SCENARIO H

An Acute Release of ^{131}I
from the
Hanford Purex Chemical Separations Plant Stack

ABSTRACT

The Hanford Scenario is based on an inadvertent acute release of ^{131}I to the environment from the Hanford (Washington) Purex Chemical Separations Plant stack that occurred on September 2-5, 1963. Monitoring data from nine counties in the northwestern United States, collected over the two-month period following the release, are provided for model testing. Pathways contributing to dose are primarily through the air and terrestrial environments. Input data include analysis of stack effluents, daily air sampling measurements, meteorological observations, and activity measurements of vegetation and milk. A limited set of test data is available for comparison with model predictions; these data include time-integrated ^{131}I concentrations in vegetation and milk at 6 locations, concentrations of ^{131}I in milk at two dairies at two time points, and thyroid burdens for two children. In addition, input information can be used for modeling atmospheric transport from the Purex Plant; concentrations of ^{131}I dispersed in air, deposited on vegetation, and measured in milk over the test area; and doses to individuals (real or reference) from different pathways of exposure. A detailed description of the Hanford Scenario is provided along with tables of input data and test data.

INTRODUCTION

An acute release of ^{131}I from the stack of the Hanford (Washington) Purex Chemical Separations Plant occurred September 2-5, 1963 (Soldat, 1965). This release resulted from the inadvertent charging of short-aged fuel elements into a dissolver of the Purex Separation Plant. Plant operations were shut down as soon as the abnormal release was detected. Steps were immediately taken to retain as much of the ^{131}I as possible within the plant. Laboratory analyses of stack effluent samples were made, and the normal program of routine environmental surveillance was augmented with additional sampling. Measurements of wind velocity and temperature were routinely made at the site meteorology tower.

The Hanford Scenario, "Scenario H," was developed from data originally collected following the release in 1963 and further evaluated as part of the Hanford Environmental Dose Reconstruction (HEDR) project in the 1990s. The scenario was originally prepared during the VAMP (Validation of Environmental Model Predictions) program of the International Atomic Energy Agency and was eventually used as the initial test exercise carried out by the Dose Reconstruction Working Group of BIOMASS (Biosphere Modelling and Assessment Methods) Theme 2: Environmental Releases (BIOMASS, 1999). Scenario H provides an opportunity to

gain insights into dose reconstruction efforts, radiological assessments for other sites involving ^{131}I, and assessments focusing on atmospheric dispersion and deposition of chemicals in general.

Although model predictions can be tested against existing data with this scenario, the available measurements are not ideally suited for model testing purposes. Either the data are not entirely representative of the locations or the sample sets are incomplete. In addition, the available measurements do not always include the time periods in which the peak concentrations probably occurred. The scenario is representative of an actual dose reconstruction, however, in that the existing data, whatever their limitations, are available for use in calculations or in calibration of models. In most cases, data are provided in the original units in which the measurements were recorded. Conversions to S.I. units, or the S.I. conversion factors, are provided throughout.

BACKGROUND

The Hanford Site is located in a rural, semiarid region of southeastern Washington State in the U.S. and occupies an area of about 1450 km^2. The Site lies about 320 km northeast of Portland, Oregon, 270 km southeast of Seattle, Washington, and 200 km southwest of Spokane, Washington. The semiarid land on which the Hanford Site is located has a sparse covering of desert shrubs and drought-resistant grasses. The most broadly distributed type of vegetation on the Site is the sagebrush/cheat grass/bluegrass community. Most abundant of the mammals is the Great Basin pocket mouse. Of the big-game animals, the mule deer is most widely found, while the cottontail rabbit is the most abundant small game animal. Coyotes are also plentiful. The bald eagle is a regular winter visitor to the area along the Columbia River.

The terrain of the central and eastern parts of the Hanford Site is relatively flat (Fig. 1). The northern and western parts of the Site have moderate to steep topographic ridges composed of basalt and sediments. The elevations of the alluvial plain that covers much of the Site vary from 105 m (345 ft) above mean sea level in the southeast corner to 245 m (803 ft) in the northwest. The central plateau of the Site varies in elevation from 190 to 245 m (623 to 803 ft). The highest point is on Rattlesnake Mountain (1093 m or 3585 ft) at the southwestern border of the Site.

The Columbia River, which originates in the mountains of eastern British Columbia, Canada, flows through the Hanford Site, forming part of the site's northern and eastern boundaries. Land surrounding the Hanford Site is used primarily for agriculture and livestock grazing. Agricultural lands are found north and east of the Columbia River and south of the Yakima River. These areas contain orchards, vineyards, and fields of alfalfa, wheat, and vegetables. The Hanford Site north of the Columbia River contains both a state wildlife management area and a federal wildlife refuge. The northeast slope of the Rattlesnake Hills along the southwestern boundary of the Site is designated as the Arid Lands Ecology Reserve and is used for ecological research.

The population in the area surrounding the Site is rural, with the exception of the area near the southeast boundary where the cities of Richland, Pasco, and Kennewick are located. Smaller communities in the vicinity are Benton City, West Richland, Mesa, and Othello. Altogether about 80,000 people lived in the vicinity of the Site at the time of the release.

The prevailing regional winds are from the northwest, with occasional cold-air drainage into valleys and strong crosswinds. The region is a typical desert basin, where frequent strong

temperature inversions occur at night and break during the day, resulting in unstable and turbulent wind conditions.

Increased vegetation sampling was begun on September 2, 1963, and continued for the next week. Leafy sagebrush (*Artemisia tridentata*, approximately 40% moisture) was collected whenever possible at on-site locations. A few samples consisted of leafy weeds, cheat grass (*Bromus tectorum*), and in one case, bare sage stems (20% moisture) where a fire had previously destroyed the normal vegetation growth. Off-site vegetation samples consisted of pasture grass samples (approximately 80% moisture) from local dairy farms and native vegetation (leafy weeds, approximately 40% moisture) along highways and at the permanent atmospheric monitoring stations. Sampling of grass and milk was extended up to 100 km southeast of the release point. The maximum off-site vegetation contamination of 0.5 Bq g^{-1} was measured on a sample of green hay from a farm 32 km SSE of the release point where no cattle were being grazed. Maximum on-site vegetation contamination was found within 3 km of the stack.

Twenty-two permanent atmospheric monitoring stations were maintained on the Hanford site. These permanent air sampling stations were supplemented with other samples during September 1963. The concentrations provided in the scenario are daily values which were averaged (divided) evenly over the varying sampling periods.

Routine milk collection in 1963 included daily to weekly samples from seven local dairy farms, two milk-shed composites twice per month, and three commercial brands of milk twice per month. Spot sampling at several other dairy farms brought the total number of farms where milk and grass were sampled up to fifteen during the month of September 1963. The Twin City Dairy processed milk from both the east and the south of the test region, and Darigold Creamery processed milk from the east of the region.

INPUT INFORMATION

Source Term Information

An acute, inadvertent release of ^{131}I from the stack of a nuclear chemical separations plant occurred beginning September 2, 1963. The Purex stack is located at 46.549 north latitude and 119.517 west longitude, near the center of the 1450-km^2 Hanford Site. The stack height is 60.5 m, and the stack radius 1.067 m. The stack flow was 56.63 m^3 s^{-1}, and the effluent temperature was approximately 25°C. Laboratory analyses of stack effluent samples during September 1963 are provided in Table 1. No protective measures were taken following the release. No atmospheric nuclear test explosions occurred in the several months period prior to this event. Routine atmospheric releases of ^{131}I from the Purex Plant prior to and following this event were of the order of 4×10^9 Bq per month (0.1 Ci per month), or less.

Chemical Forms of Iodine

The iodine released from the Hanford stack was essentially 100% molecular (I_2). It is believed that the iodine quickly partitioned into particulate, reactive gaseous, and organic phases. Equilibrium partitioning between these phases is assumed to be approximately 25% particulate (5-25%), 40% reactive gas (20-60%), and the rest organic (Ramsdell et al., 1994).

Meteorological Data

No significant rainfall occurred in the region in the few weeks following the release. Tabular data of hourly meteorological observations taken at the Hanford Meteorological Station (HMS; see Fig. 2) for September 2-5 are provided in Tables 2-3. Measurements in Table 2 are 1-hour averages; times are assigned to the end of the hour.

Additional data from other nearby stations for September 1963 are provided in electronic form in the attached workbook SEP63MET.xls. A list of the stations with their locations and measuring heights is provided in Table 4, together with an explanation of the information provided in the workbook. Data in the workbook are provided with and without column headings (separate spreadsheets in the Excel workbook). All meteorological data (Table 3 and the spreadsheet) are hourly observations. The observations were taken at the start of each hour and represent the conditions at that time. Wind speeds and directions, temperatures, and other data recorded represent the conditions at that time only, not an hourly average. SEP63Met.xls

MEASUREMENTS OF ^{131}I IN THE ENVIRONMENT

Measurements of ^{131}I in samples of air, vegetation, and milk were obtained in the area surrounding the Hanford site. Geographical positions (latitude and longitude) of all sampling locations are provided in Table 5, along with the codes to the locations listed in subsequent tables. Some of the sampling sites are also shown in Fig. 2. Farm A was the regular Hanford milk monitoring location and had the longest and most continuous sampling through the period of concern. Farm B turned out to have the highest ^{131}I concentrations measured, but this was not discovered until after the first week following the release.

Air Samples

Twenty-two permanent atmospheric monitoring stations were maintained in the Hanford environs. Equipment installed in these stations included an HV-70 brand filter and a caustic scrubber in series. These permanent air sampling stations were supplemented by several temporary caustic scrubber and charcoal cartridge samplers during September 1963. The concentrations provided in Table 6 are daily values obtained by averaging the result (dividing) evenly over the varying sampling periods, with no decay correction. The particulate filter was about 99.8% efficient for 3-μm particles. The caustic solution was reported to capture "most" of the elemental iodine, but it would have been inefficient with organic forms.

For the air sampling measurements (Table 6), locations are given notations such as 100 BSE or 200 EWC. These notations refer to positions at the Hanford Site operating areas, in these examples the 100 B and 200 E Areas. These operating areas are shown in Fig. 2. The additional designation refers to locations along the outer fence of these areas: e.g., ‘100 BSE’ means that the sampler was located at the eastern end of the southern fence of the 100 B Area, while ‘200 EWC’ indicates that the sampler was located at the center of the western fence of the 200 E Area. For areas without this type of notation, the sampler can be considered to be near the center of the designated area.

Vegetation Samples

Increased vegetation sampling was begun on September 2, 1963, and continued for the next week. Sampling of grass and milk was extended up to 100 km southeast of the release point. The maximum off-site activity concentration in vegetation (13 pCi g^{-1}) was measured in a sample of green hay from a farm 32 km SSE of the release point where no cattle were being grazed. Maximum on-site vegetation contamination was found within 3 km of the stack.

The values provided in Table 7 are those historically recorded (with the units updated to modern S.I. usage). The measurements were made and a counting room background subtracted before the results were recorded. In some instances, this results in a negative value being recorded. This indicates that the value was below the detection level of the instrumentation at the time. That lower limit is not known.

Milk Samples

Routine milk collection in 1963 included daily to weekly samples from seven local dairy farms, two milk shed composites twice per month, and three commercial brands of milk twice per month. Spot sampling at several other dairy farms brought the total number of farms where milk and grass were sampled up to fifteen during the month of September 1963. Milk measurement data are provided in Table 8.

Darigold Creamery (located in Kennewick) processed milk from the east of the Hanford Site; the Twin City Dairy (located in Pasco) processed milk from both the east and the south of the Hanford Site. The general area of each creamery's collection is represented in Fig. 2 of this report: Darigold by the area roughly bounded by Ringold, Eltopia, Pasco, and Riverview; and Twin City by the same area plus the area south of the Yakima River between Kiona and Kennewick in a band no more than 5 km wide.

Additional Data

Daily consumption rates of leafy green vegetables and fresh milk are provided in Table 9. Regional agricultural information is provided in Tables 10-20. The agricultural information is taken from "1963 United States Census of Agriculture," Volume 1, Part 46--Washington, U.S. Department of Commerce, Bureau of the Census. This information is not specific to eastern Washington state, but it is included to provide a modeler with a general idea of the nature of agricultural practices at the time of the release. Note that although sagebrush samples are included among the vegetation samples, sagebrush is not eaten by cattle. Normal agricultural practice in eastern Washington is one cutting of grass hay per year and three cuttings of alfalfa hay.

TEST DATA AVAILABLE

(1) Time-integrated concentrations of ^{131}I in pasture grass (Bq d kg^{-1} fresh weight) for the month of September 1963 for 6 locations (Table 21).

(2) Time-integrated concentrations of ^{131}I in milk (Bq d L^{-1}) for the month of September 1963 at 6 locations (Table 22).

(3) Concentrations of ^{131}I in composite milk samples taken from the Twin City Dairy and the Darigold Creamery on September 16 and 26 (Table 23).

(4) Measured thyroid burdens of ^{131}I on October 19, 1963, for a four-year-old boy and his eight-year-old sister, who were residents of Farm B (located 25 km SSE of the point of release). This was the location of the maximum off-site exposure. Milk was obtained from a single cow maintained on the farm for the sole use of the owner's family. Milk consumption estimated by the parents was 1 gallon per day (4 L d^{-1}) for the boy and one quart per day (1 L d^{-1}) for the girl (Table 24).

ACKNOWLEDGEMENTS

The Hanford Scenario, "Scenario H," was developed from data originally collected following the release in 1963 and further evaluated as part of the Hanford Environmental Dose Reconstruction (HEDR) project in the 1990s. The scenario was prepared by B. A. Napier of Pacific Northwest National Laboratory, Richland, Washington, U.S.A.

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TABLES OF INPUT DATA

Table 1. Hourly source term data[a].

Date	Time	^{131}I activity released	
		Ci	Bq
September 2	12:25 - 16:25	5.5	2.04×10^{11}
September 2	16:25 - 23:30	18.5	6.84×10^{11}
September 2-3	23:30 - 09:10	22.3	8.25×10^{11}
September 3	09:10 - 11:55	3.9	1.44×10^{11}
September 3	11:55 - 15:05	2.3	8.51×10^{10}
September 3	15:10 - 23:30	5.3	1.96×10^{11}
September 3	23:30 - 08:50	2.3	8.51×10^{10}
September 4	08:50 - 15:00	1.3	4.81×10^{10}
September 4-5	15:00 - 09:10	1.1	4.07×10^{10}
September 5	09:10 - 14:45	0.21	7.77×10^{9}
September 5-6	14:45 - 00:30	0.16	5.92×10^{9}
September 6	00:30 - 09:00	0.18	6.66×10^{9}
September 6	09:00 - 14:25	0.095	3.52×10^{9}
September 6-7	14:25 - 09:00	0.23	8.51×10^{9}
September 7	09:00 - 15:20	0.11	4.07×10^{9}
September 7-8	15:20 - 14:00	0.37	1.37×10^{10}
September 8-9	14:00 - 09:00	0.29	1.07×10^{10}
September 9 - 10	09:00 - 09:15	0.36	1.33×10^{10}
September 10 - 11	09:15 - 09:00	0.35	1.30×10^{10}
to September 30		7 – 2	2.59×10^{11}
TOTAL[b]		72 – 2	2.33×10^{12}

[a] Hourly data from handwritten record by J.K. Soldat.

[b] Monthly total (72 Ci) from HW-76525 9, p. 3, calculated as monthly average of 2.4 Ci d^{-1} times 30 d. This reference also gives a daily average for the 12 months prior to the event of 0.36 Ci d^{-1} (1.3×10^{10} Bq d^{-1}), essentially the same as that seen following the return to routine operations in the latter part of the month.

Table 2. Meteorological data for September 2-5, 1963: surface observations made at the Hanford Meteorological Station (HMS)[a].

Day and hour	Sea level pressure (millibars)[b]	Dew point (^{o}F)[c]	Wind direction	Wind speed (mph)[d]	Pressure (in Hg)[e]	Dry bulb temperature (^{o}F)[c]	Wet bulb temperature (^{o}F)[c]	Relative humidity (%)	Solar radiation (langleys)[f]
September 2									
1 am	134	47	WNW	9	29.17	64	55	54	0
2 am	136	46	WSW	11	29.17	64	54	51	0
3 am	142	46	WSW	10	29.19	61	53	57	0
4 am	146	46	W	8	29.20	61	53	58	0
5 am	149	49	WNW	10	29.21	63	55	60	3
6 am	156	48	WNW	6	29.23	63	55	59	24
7 am	160	48	W	5	29.24	63	55	52	50
8 am	163	50	NW	7	29.25	71	59	47	76
9 am	165	50	NE	7	29.25	74	60	43	97
10 am	167	49	E	3	29.26	76	60	39	104
11 am	163	49	NNE	6	29.25	78	61	36	126
12 pm	160	48	NNW	8	29.24	81	61	32	123
1 pm	156	47	NNE	3	29.23	82	61	29	112
2 pm	153	47	NE	6	29.22	83	62	29	96
3 pm	149	47	SE	2	29.21	83	62	28	67
4 pm	145	46	S	1	29.20	83	61	27	46
5 pm	145	46	NNW	1	29.20	83	61	27	20
6 pm	145	46	ESE	7	29.20	81	61	29	2
7 pm	147	46	SE	3	29.20	76	59	34	0
8 pm	155	45	ESE	10	29.22	73	57	37	0
9 pm	157	44	NW	9	29.23	70	56	40	0
10 pm	164	46	NW	7	29.25	68	56	45	0
11 pm	164	46	W	9	29.25	65	54	50	0
12 am	166	47	WNW	8	29.26	64	55	54	0

Table 2 (continued)

Day and hour	Sea level pressure (millibars)[b]	Dew point (°F)[c]	Wind direction	Wind speed (mph)[d]	Pressure (in Hg)[e]	Dry bulb temperature (°F)[c]	Wet bulb temperature (°F)[c]	Relative humidity (%)	Solar radiation (langleys)[f]
September 3									
1 am	166	48	WNW	7	29.26	64	55	56	0
2 am	170	48	NW	7	29.27	61	54	61	0
3 am	173	44	SSW	2	29.28	58	51	59	0
4 am	177	42	SSE	3	29.28	56	49	60	0
5 am	180	41	SSW	5	29.29	55	48	59	4
6 am	187	43	SSW	5	29.31	59	51	56	24
7 am	188	49	NW	4	29.32	65	56	57	50
8 am	187	50	NW	6	29.32	69	58	51	73
9 am	190	50	NNE	1	29.33	73	59	45	92
10 am	190	50	NNW	4	29.32	76	60	40	108
11 am	186	50	NNW	5	29.31	79	62	36	116
12 pm	179	47	SSE	2	29.29	82	61	29	114
1 pm	176	47	ENE	6	29.28	83	61	28	106
2 pm	169	45	N	4	29.26	86	62	24	92
3 pm	161	43	E	5	29.24	87	62	22	72
4 pm	152	44	NNE	4	29.22	87	62	22	47
5 pm	148	42	SE	4	29.21	87	61	21	20
6 pm	147	41	NNE	3	29.20	84	60	23	2
7 pm	144	40	NNW	4	29.20	78	57	26	0
8 pm	144	40	NW	8	29.20	74	56	30	0
9 pm	147	39	NW	6	29.20	69	53	33	0
10 pm	145	39	W	6	29.20	69	53	33	0
11 pm	148	39	WSW	9	29.20	69	53	33	0
12 am	145	39	WNW	8	29.20	66	52	36	0

Table 2 (continued)

Day and hour	Sea level pressure (millibars)[b]	Dew point (°F)[c]	Wind direction	Wind speed (mph)[d]	Pressure (in Hg)[e]	Dry bulb temperature (°F)[c]	Wet bulb temperature (°F)[c]	Relative humidity (%)	Solar radiation (langleys)[f]
September 4									
1 am	145	40	W	8	29.20	67	53	37	0
2 am	144	39	W	8	29.19	66	52	37	0
3 am	141	40	W	8	29.19	66	52	38	0
4 am	136	40	WNW	10	29.18	67	53	37	0
5 am	135	39	W	9	29.17	66	52	37	3
6 am	137	41	NW	3	29.18	64	52	43	24
7 am	141	44	NW	11	29.18	68	55	41	50
8 am	141	44	WNW	4	29.18	74	57	34	72
9 am	141	45	NW	10	29.18	79	59	30	92
10 am	135	42	NNW	7	29.17	82	61	29	108
11 am	128	47	N	6	29.15	84	62	27	114
12 pm	122	47	NNW	5	29.13	86	62	25	114
1 pm	110	44	NW	2	29.10	89	63	21	106
2 pm	102	46	E	2	29.08	93	65	20	90
3 pm	94	45	E	0	29.06	94	65	19	67
4 pm	88	45	ESE	2	29.04	93	64	19	42
5 pm	84	45	SSE	5	29.02	93	64	19	16
6 pm	83	44	ESE	4	29.02	89	63	21	1
7 pm	84	43	SE	2	29.02	81	59	26	0
8 pm	86	43	SSE	10	29.03	80	59	27	0
9 pm	90	41	NW	7	29.04	73	56	31	0
10 pm	92	44	WNW	7	29.05	76	58	33	0
11 pm	91	51	WNW	8	29.05	76	61	42	0
12 am	93	53	WNW	15	29.05	77	62	43	0

Table 2 (continued)

Day and hour	Sea level pressure (millibars)[b]	Dew point (^oF)[c]	Wind direction	Wind speed (mph)[d]	Pressure (in Hg)[e]	Dry bulb temperature (^oF)[c]	Wet bulb temperature (^oF)[c]	Relative humidity (%)	Solar radiation (langleys)[f]
September 5									
1 am	95	53	WNW	13	29.06	76	62	46	0
2 am	98	53	WNW	16	29.07	75	62	46	0
3 am	105	53	NW	6	29.09	71	61	52	0
4 am	104	54	WNW	11	29.08	72	61	53	0
5 am	105	53	W	9	29.09	69	59	56	4
6 am	108	53	W	6	29.09	70	60	56	21
7 am	110	54	NW	7	29.10	75	62	48	47
8 am	114	54	NW	5	29.10	78	63	42	74
9 am	114	53	W	0	29.10	82	63	37	94
10 am	108	52	WSW	1	29.09	84	64	33	109
11 am	98	50	WSW	4	29.07	88	65	28	114
12 pm	97	49	SSW	4	29.06	90	64	24	114
1 pm	91	47	W	5	29.05	93	65	21	104
2 pm	85	50	ESE	4	29.03	95	67	22	90
3 pm	77	49	ENE	3	29.01	95	67	21	68
4 pm	74	48	NE	6	29.00	95	66	20	42
5 pm	69	48	SE	6	28.98	93	66	22	16
6 pm	69	45	SE	5	28.98	90	63	21	2
7 pm	74	44	SE	8	28.99	84	61	25	0
8 pm	84	47	WNW	16	29.03	82	61	29	0
9 pm	88	48	NW	18	29.04	80	61	32	0
10 pm	93	49	NW	14	29.05	78	61	36	0
11 pm	98	47	NW	6	29.07	75	59	36	0
12 am	102	46	NW	11	29.08	74	58	38	0

[a] Measurements are 1-hour averages. Times are assigned to the end of the hour.
[b] 1 millibar = 100 Pa
[c] $T(°C) = [T(°F) — 32]/1.8$
[d] 1 mile per hour (mph) = 1.609 km h^{-1} or 0.4470 m s^{-1}
[e] 1 in Hg (32°F) = 3386.38 Pa; 1 in Hg (60°F) = 3376.85 Pa
[f] 1 langley = 41840.00 J m^{-2}

Table 3. Meteorological data for September 2-5, 1963: HMS tower observations of temperature and wind.

Day/ hour	Subsurface temperature (°F)[a]			Air temperature (°F)[a]							Wind speed (mph)[c]						Wind direction (10s of degrees)		
	Depth (in)[b]			Tower height (ft)[b]							Tower height (ft)[d]						Tower height (ft)[d]		
Sept. 2	-0.5	-15	-36	3	50	100	200	250	300	400	7	50	100	200	300	400	50	200	400
1 am	69.5	-	-	65.0	66.1	65.9	66.6	66.5	66.3	66.0	7	11	13	16	17	19	29	29	29
2 am	68.6	-	-	66.3	66.7	66.5	66.8	66.8	66.7	66.6	9	13	15	19	21	24	27	29	29
3 am	68.0	-	-	60.5	62.0	63.8	66.5	66.7	66.6	66.2	5	10	12	15	15	16	25	27	27
4 am	66.9	-	-	62.6	63.5	64.0	65.3	65.2	65.0	64.8	5	9	12	13	13	15	27	27	27
5 am	66.0	80.4	77.0	62.9	64.3	64.4	64.6	64.5	64.2	63.9	6	9	11	13	15	17	27	29	29
6 am	65.8	-	-	61.5	63.5	63.9	64.5	64.2	64.0	63.9	4	8	10	14	14	16	27	29	29
7 am	65.8	-	-	62.7	63.5	64.0	65.0	65.0	64.5	64.5	2	3	5	8	7	8	27	29	29
8 am	70.0	-	-	68.4	68.0	66.9	66.5	66.2	65.9	65.9	5	6	6	7	7	8	29	32	29
9 am	78.8	-	-	73.0	71.0	69.5	69.3	69.2	68.9	68.2	6	6	7	8	8	8	34	34	34
10 am	88.0	-	-	74.0	73.0	71.2	71.8	70.6	70.6	70.7	4	5	6	6	6	6	34	36	34
11 am	93.0	80.0	77.2	78.1	75.2	74.1	73.9	72.9	72.1	72.4	4	4	4	4	3	3	37	37	37
12 pm	100.0	-	-	78.2	77.1	76.5	76.2	75.5	75.8	76.1	4	4	4	4	4	3	37	37	37
1 pm	106.4	-	-	80.7	79.0	78.1	77.6	77.1	77.3	77.4	6	7	7	7	6	6	37	36	36
2 pm	110.0	-	-	83.0	80.4	78.9	78.5	78.6	78.4	78.5	5	5	6	5	5	4	36	36	34
3 pm	111.4	-	-	83.0	82.0	80.5	80.5	79.9	80.2	80.1	3	3	3	3	3	3	36	2	2
4 pm	108.8	-	-	83.9	83.0	81.4	80.6	80.4	80.3	80.0	2	2	2	3	3	3	2	2	37
5 pm	103.8	79.5	77.5	83.7	82.7	82.2	81.5	81.1	81.0	81.1	2	2	2	2	2	2	37	23	37
6 pm	99.9	-	-	82.8	81.6	81.3	80.7	80.5	80.3	80.1	5	5	6	7	7	7	11	11	9
7 pm	95.5	-	-	78.4	79.1	78.8	78.8	78.3	78.2	77.9	6	6	7	7	8	9	11	14	11
8 pm	85.0	-	-	73.9	75.2	76.5	77.1	76.8	76.7	76.5	5	6	8	10	11	12	14	14	14
9 pm	80.0	-	-	70.7	74.4	76.5	76.5	76.2	76.1	76.0	4	8	10	12	12	14	16	18	16
10 pm	78.1	-	-	68.6	70.9	71.2	72.0	72.0	72.0	73.1	3	7	10	15	16	15	32	32	32
11 pm	74.0	80.0	77.2	64.2	69.4	69.8	70.7	71.5	77.1	72.4	2	7	10	16	16	15	29	32	32
12 am	71.9	-	-	65.0	68.0	68.6	69.7	69.8	70.0	70.5	3	7	11	16	16	20	29	32	32

Table 3 (continued)

Day/ hour	Subsurface temperature (°F)[a]			Air temperature (°F)[a]							Wind speed (mph)[c]						Wind direction (10s of degrees)		
	Depth (in)[b]			Tower height (ft)[b]							Tower height (ft)[d]						Tower height (ft)[d]		
Sept. 3	-0.5	-15	-36	3	50	100	200	250	300	400	7	50	100	200	300	400	50	200	400
1 am	70.0	-	-	63.0	65.9	66.4	68.0	68.4	69.8	70.5	2	6	10	15	18	17	29	32	32
2 am	68.6	-	-	61.8	65.1	65.3	66.7	67.0	67.7	69.0	2	7	10	16	17	17	32	32	32
3 am	67.7	-	-	60.3	65.0	65.2	65.8	65.7	65.9	66.9	1	4	7	10	12	14	29	32	32
4 am	66.0	-	-	55.2	62.4	63.5	64.3	64.3	64.6	64.9	2	3	2	6	9	12	20	29	29
5 am	64.2	80.0	77.1	54.3	63.7	64.0	64.6	64.3	64.3	64.3	1	1	1	2	4	6	20	29	29
6 am	62.8	-	-	54.8	61.6	61.7	63.1	63.3	63.1	63.5	1	4	3	3	5	5	20	29	29
7 am	63.0	-	-	61.0	62.3	62.5	63.5	63.9	64.0	64.1	1	3	4	5	6	7	27	27	29
8 am	68.8	-	-	66.0	65.7	64.9	64.5	64.0	64.2	64.2	5	5	5	5	5	6	32	29	29
9 am	77.0	-	-	70.3	67.8	67.2	67.5	67.5	67.1	66.3	3	3	3	3	3	3	34	34	34
10 am	88.0	-	-	74.8	71.8	72.0	71.9	71.1	70.8	70.3	2	2	2	2	2	2	34	34	36
11 am	92.8	79.8	77.0	78.1	76.2	74.9	75.1	75.0	75.1	75.1	3	3	3	3	2	2	36	36	2
12 pm	101.9	-	-	80.8	79.0	77.9	77.6	76.9	76.8	77.1	4	4	4	4	4	4	5	5	5
1 pm	107.0	-	-	84.0	82.0	80.3	80.1	79.5	79.2	79.1	4	4	4	5	5	5	5	5	5
2 pm	110.5	-	-	86.1	84.0	82.3	81.6	81.4	81.0	81.0	5	5	5	6	6	6	2	5	5
3 pm	111.2	-	-	86.7	86.3	85.0	84.0	83.4	83.9	84.0	4	4	4	5	5	5	11	11	7
4 pm	110.0	-	-	86.6	86.1	84.6	84.4	84.4	84.5	84.6	3	4	4	4	4	4	2	2	7
5 pm	106.2	79.0	77.2	87.2	86.8	85.7	85.4	84.3	84.7	84.9	3	3	3	3	4	4	7	9	9
6 pm	100.5	-	-	86.0	86.4	85.1	84.9	84.4	84.6	84.4	1	2	2	3	3	3	32	36	2
7 pm	92.5	-	-	80.9	84.1	83.5	83.6	83.2	83.0	82.7	0	2	3	3	3	3	36	36	2
8 pm	86.0	-	-	74.7	81.6	81.7	82.0	81.8	81.7	81.4	2	6	7	8	7	7	32	36	36
9 pm	80.5	-	-	71.6	80.2	80.5	81.3	80.9	80.9	80.4	2	8	7	7	6	6	32	36	36
10 pm	77.0	-	-	65.2	75.7	76.5	78.9	79.5	79.7	79.5	2	6	8	12	9	8	27	32	34
11 pm	74.2	80.0	77.2	68.8	75.0	75.5	76.8	77.5	78.2	79.0	3	7	8	11	11	10	27	29	32
12 am	72.6	-	-	68.0	73.4	76.5	76.5	76.3	77.0	78.8	3	8	9	12	12	12	27	32	32

Table 3 (continued)

Day/ hour	Subsurface temperature (°F)[a]			Air temperature (°F)[a]							Wind speed (mph)[c]						Wind direction (10s of degrees)		
	Depth (in)[b]			Tower height (ft)[b]							Tower height (ft)[d]						Tower height (ft)[d]		
Sept. 4	-0.5	-15	-36	3	50	100	200	250	300	400	7	50	100	200	300	400	50	200	400
1 am	70.3	-	-	67.2	71.7	72.2	75.0	77.0	77.8	78.0	2	7	9	15	13	12	27	32	34
2 am	69.6	-	-	67.4	72.2	72.6	73.8	74.9	76.4	76.8	3	8	10	17	15	13	27	32	32
3 am	68.6	-	-	66.3	70.0	72.1	76.4	76.5	76.8	76.7	3	9	12	17	14	12	29	32	34
4 am	68.0	-	-	66.3	70.0	70.6	72.8	74.6	75.4	76.0	3	8	10	17	15	13	27	29	32
5 am	67.6	80.1	77.3	65.4	68.2	69.0	71.4	73.8	74.2	74.6	4	9	11	18	17	15	29	29	32
6 am	66.8	-	-	65.4	68.0	68.5	69.5	69.5	69.8	71.1	2	7	8	13	16	19	29	32	32
7 am	66.6	-	-	65.4	65.9	66.2	66.0	66.1	66.3	68.2	3	5	6	10	12	17	32	32	32
8 am	70.1	-	-	70.5	70.4	68.9	68.9	69.4	69.8	69.5	5	6	6	7	6	6	32	34	34
9 am	79.0	-	-	76.6	76.0	73.4	73.2	73.4	73.1	72.5	7	8	8	9	9	8	32	32	32
10 am	86.0	-	-	81.0	78.9	77.2	77.1	76.8	76.4	76.1	6	8	8	9	9	9	32	32	32
11 am	93.6	79.8	77.6	83.1	81.1	80.0	79.4	78.9	78.8	78.7	3	4	4	5	5	5	34	34	34
12 pm	102.1	-	-	85.3	83.3	82.6	82.5	81.9	82.0	82.0	3	3	3	3	3	3	2	36	36
1 pm	110.0	-	-	90.0	87.7	86.2	86.6	85.7	85.8	85.8	3	3	3	3	3	3	5	5	2
2 pm	114.0	-	-	90.9	90.1	88.7	88.9	88.4	88.5	88.6	3	3	3	3	3	2	23	25	27
3 pm	115.8	-	-	92.0	92.1	90.9	90.7	89.5	89.4	89.9	3	3	3	4	3	3	16	16	16
4 pm	114.2	-	-	94.3	93.7	92.3	91.8	91.1	91.6	92.1	3	3	3	4	3	3	14	14	14
5 pm	110.0	79.0	77.0	93.0	93.2	91.7	92.2	91.4	91.3	91.6	5	5	5	6	6	6	14	14	14
6 pm	103.8	-	-	91.6	92.3	91.3	91.2	90.7	90.5	90.4	5	5	6	6	6	6	14	14	14
7 pm	95.9	-	-	85.4	88.6	88.2	88.3	88.0	87.9	87.5	3	7	7	7	7	7	11	14	14
8 pm	89.0	-	-	80.4	86.1	87.4	87.5	87.3	87.5	87.5	4	9	9	9	7	6	14	14	14
9 pm	84.3	-	-	75.1	82.0	84.1	85.7	85.5	85.7	86.5	2	6	7	8	8	8	20	18	16
10 pm	80.3	-	-	75.8	82.1	83.0	84.0	83.6	84.1	84.7	2	7	9	12	13	13	29	32	32
11 pm	78.5	80.0	78.5	77.4	79.8	80.5	82.2	82.3	82.3	82.3	4	10	12	16	18	20	29	29	29
12 am	77.2	-	-	75.8	78.7	78.7	78.8	78.8	78.9	79.1	5	10	12	15	17	21	29	29	29

Table 3 (continued)

Day/ hour	Subsurface temperature (°F)[a]			Air temperature (°F)[a]							Wind speed (mph)[c]						Wind direction (10s of degrees)		
	Depth (in)[b]			Tower height (ft)[b]							Tower height (ft)[d]						Tower height (ft)[d]		
Sept. 5	-0.5	-15	-36	3	50	100	200	250	300	400	7	50	100	200	300	400	50	200	400
1 am	76.1	-	-	76.4	77.2	77.1	78.0	78.0	78.3	79.6	10	15	18	23	25	27	29	32	29
2 am	75.6	-	-	75.3	76.0	76.0	76.8	76.7	76.9	77.3	11	17	18	24	25	27	32	32	32
3 am	75.2	-	-	73.5	74.5	74.5	74.9	74.9	74.6	75.3	6	10	12	18	20	21	29	32	32
4 am	74.0	-	-	72.5	74.1	74.2	74.4	74.1	74.0	73.9	5	10	12	15	16	18	32	32	29
5 am	72.3	80.4	77.0	70.1	73.6	73.6	74.4	74.9	75.1	75.1	4	10	13	15	16	18	29	29	29
6 am	71.0	-	-	69.3	71.0	71.2	73.4	73.2	73.5	73.8	4	9	11	17	18	19	27	29	29
7 am	71.0	-	-	72.8	73.2	72.2	72.8	72.9	72.7	72.7	4	7	8	11	12	14	29	32	29
8 am	75.5	-	-	76.5	75.8	74.6	74.6	74.8	74.3	73.3	4	6	7	8	8	8	32	32	32
9 am	84.0	-	-	80.4	79.1	77.3	77.1	76.9	76.8	76.2	3	4	4	5	4	4	32	34	32
10 am	93.0	-	-	83.0	82.0	80.6	80.2	79.8	79.4	79.1	1	1	1	2	2	2	25	34	34
11 am	98.1	80.2	76.8	87.6	84.6	83.3	83.1	82.8	82.6	82.6	2	2	2	2	2	2	25	25	27
12 pm	107.0	-	-	89.3	87.1	86.1	85.9	85.6	85.6	85.0	3	3	4	4	4	4	25	25	25
1 pm	113.0	-	-	92.9	90.1	88.9	88.0	87.5	87.8	88.1	4	4	4	5	5	5	20	20	20
2 pm	116.5	-	-	93.5	90.7	89.7	89.4	88.5	88.2	88.6	6	6	6	6	6	6	11	11	11
3 pm	116.5	-	-	95.0	93.2	91.9	90.5	90.3	90.3	90.6	4	5	5	5	5	5	9	9	9
4 pm	114.7	-	-	94.6	93.6	92.1	91.2	91.0	91.3	91.2	4	5	5	5	5	5	5	5	7
5 pm	110.0	79.9	76.8	93.6	93.6	92.6	92.6	91.7	91.8	92.1	5	5	5	5	5	5	11	11	11
6 pm	104.0	-	-	92.1	92.4	91.6	91.5	91.1	90.9	90.9	5	8	8	8	8	8	14	14	14
7 pm	96.0	-	-	84.1	88.0	88.0	88.3	88.7	88.5	88.4	4	9	9	9	9	9	14	14	14
8 pm	90.0	-	-	85.1	87.2	86.6	86.3	85.8	85.8	85.7	5	10	11	13	14	15	32	32	32
9 pm	86.2	-	-	81.0	81.8	81.5	82.3	82.5	83.1	83.7	11	15	18	23	25	24	32	32	32
10 pm	83.8	-	-	79.1	79.6	79.3	79.8	79.3	79.6	80.3	10	15	17	21	24	25	32	32	32
11 pm	81.2	80.9	77.0	76.6	77.8	77.9	78.8	78.4	78.7	79.0	6	10	12	16	20	24	29	29	29
12 am	78.2	-	-	73.6	76.8	76.9	77.5	77.6	77.9	78.0	3	9	10	13	16	20	32	32	32

[a] $T(°C) = [T(°F) — 32]/1.8$

[b] 1 in = 0.02540 m

[c] 1 mile per hour (mph) = 1.609 km h^{-1} or 0.4470 m s^{-1}

[d] 1 ft = 0.3048 m

Table 4. Meteorological stations for which data are available in electronic format[a].

Meteorological station	Latitude (north)	Longitude (west)	Measurement height (m)	Surface roughness (m)
Hanford, WA	46.563	119.598	30.5	0.05
Walla Walla, WA	46.100	118.283	6.1	0.10
Baker, OR	44.833	117.817	10.4	0.20
Burns, OR	43.583	119.050	20.7	0.10
Dallesport, WA	45.617	121.150	6.1	0.20
Lewiston, ID	46.383	117.017	12.2	0.20
Moses Lake, WA	47.183	119.333	3.7	0.05
Pendleton, OR	45.683	118.850	6.1	0.10
Redmond, OR	44.267	121.150	9.5	0.10
Spokane, WA	47.667	117.333	12.2	0.30
Stampede Pass, WA	47.283	121.333	8.8	1.00
Yakima, WA	46.567	120.533	6.1	0.20

[a] Data are provided in an Excel workbook labeled SEP63MET.xls. The workbook contains two versions of a spreadsheet, with and without column headings. The first 3 columns contain the last 2 digits of the year (1963), the day of the year (1-365), and the hour of the observation (0-23). The next 2 columns contain the wind direction (16 pt compass) and wind speed (miles per hour) measured at Hanford at the release height. The next field is the ambient air temperature at the release height in tenths of a degree F (650 = 65.0°F); {T(°C) = [T(°F) — 32]/1.8)}. Then come 12 sets (one for each meteorological station) of data, including surface-level wind direction and speed, Pasquill-Gifford-Turner stability class, and precipitation class. The order of the stations in the record is the same as in the list above.

All wind directions are given in a 16 pt compass with 0 or 16 used for north, 4 for east, etc. Calms and variable winds are indicated by 17 and 18, and 88 and 99 indicate missing data. Wind speeds for all stations except Hanford are in knots (nautical miles per hour; 1 knot = 0.5144 m s^{-1}). Hanford winds are in miles per hour (mph; 1 mph = 0.4470 m s^{-1}). Missing data are indicated by 99. For the Pasquill-Gifford-Turner stability class, 1-7 is used in place of A-G (e.g., 1 = A, etc.), and 9 is used for missing data. Precipitation classes are 0 = none, 1 = light liquid precipitation (rain or drizzle), 2 = moderate liquid precipitation, 3 = heavy liquid precipitation, 4 = light frozen precipitation (snow), 5 = moderate frozen precipitation, 6 = heavy frozen precipitation, and 8 and 9 are missing data. Classes are based on the U.S. National Weather Service definitions of light (0.1 mm h-1), moderate (3 mm h-1), and heavy (5 mm h-1) for precipitation rates.

Table 5. Geographic positions of sampling locations.

Location	North Latitude			West Longitude		
	Deg	Min	Sec	Deg	Min	Sec
Route 2N, Mile 3	46	36	55	119	25	16
Route 2N, Mile 5	46	38	7	119	27	3
Route 2N, Mile 7	46	39	30	119	28	34
Route 2N, Mile 9	46	40	39	119	30	28
Route 2S, Mile 1	46	34	10	119	22	46
Route 2S, Mile 3	46	32	24	119	22	45
Route 2S, Mile 5	46	30	37	119	23	3
Route 4S, Mile 13	46	28	11	119	22	44
Route 4S, Mile 15	46	26	59	119	20	56
Route 4S, Mile 17	46	25	45	119	19	9
Route 4S, Mile 19	46	24	31	119	17	25
Route 4S, Mile 21	46	22	49	119	16	58
Y Barricade	46	28	56	119	23	30
200E - Gate House	46	32	42	119	32	12
ERC Gate (ERC Intersection)	46	22	14	119	26	39
ERC Gate + 1 Mile	46	22	55	119	26	3
ERC Gate + 2 Miles (to Route 10 + 4S)	46	23	3	119	24	45
ERC Gate + 3 Miles	46	23	56	119	24	32
ERC Gate + 4 Miles (to Rt 10 + 4S)	46	24	50	119	24	22
ERC Gate + 5 Miles	46	25	44	119	24	9
ERC Gate + 6 Miles (to Rt 10 + 4S)	46	26	38	119	23	58
ERC Gate + 7 Miles	46	27	32	119	23	48
ERC Gate + 8 Miles (to Rt 10 + 4S)	46	28	27	119	23	38
ERC Gate + 9 Miles	46	29	21	119	23	24
ERC Gate + 10 Miles	46	30	14	119	23	7
Route 10 + Route 4S Intersection	46	28	40	119	23	30
Route 11A + Route 3 Intersection	46	34	48	119	36	17
Route 11A + Route 4S Intersection	46	34	48	119	33	12
Route 11A + Route 6 Intersection	46	34	47	119	39	43
Route 11A, from Route 3 to Route 6	46	34	49	119	36	53
Route 11A, from Route 3 to Route 6	46	34	49	119	37	29
Route 11A, from Route 3 to Route 6	46	34	49	119	38	6
Route 11A, from Route 3 to Route 6	46	34	48	119	38	42
Route 11A, from Route 4S to Route 6	46	34	49	119	33	49
Route 11A, from Route 4S to Route 6	46	34	49	119	34	24
Route 11A, from Route 4S to Route 6	46	34	49	119	35	0
Route 4S, 3 Miles South of Y Barricade	46	26	26	119	20	8
Route 4S, 5 Miles South of Y Barricade	46	25	11	119	18	22
Route 4S, 7 Miles South of Y Barricade	46	23	50	119	16	58
Route 4S, 9 Miles South of Y Barricade	46	22	1	119	16	58

Table 5 (continued)

Location	North Latitude			West Longitude		
	Deg	Min	Sec	Deg	Min	Sec
Route 4S, 11 Miles South of Y Barricade	46	20	12	119	16	57
Route 4S, 13 Miles South of Y Barricade	46	18	20	119	17	10
Route 4S, 15 Miles South of Y Barricade	46	16	48	119	18	18
Route 4S, 17 Miles South of Y Barricade	46	15	33	119	16	46
Route 4S, 19 Miles South of Y Barricade	46	14	43	119	14	58
Route 4S, 21 Miles South of Y Barricade	46	13	55	119	12	53
200E - 1	46	33	32	119	31	13
200E - 4	46	34	9	119	30	50
200E - 7	46	33	27	119	31	41
200 - 8	46	33	28	119	30	49
200 - 10	46	33	7	119	32	8
200 - 12	46	33	10	119	30	52
Route 4S, Mile 1	46	33	53	119	33	14
Route 4S, Mile 3	46	32	36	119	32	26
Route 4S, Mile 4	46	32	36	119	31	14
Route 4S, Mile 5	46	32	28	119	30	3
A Zone	46	33	23	119	37	35
B Zone	46	33	25	119	32	4
Farm A	46	16	45	119	28	29
New Pasco Bridge to Prosser, Mile 2	46	13	30	119	9	59
New Pasco Bridge to Prosser, Mile 4	46	13	15	119	12	16
New Pasco Bridge to Prosser, Mile 6	46	14	20	119	14	27
New Pasco Bridge to Prosser, Mile 8	46	14	50	119	16	43
New Pasco Bridge to Prosser, Mile 10	46	15	19	119	18	60
New Pasco Bridge to Prosser, Mile 12	46	15	41	119	21	17
New Pasco Bridge to Prosser, Mile 14	46	15	50	119	23	29
New Pasco Bridge to Prosser, Mile 16	46	15	37	119	25	46
New Pasco Bridge to Prosser, Mile 18	46	15	7	119	27	59
New Pasco Bridge to Prosser, Mile 20	46	15	13	119	30	17
New Pasco Bridge to Prosser, Mile 22	46	15	57	119	32	28
New Pasco Bridge to Prosser, Mile 24	46	15	47	119	34	30
New Pasco Bridge to Prosser, Mile 26	46	15	0	119	36	43
New Pasco Bridge to Prosser, Mile 28	46	14	9	119	38	47
New Pasco Bridge to Prosser, Mile 30	46	13	17	119	40	50
Prosser, east of city limits	42	12	49	119	43	6
Farm J	46	17	13	119	33	11
Farm B	46	20	58	119	22	23
Farm G	46	21	33	119	14	46
Farm Z	46	25	10	119	12	6
Farm N	46	33	55	119	6	45

Table 5 (continued)

Location	North Latitude			West Longitude		
	Deg	Min	Sec	Deg	Min	Sec
Farm T	46	15	9	119	10	51
Radar Hill	46	43	13	119	10	27
Radar Hill to Pasco, Mile 2	46	41	25	119	10	25
Radar Hill to Pasco, Mile 4	46	39	36	119	10	24
Radar Hill to Pasco, Mile 6	46	37	48	119	10	25
Radar Hill to Pasco, Mile 8	46	36	9	119	10	26
Radar Hill to Pasco, Mile 10	46	34	54	119	11	27
Radar Hill to Pasco, Mile 12	46	33	28	119	12	57
Radar Hill to Pasco, Mile 14	46	31	60	119	14	6
Radar Hill to Pasco, Mile 18	46	29	17	119	12	14
Radar Hill to Pasco, Mile 20	46	27	53	119	11	41
Radar Hill to Pasco, Mile 22	46	26	3	119	11	42
Radar Hill to Pasco, Mile 24	46	24	10	119	11	43
Radar Hill to Pasco, Mile 26	46	22	20	119	11	47
Radar Hill to Pasco, Mile 28	46	20	25	119	11	48
Radar Hill to Pasco, Mile 30	46	18	46	119	11	16
Radar Hill to Pasco, Mile 32	46	17	3	119	11	17
Radar Hill to Pasco, Mile 34	46	15	17	119	10	42
Radar Hill to Pasco, Mile 36	46	14	22	119	9	27
Radar Hill to Pasco, Mile 38	46	14	21	119	7	5
Farm K	46	32	8	119	14	54
Farm H	46	15	12	119	13	39
Purex Stack	46	33	0	119	31	6
Meteorological tower	46	33	47	119	35	55
100 BSE	46	37	56	119	38	7
100-F	46	38	59	119	26	42
100-K	46	38	41	119	35	44
100-D	46	41	8	119	31	32
100-HE	46	41	38	119	29	0
200 ESE	46	32	33	119	30	52
200 EWC	46	33	2	119	33	9
200 EEC	46	33	2	119	30	52
200E SEMI	46	33	24	119	31	35
REDOX	46	32	3	119	37	7
200 WEC	46	33	15	119	36	29
200 WWC	46	33	6	119	38	14
300-A	46	22	13	119	16	37
Hanford	46	35	0	119	22	30
White Bluffs	46	39	42	119	28	30
Byers Landing	46	22	11	119	15	32

Table 5 (continued)

Location	North Latitude			West Longitude		
	Deg	Min	Sec	Deg	Min	Sec
700-A	46	16	42	119	16	30
1100-A	46	19	21	119	17	0
Benton City	46	18	0	119	30	0
Pasco	46	13	0	119	2	0
Kennewick	46	11	0	119	4	0
Eltopia	46	27	28	119	1	3
Mesa	46	34	30	119	0	0
Ringold	46	30	0	119	15	10

Table 6. Measured concentrations of ^{131}I in air ($\times 10^{-2}$ Bq m^{-3}).

Date	100 BSE	100-F	100-K	100-D	100 HE	200 ESE	200 EWC
8/26/63	0.0	0.059	0.015	-0.041	0.044	0.17	0.16
8/27/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
8/28/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
8/29/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
8/30/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
8/31/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
9/1/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
9/2/63	3.15	0.078	0.27	0.056	0.11	7.281	0.078
9/3/63	3.15	1.17	0.27	1.29	1.044	194.74	8.456
9/4/63	3.15	1.17	0.27	1.29	1.044	12.54	0.796
9/5/63	0.593	0.13	0.16	0.14	0.13	12.54	0.796
9/6/63	0.593	0.13	0.16	0.14	0.13	12.54	0.796
9/7/63	0.593	0.13	0.16	0.14	0.13	12.54	0.796
9/8/63	0.593	0.13	0.16	0.14	0.13	12.54	0.796
9/9/63	0.593	0.13	0.16	0.14	0.13	12.54	0.796
9/10/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/11/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/12/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/13/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/14/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/15/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/16/63	0.20	0.048	0.13	0.059	0.011	0.30	0.17
9/17/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/18/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/19/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/20/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/21/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/22/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/23/63	0.070	0.059	0.067	0.16	0.074	0.16	0.074
9/24/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/25/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/26/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/27/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/28/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/29/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27
9/30/63	0.16	0.063	0.11	0.081	0.10	0.530	0.27

Table 6 (continued)

Date	200 EEC	200E SEMI	REDOX	200 WEC	200 WWC	300-A	Hanford
8/26/63	0.663	0.26	0.637	0.11	0.12	-0.0074	0.0
8/27/63	31.52	0.404	0.637	0.11	0.12	1.17	0.096
8/28/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
8/29/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
8/30/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
8/31/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
9/1/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
9/2/63	31.52	0.404	1.61	0.067	5.511	1.17	0.096
9/3/63	269.27	17.24	13.46	0.10	5.511	0.31	1.75
9/4/63	8.341	0.426	1.29	0.10	0.548	0.31	1.75
9/5/63	8.341	0.426	1.29	0.10	0.548	0.31	0.15
9/6/63	8.341	0.426	1.29	0.10	0.548	0.31	0.15
9/7/63	8.341	0.426	1.29	0.10	0.548	0.31	0.15
9/8/63	8.341	0.426	1.29	0.10	0.548	0.31	0.15
9/9/63	8.341	0.426	1.29	0.10	0.548	0.31	0.15
9/10/63	0.941	0.493	1.29	0.10	0.548	0.041	0.074
9/11/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/12/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/13/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/14/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/15/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/16/63	0.941	0.493	0.063	0.17	0.28	0.041	0.074
9/17/63	0.493	0.770	0.063	0.17	0.28	0.570	0.067
9/18/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/19/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/20/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/21/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/22/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/23/63	0.493	0.770	0.496	0.096	0.24	0.570	0.067
9/24/63	0.667	0.36	0.496	0.096	0.24	0.14	0.085
9/25/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085
9/26/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085
9/27/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085
9/28/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085
9/29/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085
9/30/63	0.667	0.36	2.71	0.067	0.419	0.14	0.085

Table 6 (continued)

Date	White Bluffs	Byers Landing	700-A	1100-A	Benton City	Pasco	Kennewick
8/26/63	0.0	0.19	0.056	0.067	0.067	0.019	0.081
8/27/63	0.13	0.19	0.056	0.067	0.067	0.019	0.081
8/28/63	0.13	0.19	0.422	0.29	0.21	0.096	0.23
8/29/63	0.13	0.19	0.422	0.29	0.21	0.096	0.23
8/30/63	0.13	0.511	0.422	0.29	0.21	0.096	0.23
8/31/63	0.13	0.511	0.422	0.29	0.21	0.096	0.23
9/1/63	0.13	0.511	0.422	0.29	0.21	0.096	0.23
9/2/63	0.13	0.511	0.422	0.29	0.21	0.096	0.23
9/3/63	0.774	0.511	0.422	0.29	0.21	0.096	0.23
9/4/63	0.774	0.374	0.878	0.37	0.526	0.31	0.37
9/5/63	0.13	0.374	0.878	0.37	0.526	0.31	0.37
9/6/63	0.13	0.12	0.878	0.37	0.526	0.31	0.37
9/7/63	0.13	0.12	0.878	0.37	0.526	0.31	0.37
9/8/63	0.13	0.063	0.093	0.37	0.022	0.070	0.096
9/9/63	0.13	0.063	0.093	0.37	0.022	0.070	0.096
9/10/63	0.089	0.063	0.093	0.37	0.022	0.070	0.096
9/11/63	0.089	0.063	0.063	0.015	0.044	-0.022	0.030
9/12/63	0.089	0.063	0.063	0.015	0.044	-0.022	0.030
9/13/63	0.089	0.28	0.063	0.015	0.044	-0.022	0.030
9/14/63	0.089	0.28	0.063	0.015	0.044	-0.022	0.030
9/15/63	0.089	0.28	0.063	0.015	0.044	-0.022	0.030
9/16/63	0.089	0.28	0.063	0.015	0.044	-0.022	0.030
9/17/63	0.052	0.28	0.063	0.015	0.044	-0.022	0.030
9/18/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/19/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/20/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/21/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/22/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/23/63	0.052	0.28	0.13	0.18	0.078	0.11	0.067
9/24/63	0.070	0.28	0.13	0.18	0.078	0.11	0.067
9/25/63	0.070	0.28	0.093	0.037	0.078	0.037	0.011
9/26/63	0.070	0.11	0.093	0.037	0.093	0.037	0.011
9/27/63	0.070	0.033	0.093	0.037	0.093	0.037	0.011
9/28/63	0.070	0.033	0.093	0.037	0.093	0.037	0.011
9/29/63	0.070	0.033	0.093	0.037	0.093	0.037	0.011
9/30/63	0.070	0.033	0.093	0.037	0.093	0.037	0.011

Table 7. Measured concentrations of ^{131}I in vegetation samples.

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
	Route 2N, Mile 3		9/2/63	leafy sage	0.666	24.64
	Route 2N, Mile 5		9/2/63	bare sage stems	-0.792	-29.3
	Route 2N, Mile 7		9/2/63	bare sage stems	-0.38	-14.06
	Route 2N, Mile 9		9/2/63	leafy sage	-0.664	-24.57
	Route 2S, Mile 1		9/2/63	leafy sage	0.218	8.07
	Route 2S, Mile 3		9/2/63	leafy sage	2.29	84.73
	Route 2S, Mile 5		9/2/63	leafy sage	-0.335	-12.4
	Route 4S, Mile 13		9/2/63	bare sage stems	0.251	9.29
	Route 4S, Mile 15		9/2/63	leafy sage	-1.52	-56.24
	Route 4S, Mile 17		9/2/63	leafy sage	-0.96	-35.52
	Route 4S, Mile 19		9/2/63	leafy sage	-2.34	-86.58
	Route 4S, Mile 21		9/2/63	leafy sage	1.49	55.13
	Y Barricade		9/2/63	leafy sage	-0.582	-21.53
	200E - Gate House		9/3/63	leafy sage	8.74	323.38
	ERC Intersection		9/3/63		5	185
	ERC Intersection to Route 10 + Route 4S, Mile 2		9/3/63		0.534	19.76
	ERC Intersection to Route 10 + Route 4S, Mile 4		9/3/63		5.83	215.71
	ERC Intersection to Route 10 + Route 4S, Mile 6		9/3/63		6	222
	ERC Intersection to Route 10 + Route 4S, Mile 8		9/3/63		1.15	42.55
	Route 10 + Route 4S Intersection		9/3/63		0.917	33.93
	Route 11A + Route 3 Intersection		9/3/63	dry cheat grass	3.91	144.67
	Route 11A + Route 4S Intersection		9/3/63	leafy sage	2.33	86.21
	Route 11A + Route 6 Intersection		9/3/63	leafy sage	-0.064	-2.37
	Route 11A, from Route 3 to Route 6, Mile 0.5		9/3/63	half dry grass	0.322	11.91
	Route 11A, from Route 3 to Route 6, Mile 1		9/3/63	dry cheat grass	1.44	53.28
	Route 11A, from Route 3 to Route 6, Mile 1.5		9/3/63	dry cheat grass	0.956	35.37
	Route 11A, from Route 3 to Route 6, Mile 2		9/3/63	dry cheat grass	2.05	75.85

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
	Route 11A, from Route 4S to Route 6, Mile 0.5		9/3/63	leafy sage	3.66	135.42
	Route 11A, from Route 4S to Route 6, Mile 1		9/3/63	dry cheat grass	14.3	529.1
	Route 11A, from Route 4S to Route 6, Mile 1.5		9/3/63	dry cheat grass	5.3	196.1
	Route 4S, 3 Miles South of Y Barricade		9/3/63	leafy sage	7.72	285.64
	Route 4S, 5 Miles South of Y Barricade		9/3/63	leafy sage	91.3	3378.1
	Route 4S, 7 Miles South of Y Barricade		9/3/63	leafy sage	18.7	691.9
	Route 4S, 9 Miles South of Y Barricade		9/3/63	leafy sage	14	518
	Route 4S, 11 Miles South of Y Barricade		9/3/63	leafy sage	7.41	274.17
	Route 4S, 13 Miles South of Y Barricade		9/3/63	leafy sage	12	444
	Route 4S, 15 Miles South of Y Barricade		9/3/63	leafy sage	5.64	208.68
	Route 4S, 17 Miles South of Y Barricade		9/3/63	leafy sage	1.17	43.29
	Route 4S, 19 Miles South of Y Barricade		9/3/63	leafy sage	0.765	28.31
	Route 4S, 21 Miles South of Y Barricade		9/3/63	leafy sage	0.316	11.69
	Y Barricade		9/3/63	leafy sage	13.9	514.3
	100 B Gate		9/4/63	bare sage stems	6.53	241.61
	100 D Gate		9/4/63	leafy sage	0.094	3.48
	100 F Gate		9/4/63	leafy sage	0.099	3.66
	100 H Gate		9/4/63	bare sage stems	0.375	13.88
	100 K Gate		9/4/63	leafy sage	0.696	25.75
	200E - 1		9/4/63	leafy sage	11.1	410.7
	200E - 4		9/4/63	leafy sage	6.3	233.1
	200E - 7		9/4/63	leafy sage	4.2	155.4
	200E - 8		9/4/63	leafy sage	44	1628
	200E - 10		9/4/63	leafy sage	22.4	828.8
	200E - 12		9/4/63	leafy sage	125	4625
	Route 4S, Mile 1		9/4/63	leafy sage	19.5	721.5
	Route 4S, Mile 3		9/4/63	leafy sage	7.67	283.79

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
	Route 4S, Mile 4		9/4/63	leafy sage	246	9102
	Route 4S, Mile 5		9/4/63	leafy sage	63.7	2356.9
	A Zone		9/6/63		6.01	222.37
	B Zone		9/6/63		67.2	2486.4
	614 Building - Byers		9/7/63	leafy weeds	0.809	29.93
	A Zone		9/13/63		3.29	121.73
	B Zone		9/13/63		87.2	3226.4
	A Zone		9/20/63		1.28	47.36
	B Zone		9/20/63		30.8	1139.6
	A Zone		9/27/63		1.36	50.32
	B Zone		9/27/63		10.2	377.4
Farm A	Benton City	Benton	9/3/63	half dry grass	1.04	38.48
	New Pasco Bridge to Prosser, Mile 2	Benton	9/3/63	dry grass	-0.741	-27.42
	New Pasco Bridge to Prosser, Mile 4	Benton	9/3/63	dry grass	0.376	13.91
	New Pasco Bridge to Prosser, Mile 6	Benton	9/3/63	dry grass	3.08	113.96
	New Pasco Bridge to Prosser, Mile 8	Benton	9/3/63	leafy sage	2.49	92.13
	New Pasco Bridge to Prosser, Mile 10	Benton	9/3/63	leafy sage	2.15	79.55
	New Pasco Bridge to Prosser, Mile 12	Benton	9/3/63	green hay	13	481
	New Pasco Bridge to Prosser, Mile 14	Benton	9/3/63	leafy sage	4.06	150.22
	New Pasco Bridge to Prosser, Mile 16	Benton	9/3/63	leafy sage	1.97	72.89
	New Pasco Bridge to Prosser, Mile 18	Benton	9/3/63	half dry grass	1.8	66.6
	New Pasco Bridge to Prosser, Mile 20	Benton	9/3/63	dry grass	0.735	27.2
	New Pasco Bridge to Prosser, Mile 22	Benton	9/3/63	leafy sage	1.16	42.92
	New Pasco Bridge to Prosser, Mile 24	Benton	9/3/63	green grass	0.649	24.01
	New Pasco Bridge to Prosser, Mile 26	Benton	9/3/63	green grass	1.29	47.73
	New Pasco Bridge to Prosser, Mile 28	Benton	9/3/63	green grass	0.37	13.69
	New Pasco Bridge to Prosser, Mile 30	Benton	9/3/63	green grass	0.621	22.98

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
	Prosser, East of City Limits	Benton	9/3/63	green grass	0.405	14.99
Farm A	Benton City	Benton	9/4/63	pasture grass	1.53	56.61
Farm A	Benton City	Benton	9/5/63	pasture grass	1.39	51.43
Farm A	Benton City	Benton	9/6/63	pasture grass	1.78	65.86
Farm J		Benton	9/7/63	pasture grass	1.6	59.2
Farm M		Benton	9/7/63	pasture grass	1.36	50.32
	614 Building - Benton City	Benton	9/7/63	leafy weeds	1.53	56.61
	614 Building - Kennewick	Benton	9/7/63	leafy weeds	0.598	22.13
Farm A	Benton City	Benton	9/7/63	pasture grass	2.61	96.57
Farm A	Benton City	Benton	9/8/63	pasture grass	1.04	38.48
Farm A	Benton City	Benton	9/9/63	pasture grass	0.344	12.73
Farm A	Benton City	Benton	9/10/63	pasture grass	0.387	14.32
Farm M		Benton	9/11/63	pasture grass	0.054	2
Farm A	Benton City	Benton	9/11/63	pasture grass	0.049	1.81
Farm A	Benton City	Benton	9/12/63	pasture grass	0.376	13.91
Farm B	Twin Bridge	Benton	9/12/63	pasture grass	0.938	34.71
Farm A	Benton City	Benton	9/13/63	pasture grass	0.119	4.4
Farm B	Twin Bridge	Benton	9/13/63	pasture grass	0.24	8.88
Farm B	Twin Bridge	Benton	9/13/63	pasture grass	1.15	42.55
Farm A	Benton City	Benton	9/14/63	pasture grass	0.201	7.44
Farm A	Benton City	Benton	9/16/63	pasture grass	0.175	6.48
Farm B	Twin Bridge	Benton	9/16/63	pasture grass	0.391	14.47
Farm A	Benton City	Benton	9/17/63	pasture grass	0.371	13.73
Farm B	Twin Bridge	Benton	9/17/63	pasture grass	0.327	12.1
Farm A	Benton City	Benton	9/18/63	pasture grass	0.359	13.28
Farm B	Twin Bridge	Benton	9/18/63	pasture grass	0.994	36.78
Farm A	Benton City	Benton	9/19/63	pasture grass	0.368	13.62

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
Farm B	Twin Bridge	Benton	9/19/63	pasture grass	0.356	13.17
Farm A	Benton City	Benton	9/20/63	pasture grass	0.195	7.22
Farm B	Twin Bridge	Benton	9/20/63	pasture grass	0.495	18.32
Farm A	Benton City	Benton	9/23/63	weeds	0.223	8.25
Farm B	Twin Bridge	Benton	9/23/63	pasture grass	0.552	20.42
Farm A	Benton City	Benton	9/24/63	weeds	0.295	10.92
Farm B	Twin Bridge	Benton	9/24/63	weeds	0.839	31.04
Farm A	Benton City	Benton	9/25/63	pasture grass	0.612	22.64
Farm B	Twin Bridge	Benton	9/25/63	pasture grass	0.575	21.28
Farm A	Benton City	Benton	9/26/63	pasture grass	1.11	41.07
Farm B	Twin Bridge	Benton	9/26/6	pasture grass	1.02	37.74
Farm A	Benton City	Benton	9/27/63	pasture grass	0.311	11.51
Farm B	Twin Bridge	Benton	9/27/63	pasture grass	0.59	21.83
Farm A	Benton City	Benton	9/30/63	alfalfa	0.236	8.73
Farm B	Twin Bridge	Benton	9/30/63	pasture grass	0.374	13.84
Farm G	Byers Landing	Franklin	9/3/63	pasture grass	0.3	11.1
Farm Z	Eltopia	Franklin	9/3/63	pasture grass	0.093	3.44
Farm N	Mesa	Franklin	9/3/63	pasture grass	0.264	9.77
Farm T	Pasco	Franklin	9/3/63	pasture grass	0.468	17.32
Farm T	Pasco	Franklin	9/3/63	pasture grass	0.616	22.79
	Pasco	Franklin	9/3/63	leafy sage	0.146	5.4
	Radar Hill	Franklin	9/3/63	leafy sage	0.259	9.58
	Radar Hill to Pasco, Mile 2	Franklin	9/3/63	leafy sage	-0.076	-2.81
	Radar Hill to Pasco, Mile 4	Franklin	9/3/63	green hay	0.263	9.73
	Radar Hill to Pasco, Mile 6	Franklin	9/3/63	green alfalfa	0.264	9.77
	Radar Hill to Pasco, Mile 8	Franklin	9/3/63	green grass	0.235	8.7
	Radar Hill to Pasco, Mile 10	Franklin	9/3/63	leafy sage	0.234	8.66

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
	Radar Hill to Pasco, Mile 12	Franklin	9/3/63	leafy sage	0.0676	2.5
	Radar Hill to Pasco, Mile 14	Franklin	9/3/63	half dry grass	-0.465	-17.21
	Radar Hill to Pasco, Mile 18	Franklin	9/3/63	green hay	0.732	27.08
	Radar Hill to Pasco, Mile 20	Franklin	9/3/63	leafy sage	-0.161	-5.96
	Radar Hill to Pasco, Mile 22	Franklin	9/3/63	leafy sage	0.477	17.65
	Radar Hill to Pasco, Mile 24	Franklin	9/3/63	green clover	0.489	18.09
	Radar Hill to Pasco, Mile 26	Franklin	9/3/63	leafy sage	0.074	2.74
	Radar Hill to Pasco, Mile 28	Franklin	9/3/63	leafy sage	0.127	4.7
	Radar Hill to Pasco, Mile 30	Franklin	9/3/63	leafy sage	0.355	13.14
	Radar Hill to Pasco, Mile 32	Franklin	9/3/63	leafy sage	0.37	13.69
	Radar Hill to Pasco, Mile 34	Franklin	9/3/63	dry rye heads	-0.414	-15.32
	Radar Hill to Pasco, Mile 36	Franklin	9/3/63	leafy sage	0.152	5.62
	Radar Hill to Pasco, Mile 38	Franklin	9/3/63	leafy sage	-0.249	-9.21
Farm K	Ringold	Franklin	9/3/63	pasture grass	1.25	46.25
Farm H	Riverview	Franklin	9/3/63	pasture grass	0.495	18.32
Farm G	Byers Landing	Franklin	9/4/63	pasture grass	0.18	6.66
Farm Z	Eltopia	Franklin	9/4/63	pasture grass	0.174	6.44
Farm Z	Eltopia	Franklin	9/4/63	hay	-0.0104	-0.38
Farm T	Pasco	Franklin	9/4/63	pasture grass	0.365	13.51
Farm K	Ringold	Franklin	9/4/63	pasture grass	0.204	7.55
Farm N	Mesa	Franklin	9/5/63	pasture grass	0.245	9.07
Farm T	Pasco	Franklin	9/5/63	pasture grass	0.537	19.87
Farm K	Ringold	Franklin	9/5/63	pasture grass	0.504	18.65
Farm H	Riverview	Franklin	9/5/63	pasture grass	2.68	99.16
Farm T	Pasco	Franklin	9/6/63	pasture grass	0.278	10.29
Farm K	Ringold	Franklin	9/6/63	pasture grass	0.083	3.07
	614 Building - Pasco	Franklin	9/7/63	leafy weeds	0.57	21.09

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
Farm T	Pasco	Franklin	9/7/63	pasture grass	0.323	11.95
Farm K	Ringold	Franklin	9/7/63	pasture grass	0.461	17.06
Farm T	Pasco	Franklin	9/8/63	pasture grass	0.61	22.57
Farm K	Ringold	Franklin	9/8/63	pasture grass	0.433	16.02
Farm T	Pasco	Franklin	9/9/63	pasture grass	0.184	6.81
Farm K	Ringold	Franklin	9/9/63	pasture grass	0.466	17.24
Farm H	Riverview	Franklin	9/9/63	pasture grass	0.792	29.3
Farm T	Pasco	Franklin	9/10/63	pasture grass	0.177	6.55
	Pasco	Franklin	9/10/63	clover	0.579	21.42
Farm K	Ringold	Franklin	9/10/63	pasture grass	0.13	4.81
Farm G	Byers Landing	Franklin	9/11/63	pasture grass	0.261	9.66
Farm Z	Eltopia	Franklin	9/11/63	pasture grass	0.195	7.22
Farm N	Mesa	Franklin	9/11/63	pasture grass	0.118	4.37
Farm T	Pasco	Franklin	9/11/63	pasture grass	0.11	4.07
Farm K	Ringold	Franklin	9/11/63	pasture grass	0.374	13.84
Farm T	Pasco	Franklin	9/12/63	pasture grass	0.327	12.1
Farm K	Ringold	Franklin	9/12/63	pasture grass	0.259	9.58
Farm T	Pasco	Franklin	9/13/63	pasture grass	0.0534	1.98
Farm K	Ringold	Franklin	9/13/63	pasture grass	0.0134	0.5
Farm T	Pasco	Franklin	9/14/63	pasture grass	0.129	4.77
Farm T	Pasco	Franklin	9/16/63	pasture grass	0.0935	3.46
Farm K	Ringold	Franklin	9/16/63	pasture grass	0.081	3
Farm G	Byers Landing	Franklin	9/17/63	pasture grass	0.251	9.29
Farm T	Pasco	Franklin	9/17/63	pasture grass	0.128	4.74
Farm T	Pasco	Franklin	9/18/63	pasture grass	0.225	8.33
Farm Z	Eltopia	Franklin	9/19/63	pasture grass	0.204	7.55
Farm N	Mesa	Franklin	9/19/63	pasture grass	0.191	7.07

Table 7 (continued)

Farm	Collection site	County	Date	Vegetation type	Concentration of ^{131}I	
					pCi g^{-1}	Bq kg^{-1}
Farm T	Pasco	Franklin	9/19/63	pasture grass	0.297	10.99
Farm K	Ringold	Franklin	9/19/63	pasture grass	0.154	5.7
Farm H	Riverview	Franklin	9/19/63	pasture grass	0.902	33.37
Farm T	Pasco	Franklin	9/20/63	pasture grass	0.279	10.32
Farm K	Ringold	Franklin	9/20/63	pasture grass	0.103	3.81
Farm T	Pasco	Franklin	9/23/63	weeds & alfalfa	-0.014	-0.52
Farm K	Ringold	Franklin	9/23/63	weeds	0.319	11.8
Farm T	Pasco	Franklin	9/24/63	weeds	0.31	11.47
Farm K	Ringold	Franklin	9/24/63	pasture grass	0.407	15.06
Farm G	Byers Landing	Franklin	9/25/63	alfalfa	0.185	6.85
Farm Z	Eltopia	Franklin	9/25/63	alfalfa	0.161	5.96
Farm N	Mesa	Franklin	9/25/63	alfalfa	0.359	13.28
Farm T	Pasco	Franklin	9/25/63	weeds	0.217	8.03
Farm K	Ringold	Franklin	9/25/63	pasture grass	0.47	17.39
Farm H	Riverview	Franklin	9/25/63	weeds	0.317	11.73
Farm T	Pasco	Franklin	9/26/63	alfalfa	0.095	3.52
Farm K	Ringold	Franklin	9/26/63	pasture grass	0.178	6.59
Farm T	Pasco	Franklin	9/27/63	pasture grass	0.101	3.74
Farm K	Ringold	Franklin	9/27/63	pasture grass	0.315	11.66
Farm T	Pasco	Franklin	9/30/63	pasture grass	0.203	7.51

Table 8. Measured concentrations of ^{131}I in milk samples.

Farm or Dairy	Collection site	County	Date	Concentration of ^{131}I	
				pCi g^{-1}	Bq kg^{-1}
Farm A	Benton City	Benton	9/4/63	64.8	2.40
Farm L	Kiona	Benton	9/4/63	10.3	0.38
Farm A	Benton City	Benton	9/5/63	117	4.33
Twin City	Prosser - Benton City	Benton	9/5/63	3.1	0.11
Farm A	Benton City	Benton	9/6/63	113	4.18
Farm A	Benton City	Benton	9/7/63	96.7	3.58
Farm J		Benton	9/7/63	91	3.37
Farm M		Benton	9/7/63	56.6	2.09
Twin City	Prosser - Benton City	Benton	9/7/63	58.7	2.17
Farm A	Benton City	Benton	9/8/63	77.7	2.87
Farm L	Kiona	Benton	9/8/63	< 4.2	< 0.16
Farm A	Benton City	Benton	9/9/63	69.4	2.57
Farm A	Benton City	Benton	9/10/63	33.8	1.25
Farm A	Benton City	Benton	9/11/63	29.4	1.09
Farm A	Benton City	Benton	9/12/63	22.9	0.85
Farm B	1 Mile North of Twin Bridges	Benton	9/12/63	136	5.03
Farm A	Benton City	Benton	9/13/63	19.6	0.73
Farm B	1 Mile North of Twin Bridges	Benton	9/13/63	119	4.40
Farm A	Benton City	Benton	9/14/63	16.1	0.60
Farm B	1 Mile North of Twin Bridges	Benton	9/14/63	95.1	3.52
Farm A	Benton City	Benton	9/16/63	24.5	0.91
Farm B	1 Mile North of Twin Bridges	Benton	9/16/63	48.4	1.79
Farm A	Benton City	Benton	9/17/63	22	0.81
Farm B	1 Mile North of Twin Bridges	Benton	9/17/63	65.2	2.41
Twin City	Prosser - Benton City	Benton	9/17/63	19.7	0.73
Farm A	Benton City	Benton	9/18/63	19.5	0.72
Farm B	1 Mile North of Twin Bridges	Benton	9/18/63	43.4	1.61
Farm A	Benton City	Benton	9/19/63	20.2	0.75
Farm B	1 Mile North of Twin Bridges	Benton	9/19/63	54.4	2.01
Farm A	Benton City	Benton	9/20/63	19.2	0.71
Farm B	1 Mile North of Twin Bridges	Benton	9/20/63	51.9	1.92
Farm A	Benton City	Benton	9/23/63	19.2	0.71
Farm B	1 Mile North of Twin Bridges	Benton	9/23/63	38.7	1.43
Farm A	Benton City	Benton	9/24/63	14.3	0.53
Farm B	1 Mile North of Twin Bridges	Benton	9/24/63	31.3	1.16
Farm A	Benton City	Benton	9/25/63	11.4	0.42
Farm B	1 Mile North of Twin Bridges	Benton	9/25/63	32.9	1.22
Farm A	Benton City	Benton	9/26/63	9.4	0.35
Farm B	1 Mile North of Twin Bridges	Benton	9/26/63	25.8	0.95
Farm A	Benton City	Benton	9/27/63	9.8	0.36

Table 8 (continued)

Farm or Dairy	Collection site	County	Date	Concentration of ^{131}I	
				pCi g^{-1}	Bq kg^{-1}
Farm B	1 Mile North of Twin Bridges	Benton	9/27/63	25.8	0.95
Farm A	Benton City	Benton	9/30/63	10.7	0.40
Farm B	1 Mile North of Twin Bridges	Benton	9/30/63	29.1	1.08
Darigold		composite	9/16/63	8	0.30
Lucerne		composite	9/16/63	< 1.2	< 0.04
Twin City		composite	9/16/63	12.3	0.46
Darigold		composite	9/26/63	1.9	0.07
Lucerne		composite	9/26/63	3.8	0.14
Twin City		composite	9/26/63	4.1	0.15
Farm T	Pasco	Franklin	9/3/63	< 2.0	< 0.07
Farm Z	Eltopia	Franklin	9/4/63	9.9	0.37
Farm G	Byers Landing	Franklin	9/4/63	10.2	0.38
Farm K	Ringold	Franklin	9/4/63	16.1	0.60
Farm T	Pasco	Franklin	9/4/63	18.9	0.70
Farm H	Riverview	Franklin	9/5/63	40	1.48
Farm K	Ringold	Franklin	9/5/63	30.4	1.12
Farm N	Mesa	Franklin	9/5/63	3.6	0.13
Farm T	Pasco	Franklin	9/5/63	22.8	0.84
Twin City	Columbia Basin	Franklin	9/5/63	4	0.15
Farm K	Ringold	Franklin	9/6/63	36.1	1.34
Farm T	Pasco	Franklin	9/6/63	17.2	0.64
Farm K	Ringold	Franklin	9/7/63	32.9	1.22
Farm T	Pasco	Franklin	9/7/63	14.4	0.53
Farm K	Ringold	Franklin	9/8/63	27.5	1.02
Farm T	Pasco	Franklin	9/8/63	17.3	0.64
Twin City	Columbia Basin	Franklin	9/8/63	18.1	0.67
Farm K	Ringold	Franklin	9/9/63	89.2	3.30
Farm T	Pasco	Franklin	9/9/63	37.1	1.37
Farm K	Ringold	Franklin	9/10/63	23.2	0.86
Farm T	Pasco	Franklin	9/10/63	20.8	0.77
Farm Z	Eltopia	Franklin	9/11/63	10.1	0.37
Farm G	Byers Landing	Franklin	9/11/63	28.6	1.06
Farm H	Riverview	Franklin	9/11/63	37	1.37
Farm K	Ringold	Franklin	9/11/63	14.9	0.55

Table 8 (continued)

Farm or Dairy	Collection site	County	Date	Concentration of ^{131}I	
				pCi g^{-1}	Bq kg^{-1}
Farm N	Mesa	Franklin	9/11/63	34.2	1.27
Farm T	Pasco	Franklin	9/11/63	13.8	0.51
Farm K	Ringold	Franklin	9/12/63	12.2	0.45
Farm T	Pasco	Franklin	9/12/63	14.3	0.53
Farm K	Ringold	Franklin	9/13/63	8.2	0.30
Farm T	Pasco	Franklin	9/13/63	19.8	0.73
Farm T	Pasco	Franklin	9/14/63	8.3	0.31
Farm K	Ringold	Franklin	9/16/63	5.8	0.21
Farm T	Pasco	Franklin	9/16/63	4.2	0.16
Farm G	Byers Landing	Franklin	9/17/63	36.8	1.36
Farm K	Ringold	Franklin	9/17/63	32.3	1.20
Farm T	Pasco	Franklin	9/17/63	4.7	0.17
Twin City	Columbia Basin	Franklin	9/17/63	18.7	0.69
Farm K	Ringold	Franklin	9/18/63	8.3	0.31
Farm T	Pasco	Franklin	9/18/63	5.2	0.19
Farm Z	Eltopia	Franklin	9/19/63	7.1	0.26
Farm H	Riverview	Franklin	9/19/63	12.3	0.46
Farm K	Ringold	Franklin	9/19/63	12.3	0.46
Farm N	Mesa	Franklin	9/19/63	19	0.70
Farm T	Pasco	Franklin	9/19/63	7	0.26
Farm K	Ringold	Franklin	9/20/63	31	1.15
Farm T	Pasco	Franklin	9/20/63	6.2	0.23
Farm K	Ringold	Franklin	9/23/63	11.4	0.42
Farm T	Pasco	Franklin	9/23/63	3	0.11
Farm K	Ringold	Franklin	9/24/63	14.2	0.53
Farm T	Pasco	Franklin	9/24/63	3.8	0.14
Farm Z	Eltopia	Franklin	9/25/63	8.4	0.31
Farm G	Byers Landing	Franklin	9/25/63	12.3	0.46
Farm H	Riverview	Franklin	9/25/63	7.4	0.27
Farm K	Ringold	Franklin	9/25/63	8.7	0.32
Farm N	Mesa	Franklin	9/25/63	17.3	0.64
Farm T	Pasco	Franklin	9/25/63	5.4	0.20
Farm K	Ringold	Franklin	9/26/63	14.2	0.53
Farm T	Pasco	Franklin	9/26/63	8	0.30
Farm K	Ringold	Franklin	9/27/63	10.6	0.39
Farm T	Pasco	Franklin	9/27/63	5.5	0.20
Farm K	Ringold	Franklin	9/30/63	4.8	0.18
Farm T	Pasco	Franklin	9/30/63	5.2	0.19

Table 9. Average daily consumption of leafy green vegetables and fresh milk by age group in the spring of 1965.

Age group	Leafy green vegetables (g)	Fresh milk (g)	Number of observations
Males			
< 1	0 (0)[a]	588 (478)	8
1-4	9 (16)	453 (250)	52
5-9	15 (22)	678 (314)	72
10-14	18 (29)	725 (388)	99
15-19	32 (39)	755 (564)	84
> 20	47 (60)	377 (370)	534
Females			
< 1	0 (0)	550 (498)	14
1-4	5 (13)	549 (273)	44
5-9	18 (20)	635 (301)	71
10-14	22 (32)	588 (328)	79
15-19	29 (44)	523 (403)	88
> 20	50 (63)	260 (257)	608

[a] Mean (Standard deviation)

Table 10. Commercial acreage and production of lettuce in Washington state, early fall 1963.

Production measure	Quantity
Acreage	1,000 acres (400 ha)
Production	165,000 cwt (7,500 tonnes)

Table 11. Total acreage and production of hay in Washington state in 1963.

Production measure	Quantity
Area harvested	854,000 acres (346,000 ha)
Total production	1,976,000 tons (1,800,000 tonnes)
Kept on farms	1,304,000 tons (1,185,000 tonnes)
Sold	672,000 tons (615,000 tonnes)

Table 12. Acreage and production of alfalfa and alfalfa mixtures, clover, timothy, and mixtures of clover and grasses in Washington state in 1963.

Production measure	Quantity
Alfalfa and alfalfa mixtures	
Area harvested	444,000 acres (180,000 ha)
Production	1,243,000 tons (1,130,000 tonnes)
Clover, timothy, and mixtures of clover and grasses	
Area harvested	238,000 acres (96,000 ha)
Production	476,000 tons (433,000 tonnes)
Wild hay	
Area harvested	43,000 acres (17,400 ha)
Production	54,000 tons (49,000 tonnes)

Table 13. Feed (including pasture) consumed by dairy cattle in Washington state, expressed in feed unit[a] per head or per unit of production (year beginning October 1, 1962).

Intake	Quantity
Milk cows, per head	7,405
Milk cows, per 100 lb (45 kg) milk produced	110
Other dairy cattle, per head	4,474

[a] A feed unit is the equivalent of 1 lb (0.454 kg) of corn (maize) in feeding value.

Table 14. Milk cow rations in Washington state in 1963.

Type of feed	Quantity
Grain and other concentrates fed during calendar year	
Per cow	2,490 lb (1,130 kg)
Per 100 pounds (45 kg) of milk produced	28 lb (12.7 kg)
Roughage fed during winter feeding period[a]	
Hay, per cow	2.7 tons (2.45 tonnes)
All roughage, per cow, hay equivalent[b]	3.6 tons (3.26 tonnes)
Condition of dairy pasture feed, percent of normal[c]	89%

[a] Average for the October-May feeding period as reported by dairy correspondents.
[b] In computing hay equivalents, 3 tons (2.7 tonnes) of silage are considered equal to 1 ton (0.91 tonne) of hay.
[c] Seasonal average condition for the period April 1-October 1.

Table 15. Individual feeds as a percentage of total concentrate rations fed to milk cows in 1963.

Feed constituents	Percentage
Corn	3
Oats	3
Barley	4
Commercial mixed feeds	79
Miscellaneous, other	11

Table 16. Milk, milk fat, and butter production on farms: Number of producing cows, yield per cow, and total quantity produced in Washington state.

Production information	Quantity
Number of milk cows on farms[a]	222,000
Production per milk cow[b]	
Milk	8,960 lb (4,060 kg)
Milk fat	349 lb (158 kg)
Percentage of fat in milk	3.90%
Total production on farms	
Milk	994,000 tons (900,000 tonnes)
Milk fat	39,000 tons (35,000 tonnes)
Butter churned on farms	400,000 lb (180,000 kg)

[a] Estimated average number during year, excluding heifers not freshened.
[b] Excludes milk sucked by calves.

Table 17. Quantities of milk used and marketed by farmers in Washington state in 1963.

Production information	Quantity
Milk used on farms where produced	
Fed to calves[a]	24,500 tons (22,000 tonnes)
Consumed as fluid milk or cream	28,500 tons (26,000 tonnes)
Used for farm-churned butter	4,500 tons (4,100 tonnes)
Total utilized on farms	57,500 tons (52,000 tonnes)
Milk marketed by farmers	
Delivered to plants and dealers	
Whole milk	905,000 tons (822,000 tonnes)
Farm-skimmed cream	15,000 tons (13,600 tonnes)
Retailed by farmers as milk and cream[b]	17,000 tons (15,500 tonnes)
Combined milk and cream marketing	937,000 tons (852,000 tonnes)

[a] Excludes milk sucked by calves.
[b] Sales by producer-distributors and other farmers on own routes or at farm.

Table 18. Quantities of farm dairy products sold in Washington state in 1963.

Production information	Quantity
Deliveries to plants, dealers, etc., at wholesale	
Whole milk sold	905,000 tons (822,000 tonnes)
Farm-separated milk fat cream sold	630 tons (573 tonnes)
Milk and cream retailed by farmers, milk equivalent	16,000,000 quarts (15,000,000 L)

Table 19. Annual per capita civilian consumption of dairy products in the United States in 1963.

Product	Quantity
Butter[a]	6.7 lb (3.0 kg)
Cheese[b]	9.3 lb (4.2 kg)
Condensed and evaporated milk[c]	11.7 lb (5.3 kg)
Ice cream (product weight)	18.1 lb (8.2 kg)
Dry whole milk	0.19 lb (0.086 kg)
Non-fat dry milk	5.6 lb (2.5 kg)

[a] Includes both farm and factory-made butter.
[b] Includes all kinds of cheese except cottage, pot, and bakers cheese, and full-skim American.
[c] The evaporated milk is unskimmed, unsweetened, case goods. The condensed milk is unsweetened (plain condensed) unskimmed, bulk goods, and sweetened condensed milk is unskimmed, case, and bulk goods.

Table 20. Milk cow feeding regimes (developed from preceding data, for early autumn season; Beck et al., 1992).

Type of feed	Quantity
Private milk cows	
Pasture grass (dry weight)	9 kg d^{-1}
Grain supplement	1 kg d^{-1}
Commercial dairy cattle	
Pasture grass (dry weight)	8.5 kg d^{-1}
Grain supplement	1.5 kg d^{-1}
Alfalfa hay	1.0 kg d^{-1}

TABLES OF TEST DATA

Table 21. Time-integrated concentrations of ^{131}I in pasture grass (Bq d kg^{-1} fresh weight) for the month of September 1963 for 6 locations.

Location	Concentration
Farm A	600
Farm B	940
Mesa	230
Eltopia	180
Pasco	250
Ringold	290

Table 22. Time-integrated concentrations of ^{131}I in milk (Bq d L^{-1}) for the month of September 1963 at 6 locations.

Location	Concentration
Farm A	36
Farm B	110
Mesa	26
Eltopia	8.5
Pasco	11
Ringold	20

Table 23. Concentrations of ^{131}I in composite milk samples (Bq L^{-1}) taken from the Twin City Dairy and the Darigold Creamery on September 16 and 26, 1963.

	Location	
Date	Twin City Dairy	Darigold Creamery
September 16, 1963	0.46	0.30
September 26, 1963	0.15	0.07

Table 24. Measured thyroid burdens of ^{131}I on October 19, 1963, for two children who were residents of Farm B[a].

Child	Milk consumption[b]	Thyroid burden
Boy (4 years old)	1 gallon per day (4 L d^{-1})	73 pCi (2.7 Bq)
Girl (8 years old)	1 quart per day (1 L d^{-1})	Below detection limit of 30 pCi (1 Bq)

[a] Farm B was located 25 km SSE of the point of release and was the location of the maximum off-site exposure.

[b] Milk consumption was estimated by the parents. Milk was obtained from a single cow maintained on the farm for the sole use of the owner's family.

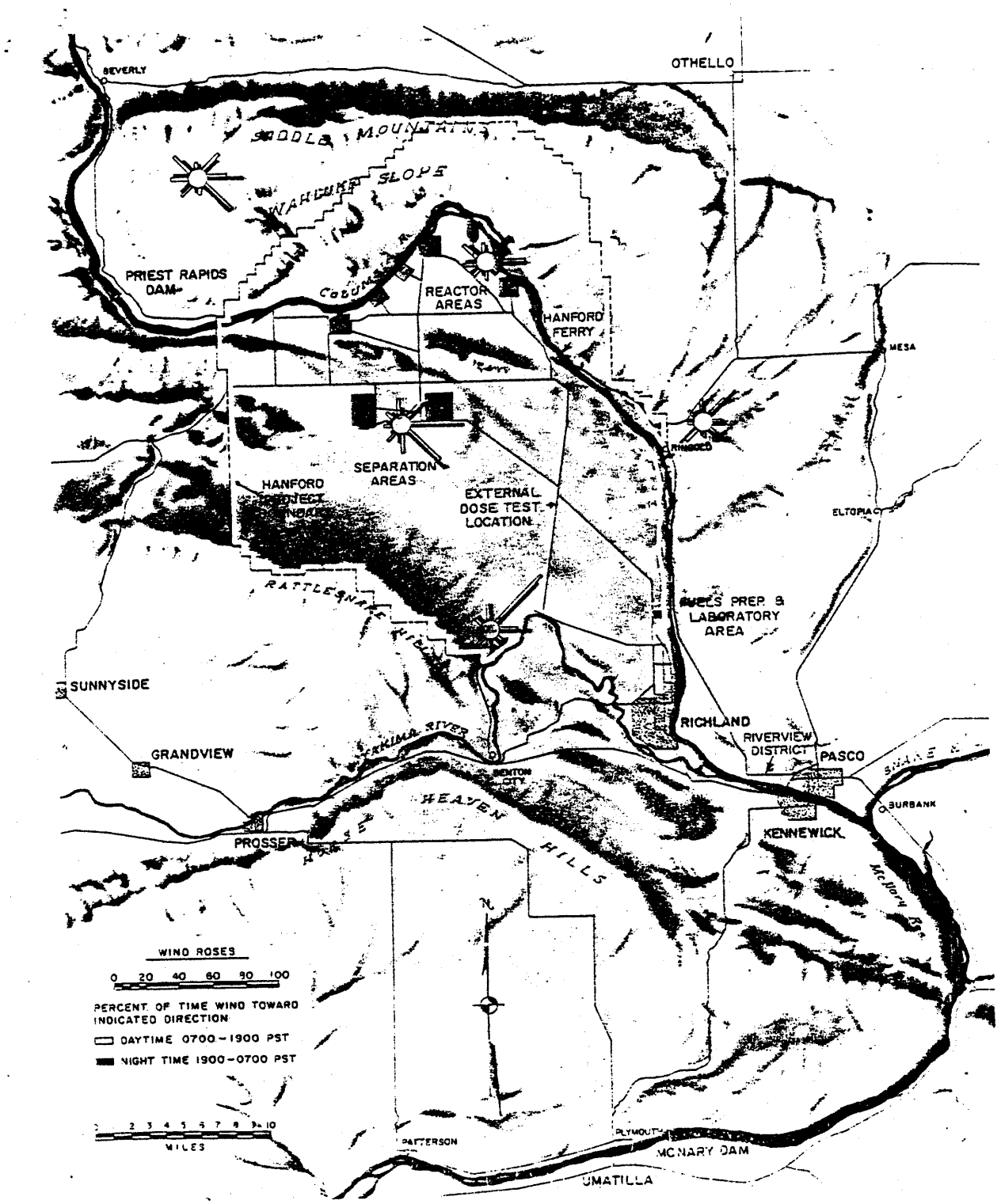

Figure 1. Map of the Hanford site and vicinity showing the major topographic features.

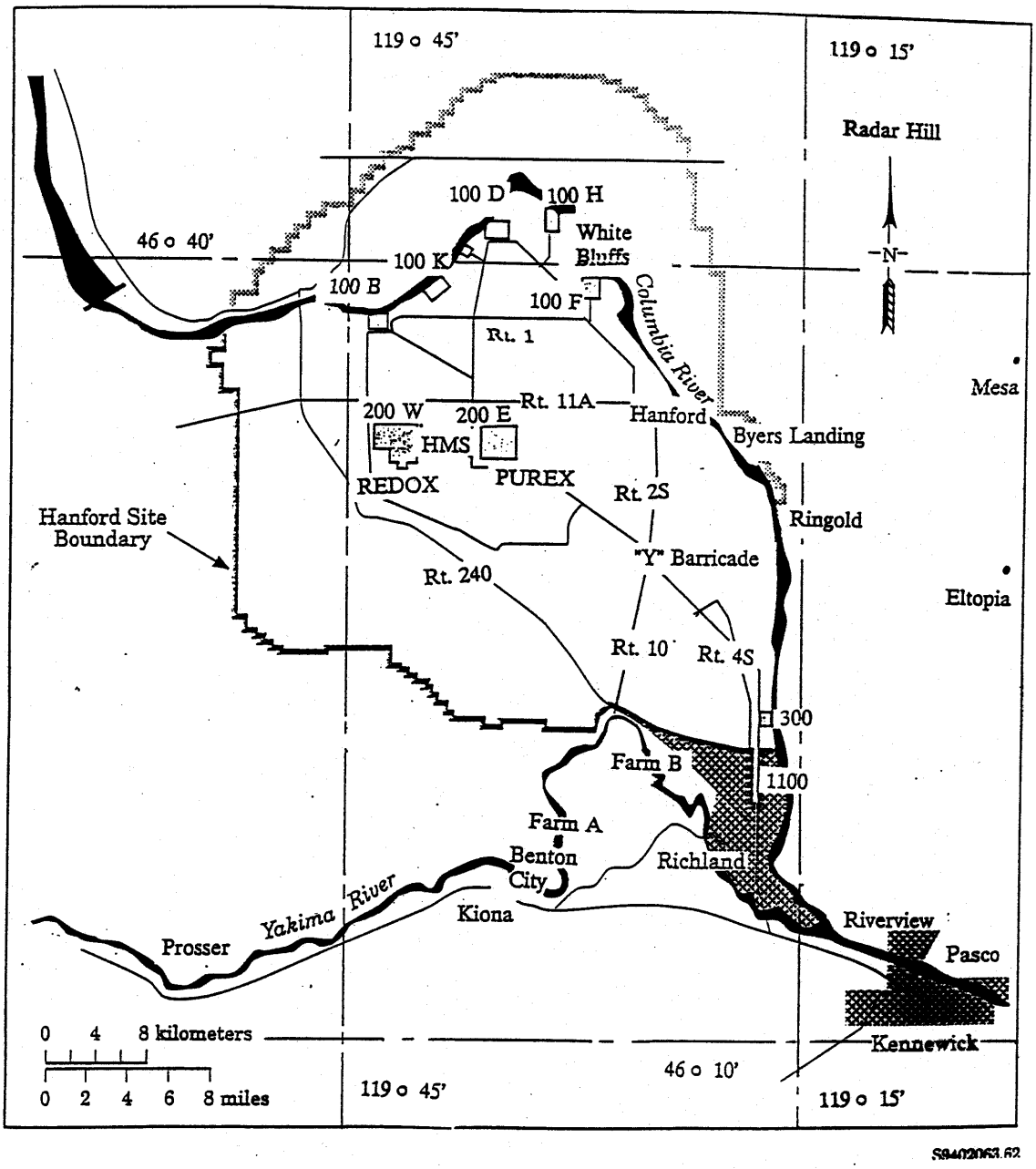

Figure 2. Map of the Hanford site. The release originated at the Purex plant (PUREX). The Hanford Meteorological Station (HMS) is adjacent. Test locations included Farm A, Farm B, Mesa, Eltopia, Pasco, and Ringold. Locations of many of the sampling sites (Table 5) are also indicated.