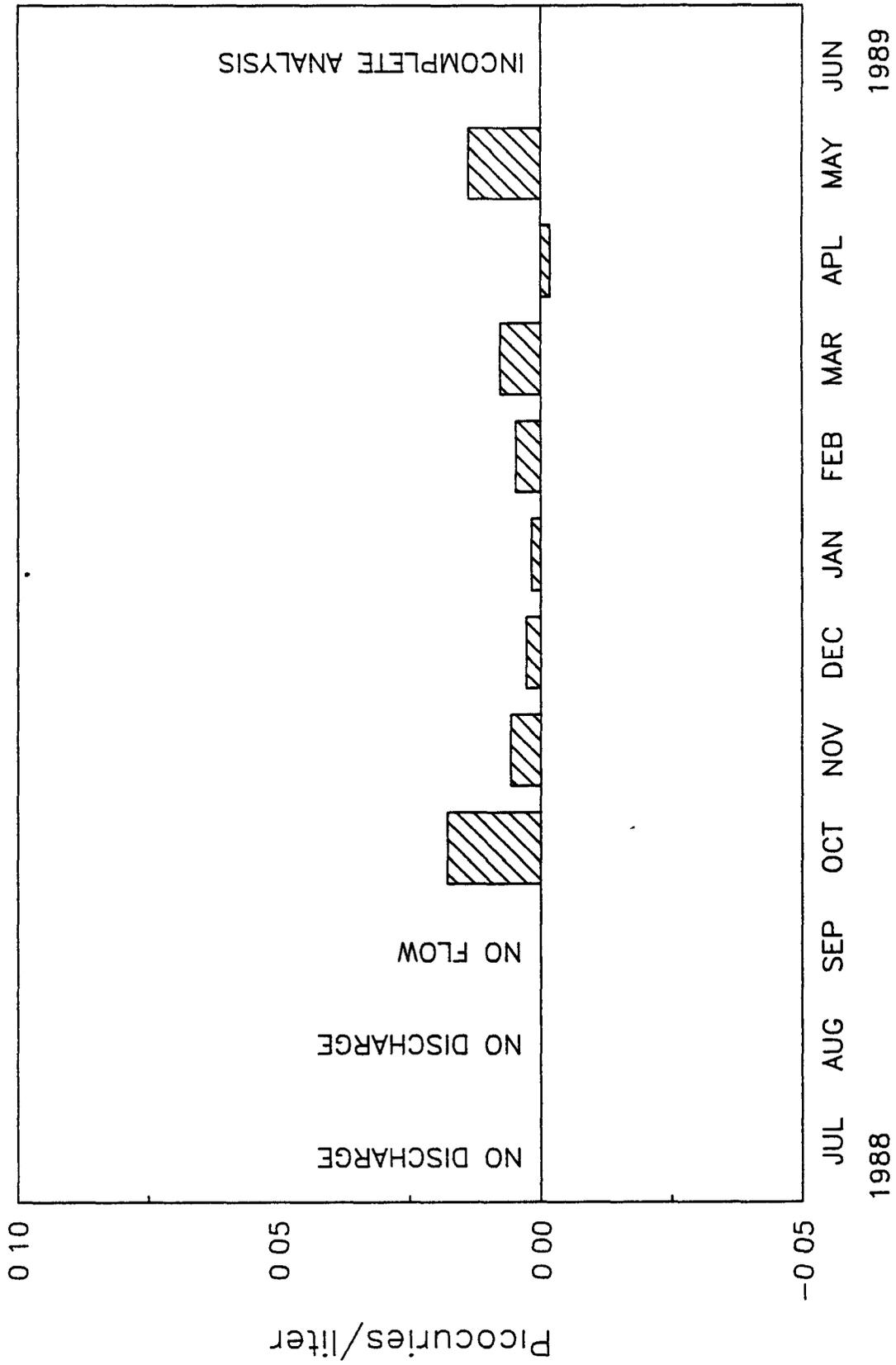
PLUTONIUM IN POND B-5 EFFLUENT WATER



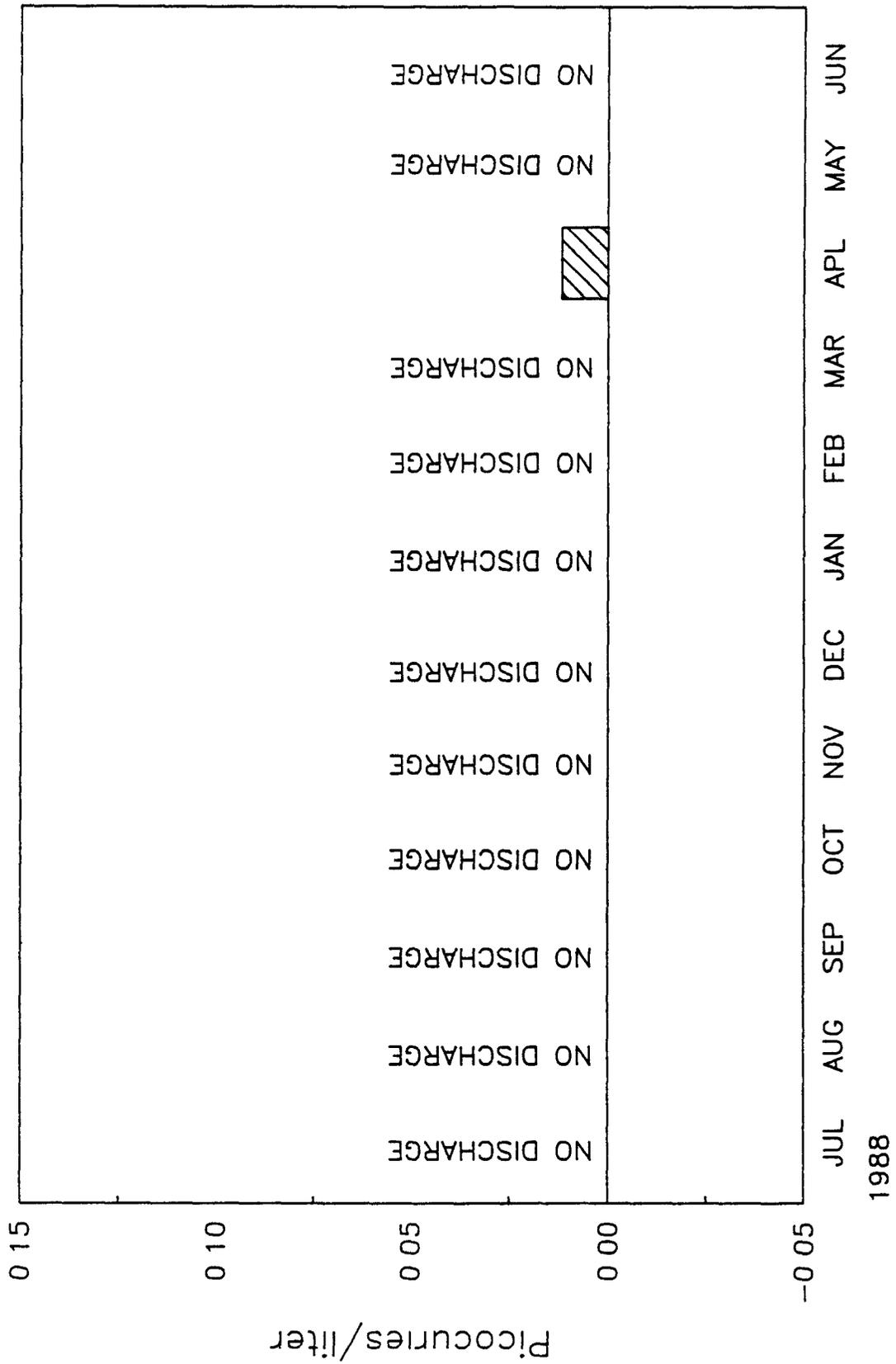
24/39

25/39

# PLUTONIUM IN POND C-1 EFFLUENT WATER

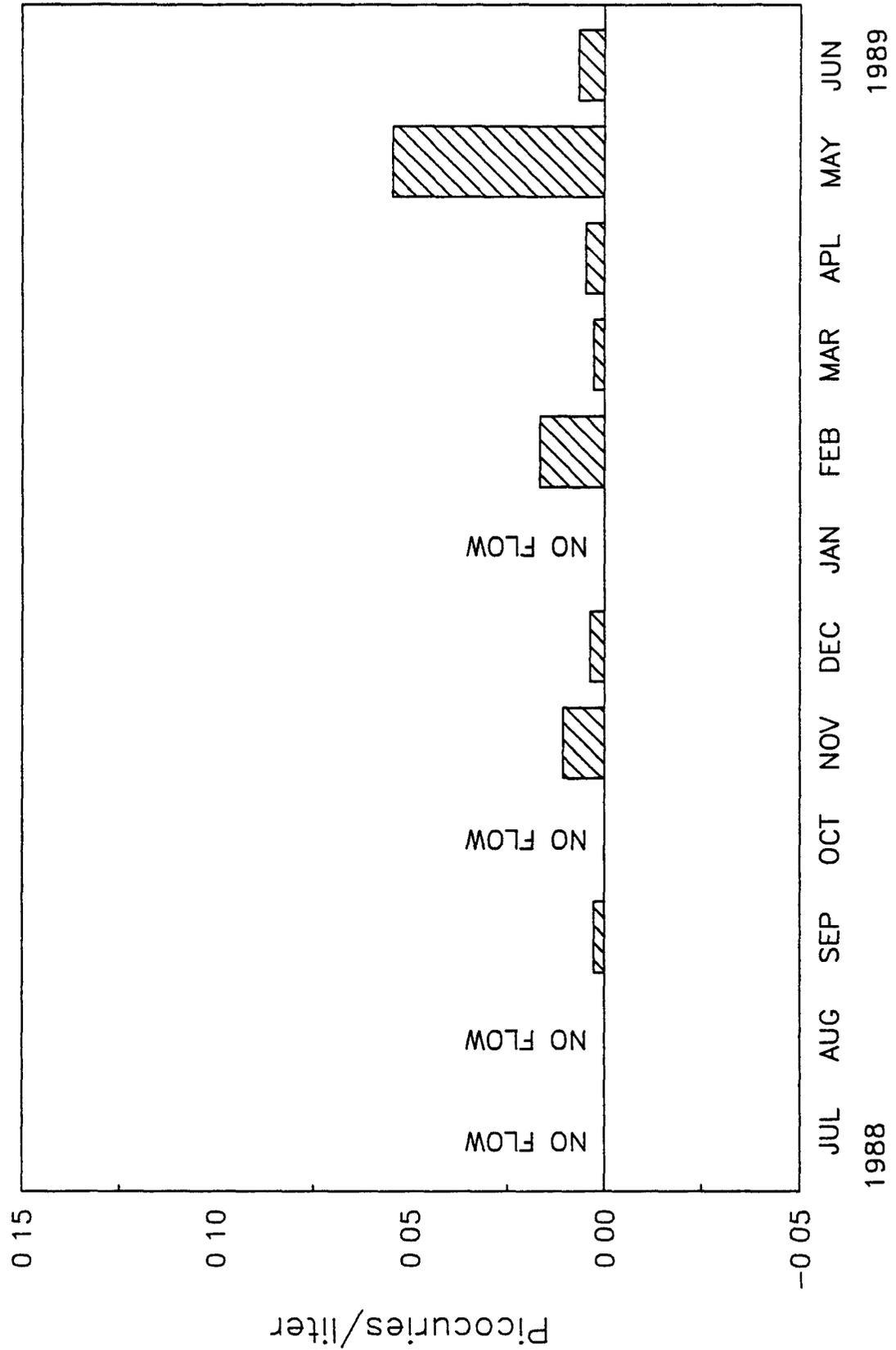


PLUTONIUM IN POND C-2 EFFLUENT WATER



26/39

PLUTONIUM IN WALNUT CREEK AT INDIANA WATER



27/39

JUNE 1989

Table VII. Offsite Water Sample Results - Plutonium, Uranium, and Americium

Reservoirs (pCi/l)

<u>Location</u>	<u>n</u>	<u>Plutonium</u>	<u>Uranium</u>	<u>Americium</u>
Great Western	1*	-0.003 ± 0.006	1.54 ± 0.15	0.003 ± 0.005
Standley Lake	1*	0.000 ± 0.006	1.66 ± 0.17	-0.002 ± 0.005

Community Tap Water (pCi/l)

<u>Location</u>	<u>n</u>	<u>Plutonium</u>	<u>Uranium</u>	<u>Americium</u>
Arvada	1	0.031 ± 0.033	**	0.026 ± 0.028
Boulder	1*	0.001 ± 0.006	-0.10 ± 0.06	0.000 ± 0.006
Broomfield	1*	-0.001 ± 0.006	0.59 ± 0.11	0.003 ± 0.005
Denver	1	**	**	**
Golden	1	**	**	**
Lafayette	1	0.004 ± 0.029	**	0.002 ± 0.025
Louisville	1	-0.011 ± 0.028	**	0.012 ± 0.027
Thornton	1	**	**	**
Westminster	1*	-0.001 ± 0.006	0.69 ± 0.11	0.002 ± 0.005

\* Plutonium, uranium and americium analyses were performed on one sample composited from four weekly grab samples.

\*\* Analyses incomplete.

28/39

JUNE 1989

Table VIII. Onsite and Offsite Water Sample Results - Tritium

Tritium (pCi/l)

<u>Location</u>	<u>n</u>	<u>C<sub>Minimum</sub></u>	<u>C<sub>Maximum</sub></u>	<u>C<sub>Average</sub></u>
Pond C-1	3	- 30 ± 350	120 ± 430	70 ± 390
Walnut Creek at Indiana	11	-100 ± 400	310 ± 410	70 ± 400
Arvada	1	200 ± 290	200 ± 290	200 ± 290
Boulder	5	-160 ± 390	110 ± 420	- 10 ± 370
Broomfield	5	-230 ± 290	180 ± 400	- 40 ± 370
Denver	1	- 90 ± 330	- 90 ± 330	- 90 ± 330
Golden	1	120 ± 330	120 ± 330	120 ± 330
Great Western	5	- 90 ± 300	100 ± 290	10 ± 370
Lafayette	1	60 ± 290	60 ± 290	60 ± 290
Louisville	1	210 ± 290	210 ± 290	210 ± 290
Standley	5	-390 ± 400	300 ± 430	10 ± 230
Thornton	1	90 ± 320	90 ± 320	90 ± 320
Westminster	5	-220 ± 420	300 ± 410	40 ± 370

29/39

JUNE 1989

Table IX. Offsite Water Sample Results - Nitrate as Nitrogen

Nitrate (as N) at Great Western Reservoir

<u>Sample Date</u>	<u>Nitrate (as N) (mg/l)</u>
06/01/89	0.02
06/09/89	0.03
06/15/89	0.02
06/22/89	0.02
06/29/89	0.03

Nitrate (as N) at Standley Lake

<u>Sample Date</u>	<u>Nitrate (as N) (mg/l)</u>
06/01/89	0.10
06/09/89	0.15
06/15/89	0.27
06/22/89	0.19
06/29/89	0.21

NOTE: For some nonradioactive parameters, the concentrations that are measured at or below the minimum detectable concentration (MDC) are assigned to MDC. The less than symbol (<) indicates MDC values and calculated values that include one or more MDC's.

JUNE 1989

Table X. NPDES Permit Water Sample Results

Discharge 001 (Pond B-3)

No Discharge

<u>Parameters</u>		<u>Measured</u> 30-Day <u>Average</u>	<u>Limits</u> 30-Day* <u>Average</u>	<u>Measured</u> Daily <u>Maximum</u>	<u>Limits</u> Daily <u>Maximum</u>
Biochem. Oxygen Demand, 5 Day	mg/l	No Discharge	10	No Discharge	25
Total Suspended Solids	mg/l		30		NA
Nitrates as N	mg/l		10		NA
Total Chromium	mg/l		0.05		0.1
Total Phosphorus	mg/l		8		NA
Oil and Grease, Visual			NA		NA
Total Residual Chlorine	mg/l		NA		0.5
Fecal Coliforms	#/100 ml		200		NA

<u>Parameter</u>		<u>Measured</u> Daily <u>Minimum</u>	<u>Limits</u> Daily <u>Minimum</u>	<u>Measured</u> Daily <u>Maximum</u>	<u>Limits</u> Daily <u>Maximum</u>
pH	S.U.	No Discharge	6.0	No Discharge	9.0

Discharge 002 (Pond A-3)

No Discharge

<u>Parameters</u>		<u>Measured</u> 30-Day <u>Average</u>	<u>Limits</u> 30-Day* <u>Average</u>	<u>Measured</u> Daily <u>Maximum</u>	<u>Limits</u> Daily <u>Maximum</u>
Nitrates as N	mg/l	No Discharge	10	No Discharge	20

<u>Parameter</u>		<u>Measured</u> Daily <u>Minimum</u>	<u>Limits</u> Daily <u>Minimum</u>	<u>Measured</u> Daily <u>Maximum</u>	<u>Limits</u> Daily <u>Maximum</u>
pH	S.U.	No Discharge	6.0	No Discharge	9.0

Discharge 003 (RO Pilot Plant)

No Discharge

<u>Parameter</u>		<u>Measured</u> Daily <u>Minimum</u>	<u>Limits</u> Daily <u>Minimum</u>	<u>Measured</u> Daily <u>Maximum</u>	<u>Limits</u> Daily <u>Maximum</u>
pH	S.U.	No Discharge	6.0	No Discharge	9.0

\* This limitation applies when a minimum of 3 consecutive samples are taken during separate weeks.

31/39

JUNE 1989

Table X. NPDES Permit Water Sample Results (Continued)

Discharge 004 (RO Plant)  
No Discharge

Parameters		<u>Measured</u>	<u>Limits</u>	<u>Measured</u>	<u>Limits</u>
		<u>30-Day</u>	<u>30-Day*</u>	<u>Daily</u>	<u>Daily</u>
		<u>Average</u>	<u>Average</u>	<u>Maximum</u>	<u>Maximum</u>
Total Suspended Solids	mg/l	No Discharge	15	No Discharge	25
Total Organic Compounds	mg/l		22		30
Total Phosphorus	mg/l		8		12
Nitrates as N	mg/l		10		20
Total Chromium	mg/l		0.05		0.1
Total Residual Chlorine	mg/l		NA		0.5
		<u>7-Day</u>	<u>7-Day</u>	<u>30-Day</u>	<u>30-Day</u>
		<u>Average</u>	<u>Average</u>	<u>Average</u>	<u>Average</u>
Fecal Coliform	#/100 ml	No Discharge	400	No Discharge	200
		<u>Daily</u>	<u>Daily</u>	<u>Daily</u>	<u>Daily</u>
		<u>Minimum</u>	<u>Minimum</u>	<u>Maximum</u>	<u>Maximum</u>
pH	S.U.	No Discharge	6.0	No Discharge	9.0

Discharge 005 (Pond A-4)  
No Discharge

<u>Parameters</u>		<u>n</u>	<u>C<sub>Minimum</sub></u>	<u>C<sub>Maximum</sub></u>	<u>C<sub>Average</sub></u>
pH	S.U.	No Discharge			
Nitrates as N	mg/l				
Nonvolatile Suspended Solids	mg/l				

Discharge 006 (Pond B-5)  
No Discharge

<u>Parameters</u>		<u>n</u>	<u>C<sub>Minimum</sub></u>	<u>C<sub>Maximum</sub></u>	<u>C<sub>Average</sub></u>
pH	S.U.	No Discharge			
Nitrates as N	mg/l				
Nonvolatile Suspended Solids	mg/l				

Discharge 007 (Pond C-2)  
No Discharge

<u>Parameters</u>		<u>n</u>	<u>C<sub>Minimum</sub></u>	<u>C<sub>Maximum</sub></u>	<u>C<sub>Average</sub></u>
pH	S.U.	No Discharge			
Nitrates as N	mg/l				
Nonvolatile Suspended Solids	mg/l				

32/39

JUNE 1989

Table XI. Water Sample Results, Nonradioactive Parameters

Walnut Creek at Indiana Street

<u>Parameters</u>		<u>n</u>	<u>C<sub>Minimum</sub></u>	<u>C<sub>Maximum</sub></u>	<u>C<sub>Average</sub></u>
pH	S.U.	11	6.8	8.3	7.4
Nitrates as N	mg/l	11	<0.02	0.61	<0.10

Total Volume (gallons) = 4,372,700

33/39

Table XII.  
 Daily Flow Data Recorded at the  
 Walnut Creek at Indiana Gaging Station  
 Ponds A-4 and B-5,  
 June, 1989

<u>DATE</u>	<u>WALNUT CREEK AT INDIANA (gallons)</u>	<u>POND A-4 (gallons)</u>	<u>POND B-5** (gallons)</u>
06/01/89	No Flow	No Discharge	No Discharge
06/02/89	2,700*	" "	" "
06/05/89	3,640,000*	" "	" "
06/06/89	575,000*	" "	" "
06/07/89	155,000*	" "	" "
06/08/89	No Flow	" "	" "
06/09/89	Low Flow	" "	" "
06/12/89	Low Flow	" "	" "
06/13/89	Low Flow	" "	" "
06/14/89	Low Flow	" "	" "
06/15/89	Low Flow	" "	" "
06/16/89	Low Flow	" "	" "
06/19/89	Low Flow	" "	" "
06/20/89	Low Flow	" "	" "
06/21/89	No Flow	" "	" "
06/22/89	" "	" "	" "
06/23/89	" "	" "	" "
06/26/89	" "	" "	" "
06/27/89	" "	" "	" "
06/28/89	" "	" "	" "
06/29/89	" "	" "	" "
06/30/89	" "	" "	" "
<b>TOTAL VOLUME</b>	<b>4,372,700</b>	<b>No Discharge</b>	<b>No Discharge</b>

\* Precipitation runoff

\*\* Low Flow through flumes, samples collected. Not enough flow to activate sensor flow totalizer, therefore no flow quantification possible.

34/39

Table XIII.  
 Daily Flow Data Recorded at  
 Ponds C-1 and C-2 During  
 JUNE, 1989

(WOMAN CREEK)

<u>DATE</u>	<u>POND C-1 (gallons)</u>	<u>POND C-2 (gallons)</u>
06/01/89	126,000	No Discharge
06/02/89	124,000	" "
06/05/89	970,000	" "
06/06/89	162,000	" "
06/07/89	56,000	" "
06/08/89	12,000	" "
06/09/89	4,000	" "
06/12/89	122,000	" "
06/13/89	2,000	" "
06/14/89	2,000	" "
06/15/89	**	" "
06/16/89	**	" "
06/19/89	**	" "
06/21/89	**	" "
06/22/89	**	" "
06/23/89	**	" "
06/26/89	**	" "
06/27/89	**	" "
06/28/89	**	" "
06/29/89	**	" "
06/30/89	**	" "
TOTAL VOLUME	Not available	No Discharge

\*\* Flow meter operation in process of evaluation.

35/8

# Appendix

## RADIATION STANDARDS FOR PROTECTION OF THE PUBLIC

### Introduction

The primary standards for protection of the public from radiation are based on radiation dose. Radiation dose is a means of quantifying the biological damage or risk of ionizing radiation. The unit of radiation dose is the rem or the millirem (1 rem = 1,000 mrem). Radiation protection standards for the public are annual standards, based on the projected radiation dose from a year's exposure to or intake of radioactive materials.

Radiation dose is a calculated value. It is calculated by multiplying radioactivity concentrations in air and water or on contaminated surfaces by assumed intake rates (for internal exposures) or exposure times (for external exposure to penetrating radiation), then by the appropriate radiation dose conversion factors. That is:

$$\begin{aligned} \text{RADIATION DOSE} = & \\ (\text{RADIOACTIVITY CONCENTRATION}) \times & \\ (\text{INTAKE RATE/EXPOSURE TIME}) \times & \\ (\text{DOSE CONVERSION FACTOR}) & \end{aligned}$$

The radioactivity concentrations can be determined either by measurements in the environment or by calculations using computer models. These computer models perform airborne dispersion/dose modeling of measured

building radioactivity effluents and estimated diffuse source term emissions (e.g., from resuspension from contaminated soil areas).

The assumed intake rates and dose conversion factors used are based on recommendations of national and international radiation protection advisory organizations, such as the National Council of Radiation Protection and Measurements (NCRP) and the International Commission on Radiological Protection (ICRP).

The radioactive materials of importance in calculating radiation dose to the public from Rocky Flats Plant activities include plutonium, uranium, americium, and tritium. The alpha radiation emissions from the plutonium, uranium, and americium are the primary contributors to the projected radiation dose.

Potential public radiation dose commitments, which could have resulted from Plant operations and from background (i.e., non-Plant) contributions, are calculated from average radionuclide concentrations measured at the Department of Energy (DOE) property boundary and in surrounding communities. Inhalation and water ingestion are the principal potential pathways of human exposure.

36/39

**Calculation of Potential Plant Contribution to Public Radiation Dose**

Pending final revision of its DOE Order for radiation protection standards for the public, DOE adopted an interim radiation protection standard for DOE environmental activities to be implemented in CY1985 (Va85). This interim standard incorporates guidance from the National Council on Radiation Protection and Measurements (NCRP), as well as the Environmental Protection Agency Clean Air Act air emission standards (as implemented in 40 CFR 61, Subpart H). Included in the interim standard is a revision of the dose

limits for members of the public. Tables of radiation dose conversion factors currently used for calculating dose from intakes of radioactive materials were issued in July 1988 (US88a, US88b). The dose factors are based on the International Commission on Radiological Protection (ICRP) Publications 30 and 48 methodology and biological models for radiation dosimetry. The DOE interim standard and the dose conversion factor tables are used for assessment of any potential Rocky Flats Plant contribution to public radiation dose. The DOE radiation standards for protection of the public are given below.

**DOE RADIATION PROTECTION  
STANDARDS FOR THE PUBLIC**

**ICRP-, NCRP- RECOMMENDED STANDARDS FOR ALL PATHWAYS.**

OCCASIONAL EXPOSURES -	500 mrem/year EFFECTIVE DOSE EQUIVALENT*
PROLONGED EXPOSURES - (>5 YEARS)	100 mrem/year EFFECTIVE DOSE EQUIVALENT
INDIVIDUAL ORGAN -	5,000 mrem/year DOSE EQUIVALENT

**EPA CLEAN AIR ACT STANDARDS FOR THE AIR PATHWAY ONLY:**

WHOLE BODY -	25 mrem/year DOSE EQUIVALENT
ANY ORGAN -	75 mrem/year DOSE EQUIVALENT

Secondary radioactivity concentration guides can be calculated from the primary radiation dose standards and used as comparison values for measured radioactivity concentrations. DOE provided guidance for calculating these concentration guides - called "Derived Concentration Guides" - in a 1985 memorandum to its facilities (St85). Derived Concentration Guides (DCGs) are the concentrations which would result in an effective dose equivalent of 100 mrem from one year's chronic exposure or intake. In calculating air inhalation DCGs, DOE assumes that the exposed individual inhales 8,400 cubic meters of air at the calculated DCG during the year. Ingestion DCGs assume a water intake of 730 liters at the calculated DCG for the year. The following table lists the air and water DCGs for the principal radionuclides of interest at the Rocky Flats Plant.

To determine compliance with the EPA air emissions standards, measured airborne effluent radioactivity emissions and estimated radioactivity resuspension from soil are entered into the EPA-approved atmospheric dispersion/dose calculation computer model, AIRDOS-EPA, for calculation of the maximum radiation dose that an individual in the public could receive from the air pathway only.

For comparison with the annual radiation dose standards for protection of the public, the maximum annual effective dose equivalent that a member of the public could receive as a result of Rocky Flats Plant activities is typically less than 1 mrem, or less than 1 percent of the recommended annual standard for all pathways.

**DOE DERIVED CONCENTRATION GUIDES FOR RADIONUCLIDES OF INTEREST AT THE ROCKY FLATS PLANT**

**AIR INHALATION:**

<u>Radionuclide</u>	<u>DCG (pCi/m<sup>3</sup>)</u>
Pu-239, -240	0.02

**WATER INGESTION:**

<u>Radionuclide</u>	<u>DCG (pCi/l)</u>
Pu-239, -240	30
Am-241	30
U-233, -234, -238	500
H-3	2,000,000

78/39

## References

- US88a DOE/EH-0070, "External Dose-Rate Conversion Factors for Calculation of Dose to the Public," U S Dept. of Energy, Asst. Secretary for Environment, Safety and Health, Office of Environmental Guidance and Compliance, July 1988
- US88b DOE/EH-0071, "Internal Dose Conversion Factors for Calculation of Dose to the Public," U S Dept of Energy, Asst. Secretary for Environment, Safety and Health, July 1988
- Va85 Vaughan, W A., Asst. Secretary, "Radiation Standards for Protection of the Public in the Vicinity of DOE Facilities," DOE memorandum from Environment, Safety and Health, August 5, 1985.
- St86 Stern, R. J., Director, "Preparation of Annual Site Environmental Reports for Calendar Year 1985," DOE memorandum, Office of Environmental Guidance, February 28, 1986

**\*NOTE:** "Dose equivalent" is a calculated value used to quantify radiation dose; it reflects the degree of biological effect from ionizing radiation. Differences in the biological effect of different types of ionizing radiation (e g , alpha, beta, gamma, or x-rays) are accounted for in the calculation of dose equivalent

"Effective dose equivalent" is a calculated value used to allow comparisons of total health risk (based primarily on the risk of cancer

mortality) from exposures of different types of ionizing radiation to different body organs. It is calculated by first calculating the dose equivalent to those organs receiving significant exposures, multiplying each organ dose equivalent by a health risk weighting factor, and then summing those products. One millirem effective dose equivalent from natural background radiation would have the same health risk as one millirem effective dose equivalent from artificially-produced sources of radiation.