4.4 Food and Farm Product Surveillance

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Alfalfa and foodstuffs, including milk, vegetables, fruits, and wine, were collected in 1997 at several locations surrounding the Hanford Site (Figure 4.4.1). Samples were collected primarily from locations in the prevailing downwind directions (south and east of the site) where deposition of airborne effluents from the Hanford Site could be expected. Samples were also collected in generally upwind directions at the site perimeter and at locations somewhat distant from the site to provide information on background radioactivity. Alfalfa was sampled because it is a primary feed commodity for dairy and beef cattle.

The food and farm product sampling design addresses the potential influence of Hanford Site releases in two ways: 1) by comparing results from several downwind locations to those from generally upwind or distant locations and 2) by comparing results from locations irrigated with Columbia River water withdrawn downstream from the Hanford Site to results from locations irrigated with water from other sources. In 1996, the food and farm product sampling schedule was modified by establishing a 2- or 3-year rotation for certain farm products. Additionally, analyses for specific radionuclides that historically have not been detected in a food or farm product were discontinued. These changes were adopted because of the emphasis on the cleanup mission of the site. Specific details of the 1997 food and farm product sampling design, including sampling locations and radionuclides analyzed, are reported in DOE/RL-91-50, Rev. 2 and PNNL-11464 and are summarized in Table 4.4.1.

Gamma scans (cobalt-60, cesium-137, and other radionuclides; see Appendix E) and strontium-90 analyses were performed routinely for nearly all products. Additionally, milk was analyzed for iodine-129, and wine was analyzed for tritium. Results for fruits and vegetables are reported in picocuries per gram wet weight. Results for alfalfa are reported in picocuries per gram dry weight. Results for tritium in wine are reported in picocuries per liter of liquid distilled from wine. Most tritium is found as water, and very little tritium is organically bound to other constituents present in food products.

Tritium and iodine-129 from site facilities are released to the atmosphere and to the Columbia River via riverbank springs. Strontium-90 from Hanford is released to the Columbia River through riverbank springs. Cesium-137 is present in atmospheric fallout from weapons testing and is found in site radiological waste.

For many radionuclides, concentrations are below levels that can be detected by the analytical laboratory. When this occurs for an entire group of samples, a nominal detection limit is determined by using two times the total propagated analytical uncertainty (2-sigma). This value from a group of samples is used as an estimate of the lower level of detection for that analyte and particular food product. The total propagated analytical uncertainty includes all sources of analytical error associated with the analysis (e.g., counting errors and errors associated with weight and volumetric measurements). Theoretically, reanalysis of the sample should yield a result falling within the range of the uncertainty 95% of the time. Results, counting, and total propagated analytical uncertainty not given in this report may be found in PNNL-11796.

4.4.1 Collection of Milk Samples and Analytes of Interest

Composite samples of raw, whole milk were collected in 1997 from three East Wahluke and three Sagemoor dairy farms. These sampling areas are located near the site perimeter in the prevailingly downwind direction (see Figure 4.4.1). Milk samples were also collected from a Sunnyside dairy to indicate background radionuclide concentrations at a generally upwind location.

Milk was analyzed for strontium-90, iodine-129, and gamma emitters such as cesium-137 because these radionuclides have the potential to move through the air-pasture-cow milk or water-pasture-cow milk food chains to humans. Gamma scans and strontium-90 analyses were

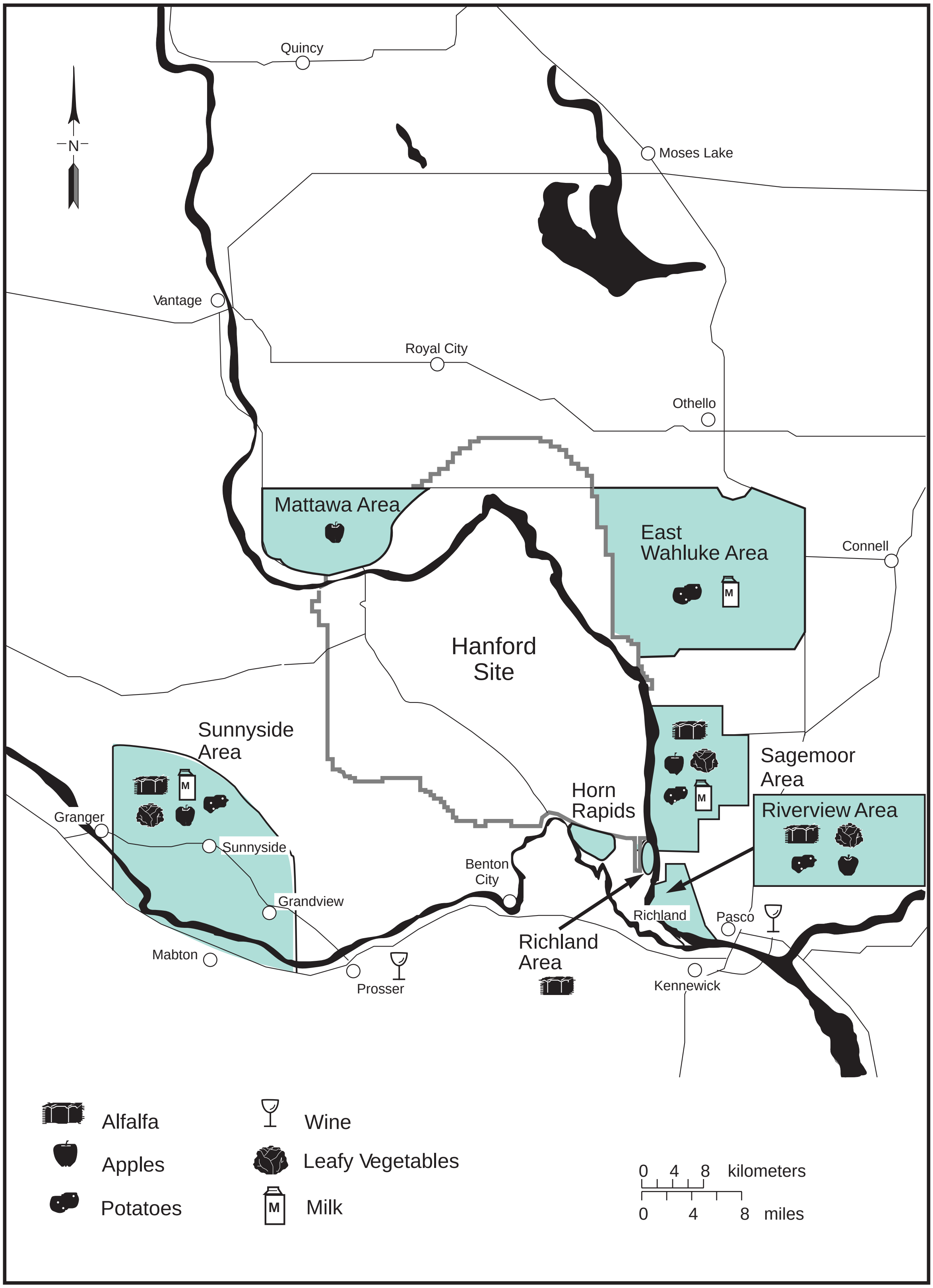

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Figure 4.4.1. Food and Farm Product Sampling Locations, 1997

Table 4.4.1. Locations, Sampling Frequencies, and Analyses Performed for Routinely Sampled Food and Farm Products, 1997[(a)]

	Number of Locations			Number of Locations Analyzed			
Product	Upwind	Downwind	Sampling Frequency[(b)]	^{3}H	Gamma	^{90}Sr	^{129}I
Milk	1	2	Q or SA	0	3	3	3
Vegetables	1	3	A	0	4	4	0
Fruit	1	3	A	0	4	4	0
Wine	2	2	A	4	4	0	0
Alfalfa	1	3	BA	0	4	4	0

(a) Products may include multiple varieties for each category.
(b) Q = quarterly, SA = semiannually, A = annually, BA = biannually.

conducted quarterly, and iodine-129 analyses were conducted on two semiannual composite samples.

One factor influencing concentrations of radionuclides in milk is the source of food for the dairy cows. Dairy cows may be fed food grown outside of the sampling area in which the dairy farm is located. Generally, levels of fallout radioactivity in environmental media correlate positively with the amount of precipitation that an area receives. The agricultural areas around the site are arid and historically have received less weapons-testing atmospheric fallout than some distant locations. Consequently, levels of radioactivity in hay or alfalfa grown in some distant, rainy locations and purchased by local dairies may contribute more radioactivity to milk than levels in feed grown locally. Alternatively, it is possible that alfalfa fed to dairy cows in Sunnyside could have been grown in Sagemoor. Fallout radionuclides in feed may be a significant source of radioactivity in milk products; however, measured levels in milk are usually near levels considered to be background.

4.4.1.1 Radiological Results for Milk Samples

Strontium-90 was measured in 8 of 12 (67%) milk samples analyzed in 1997, with no apparent differences between upwind and downwind locations. Concentrations of strontium-90 remain near the nominal detection limit (0.7 pCi/L) and have been relatively constant over the past 6 years (Figure 4.4.2). The maximum observed concentration of strontium-90 in milk in 1997 was 2.1 ± 0.59 pCi/L in a Sunnyside sample. While there is no strontium-90 standard for milk, the drinking water standard (based on a 2-L/d consumption) is 8 pCi/L (40 CFR 141). The maximum milk consumption rate for estimating dose is approximately 0.75 L/d (see Appendix D, Table D.2).

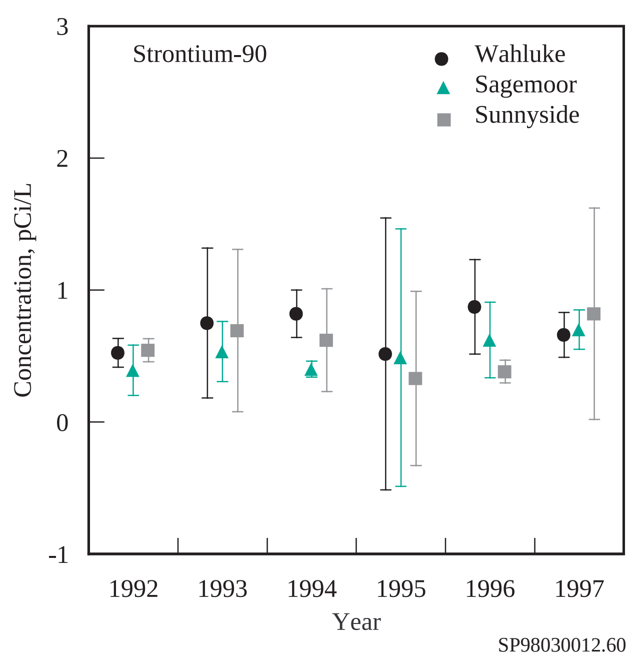

Figure 4.4.2. Mean Strontium-90 Concentrations (±2 standard error of the mean) in Milk, 1992 Through 1997

Iodine-129 was identified by high-resolution mass spectrometry in six milk samples tested. In recent years, the levels of iodine-129 in milk collected from generally downwind dairies in Sagemoor and East Wahluke have persisted at levels two to four times greater than levels measured upwind in Sunnyside (Figure 4.4.3). Iodine-129 concentrations have been declining with the end of nuclear production activities onsite. Iodine-129 contributes less than 1% of the dose to the maximally exposed individual through the consumption of dairy products (Section 5.0, "Potential Radiological Doses from 1997 Hanford Operations"). The maximum observed concentration of iodine-129 in milk in 1997 was 0.0006 ± 0.0001 pCi/L in a sample collected from Sagemoor. While there is no iodine-129 standard for milk, the drinking water standard is 1 pCi/L (EPA-570/9-76-003).

None of the 12 milk samples collected and analyzed in 1997 contained detectable concentrations of cesium-137 (<3.2 pCi/L). While there is no cesium-137 standard for milk, the drinking water standard is 200 pCi/L (EPA-570/9-76-003). Additionally, no other manmade gamma emitters were detectable in milk (PNNL-11796).

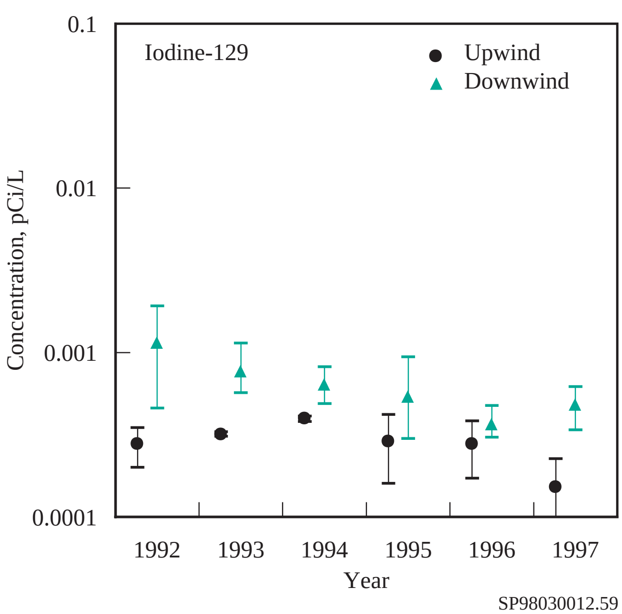

Figure 4.4.3. Minimum, Mean, and Maximum Iodine-129 Concentrations in Milk, 1992 Through 1997

4.4.2 Collection of Vegetable Samples and Analytes of Interest

Samples of leafy vegetables (i.e., cabbage, broccoli, beet tops, turnip greens) and potatoes were obtained during the summer from gardens and farms located within selected sampling areas (see Figure 4.4.1). Leafy vegetables are sampled because of the potential deposition of airborne contaminants. Riverview, Horn Rapids, and Richland are sampled because of exposure to potentially contaminated irrigation water withdrawn from the Columbia River downstream of the Hanford Site. All vegetable samples were analyzed for gamma-emitting radionuclides and strontium-90.

4.4.2.1 Radiological Results for Vegetable Samples

Measurements of gamma emitters in potatoes and leafy vegetable samples were all less than their respective detection limits (0.02 pCi/g) and are consistent with results in recent years (see PNNL-11796). Strontium-90 was detected in one leafy vegetable sample collected from Riverview (0.034 ± 0.008 pCi/g) and in one potato sample collected at Horn Rapids (0.010 ± 0.005 pCi/g); strontium-90 levels in all other potato samples were below detection (<0.010 pCi/g).

4.4.3 Collection of Fruit Samples and Analytes of Interest

Apples were collected during harvest from the areas shown in Figure 4.4.1. All apple samples were analyzed for gamma-emitting radionuclides and strontium-90.

4.4.3.1 Radiological Results for Fruit Samples

Measurable levels of strontium-90, cesium-137 and other manmade radionuclides were not detected in apples in

1997. These results are consistent with measurements in grapes, apples, and melons over recent years (PNL-8683, PNL-9824, PNL-10575, PNNL-11140, PNNL-11473). Nominal levels of detection were 0.01 pCi/g wet weight for cesium-137 and 0.003 pCi/g wet weight for strontium-90.

4.4.4 Collection of Wine Samples and Analytes of Interest

Locally produced red and white wines (1997 vintage grapes) were analyzed for tritium and gamma-emitting radionuclides. The wines were made from grapes grown at individual vineyards downwind of the site and at an upwind location in the lower Yakima Valley. Two samples each of red and white wines were obtained and analyzed from each location. Samples were analyzed for gamma emitters and for low-level tritium with the electrolytic enrichment method (DOE/RL-91-50, Rev. 2).

4.4.4.1 Radiological Results for Wine Samples

Gamma spectroscopy did not indicate the presence of cesium-137 or any other manmade gamma emitters in any of the 1997 wine samples. The nominal detection limit for cesium-137 in wine is approximately 3 pCi/L.

Concentrations of tritium in 1997 wine samples ranged from 19.4 to 34.4 pCi/L of distillate (Figure 4.4.4). There was generally no difference between the variety of wine or locations sampled. While there is no tritium standard for wine, the drinking water standard (40 CFR 141) is 20,000 pCi/L. This standard is based on the daily consumption of 2 L of water.

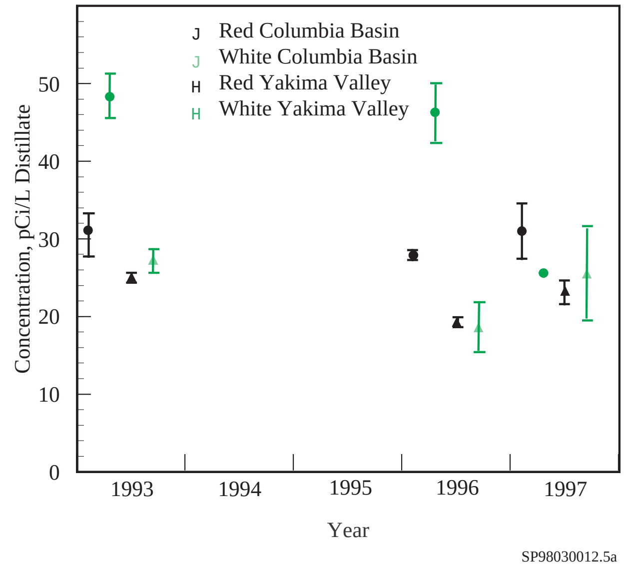

Figure 4.4.4. Minimum, Mean, and Maximum Tritium Concentrations in Wine Samples Collected in 1993, 1996, and 1997

4.4.5 Collection of Alfalfa Samples and Analytes of Interest

Alfalfa samples were collected from the locations identified in Figure 4.4.1. Columbia River water withdrawn downstream of the Hanford Site is used in Richland and Riverview for irrigation. Sagemoor and Sunnyside use other sources of irrigation water. Samples were analyzed for gamma-emitting radionuclides and strontium-90.

4.4.5.1 Radiological Results for Alfalfa Samples

From 1988 through 1994, alfalfa grown in locations irrigated with Columbia River water withdrawn downstream from the Hanford Site (Riverview, Richland, and Horn Rapids) contained slightly higher concentrations of strontium-90 relative to other locations (Poston et al. 1998). Further, mean strontium-90 concentrations in samples collected in 1995 and 1997 from locations irrigated with Columbia River water were higher than concentrations found in samples collected from locations using other sources of irrigation water. These differences in concentrations, however, are not statistically significant ($p = 0.191$) for either year (Figure 4.4.5). The concentrations of strontium-90 collected from all locations in 1997 were low and difficult to separate from the influence of historic fallout from atmospheric weapons testing. Cesium-137 and other manmade gamma-emitting radionuclides were not detected in any alfalfa sample collected in 1997.

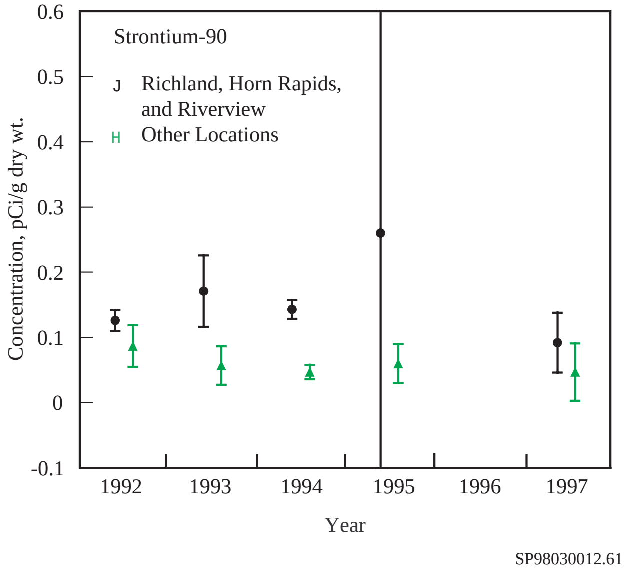

Figure 4.4.5. Mean Strontium-90 Concentrations (±2 standard error of the mean) in Alfalfa Routinely Collected, 1992 Through 1997. Samples were not collected in 1996.