4.4 Food and Farm Product Surveillance

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Alfalfa and a number of foodstuffs including milk, wheat, beef, chickens, eggs, vegetables, fruits, and wine were collected 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 Hanford could be expected. Samples were also collected in generally upwind directions on the Site perimeter and at locations somewhat distant from the Site to provide information on background radioactivity. This section summarizes the radiological analyses performed on samples collected in 1995. Detailed analytical results are provided in Bisping (1996). The potential dose to the public from consuming local foods and farm products is addressed in Section 5.0, "Potential Radiation Doses from 1995 Hanford Operations." Results for fruits, vegetables, and animal products are reported in picocuries per gram wet weight. Results for wheat and alfalfa are reported in picocuries per gram dry weight. Radionuclide concentrations in most samples were less than the limits of detection. Results for tritium (tritium present as water) in milk, wine, and fruits are reported in picocuries per liter of liquid distilled from the food product. Most tritium is found as water, and very little tritium is organically bound to other constituents present in biological material.

The food and farm product sampling design addresses the potential influence of Hanford Site releases in two ways: by comparing results from several downwind locations to those from generally upwind or distant locations, and by comparing results from locations irrigated with Columbia River water withdrawn downstream from Hanford to results from locations irrigated with water from other sources. Specific details of the sampling design, including sampling locations and radionuclides analyzed, are reported by Bisping (1995a) and DOE (1994) and are summarized in Table 4.4.1. Gamma scans (cesium-137, cobalt-60, and other radionuclides; see Appendix E) and strontium-90 analyses were performed routinely for nearly all products. Selected food products were analyzed specifically for additional radionuclides including iodine-129, plutonium, technetium-99, tritium, and uranium. 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 error. This value is used as an estimate of the lower level of detection for that analyte and particular media. The total propagated analytical error 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 between the upper and lower error for the analysis. Propagated errors not reported in this report may be found in Bisping (1996).

One uncontrolled factor influencing concentrations of radionuclides in milk and other dairy products, beef, and poultry is the source of food for the farm animals. Cattle and poultry may be fed food grown outside of their sampling locations. Fallout radioactivity in feed may be a significant source of monitored levels in animal products; observed levels are very near levels considered to be background. Generally, levels of fallout radioactivity in environmental media correlate positively with the amount of precipitation that an area receives.

Collection and Analysis of Milk Samples

Composite samples of raw, whole milk were collected from three East Wahluke and three Sagemoor Area dairy farms near the Site perimeter in the prevailingly downwind direction to evaluate possible Hanford impacts (Figure 4.4.1). Milk samples were also collected from a Sunnyside dairy to indicate general background radionuclide concentrations at a generally upwind location. Samples were collected monthly throughout the year from the Sagemoor Area and collected quarterly from the other areas.

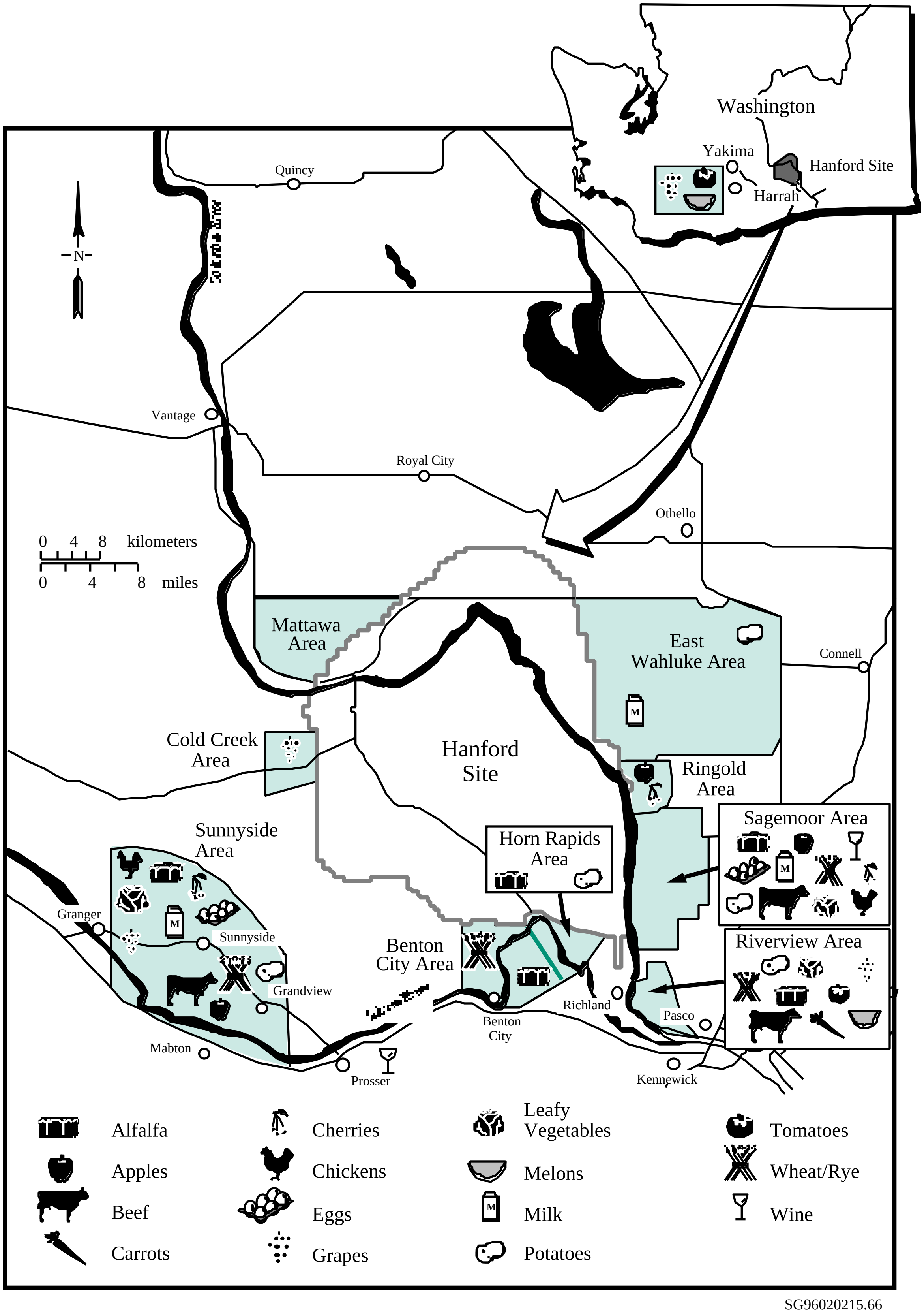

Figure 4.4.1. Food and Farm Product Sampling Locations, 1995

Table 4.4.1. Numbers of Locations, Sampling Frequencies, and Analyses Performed for Routinely Sampled Food and Farm Products, 1995[(a)]

Media	Number of Locations Upwind	Number of Locations Downwind	Sampling Frequency[(b)]	^{3}H	Gamma	^{90}Sr	^{99}Tc	^{129}I	U	Pu
Milk	1	2	M, Q, or SA	3	3	3	0	3	0	0
Eggs, meat, and poultry	1	2	A	0	3	3	0	0	0	0
Vegetables	2	4	A	2	6	5	3	1	2	3
Fruit	2	3	A	6	5	6	0	3	0	3
Wheat and alfalfa	1	4	A	0	5	5	0	0	0	1
Wine	1	2	A	3	3	0	0	0	0	0

(a) Media may include multiple varieties for each category. Not all analytes were assayed at all locations or for each variety of media.
(b) M = monthly; Q = quarterly; SA = semiannually; A = annually.

Milk was analyzed for iodine-129, strontium-90, tritium, 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. Tritium is released into the atmosphere from Site facilities and to the Columbia River via shoreline springs. Strontium-90 is released into the Columbia River through the ground-water springs. Iodine-129 has been released to the air from Hanford operations in the past and is still being released to the Columbia River via the Site ground water. Cesium-137 was present in atmospheric fallout from weapons testing and is found in Site radiological waste. Tritium and gamma analyses were conducted on each monthly sample, strontium-90 analyses were conducted on each quarterly sample, and iodine-129 analyses were conducted on two semiannual composite samples (Sagemoor, Wahluke, and Sunnyside Areas). Tritium analyses were performed on water distilled from milk; consequently, the true concentration of tritium in bulk milk would be slightly overestimated.

Radiological Results for Milk Samples

Tritium was detected in 3 of the 21 (14%) milk samples analyzed; the maximum concentration was 310 ± 150 pCi/L in a sample collected from the Sagemoor Area. While there is no tritium standard for milk, the standard for drinking water is 20,000 pCi/L (see Appendix C, Table C.2).

Strontium-90 was measured in 1 of 14 (7%) milk samples analyzed in 1995, with no apparent differences between upwind and downwind locations. Concentrations of strontium-90 have remained near the nominal detection limit (0.7 pCi/L) and relatively constant over the past 6 years (Figure 4.4.2). The maximum observed concentration of strontium-90 in milk in 1995 was 0.7 ± 0.43 pCi/L. While there is no strontium-90 standard for milk, the standard for drinking water is 8 pCi/L.

Iodine-129 was identified by high-resolution mass spectrometry in all seven milk samples tested. In recent years, the levels of iodine-129 in milk collected from generally downwind dairies in the Sagemoor and East Wahluke Areas have persisted at levels two to four times greater than levels measured upwind in the Sunnyside Area (Figure 4.4.3). Iodine-129 concentrations have been declining with the end of nuclear production activities onsite and there appears to be no concentration differences between upwind and downwind locations in 1995. Iodine-129 contributes less than 1% of the dose to the maximally exposed individual through the consumption of dairy products (see Section 5.0, "Potential Radiation Doses from 1995 Hanford Operations"). The maximum observed concentration of iodine-129 in milk in 1995 was 0.0009 ± 0.0001 pCi/L in a sample collected from the Sagemoor Area. While there is no iodine-129 standard for milk, the standard for drinking water is 1 pCi/L.

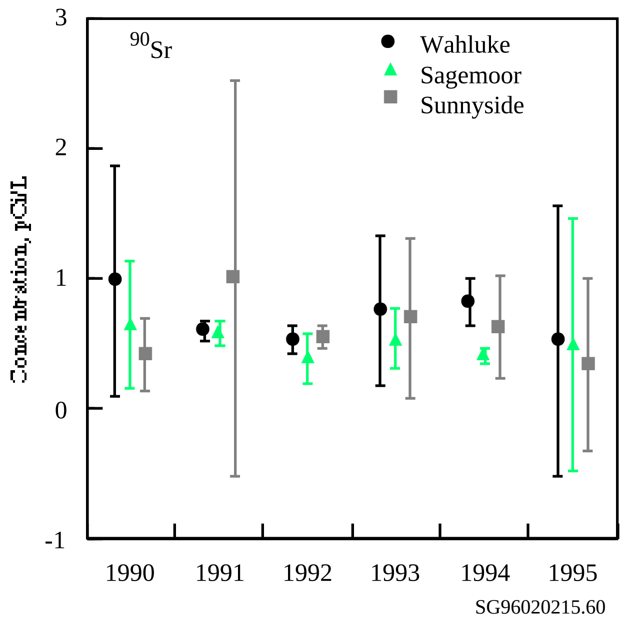

Figure 4.4.2. Mean (±2 standard error of the mean) Strontium-90 Concentrations in Milk, 1990 Through 1995. As a result of figure scale, some uncertainties are concealed by point symbol.

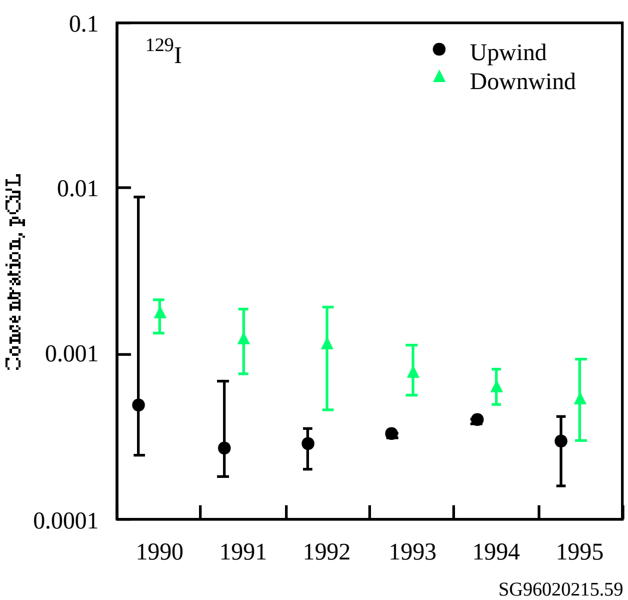

Figure 4.4.3. Mean (±2 standard error of the mean) Iodine-129 Concentrations in Milk, 1990 Through 1995. As a result of figure scale, some uncertainties are concealed by the point symbol.

One of the 21 (5%) milk samples collected and analyzed for cesium-137 in 1995 contained detectable concentrations (>3.3 pCi/L). For all 21 samples, there was no apparent difference between results upwind and downwind of the Site. The maximum observed concentration of cesium-137 in milk in 1995 was 3.3 ± 2.4 pCi/L. While there is no cesium-137 standard for milk, the standard for drinking water is 200 pCi/L. Additionally, no other manmade gamma emitters were detectable in milk (Bisping 1996).

Collection and Analysis of Beef, Chicken, and Chicken Egg Samples

Samples of locally produced poultry and eggs were collected once in 1995 from areas adjacent to the Hanford Site (Sagemoor and Sunnyside Areas, Figure 4.4.1) and analyzed for strontium-90 and gamma emitters such as cesium-137. Beef was collected once in 1995 from the Sagemoor, Riverview, and Sunnyside Areas for analysis of strontium-90 and gamma emitters such as cesium-137. Strontium-90 and cesium-137 are known Hanford Site contaminants that have the potential to move through the food chain to beef, chickens, and eggs.

Radiological Results for Beef, Chicken, and Chicken Egg Samples

In 1995, strontium-90 was measured in eggshells collected from the Sunnyside and Sagemoor Areas. The maximum concentration was 0.21 ± 0.07 pCi/g in a shell sample from the Sagemoor Area. Strontium-90 was not detected in the edible portion of the eggs collected in prior samplings (Dirkes and Hanf 1995). Strontium-90 was not detected in chicken muscle collected in 1995. Cesium-137, however, was measured in chicken muscle collected from the Sagemoor Area (0.04 ± 0.03 pCi/g), but not in eggs collected in 1995 from Sagemoor or Sunnyside.

In 1995, manmade radionuclides were not detected in any samples of locally produced beef.

Collection and Analysis of Vegetable Samples

Samples of leafy vegetables (cabbage, broccoli, beet tops, or turnip greens), tomatoes, carrots, and potatoes were obtained during the summer from gardens and farms located within selected sampling areas (see Figure 4.4.1). In conjunction with the Washington State Department of Health, grapes, melons, and tomatoes were also sampled from Harrah, a farming community about 13 km (8 mi) south of Yakima and upwind of the Hanford Site. Samples were collected from the Riverview and Horn Rapids Areas to assess potential contamination from crop irrigation at those locations. Irrigation water for the Horn Rapids and Riverview Areas is withdrawn from the Columbia River downstream from Hanford.

Leafy vegetables are sampled because of the potential deposition of airborne contaminants and, at some locations, deposition from overhead irrigation. All vegetable samples were analyzed for gamma-emitting radionuclides and strontium-90; in addition, tomatoes from selected locations were analyzed for tritium, and potatoes from selected locations were analyzed for plutonium-238; plutonium-239,240; technetium-99; and uranium isotopes. Tritium is monitored because it has been released into the atmosphere from Site facilities and to the Columbia River via shoreline ground-water springs. Strontium-90 is monitored because it is released into the Columbia River at the shoreline springs and is known to accumulate in some plants. Technetium-99 is monitored because it is known to enter the Columbia River through shoreline seeps and springs, has a long half-life, and can accumulate in farm products that may be irrigated with Columbia River water withdrawn downstream from Hanford. Iodine-129 is monitored because it can move through the air-vegetation-human food chain. Cesium-137 is monitored because it is present in Hanford wastes and atmospheric fallout from weapons testing. Isotopes of uranium are monitored because they enter the Columbia River in springs near the 300 Area and are known to accumulate in soil and vegetation. Plutonium-238 and plutonium-239,240 are monitored because of past releases and to assure the public that concentrations of plutonium isotopes are not a concern in vegetables.

Radiological Results for Vegetable Samples

Many of the analytical results for vegetables were below the nominal detection limits for specific radionuclides. For leafy vegetable samples in 1995, the only radionuclide measured above the detection limit was strontium-90. The Sagemoor Area sample (0.006 ± 0.003 pCi/g) exceeded the nominal detection limit of 0.003 pCi/g. There were no concentrations of manmade radionuclides above detection limits in carrot or tomato samples in 1995. The only manmade radionuclide measured in vegetable samples was strontium-90 in the Riverview Area potato sample (0.005 ± 0.004 pCi/g). Measurements of gamma emitters; plutonium-238; plutonium-239,240; technetium-99; and uranium isotopes were all less than their respective detection limits.

Collection and Analysis of Fruit Samples

Samples of apples, cherries, concord grapes, and melons were collected before or during harvest from the areas shown in Figure 4.4.1 (not all types were collected in each area). The edible portions were analyzed for gamma emitters, strontium-90, tritium, and for selected samples, iodine-129 and plutonium-239,240. Tritium was analyzed in the distillate collected from fruit samples.

Radiological Results for Fruit Samples

Measurable levels of manmade radioactivity were not detected in apples, cherries, concord grapes, or melons collected in 1995. These results are consistent with fruit measurements over recent years (Bisping and Woodruff 1990, 1991, 1992, 1993, Bisping 1994, 1995b). Nominal levels of detection were 0.02 pCi/g wet weight for cesium-137; 0.04 pCi/g wet weight for iodine-129; 0.0001 pCi/g wet weight for plutonium-239,240; 0.004 pCi/g wet weight for strontium-90; and 200 pCi/L plant distillate for tritium.

Collection and Analysis of Wine Samples

Locally produced red and white wines (1995 vintage grapes) were analyzed for tritium and gamma-emitting radionuclides. The wines were made from grapes grown at individual vineyards in the Sagemoor Area downwind of the Site and at an upwind location, near Prosser. Three samples each of red and white wines were obtained from each area.

Radiological Results for Wine Samples

Gamma spectroscopy of wine samples did not indicate the presence of cesium-137 in any of the samples. The minimum level of detection for cesium-137 in wine is 5 pCi/L.

The results for tritium in 1995 wine samples indicate no difference between upwind and downwind locations (Figure 4.4.4). Concentrations reported in 1995 showed a wide range of concentrations although within the range observed over the past 6 years. Wine analyses for tritium performed by other laboratories on duplicate samples are consistently lower than the data reported by the Pacific Northwest National Laboratory (Dirkes and Hanf 1995), and the results reported in 1995 are considered to be biased high due to a difference in analytical methods used among laboratories. In 1995, all measured concentrations of tritium in wine were well below levels considered hazardous for the consumption of liquids. While there is no tritium standard for wine, the standard for drinking water is 20,000 pCi/L.

Collection and Analysis of Wheat and Alfalfa Samples

Samples of grain and mature alfalfa were collected from the areas shown in Figure 4.4.1. Rye was collected in the Riverview Area because wheat was not available. Three replicate samples of alfalfa were collected at each location and analyzed for gamma emitters and strontium-90. Wheat from the Sagemoor Area was analyzed for gamma emitters; plutonium-239,240; and strontium-90.

Radiological Results for Wheat and Alfalfa Samples

Strontium-90 was measured in the rye sample collected from the Riverview Area (0.009 ± 0.006 pCi/g). All other manmade radionuclide concentrations in wheat and rye were below the nominal detection limit (<0.009 pCi/g) and are listed by Bisping (1996).

Alfalfa irrigated with Columbia River water withdrawn downstream from Hanford (the Riverview and Horn Rapids Areas) continued to show slightly higher concentrations of strontium-90 relative to other locations (Figure 4.4.5); however, this difference was not statistically significant in 1995. A single high result for one of the three replicate samples collected at Riverview caused the exceedingly high variability for the 1995 Riverview, Horn Rapids, and Richland group. Samples from the Sagemoor and East Wahluke Areas (locations that use Columbia Basin Irrigation Project water) and Sunnyside and Benton City Areas (locations that use irrigation water from the Yakima River or wells) had strontium-90

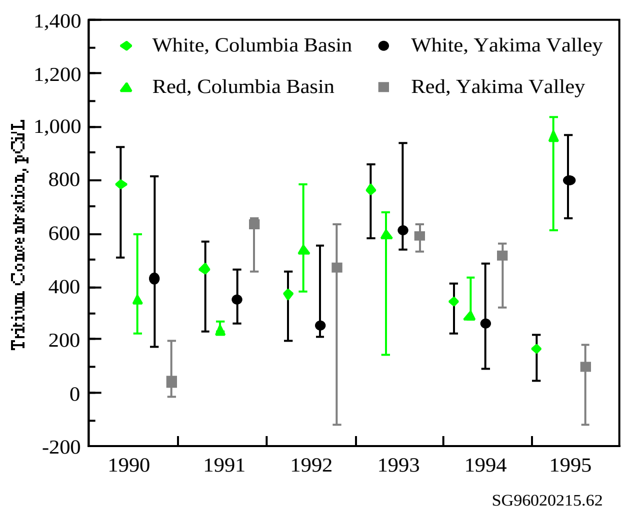

Figure 4.4.4. Maximum, Median, and Minimum Tritium Concentrations in Wine Samples, 1990 Through 1995

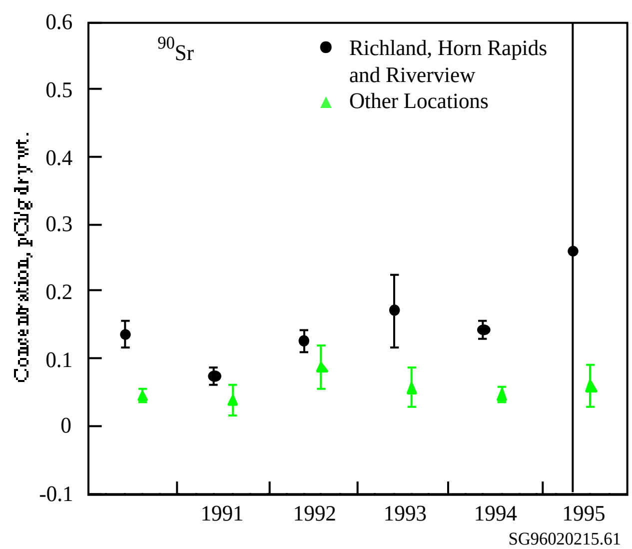

Figure 4.4.5. Mean (±2 standard error of the mean) Strontium-90 Concentrations in Alfalfa Routinely Collected at Riverview, Horn Rapids, Richland, and All Other Sampling Locations, 1990 Through 1995

concentrations that were lower than those in the Riverview and Horn Rapids Areas in 1995. The actual concentrations at all locations were low and difficult to separate from the influence of fallout (Jaquish 1993).

Cesium-137 was not consistently measured in wheat, rye, or alfalfa during 1995.